

Workplace Homicides: Reconsidering the Role of Firearms

by

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A dissertation submitted to Johns Hopkins University in conformity with
the requirements for the degree of Doctor of Philosophy

Baltimore, Maryland

April 14, 2018

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Abstract

The number of fatal, intentional workplace shootings rose 15% in 2015 from 2014. Workplace homicides remain a leading cause of occupational death, fourth among males and second among females. Workplaces that allow employees to carry a firearm are at 5-times greater odds of having a workplace homicide compared to workplaces that do not. Prevention efforts largely focus on preventing robbery-motivated crimes, which constitute between 55% to 60% of deaths each year. Workplace homicides are largely a firearms issue, as perpetrators use firearms in nearly 80% of all deaths. There is a need to understand firearm exposure at work, laws that restrict employers' ability to govern firearm exposure at work, and how state laws designed to affect firearm exposure impact firearm-related workplace homicides.

This dissertation contains six chapters. Chapter one provides an introduction to occupational safety and health, workplace homicide trends, and state-level firearm policy. It also provides a rationale for this research and offers specific research questions. Chapter two epidemiologically examines how perpetrators accessed firearms to commit workplace homicides from 2011-2015. Among the firearm-related workplace homicides where firearm access points were able to be categorized, proximal and distal firearm access played a large role in escalating arguments into argumentative workplace homicides, particularly for customers and employees. Chapter three is a legal analysis of a set of state laws that restrict employers' ability to limit employee firearm storage in motor vehicles at work, referred to as parking lot laws. The 16 existing parking lot laws displayed similar characteristics. More than half of the laws released employers from civil liability for events resulting from an employee storing a firearm in their car at work.

Chapter four is a longitudinal panel analysis of the impact of state-level laws on firearm-related workplace homicides from 1992-2015. Right-to-carry laws were associated with a 32% increase in the rate of firearm-related workplace homicides. Chapter five provides additional methodologic detail for Chapters two, three, and four. Chapter six provides a summary of findings, areas of future research, and implications.

Customer and employee firearm access plays a large role in escalating arguments to argumentative workplace deaths. Given right-to-carry laws' impact on loaded handgun carrying, it is unsurprising that states with these laws have greater rates of firearm-related workplace homicides. Right-to-carry laws generally allow private property owners to prohibit firearms from their premises. Yet, parking lot laws limit the ability of employers to prohibit employee firearm access within parking lots. Overall, firearm exposure within the workplace is likely detrimental to workers' safety and health and efforts to restrict employee firearm exposure are needed.

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Acknowledgements

I am not the best writer of words. Anyone who has edited my work can attest to this. To those that have, I owe you a great debt. To those that will, I am sorry in advance. But, where I do excel is in creating ideas. Unfortunately, even the best ideas need space to land and oxygen to breathe. To the bellows of my work, I am eternally grateful.

Shannon, you always pushed me to ask why something mattered. Doing so enriched my thought process and improved this dissertation, and everything else I do, immeasurably. No matter the situation, I was always confident in my decision because I knew you would support me. I cannot thank you enough.

I would like to thank Cassandra Crifasi for her help and guidance over the last 3 years. I am so appreciative of the time and thoughts you gave me, not only because of their quality, but because of the willingness that accompanied them. Your contributions were instrumental to this dissertation.

I would like to thank Jon Vernick for his sage advice. No matter the topic, no matter the situation, you offered invaluable insight into your decisions and gave advice on how I could make mine. It was tremendously helpful as I look towards my future.

To Maria Bulzacchelli; I cannot thank you enough for the help and support over the last 6 years. You have been truly influential in my progression as a researcher and a person. You always believed in my ideas, even though the first few needed some extra massaging. I am always thankful for the doors you opened for me.

To Annie; you have always supported me, and my academic pursuits, even when it meant moving to Baltimore. If that's not true love, I do not know what is. I am

endlessly lucky to have you as my wife and partner. I owe you countless weekends and vacations. Though, that might have to wait a little while, at least until Amelia is older.

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Chapter One: Introduction

Occupational Safety and Health

Occupational safety and health is a leading focus area for public health professionals, including injury prevention and control researchers. Each day, over 145 million U.S. workers face work-related injury and illness.¹ Work-related injuries and illnesses can be acute or long term. As a field, occupational safety and health focuses on the prevention of unintentional injuries, intentional injuries, and environmental exposures.

Occupational Safety and Health Act of 1970

On December 29th, 1970, President Nixon signed into law the Occupational Safety and Health Act (OSH Act) to reduce employee exposure to hazards at work.^{2,3} The law created the Occupational Safety and Health Administration (OSHA) within the U.S. Department of Labor. To protect worker safety and health, the OSH Act gave OSHA the power to set and enforce industry standards, or minimum requirements for worker protection. OSHA standards describe methods employers must take to protect their workers from workplace hazards. OSHA standards protect workers from a swath of serious hazards by requiring actions by employers. OSHA standards cover all private sector employers in all 50 states, the District of Columbia, and federal jurisdictions. The OSH Act invited states to create their own state-run OSHA,ⁱ in which several states

ⁱ The following 23 states and territories have their own state-level OSHA: Alaska, Arizona, California, Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Washington, Wyoming

approved additional protections for state-and-local government workers.ⁱⁱ OSHA has the power to issue citations when workplaces are found to violate a workplace standard.

The 1970 OSH Act also created the OSHA general duty clause which states all employers must create a place of employment free from recognized hazards likely to cause or causing death or serious physical harm.³ Later, in 1979, OSHA provided further clarification regarding the enforcement of the general duty clause. In a letter, OSHA described the application of the general duty clause stating inspectors should use the provision when no specific standard is applicable to the relevant hazard. Inspectors may cite any recognizable hazard not covered by a standard. OSHA went on to describe how an inspector could deem a hazard recognizable, stating:

...if it is a condition that is (a) of a common knowledge or general recognition in the particular industry in which it occurred, and (b) detectable (1) by means of the senses (sight, smell, touch, and hearing), or (2) is such a wide, general recognition as a hazard in the industry that even if it is not detectable by means of the senses, there are generally known and accepted tests for its existence which are generally known to the employer.

The clarification letter further stipulated the general duty clause would apply to serious health and safety hazards; non-serious citation violations would not be issued under the general duty clause.⁴

Non-fatal Occupational Injuries and Illnesses

From the passage of the OSH Act to current day, the primary concern of the field of occupational safety and health is to protect workers from non-fatal and fatal injuries as well as environmental exposures. This dissertation does not discuss environmental exposures.

ⁱⁱ These states include: Connecticut, Illinois, New Jersey, New York

In 2015, according to the United States Bureau of Labor Statistics, private industry reported approximately 2.9 million nonfatal workplace injuries and illnesses at a rate of 3.0 cases per 100 equivalent full-time workers.^{iii, 5} These injuries occurred on a spectrum of severity, from minor to severe. Of the 2.9 million cases, 2.8 million (95.2%) were injuries.

There were nearly 48,000 fewer non-fatal injuries reported in 2015 compared to 2014, continuing a downward trend in injury and illness incidence. The overall incidence rate for injuries and illnesses requiring days away from work was 104 cases per 10,000 full time workers in 2015, slightly less than the rate seen in 2014 (107.1).⁶ Mid-size private industry, those employing 50-249 employees, had the highest rate of injuries and illnesses.⁵ According to the 2017 Liberty Mutual Workplace Safety Index, a resource that highlights critical risk areas for businesses, risk managers, and safety practitioners, severe nonfatal injuries cost U.S. employers nearly \$60 billion in direct workers' compensation, or over \$1 billion per week.⁷ In 2015, there were 902,160 lost-time injuries, or injuries where a worker was unable to work for at least one day.¹ Women suffered 38% of those lost-time injuries. (n = 341,130); men suffered 62% (n = 556,370).

Workplace Violence

An important form of workplace injury is workplace violence. Workplace violence encompasses any act or threatening act of physical violence, harassment, intimidation, or assaults that occur in the workplace.⁸⁻¹⁰ Workplace violence occurs on a

ⁱⁱⁱ A full time equivalent (FTE) employee is a ratio meant to standardized employee contribution regardless of if the company relies on more part time workers or full time workers. It is a ratio of the total number of paid hours during a pay period (part time, full time, contracted) by the number of working hours in that period Mondays through Fridays.

spectrum ranging from intimidation to fatal injury.¹¹ Nearly 2 million workers report being victims of workplace violence every year.⁸ The true magnitude of the problem is likely higher as workplace violence victims often do not report their victimization.^{12,13} Workplace violence injuries can include fractures, sprains, contusions, lacerations and fatalities.¹⁰ Workplace violence constitutes a significant occupational hazard¹³ and is a large public health concern.^{8,11,12,14}

Workplace violence is a public health issue that is worsening over time. The overall U.S. workplace injury rate has decreased since 1992. For five years in a row (2011-2015), the rate of workplace violence injury has not decreased (4.0 per 100,000 FTE workers in 2015).¹ Female workers suffer a disproportionate burden of workplace violence-related injuries involving days away from work.¹ In 2015, there were 26,420 non-fatal workplace violence injuries involving days away from work, though this number is likely underreported. Female workers experienced 18,050 of those injuries. These injuries were primarily committed by a patient or a client/customer and in the health care industry. As the health care sector continues to grow, with it the number of employees, likely workplace violence will continue to rise.

Workplace violence represents a significant societal cost.¹⁵ Analysis of direct costs associated with workplace violence assaults committed in Minnesota in 1992 found total direct costs of almost \$6 million (\$9,056,932 in 2016 dollars).¹⁶ Other authors examined Rhode Island's worker compensation claims from 1998 to 2002 and found a total cost of \$7 million with an average cost of \$1,097 per claim over the study period.¹⁷ The authors used incident claims data from the U.S. Department of Labor to derive estimates of injury and cost.

Developed in 1995 by the California Occupational Safety and Health Administration (Cal/OSHA) and expanded by the National Institute of Occupational Safety and Health (NIOSH) in 2006, workplace violence typology is based on perpetrator profiles, dividing violent circumstances into four categories (**Table 1**, below).¹⁸ These typologies heavily influence how researchers and public health professionals think about workplace violence.^{10,19,20}

Table 1: Workplace Violence Typology

Typology	Description
Type I	Type I violence is committed in the workplace by individuals unknown to the victim and with no relationship to the business.
Type II	Type II violence is committed in the workplace by a person with a business relationship to the workplace; typically, customers, clients, etc.
Type III	Type III violence is committed in the workplace by an employee or former employee against other current or former employees.
Type IV	Type IV violence is committed in the workplace by an individual with a personal relationship to the victim, typically a friend, relative, significant other, but the perpetrator is not a current or former employee of the company.

Non-fatal workplace violence is difficult to estimate due to underreporting and a lack of uniform definition.¹⁰ To more accurately understand the incidence of workplace violence, the Bureau of Labor Statistics (BLS) conducted a survey of 7.3 million U.S. employers, public and private, in 2005.²¹ Five percent of workplace establishments (n = 389,380) reported a workplace violence incident in the 12 months prior to the survey, with 35% of those workplaces reporting it had a negative impact on their workers and only 10% reporting a program or policy change after the incident. Among companies with 1,000 or more employees, 17% of all establishments experienced a Type I workplace violence, 28% experienced a Type II workplace violence, 33% experienced a

Type III workplace violence, and 25% experienced a Type IV workplace violence, or violence by an intimate partner or relative.²¹

As evidenced by the BLS survey of U.S. employers discussed above, intimate partner violence often spills into the workplace. A large percent (25%) of the 389,380 workplaces that reported a worker suffer violence at the hands of an intimate partner or relative in the past 12-months.²¹ Employers recognize the negative impact of intimate partner violence in the workplace but often fall short of enacting prevention measures. A national survey of businesses' intimate partner violence prevention policies found only 4% of businesses provide intimate partner violence prevention training.²¹

Although researchers have documented the positive outcomes associated with discussing intimate partner violence with someone at work, large-scale barriers remain. Barriers include a fear of retaliation through dismissal and a lack of training for how managers should deal with intimate partner violence.²² In some cases, reporting intimate partner violence to a superior may increase the victim's risk of harm if the superior was inflicting the abuse. Workplaces' best practices for helping to reduce employees' intimate partner violence remain difficult to identify and are largely not scientifically evaluated.^{19,23}

Intimate partner violence victims that suffer violence at work have likely suffered violence outside of work as well. Addressing intimate partner violence that occurs outside of work may reduce violence that occurs at work. Interviews with 133 female workers who had suffered past-year intimate partner violence outside of work found, in general, women wanted supportive supervisors as they took action towards ending their abusive relationship.²⁴ A potential avenue for addressing employees that are victims of

intimate partner violence is employee assistance programs. These programs offer resources to employees with issues that impact job performance. These programs have been found to promote good mental health and reducing drug use.^{25,26} Recent literature suggests these programs could be used to reduce or prevent intimate partner violence.^{19,27} However, a purposeful sample of 28 employee assistance programs found most did not have a standardized approach for discussing intimate partner violence with employees.²⁷

Government Response to Workplace Violence

OSHA has not established an industry standard to protect workers from the hazard of workplace violence though it does recognize workplace violence as an occupational hazard for some industries, such as health care, late-night retail establishments, and taxi driving. Under the Obama administration, OSHA issued a directive, titled, “Enforcement of Procedures for Investigating or Inspecting Incidents of Workplace Violence,” which created a uniform process for how OSHA was to respond to complaints of workplace violence.²⁸ On January 10th, 2017, OSHA issued another directive, cancelling and superseding the 2011 directive, which took additional steps to reduce workplace violence.²⁹ This directive expanded the definition of recognized industries with a heightened risk of workplace violence, adding corrections facilities and taxi driving, and provided additional resources to OSHA inspectors investigating claims of workplace violence.

In 2015 OSHA updated its guidance on preventing workplace violence for the healthcare and social service workers. The document provided information on risk factors and highlighted measures for effective violence prevention. Measures included effective

management leadership, worksite analysis and hazard identification^{iv}, and records analysis and training. The guidance document cited customer/client firearm prevalence, or access, as a risk-factor for violence in the workplace and states that agitation that can accompany exposure to medical facilities is often the cause of violent behaviors.³⁰

Since the 2011 directive, efforts from OSHA to combat workplace violence have steadily increased over time. In 2013, there were 5 workplace violence OSHA inspections, 90 in 2014, 85 in 2015, and 126 in 2016.¹ In 2016, 59 of the 126 workplace violence inspections resulted in citations against the employer with a median penalty of \$4,200.¹ Due to the lack of industry standard concerning workplace violence, OSHA inspectors cited workplaces under the general duty clause, section 5(a)(1) of the 1970 OSH Act.¹

In 2016, the U.S. Government Accountability Office (GAO) issued a report examining current workplace violence prevention programs and policies. As part of the report, the GAO recommended OSHA increase the workplace violence citation training for their inspectors and assess current workplace violence prevention efforts. Most importantly, the GAO recommended that OSHA pass a workplace violence standard for the health care and social service industries, citing the established hazard of workplace violence and the clear need for worker protection.³¹

In 2017, California OSHA passed the first workplace violence standard, covering all health care facilities in the state. It is the first industry standard meant to protect

^{iv} Worksite analysis and hazard identification are a set of systematic actions to recognize and understand hazards and potential hazards in the workplace. The actions are as follows: 1) identify comprehensive hazard identification, 2) comprehensive hazard surveys, 3) hazard analysis of changes to workplace, 4) routine hazard analysis or job safety analysis, 4) regular site safety and health inspections, 5) employee reports of hazards, 6) accident/incident inspections, and 8) injury and illness trend analysis.

workers from the hazard of workplace violence. The law, which went into effect on April 1st, 2017, mandated health facilities: 1) create and maintain a violent incident log; 2) establish record keeping practices for workplace violence-related hazard identification, evaluation, correction, and training; and 3) report any incident involving the use of physical force against an employee. It also mandated the creation and implementation of a workplace violence-prevention plan for all health facilities by April 1st 2018.³²

There is little reason to expect a federal workplace violence standard, whether covering all industries or covering a select group of industries, will be passed by OSHA under the Trump administration. One of President Trump's first actions was to issue a memorandum directing agencies to freeze in-process regulations and to delay effective dates of final rules not in effect. President Trump has repealed an Obama-era rule which clarified employers' obligations to keep injury and illness records. The 2017 budget proposal by President Trump sought to cut the Department of Labor's budget by 21% and proposed an elimination of OSHA's worker safety and health training program. Actual cuts to OSHA have left the administration with fewer inspectors now than they had in 2009, likely limiting the administration's enforcement abilities.¹ These actions are in stark contrast to the previous administration's efforts to support OSHA's goal of protecting workers' safety and health.

Workplace Homicide Trends, Risk Factors, and Prevention Efforts

Fatal Workplace Injuries

In 2015, 4,836 workers died at work in the U.S., occurring at a rate of 3.4 deaths per 100,000 FTE workers.¹ North Dakota (12.5), Wyoming (12.0), Montana (7.5), Mississippi (6.8), Arkansas (5.8), and Louisiana (5.8) had the highest fatality rate per

100,000 workers in 2015. Latino and immigrant workers were at increased risk for death on the job, as well as older workers, and workers in construction, transportation, agriculture, and mining and extraction occupations.

Among both male and female workers, roadway incidents constitute the largest percent of fatal work injuries (31% and 26% respectively) in 2015. For males, deaths from falls, slips, and trips and contact with objects and equipment accounted for around 17% each. Homicides accounted for 10% of all male occupational fatalities. For female workers, homicide was the second leading cause of death, accounting for 18% of workplace fatalities. Falls, slips, and trips (12%) and exposure to harmful substances or environments were third and fourth leading causes of death for females. See **Table 2** (below).³³

Table 2: Leading Causes of Occupational Death by Gender, 2015

Males (n=4,492)		Females (n=344)	
Cause of Death	Percent	Cause of Death	Percent
Roadway incidents	31%	Roadway incidents	26%
Falls, slips, trips	17%	Homicide	18%
Contact with Objects/equipment	17%	Falls, slips, trips	12%
Homicide	10%	Exposure to harmful substances	10%
Exposure to harmful substances	9%	Contact with Objects/equipment	6%

In 2015, workplace homicide was the 4th leading cause of occupational death for males and 2nd leading cause of death for females. In 2015, 417 individuals were intentionally killed at work. In 85% of workplace homicides (354), firearms were the mechanism of death. These numbers represent a notable increase in fatal workplace

shootings. After several years of decreasing incidence, 2015 saw the first increase (15%) in occupational firearm homicide since 2012.³³

In 1992, NIOSH conducted its first formal inquiry into workplace homicides, finding strong evidence of a rising public health problem.³⁴ From this evaluation, NIOSH declared workplace homicides a nation-wide issue in need of a research agenda. The resulting report, informed by academic research, noted a need to increase understanding of workplace homicide risk factors and causes.

Prior to 1992, researchers conducted several epidemiologic examinations of trends and risk factors related to workplace homicides.³⁵⁻³⁸ Kraus (1987) identified and described California workplace homicide trends from 1979 through 1981, finding males were 4 times more likely to be a victim. The author also found an increased homicide risk for occupations with heightened exposure to the public, involving an exchange of money, and late afternoon or evening hours.³⁵ Davis (1987), reviewing Texas death certificates from 1975-1984, added male workers greater than 65 years of age were 3.5 times more likely to be a victim of a workplace homicide compared to males under 65 years of age.³⁸ Davis, Honchar, & Suarez (1987), examining the same data as Davis (1987) restricted to females killed at work, found homicides constituted 53% of the fatal occupational injuries among women, with firearms the mechanism of death in 70% of the cases.³⁷ Bell (1991), one of the first researchers to use national surveillance data from the National Traumatic Occupational Fatalities surveillance system (NTOF)^v identified that working

^v National Traumatic Occupational Fatalities (NTOF) was the national census of occupational injury fatalities up until 1992, when the Census of Fatal Occupational Injuries (CFOI) took up that role. The database was maintained through the CDC from 1980-1995 and was reported to include an average of 81% of all occupational injury deaths nationwide per year. For more information visit, <https://www.cdc.gov/niosh/injury/data.html>

women 65 or older had the highest age-adjusted workplace homicide rate. Additionally, the study was one of the first to identify racial disparities in workplace homicides. Rates of workplace homicides for races other than whites were nearly double. Nearly 43% of women killed worked in the retail industry.³⁶

Current Trends, 1992-2017

After NIOSH's formal evaluation in 1992, research concerning workplace homicide trends and risk factors increased, and continues to be the subject of academic research.³⁹⁻⁴² Castillo & Jenkins (1994), using NTOF data, found, from 1980-1988, taxi-cab employees had the highest rate of WPH (26.9 per 100,000 workers).⁴³ The study also found racial disparities among male workers—rates of workplace homicides for blacks and non-black workers differed by industry and occupation—with the authors calling for an increase in short and long term prevention interventions.⁴³

Peek-Asa, Erickson, & Kraus (1999) were first to explore epidemiologic trends of workplace homicides specific to the retail industry.⁴⁴ Using Census of Fatal Occupational Injury data (CFOI)^{vi} the study examined workplace deaths from 1992-1996 comparing the retail industry to all other industries. Violence, or homicide, was the leading cause of retail industry occupational fatality (69.5%) eclipsing to motor vehicle crashes (19.3%). Findings from the study reinforced findings from Bell (1991) as perpetrators were more likely to kill women in the retail industry compared to other industries. The study also agreed with Castillo & Jenkins (1994) finding minority workers had a heightened risk of workplace homicide in the retail industry compared to other industries. Smaller sized

^{vi} A formal discussion of CFOI data is available in Chapter 5 of this dissertation

businesses, businesses open later, and urban-based businesses were at increased risk of having a workplace homicide in the retail industry.⁴⁴

Moracco, Runyan, Loomis and colleagues (2000) identified the contextual differences between male and female workplace homicides. Using data from the North Carolina medical examiners (ME), the authors examined workplace homicides that occurred between 1977-1991 finding Type I violence accounted for 50% of cases. Twenty percent of cases involved an altercation or dispute. Of the dispute-related workplace homicides, coworkers (33%), customers (17.5%) and other non-strangers (25.5%) were leading causes of male death; no current or former intimate partners killed male workers. Current or former intimate partners killed 75% of females involved in a dispute.

Fayard (2008) examined 2,057 workplace fatalities which occurred in parking lots from 1993-2002 and compared his findings to fatalities from all other locations. He found the largest proportion of events were homicides (36%). The rate of workplace homicides committed by intimate partners was two-fold greater in parking lots compared to all other locations. Robbers committed a lower percentage of parking lot workplace homicides (25%) compared to all-location workplace homicides (38%). Around 80% of all parking lot workplace homicides involved a firearm.⁴⁵

Gurka, Marshall, Runyan and colleagues (2009), reviewed North Carolina medical examiner records for workplace homicides that occurred from 1994 to 2003.⁴⁶ The authors included all on-the-job homicides in the study (n = 228) and coded motive (robbery versus non-robbery) and violence typology (Type I – IV) from narrative text. Of the workplace homicides, 63% were robbery-motivated, 36% were non-robbery-

motivated, and 1% could not be determined. Strangers perpetrated 73% of robbery-motivated homicides and 11% of non-robbery homicides. The study found equal distribution of robbery-motivated homicides among all industries whereas 67% of non-robbery-motivated homicides occurred in the retail industry. Personal-relationship violence (Type IV), with intimate partners comprising the large majority (85%), constituted the largest portion of non-robbery-motivated workplace homicide. Firearms accounted for 83% of the 228 homicides across all categories. However, the study did not provide frequencies of non-robbery-motivated workplace homicides by gender.⁴⁶

Konda, Tiesman, Hendricks and colleagues (2014) analyzed non-robbery-motivated workplace homicides within the retail industry from 2003-2008 finding results similar to Gurka and colleagues (2009).⁴⁷ The authors abstracted the CFOI data and assigned motive and violence typology using narrative fields. Of all 1,434 workplace homicides in the retail industry, 58% were robbery-motivated, 23% were non-robbery-motivated, and 19% were unknown. Customers (Type II) perpetrated the majority of non-robbery-motivated workplace homicides. However, among females killed in the retail industry, personal relationship violence (Type IV) accounted for 63% of their deaths. Intimate partners committed more than half of the Type IV deaths. The study did not provide information regarding the types of weapons used to commit these crimes.⁴⁷

Tiesman, Gurka, Konda and colleagues (2012) expanded on the earlier work of Davis, Honchar, & Suarez (1987) and Moracco and colleagues (2000), examining the role of intimate partner violence for female workplace homicide victims.¹⁹ Using the CFOI data from 2003-2008, authors found 648 women murdered on the job, with criminal intent (Type I) as the leading cause of death (39% n=212). Individuals with a

personal relationship were the second leading cause of death (33%, n=181) with intimate partners accounting for the largest portion of personal relationship workplace homicide (78%, n=142). Finding similar results as Fayard (2008), around 50% of intimate partner perpetration occurred in parking lots. The authors called for workplace violence prevention to consider and include strategies for preventing and responding to intimate partner violence.

Recent epidemiologic examinations of workplace homicides focused on disparities by worker and industry.^{48,49} Menendez, Konda, Hendricks and colleagues (2013) used the CFOI data from 2003-2008 to investigate disparity trends in workplace homicide fatality rates in the retail industry.⁴⁸ The authors, leaning on previous work of Peek-Asa (1999), sought to describe disparities in workplace homicide fatality rates in the retail industry, noting differences by gender and race. The authors found significant increased odds for older males (OR 5.4; 95% CI: 4.5, 6.3), minorities,^{vii} and foreign-born employees (OR: 3.5; 95% CI: 3.1, 3.9).⁴⁸ Steege, Baron, Marsh and colleagues (2014) examined CFOI data from 2005 to 2009 finding similar results to Menendez and colleagues (2013).⁴⁹ Workplace homicide rate ratios^{viii} were elevated for black, Asian and foreign-born workers, as well as American Indian/Alaska native workers.⁴⁹

Workplace Homicide Risk Factors

To identify workplace characteristics related to increased workplace homicide risk, Loomis, Wolf, Runyan and colleagues (2001) conducted the first case control study

^{vii} With white, non-Hispanic as the reference group; black, non-Hispanic employees had an OR of 2.8 and 95% CI of 2.3, 3.4; Hispanic employees had an OR of 1.3 and 95% CI of 1.1, 1.5; Asian employees had an OR of 6.1 with a 95% CI of 5.1, 7.1

^{viii} Rate ratios discussed further are calculated using employment data from the Current Population Survey administered by the U.S. Census Bureau. Rates calculated differently will be noted.

of workplace homicides. Using North Carolinian medical examiner data, workplaces with a workplace homicide between 1994-1998 (n=105), were 2:1 matched to control workplaces without a workplace homicide on time operating and industry sector (n=210). Authors conducted telephone interviews with workplace managers, assessing workplace characteristics and measuring exposure. The study identified a number of workplace-level characteristics associated with increased risk of having a workplace homicide: being at the current location for less than 2 years (Odds Ratio (OR): 5.3; 95% CI: 2.2,12.6); employing one worker (OR: 2.9; 95% CI: 1.2, 7.2); operating at night (OR: 4.9; 95% CI: 2.7,8.8) or on Saturday (OR; 4.2; 95% CI 1.9, 9.2); and employing only male employees (OR: 3.1; 95% CI 1.5, 6.5).⁵⁰

Using the same data as Loomis and colleagues (2001), Loomis, Marshall, & Ta (2005) preformed a case-control study of workplaces in North Carolina examining the association between employer policies on weapons and risk of a workplace homicide.⁵¹ The study asked workplace representatives about whether their company allowed employees to carry certain weapons, including firearms. After controlling for covariates, workplaces which allowed employees to carry firearms had an almost 5-times greater odds of a workplace homicide compared to workplaces that prohibited weapons (95% CI: 1.70, 13.65). Workplaces that allowed weapons other than firearms, such as a knife, had no significant changes in homicide risk.⁵¹

Societal Costs of Workplace Homicides

One study examined potential societal costs associated with workplace homicides. Hartley, Biddle, & Jenkins (2005) assessed indirect and direct costs related to workplace homicides. The authors utilized a cost-of-illness approach accounting for medical

expenses and future earnings aggregated from the year of death until age 67 as well as household production losses, such as childcare. Analysis found workplace homicides, from 1992-2001, likely had a total cost of close to \$6.5 billion with a mean of \$800,000 per death. Males killed in the retail industry accounted for 32% of the total societal cost, the largest portion (\$2.1 billion).⁴¹

Workplace Homicide Prevention Efforts

Possible prevention strategies put forth in the 1995 NIOSH report, “Preventing Homicide in the Workplace,” focused on researching the efficacy of robbery-prevention interventions for preventing workplace homicides.⁵² Several authors during that time viewed prevention strategies for reducing robberies as a viable prevention strategy for reducing workplace homicides,^{43,53,54} leading crime prevention strategies to become the prevailing theoretical framework. Crime Prevention Through Environmental Design (CPTED), the most widely accepted theoretical framework, dictates the risk of robbery is modifiable through the design and administration of the workplace. Modifiable interventions consist of environmental interventions, such as the appearance or layout of the workplace and administrative interventions, such as staffing decisions, designed to make the workplace less attractive to potential perpetrators.⁵⁵

Loomis, Marshall, Wolf and colleagues (2002) evaluated the effectiveness of CPTED interventions on workplace homicide risk.⁵⁵ Using the same data as Loomis and colleagues (2001), the authors conducted a case-control study of 105 workplaces with a workplace homicide between 1994-1998 compared to 210 control workplaces matched on industry and operating hours, finding mixed results. An environmental intervention, bright exterior lighting (OR: 0.5; 95% CI: 0.3-1.0), and an administrative intervention,

preventing solo work at night (OR: 0.4; 95% CI: 0.2, 0.9), displayed marginal statistical significance in reducing the odds of having a workplace homicide. Other interventions, such as making workers visible from outside, creating a barrier between workers and the public, installing security and surveillance devices did not reduce the odds of having a workplace homicide. The authors noted that measures intended to make the workplace less attractive to would-be criminals had little effect on preventing violence.

Gurka, Marshall, Casteel and colleagues (2012) examined the effectiveness of CPTED interventions for Type II-IV workplace homicide, or prior relationship violence.²⁰ The authors used the same data as Loomis and colleagues (2001) and (2002), adding additional years of data, expanding the study period to 2003. Using similar methodology, the authors investigated whether measures aimed at preventing robbery-motivated crimes had an effect on non-robbery-motivated workplace homicides. The authors found case workplaces were 5 times more likely to have previously reported workplace violence (95% CI: 1.73, 15.55). Only a select number of CPTED-related strategies proved effective. Keeping entrances locked when employees were working (OR: 0.36; 95% CI: 0.13, 0.99) and having at least one security device (OR: 0.28; 95% CI: 0.10, 0.74) reduced the odds of a workplace having a prior-relationship workplace homicide. Other types of prevention efforts, such as training employees how to deal with a hostile coworker, proved insignificant.²⁰ The authors noted, in their discussion, “Given that robbery- and non-robbery-[motivated] workplace homicides differ with regard to a number of factors (such as industry), it is not surprising that strategies need to be developed and evaluated specifically for preventing prior-relationship homicide,”

acknowledging the lack of research surrounding causes and potential prevention efforts for prior-relationship workplace homicides.

Menendez, Amandus, Damadi and colleagues (2013) evaluated the effectiveness of installing security equipment in taxicabs.⁵⁶ The authors used news media to establish counts of taxicab workplace homicides from 1996-2010 and compared rates across 26 major U.S. cities. The study examined two security measures; requiring cameras and requiring bullet-resistant partitions. Controlling for city homicide rates, cities that required cameras in taxis saw a 75% reduction in the relative risk of having a taxicab workplace homicide. Cities that required bullet-resistant partitions did not see significant reductions in taxicab workplace homicides.⁵⁶

General Decline of Type I Workplace Homicide

Despite mixed evidence for the support of CPTED, the public health burden of workplace homicides has declined significantly. A primary hypothesis for the reduction in workplace homicides centers around declining violent crime trends in general and the role of Type I workplace homicides. Hendricks, Jenkins, & Anderson (2013) documented workplace homicides trends from 1993-2002, comparing the results to U.S. homicide rates.⁵⁷ The authors cited a lack of crossover analysis by both occupational health and violent crime researchers and sought to assess whether the workplace homicide decline was homogeneous across victims, circumstances, and typologies. Using workplace homicide data from the CFOI and violent crime data from the Uniform Crime Reports (UCR),^{ix} the authors compared homicide deaths in the population to those at work.

^{ix} The UCR is one of the most important sources of crime data available in the U.S and is tabulated by the Federal Bureau of Investigation. The UCR represents a nationwide effort as 17,000 law enforcement

Utilizing a Poisson regression model, researchers found Type I workplace homicides were the only typology to display a statistically significant average annual decline (7.7%; 95% CI: 6.9-8.6%.) workplace homicides committed by customers, co-workers, or personal relationships did not display statistically significant declines during the study period. The difference in the decline of Type I workplace homicides and population-level robbery-motivated homicides was 0.6%, a non-significantly different trend line.⁵⁷ The authors concluded that reductions in Type I workplace homicides significantly contributed to the decline in workplace homicides from 1993-2002, mirroring declines in general robbery-motivated crimes.

Much of the research and prevention efforts for workplace homicides has focused largely on robbery-motivated violence.⁴⁷ This is due to early research that found robbery was the primary motivation for workplace homicides, accounting for between 60-to-80% of crimes.^{46,58} Recent investigations found declines in robbery-motivated workplace homicide have likely driven declines in workplace homicides overall⁵⁷ and while robbery-motivated workplace homicides primarily occur in the retail industry, non-robbery-motivated crimes occur almost uniformly across several industries. Very little research has described the circumstances of non-robbery-motivated crimes.⁴⁷ Importantly, across epidemiologic investigations, firearms were used around 80% of the time for workplace homicides regardless of motivation or circumstance making workplace homicides a firearms issue. Little research has examined firearms in workplace homicides.

agencies voluntarily report crime data, or around 95% of law enforcement agencies. Limitations of the UCR are discussed in Chapter 5, Manuscript Three

Firearms in Workplace Homicides

The role of firearms in workplace homicides is well established. In a 1987 study, firearms were the mechanism of death in 70% of workplace homicides involving female workers in Texas from 1975-1984.³⁷ In a 2000 study, firearms were the mechanism of death in 75% of workplace homicides from 1977-1991.⁵⁸ In a 2008 study, firearms were the mechanism Perpetrators used firearms in 81% of robbery-motivated and 79% of non-robbery-motivated crimes.⁴⁶ Perpetrators used firearms in 67% of female workplace homicides from 2003-2008.¹⁹ Across workplace homicide typologies and gender of victims, research shows firearms are perpetrators' weapon of choice.

Parking Lot Laws

Despite the role of firearms in workplace fatalities, several states have passed legislation restricting companies from banning employees from storing firearms in their motor vehicle at the workplace. These laws are referred to as parking lot laws.

Starting in the early 2000's an increasing number of businesses placed restrictions on firearms in the workplace.⁵⁹ In 2002, Weyerhaeuser Corporation terminated several employees after determining they were storing guns in their vehicles in the company parking lot, a violation of their zero-tolerance firearm policy.⁶⁰ The former employees sued Weyerhaeuser Corp. stating the zero-tolerance firearm policy and subsequent termination violated Oklahoma's constitutional and statutory authority establishing their right to carry firearms. The Eastern District court of Oklahoma granted summary judgement to Weyerhaeuser Corp. in 2004 with the U.S. Court of Appeals, 10th circuit affirming on February 13, 2006.⁶¹ The 10th circuit of appeals reasoned, "Both the

Oklahoma Constitution and the Oklahoma courts recognize that the right to bear arms is not unlimited, and, indeed, may be regulated.”

In response, the National Rifle Association (NRA) lobbied Oklahoma legislators to pass laws against such bans.⁶² The NRA contended, with policy makers in Oklahoma agreeing, a gun-free parking lot would put employees at risk as it advertised to criminals that employees are unarmed and thus unable to defend against a criminal attack on company property.^{59,63} Oklahoma amended the Oklahoma Firearms Act of 1971 and the Oklahoma Self-Defense act of 1995 to prohibit employers from banning the storage of firearms in vehicles located at work. The amendment reads:

No person, property owner, tenant, employer, or business entity shall be permitted to establish any policy or rule that has the effect of prohibiting any person, except a convicted felon, from transporting and storing firearms in a locked vehicle on any property set aside for any vehicle.

In response, Whirlpool Corporation filed initial action seeking an injunction against enforcement of the amendments with several other corporations joining the suit in October of 2004. The plaintiffs argued the amendments were unconstitutionally vague, were an unconstitutional taking of private property, a violation of the plaintiff’s due process right to exclude others from their property, and preempted by various federal statutes, including the OSHA general duty clause. Whirlpool Corporation, though, withdrew from the suit at the same time pro-gun supporters began to threaten a large-scale boycott of Whirlpool products⁶⁴ leaving ConocoPhillips as the lead plaintiff.⁶⁵ A week after, the Oklahoma State Chamber of Commerce withdrew as amicus curiae of the plaintiffs.⁶⁵

In response to the backlash from Oklahoman businesses, the legislature further amended the Oklahoma Firearms Act of 1971 in 2005 to immunize businesses from the potential ramifications resulting from enforcing the parking lot law.^xThe amendment reads:

No person, property owner, tenant, employer, or business entity shall be liable in any civil action for occurrences which result from the storing of firearms or ammunition in a locked motor vehicle on any property set aside for any motor vehicle, unless the person, property owner, tenant, employer, or owner of the business entity commits a criminal act involving the use of the firearms or ammunition.

The remaining plaintiffs continued with their lawsuit. In August of 2005, the Tulsa World newspaper reported the NRA's chief executive, Wayne LaPierre told a crowd of supporters, "We're going to make ConocoPhillips the example of what happens when a corporation takes away your second Amendment rights."⁶⁶

In 2007, the Northern District court of Oklahoma found the parking lot law was preempted by the OSH Act and enjoined the enforcement of the amendments. The court found that gun-related workplace violence was a 'recognizable hazard' under the general duty clause and allowing firearms in company parking lots would violate the OSH Act. As part of their definition of a 'recognized hazard,' the Northern District court cited an OSHA general duty clause citation issued to a Psychiatric hospital in 1993 for failing to protect its workers from patients' violent behavior.⁶⁰

In 2009, the 10th circuit of appeals reversed the findings of the Northern District court of Oklahoma stating the OSHA had not commented as to whether employers should prohibit firearms from company parking lots. The 10th circuit held, the OSHA's website,

^x 21 Okla. Stat. § 1289.7a

guidelines, and history do not speak of such firearm prohibition.⁶⁰ Further, the court found the injuries which occurred as a result of the OSHA general duty clause in 1993 arose from a ‘work situation,’ and were thus not a violation of the general duty clause. The 10th circuit judges noted a letter dated January 16th, 2009 issued by OSHA’s then Acting Assistant Secretary of Labor, Thomas Stohler, to Oklahoma State Senator Jerry Ellis which stated, “Gun-related violence is not a recognized occupational hazard in industry as a whole... [OSHA] do[es] not believe... the general duty clause of the OSH Act.” preempts [the parking lot law],”in their decision.

Currently, the impact of parking lot laws on worker safety and health is unclear. Research suggests workplaces that allow employees to have access to firearms are at greater risk of having a workplace homicide.⁵¹ Further, the number of states with parking lot laws is unknown as are when parking lot laws went into effect.

Public Policy and Firearm Violence

Firearm violence is a large public health concern in the U.S. In 2016, there were 14,415 firearm homicides, up 11% from 2015 which saw 12,979 firearm homicides.⁶⁷ From 2010-2012, there were 48,534 nonfatal firearm assaults, at a rate of 15.67 per 100,000 population.⁶⁸ The United States has a nearly 6-times greater average homicide rate compared to other high-income countries.⁶⁹ The higher average is due in part to the nearly 20-times higher average of firearm-related homicides compared to high-income countries. Compared to other high-income countries, the U.S. has average rates of non-fatal violent crimes and aggressive behaviors committed without a firearm.⁷⁰ U.S. rates of gun ownership are greater, by far, than any other nation in the world.⁷¹

One possible way to reduce firearm violence is through public policy. Public policies affect the conditions that influence peoples' health. Government entities use them to promote certain behaviors, such as mandatory seat belt laws. Public policies and health are inextricably linked as policies are designed to impact health through behavior promotion/restriction. What constitutes public policy is vast; it is the laws, regulatory measures, and funding conditions implemented by government entities. Policies are implemented at the federal level, the state level, and the local level. Regardless of what level of government policies are implemented, their effect on health is notable and present.⁷²⁻⁷⁵

Several different firearm policies have displayed significant relationships to state-level firearm homicide rates. This section details several of these laws—permit-to-purchase laws, right-to-carry laws, stand your ground laws, and firearm prohibition laws for violent misdemeanants and violent intimate partners—providing an overview of the research surrounding their relationships to state-level firearm homicide rates. The laws included in this section have all shown to impact firearm-related homicides at the state level. Each type of law represents a different, but interconnected, aspect of firearm use, ownership, and access: permit-to-purchase laws affect how individuals purchase firearms; right-to-carry laws affect who is allowed to carry a firearm in public spaces; stand your ground laws affect gun owners' ability to use their firearms in certain situations; and firearm prohibition laws for violent misdemeanants and violent intimate partners affect who is allowed to own and possess firearms. This section also discusses the contentious nature of firearm policies within the U.S. As workplace homicides are by-in-large committed by firearms, policies that impact firearm violence in the general population

likely impact workplace homicides. For effective dates for all laws discussed below, see **Table 18** in the Appendix.

Federal law places firearm purchasing prohibitions on individuals who are convicted felons, convicted of a felony and misdemeanor crime of intimate partner violence, subjected to a certain intimate partner violence restraining orders, fugitives from justice, adjudicated as mentally defective, committed involuntarily to a mental institution, or addicted to a controlled substance.⁷⁰ Additionally, federal law requires 18 years as the earliest age for legal handgun possession and 21 years for purchasing a handgun from a licensed firearm dealer. Individuals aged 18 to 20 are allowed to purchase a handgun through a private transaction.⁷⁰ Federal law mandates individuals who purchase a gun from a federally licensed firearm dealer pass a background check, though the mandate does not exist for private sales.⁷⁶ Evidence suggests a large percent of individuals prohibited under federal law from purchasing firearms have access to firearms and use them to commit violent crimes.⁷⁰ These individuals typically obtain their firearm through a private sale or straw purchase, where a non-prohibited individual purchases the firearm for the prohibited individual. As such, state legislatures have passed policies aimed at preventing firearm diversion to prohibited individuals, referred to as permit-to-purchase laws.

Permit-to-purchase Laws

In an attempt to curb criminal access to firearms, states have established regulations for the sale of handguns beyond the scope of the federal government, requiring permits for handgun sales through permit-to-purchase handgun licensing laws. These laws make obtaining a firearm more difficult for prohibited individuals by

requiring they obtain a permit to purchase a firearm through a federally licensed dealer and a private seller. Eleven states have some kind of permit-to-purchase handgun law.^{70,77} States issue permits to individuals after passing a background check or, in some states, having passed a background check in the past.⁷⁶ The duration of the permit and stringency of the permitting process vary across states as permits can last from 10 days to 10 years and some states will process applications through the mail or online. Massachusetts, New Jersey, and New York permit local law enforcement agencies discretion over issuing permit-to-purchase.⁷⁰

Several investigations have found permit-to-purchase laws to be protective against firearm homicides. Webster, Crifasi, & Vernick (2014) used a quasi-experimental research design to estimate the association between the repeal of Missouri's permit-to-purchase law and homicide rates.⁷⁸ To evaluate the impact of changes to Missouri's permit-to-purchase laws, the authors compared Missouri's state-level homicide rates to states that border Missouri and to the US from 1999 to 2010. Missouri's 2007 permit-to-purchase repeal was associated with a 23% increase in the annual firearm homicide rate, equating to an increase of between 55 and 63 homicides per year.⁷⁸ Rudolph and colleagues (2015) used a synthetic control model^{xi} to evaluate the association between Connecticut's 1995 permit-to-purchase law and homicide rates. The study sought to quantify the percent reduction in homicide rates caused by the law's implementation. The authors estimated the counterfactual using longitudinal data from a weighted sample of

^{xi} Synthetic control model is an approach for dealing with heterogeneity in state-policy effects across states. The approach measures the counterfactual (see methods section for discussion of counterfactual) for a state that adopts a new policy based on the states pre-law change trends in a number of relative characteristics rather than proximity.

comparison states. The authors identified comparison states using pre-law homicide trends and covariates. Connecticut's permit-to-purchase law was associated with a 40% reduction in firearm homicides from 1995 to 2005. No significant reductions were seen in non-firearm homicides.⁷⁶ Further, a 45-state panel analysis using generalized mixed models to estimate the population-average effect of having a permit-to-purchase law on intimate partner homicides committed by firearms found protective effects.⁷⁹ The analysis showed permit-to-purchase laws were associated with 10% reductions in intimate partner homicides committed by firearms from 1980 to 2013.

Right-to-carry Laws

Firearm owners feel carrying a concealed firearm in public spaces can possibly lead to reductions in violent-crime. Perceived reductions stem from the possible ability to thwart attempted acts of violence with their own firearm. However, carrying concealed firearms in public spaces comes with added risk to public safety. Because of this added risk, states have regulated who can carry a concealed firearm and where. Regulations include mandating a permit to carry a concealed firearm and requiring firearm owners to meet safety, training, and personal character requirements.

As of 2018, every state allows for some level of concealed carry of a firearm.⁸⁰ Currently 8 states give authorities permit-issuing discretion over who can carry a concealed firearm, referred to as 'may-issue' permitting.^{xii} The discretion can be based on the firearm owner's good character, need to carry a concealed firearm (due to threats), or deciding whether the person is 'proper' to be licensed.⁸¹ Thirty states and D.C. issue

^{xii} 'May-issue' states: California, Delaware, Hawaii, Maryland, Massachusetts, New Jersey, New York, Rhode Island

concealed carry firearms permits on a ‘shall-issue’^{xiii}, basis, giving authorities no discretion over permit issuing. In 12 states, there are no permit requirements for carrying a concealed firearm other than being able to legally possess a firearm.^{xiv} States that either do not require a permit to carry a concealed weapon or issue a concealed carry weapons permit on a shall-issue are considered right-to-carry states.

Right-to-carry laws generally allow private property owners or persons legally in control of private property through a lease, rental agreement, or contract to control access to private property.^{82,83} These rights typically extend to exclude or eject a person who is in possession of a firearm on private property including licensed holders of concealed firearms. Right-to-carry laws often ban weapon carrying in certain locations, such as a bar, a courthouse, a prison, or a nuclear power facility, though location exemptions vary across states. How businesses exclude licensed concealed carry weapons holders is not known. Texas, in 2015, provided prescriptive language for businesses to exclude licensed concealed carry weapons from their establishments, requiring written communication at all entries in the form of a sign or card stating, “Pursuant to Section 30.06, Penal Code (trespass by license holder with a concealed handgun), a person licensed under Subchapter H, Chapter 411, Government Code (handgun licensing law), may not enter this property with a concealed handgun.”^{xv}

^{xiii} ‘*Shall-issue*’ states: Alabama, Arkansas, Colorado, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, Wisconsin

^{xiv} *Permitless* concealed carry states and (year changed): Alaska (2003), Arizona (2010), Idaho (2016), Kansas (2015), Maine (2015), Mississippi (2015), Vermont (pre-1990), West Virginia (2016), Wyoming (2011)

^{xv} V.T.C.A. Penal Code Ch. 30.06. Trespass by License Holder with a Concealed Handgun

An early report, published in 1997, on the impact of right-to-carry laws on businesses, produced by the Center to Prevent Handgun Violence, now known as the Brady Campaign to Prevent Gun Violence (Brady Campaign), notes a number of national chains that prohibited firearms for workers and customers, including the Holiday Inn, General Motors, State Farm Insurance, and the United States Postal Service.⁸² Little is known about businesses in right-to-carry states with established customer and employee firearm prohibitions. The extent to which these prohibitions actually create a gun-free environment is also not known. Further, it is currently unclear the liability associated with the failure to prohibit handguns for employers.

Recent evidence supports the notion that loaded gun carrying in right-to-carry states is greater than in non-right-to-carry states. Researchers conducted a nationally representative survey of U.S. adult handgun owners, asking about their previous 30-day firearm carrying behavior. Authors Rowhani-Rahbar, Azrael, Lyons and colleagues (2017) found 24% of handgun owners carried a loaded firearm monthly, 35% of whom did so daily. Notably, the authors found greater proportions of handgun owners reported past-30-day loaded handgun carrying in right-to-carry states compared to non-right-to-carry states; around 21% of handgun owners reported past-30-day loaded handgun carrying in permitless states, 20% in ‘shall-issue’ states, and 9% in may-issue states.⁸⁴

In 2004, the National Research Council published a critical review of the literature titled, “Firearms and Violence.” In it, the National Research Council recognized violent crime rates were higher in states after they passed right-to-carry laws. The council stopped short of determining a true causal effect citing a lack of reliable and often inadequate data.⁸⁵ However, 14 years have passed since the National Research Council’s

efforts, and with it injury surveillance efforts have increased. Additional data trend lines give researchers opportunity for higher quality, quasi-experimental ecological studies. One of the most rigorous studies to date, carried out by Donohue, Aneja, & Weber (2017), used advanced statistical techniques, referred to as synthetic control models^{xvi} to examine the effect of passing a right-to-carry law on various rates of violent crimes.⁸⁶ The study used models which had previously shown positive health effects of right-to-carry laws,⁸⁷ as well as more preferred panel data regression specifications.⁸⁶ Under each model specification, right-to-carry laws were associated with greater rates of aggregate violent crime with the magnitude of association increasing the longer the policies were in place. Right-to-carry laws were not associated with murder rates and property crime rates. In states 10 years after right-to-carry implementation, the violent crime rate was 13-15% higher than it would have been had right-to-carry laws not gone into effect.

Ginwalla, Rhee, Friese and colleagues (2014) aggregated and analyzed injury and death event data from Pima County (Tucson) Arizona via police, hospital, and medical records to analyze the effect of Arizona's 2010 law change from shall-issue permitting to not requiring a concealed carry permit.⁷¹ The study also examined data on background checks related to firearm purchase for Arizona and the United States. The study examined a period of 48 months; 24 pre-law and 24 post-law months. The authors found firearm purchases increased in Arizona after the change to their right-to-carry law while US purchasing rates remained steady. Firearm-related fatalities increased 27% (Relative Risk (RR), 1.27; 95% CI: 1.02, 1.58). The study did not find any significant changes in other violent crimes, however.

^{xvi} See footnote xii

Siegel, Xuan, Ross and colleagues (2017) examined the impact of shall-issue concealed carry weapons permitting laws, compared to may-issue laws, on homicides disaggregated to deaths by handguns, long gun, non-firearms, and total firearms from 1991-2015.⁸⁰ The paper found shall-issue laws were significantly associated with 6.5% greater total homicide rates, 8.6% greater firearm homicide rates, and 10.6% greater handgun homicide rates with no significant association with long-guns or homicides not committed by a firearm. The paper conducted several sensitivity analyses to check the robustness of their study, with consist results. They restricted their analysis to the 23 states that changed to shall-issue concealed carry weapons permitting between 1991 and 2015. They used raw count data for homicides with a population offset. They restricted the analysis to only populous states (population greater than 1 million people). They restricted the analysis period to 2003-2015 to avoid potential confounding with the violent crack cocaine epidemic. Results held true regardless of the type of analysis, indicating a robust model.⁸⁰

Economist John J. Donohue further tested the robustness of the model specified by Siegel, Xuan, Ross and colleagues (2017).⁸⁸ Donohue reproduced the analysis using several different model types from 1991-2014 and from 2000-2014. He used his available data to mirror the original model using raw counts with a population offset and modified the model to eliminate potentially confounding variables related to violent crime (e.g. homicide rate, household gun availability, other state laws). Donohue found nearly identical magnitudes of association to Siegel and colleagues across outcome type. The author posited Siegel and colleague's work constituted overwhelmingly support for the

hypothesis that right-to-carry laws increase firearm homicides, and more specifically, handgun homicides.⁸⁸

Evidence from Simonetti, Rowhani-Rahbar, Mills and colleagues (2015) suggests possible lower rates of non-fatal firearm violence in states with stricter firearm laws; though their methods for stratifying law presence is not ideal and thus their results should be taken with caution. The authors examined age-adjusted hospital discharge rates for nonfatal firearm injuries in 18 states using healthcare cost and state emergency databases. The authors compared state rates across tertiles based on Brady Scores, a score indicating the overall strength of firearm policies in a given state, from the Brady Campaign. The authors found states with lower Brady Scores, or more permissive firearm laws including right-to-carry laws, had greater rates of nonfatal firearm injuries. One should not draw strong inferences from this type of research due to a lack of complete state data and emphasis on overall legislative score rather than presence of specific laws, a far less arbitrary metric.⁸⁹

Stand Your Ground Laws

Stand your ground laws, also referred to as shoot-first laws, weaken legal consequences for using lethal force which may accelerate aggressive interactions. These laws make it so individuals can apply lethal force as a means of self-defense without first a ‘duty to retreat.’ Advocates of these laws suggest the increased threat of retaliatory violence acts as a deterrent for would be criminals. Critics, though, state the weakened consequences of using deadly force may intensify aggressive altercations. An interrupted time-series analysis of these laws conducted by Humphreys, Gasparini, & Wiebe (2017) found significantly higher mean monthly homicide rates in Florida post stand your

ground implementation.^{xvii} Authors found a 24% increase in the monthly homicide rate and a 31.6% increase in firearm-related homicides. Over the same time period, other states without stand your ground laws did not display statistically significant changes to homicide rates in general or firearm-related homicide rates specifically.⁹⁰ The authors repeated their analysis using unlawful homicides and justifiable homicide as outcomes, with similar results.⁹¹

Firearm Prohibitions Violent Individuals

Several types of state laws attempt to address firearm access among perpetrators of intimate partner violence. Women are killed by someone known to them twelve times more often than by a stranger.¹⁹ Evidence indicates women whose intimate partner has access to a firearm is at increased risk of death.⁹² From 1980-2008, firearms were used in more than half of all incidents where females were killed by an intimate partner.^{92,93} Half of all female victims of intimate partner homicide in some way interacted with police regarding their abuser, i.e. obtained a domestic violence restraining order, reported stalking, etc.⁹⁴ As firearm access is one of the primary risk factors for intimate partner homicide⁹⁵ there is need to separate both victims from abusers and abusers from their firearms.

Quantitative and qualitative research methods have found policies restricting firearm access likely reduce rates of intimate partner homicide. Vigdor & Mercy (2006) used a multiple time-series design with state and year fixed-effects controlling for a large range of potential confounders to estimate average treatment effects of firearm restriction

^{xvii} Florida's stand your ground went into effect October 1, 2005

policies for intimate partner violence perpetrators.⁹⁶ States with any of type of firearm prohibitions for intimate partner violence perpetrators had an 8% reduction in intimate partner homicides. States with prohibition and possession restrictions for intimate partner violence perpetrators saw a 10% reduction in intimate partner homicide. However, results were significant only if states had the ability to check criminal history via background checks. That the reductions in intimate partner homicides were largely contingent on implementers' ability to assess domestic-violence related criminal history speaks to the role implementation plays in policy outcomes.⁹⁶ Zeoli & Webster (2010) sought to evaluate the effect of policies on intimate partner homicides at the city level, controlling for alcohol taxes, police staffing levels, and known confounders of intimate partner homicides. Using the same study design and policy outcomes as Vigdor & Mercy (2006), the authors found similar results. Cities in states with laws restricting firearm access for individuals under a domestic violence restraining order and laws mandating arrest of domestic violence perpetrators saw statistically significant reductions in firearm-related intimate partner homicides.⁹³ A closed ended survey analysis of California's domestic violence restraining order firearm prohibition produced insight concerning the experience of 17 female restraining order recipients.⁹⁵ The majority of women reported wanting their abuser's firearms removed and feeling safer after removal. However, results from the analysis showed issues with the how firearm-prohibitions for domestic violence restraining order respondents were implemented.⁹⁵

The most recent and robust research conducted by Zeoli, McCourt, Buggs and Colleagues (2017) show state-laws prohibiting firearm possession and purchase for those with a domestic violence restraining order are only significant if the laws cover dating

partners or allow ex parte orders. Judges issue ex-parte domestic violence restraining orders in an emergency setting when it is clear the petitioner is in need of immediate protection. In a 45-state panel analysis, using generalized estimating equations, researchers showed allowing ex parte domestic violence restraining orders was associated with 10% reduction in intimate partner homicides and expanding domestic violence restraining orders to cover dating partners was associated with 12% reduction in intimate partner homicides from 1980-2013.⁷⁹

Firearm prohibitions for those convicted of a violent misdemeanor also display reductions in future violent crimes.⁹⁷ In 1991, California amended its statutes to prohibit those convicted of a violent misdemeanor from purchasing firearms. To estimate the effect of the law, Wintemute and colleagues conducted a retrospective cohort study of those under the age of 35 who sought to purchase a handgun. The authors compared the violent offenders denied a firearm license (post-law implementation) to violent offenders sold a firearm (pre-law implementation) in 1991. After controlling for covariates related to age, sex and prior criminal history, violent offenders who were able to purchase a firearm prior to the law were 29% more likely to be arrested for future gun or violent crimes from 1991-1994 (relative hazard 1.29, 95% CI: 1.04-1.60). Previously discussed research from Zeoli and colleagues (2017) also showed firearm prohibitions for any type of violent misdemeanor were significantly associated with 23% reductions in intimate partner homicide from 1980-2013.⁷⁹

Politics of Firearm Policy in the United States

Attempting to address firearm violence through public policy is difficult.⁹⁸ This is due in part because firearm policy is one the most contentious aspects of public policy in

the U.S. For gun owning Americans, firearms broadly represent a set of conservative values.⁹⁹ Values that emphasize rural living, personal ownership, and limited reach of government that originated with the United States' birth as a resistant colony and have survived despite modernity and urbanization. These values are linked strongly to the Republican political party, making firearms representative of Republican ideology.⁹⁹ It is important to note, the two categories, firearm owners and Republicans, are not one in the same.

Public opinion polls indicate large portions of the population do favor some firearm policies, regardless of firearm ownership status.¹⁰⁰ A national public opinion survey conducted in January 2013 asked a nationally representative sample of 2,703 Americans about their opinion on a host of firearm policies. The study included non-gun-owners (n=913), non-gun-owners that lived in a house with a gun (n=843), and gun owners (n=947). Results of the survey indicated 89% respondents overall and 84% of firearm owners supported mandatory background checks for firearm sale. Further, the survey found similar support for policies that prohibit firearms for persons convicted of violating a domestic violence restraining order. Overall, 80% of respondents and 75.6% of firearm owners supported prohibiting firearms for persons convicted of violating a domestic violence restraining order.¹⁰⁰

The debate over whether right-to-carry laws increase violent crime in the general population is on-going. This is despite the fact that early research by Lott & Mustard, suggesting right-to-carry laws are associated with reductions in violent crime,⁸⁷ has largely been debunked by more advanced statistical techniques.¹⁰¹⁻¹⁰³ Proponents of right-to-carry laws feel more gun carrying individuals in a population makes the risk of violent

crime lower as would-be criminals face a larger threat that their violence would be met with lethal force. They claim gun owners use their firearms to successfully defend themselves at least a million times a year. These claims, however, are based on very flawed research from 1993 by criminologist Gary Kleck.¹⁰⁴ Kleck performed a telephone survey of around 5,000 adults in 1993 and estimated around 2.5 million cases of civilian defensive gun uses per year in the U.S. This study was performed at a time when public gun carrying was uncommon and during a year in which there were only 1.5 million total firearm crimes, fatal and nonfatal. Further, Kleck estimated over 200,000 criminals were shot as part of civilian defensive gun use. This estimate is more than double the number of actual individuals treated for nonfatal gunshot wounds resulting from criminal assaults in emergency rooms. That fact holds true for every year between 2001-2015.⁸¹

The idea that concealed carry firearm holders are the ‘good guys’ with guns who can stop the bad guys may be far outweighed by the risk these individuals pose to public safety. The Violence Policy Center maintains a database of the fatal violence committed by concealed carry firearms permit holders since 2007 using mostly media reports. Excluding homicides legally determined to be in self-defense, the research center has identified 914 incidents in 40 states and the District of Colombia resulting in 1,119 total people killed by concealed carry permit holders. These individuals committed 31 mass shootings, defined as the death of 4 or more people. Twenty-one of the victims were police officers.¹⁰⁵

Most Americans do support public place restrictions for where firearm owners can carry their concealed weapon.¹⁰⁶ A 2013 nationally representative survey, including firearm owners, non-firearm owners, and non-firearm owners that lived in a household

with a firearm, were asked about their opinions regarding carrying concealed firearms in public places. Overall, 70% of respondents thought individuals should not legally be allowed to carry firearms to sports stadiums and 69% felt individuals should not legally be allowed to carry firearms in bars and in schools. However, support of carrying a firearm in public places was consistently greater for firearm owners compared to non-firearm owners. Restaurants had the biggest disparity in opinion after stratifying by firearm ownership status; 60% of non-firearm owners, 35% of non-firearm owners living in a household with a firearm, and 23% of firearm owners felt individuals should not be legally allowed to carry firearms in a restaurant.¹⁰⁶

One of the biggest political issues surrounding right-to-carry laws currently is reciprocity. Reciprocity is the exchange of privileges between states. In the case of right-to-carry laws, there have been attempts at the federal level to create national right-to-carry reciprocity, requiring each state to honor the concealed carry firearm permits of all other states.⁸¹ ^{xviii} This would mean states that give authorities discretion over who can obtain a concealed carry firearm permit would have to honor individuals from states that do not require a permit to carry a concealed firearm. States that issue concealed carry firearm permits on a ‘shall-issue’ basis but require individuals to undergo safety training would be required to allow individuals from other shall-issue states to carry a concealed firearm regardless of whether the individuals underwent safety training. Currently, reciprocity between shall-issue states is high as the majority of states acknowledge permits of at least 20 other states.¹⁰⁷ However, may-issue states do not grant reciprocity.¹⁰⁷ These laws, if passed, would erode states’ ability to determine who is

^{xviii} House bill 38 and Senate bill 446, 2017

allowed to carry a concealed firearm within their state, disproportionately affecting may-issue states.

Unfortunately, the success of many of the laws discussed above, such as firearm prohibition laws for violent misdemeanants, are often contingent on states' existing firearm policy structure. For example, laws that prohibit individuals with violent misdemeanor convictions from purchasing firearms are limited if the prohibited individual has a means to purchase a firearm without a background check. In places without permit-to-purchase laws, individuals can purchase a firearm from a private seller without a background check, negating the law's ability to restrict firearm access for prohibited individuals.

Permit-to-purchase laws, right-to-carry laws, stand your ground laws, and firearm prohibition laws for violent misdemeanants and violent intimate partners all have displayed significant relationships with state-level firearm homicides. As workplace homicides are by-in-large a firearms issue, there is need to explore what impact these laws may have on workplace homicides. Currently, when considering ways to reduce firearm-related workplace homicides, firearm policies are not considered.

Rationale for Research

Examinations of risk factors and disparities associated with workplace homicides are robust and ongoing. Males are at heightened risk for workplace homicides;^{47,108} as are foreign born workers,⁴⁸ older workers,^{48,108} and minorities.^{44,91} Workplaces with a prior history of workplace violence or workplace homicide,¹⁰⁸ residing in a low-poverty area,¹⁰⁹ employing solo workers,²⁰ and open late are at heightened risk for a workplace homicide.^{19,48,51} Workplaces with bright lights, that restrict access to the workplace

during work, and with at least one security device have decreased risk for having a workplace homicide.⁵¹ Retail industry workplaces are at increased risk of having a workplace homicide.^{43,47,53} Female retail workers are at increased risk for having a Type IV workplace homicide.¹⁹ Allowing access to firearms at work increases the risk of having a workplace homicide five-fold.⁵¹

However, from the onset, OSHA and other occupational safety institutions viewed workplace homicide as a robbery issue despite early evidence suggesting a need for more a nuanced understanding. The resulting prevention efforts focused on robbery-motivated workplace homicides, eschewing customer, co-worker, and personal relationship violence types.¹¹⁰ Earlier and more current research noted the female and male experience of workplace homicides differed greatly, as 75% of females killed in the retail industry died from Type IV workplace homicide.^{36,111} Else, a large portion of workplace homicides occurs as part of disputes.^{55,58} There is a clear disconnect between existing prevention efforts and workplace homicide typology almost a two decades after NIOSH declared occupational homicides a significant issue.²⁰

Firearm violence constitutes a major proportion of workplace homicides each year. Prevention efforts have done little to address workplace homicides committed by customers, co-workers, or individuals known to the victim. While researchers have documented firearm-use prevalence in workplace homicides, there has been no attempt to characterize the types of firearm-use behaviors or how perpetrators access their firearms. Prevention efforts at both the state and workplace level could be refocused with 1) knowledge of how firearm violence at work occurs and 2) a greater understanding of how perpetrators access their firearms.

Loomis, Marshall, & Ta (2005) found a significant association between firearm exposure at work and increased odds of having a workplace homicide.⁵¹ Yet, the role of state-level firearm policy remains undiscussed within the workplace homicide literature. Policies that affect firearm exposure and firearm access for dangerous individuals are associated with firearm homicide rates. Policy makers designed parking lot laws to increase firearm exposure at work, ensuring firearm access for workers via their motor vehicle. Firearm policies may impact workplace homicide rates as firearm exposure at work increases the odds of having a workplace homicide. Furthermore, intimate partners may use the workplace to locate and kill their victims, and guns are often used in those instances.¹⁹ Given the current literature, there is a need to acknowledge and investigate the role of firearm policy in workplace homicide incidence.

Conceptual Model

Injury prevention scholarship often begins with the Haddon Matrix. William Haddon, Jr. created this conceptual framework in the 1970's as a tool for examining motor vehicle injuries.¹¹² The Matrix assists in comprehensively examining an injury from multiple perspectives, and consists of three rows, representing time, split into pre-injury event, injury event, and post-injury event as well as four columns, representing human factors, the agent, physical environment, and social environment.¹¹³ Human factors refers to the individual at risk of injury or perpetrator of an intentional injury. Agent of injury refers to the energy transferred from the host through a vehicle or vector. Physical environment refers to the characteristics of the setting of injury. Social environment refers to social norms, laws, and community level practices. A Haddon Matrix allows researchers to consider possible key determinants and related risk factors

associated with a specific injury outcome. **Table 12** (in the Appendix) presents a Haddon Matrix considering the role of firearms in workplace violence.

Both the victim and perpetrator are considered within the Haddon Matrix's human factor pre-event phase. Evidence from the literature showed workers of Hispanic ethnicity, foreign born workers,^{47,48} and a worker who did not disclosed intimate partner violence to a workplace superior are at increased odds of having a workplace homicide incident.⁴⁶ If perpetrators have access to the workplace, either because they are a former or current employee, there is increased risk of having a fatal workplace violence incident. If perpetrators have anger issues, a history of violent behaviors, an abusive supervisor, or have access to a firearm there is also an increased risk of having a fatal workplace violence incident.¹¹⁴ Prior to the event, within the agent of injury, personalized gun technology, gun locks, and restricting firearm access in the workplace are potential ways to reduce the lethality or impact of injury.⁵¹ Also prior to the event, workplaces with locked doors, alarms, bright lights, multiple workers, a lighted perimeter, a separate employee parking lot from public parking, security and metal detectors, and union representation are at decreased risk for having a fatal workplace violence incident.^{11,20,45} Workplaces open at night,⁴⁸ with a majority of male workforce,¹⁰⁸ and which allow firearms and or ammunition at work are at increased odds for having a fatal workplace violence incident. Manager attitude can be a potential protective or risk factor.^{114,115} Prior to a fatal workplace violence incident, the social environment encompasses both state and workplace characteristics. Workplaces in states with more lenient firearm access laws are potentially at increased risk for having a fatal workplace violence incident. State-level

characteristics are also known to increase risk for firearm homicide, such as population density, unemployment rates, educational attainment, and poverty levels.⁷⁰

For the event phase, potential risk factors for reducing the energy of the injury are wearing protective material or training employees on safe response strategies. Limiting magazine size, type of ammunition, and caliber available at the state level may affect the lethality of the event. For the post-event phase, certain comorbidities of the victim, whether or not the staff is trained in first aid, and providing workplace crisis intervention counseling helps to minimize the damage of potentially fatal workplace violence incidents.¹¹⁶ Also, a way to reduce further harm associated with the agent of injury is to improve the ability to trace firearms and apprehend suspects. The physical layout of the workplace, i.e. the proximity to an accessible exit, and the time of arrival of emergency medical services reduces the likelihood the workplace violence incident results in a fatality.

In conjunction with the Haddon Matrix, the social-ecological model guides this study.^{117,118} The social-ecological approach is one that considers the dynamic interrelations between an individual and their environment as well as the context within which they exist. It recognizes the complexities of human situations and health behaviors. To do this, the social-ecological approach considers several spheres of influence that surround a health behavior at the intrapersonal level, the interpersonal level, the community level, and the societal level.¹¹⁹ Health educators, researchers, and public health practitioners use this framework to identify determinants of a given problem and pinpoint possible avenues for behavior change. This model contains proximal determinants, or determinants with more direct influence over a health behavior, and

distal determinants, or determinants less directly associated with a given health behavior. In this context, determinants are proximally or distally located to the individual performing the health behavior.

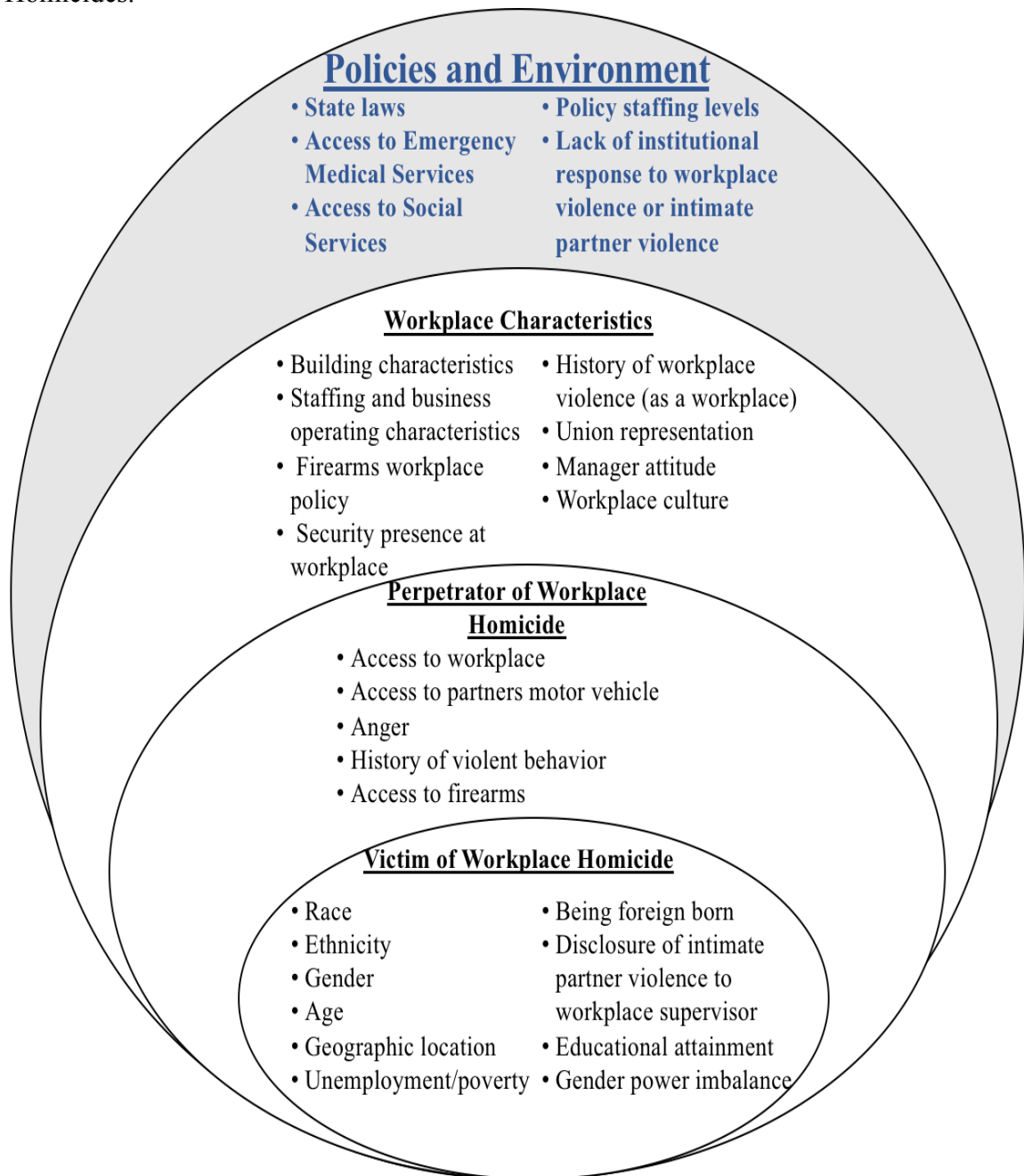
The social-ecological model considers public policies a distal determinant of health behavior, for example, state laws that require interlocks for all drunk driving offenders. This type of law requires all individuals who receive a driving under the influence of alcohol citation install an ignition interlock, or alcohol-sensing device and are associated with 8% decrease in fatal drunk crashes.⁷⁴ Given the lack of consideration for public policy's role in the incidence of workplace homicides, there is a need to conceptualize workplace homicides with an added emphasis for policy as a determinant.

Figure 1 (below) takes the determinants for firearm-related workplace violence presented in the Haddon Matrix (**Table 12**, in the Appendix) and considers them within the context of the social-ecological model. For this conceptual model, we have highlighted the societal-level determinants of policies and environment in grey. The reason for this is to highlight the impact policy can have on a given health outcome. This denotes the importance of structural or institutionalized policies and environments as determinants of a given health outcome.

For this social-ecological model, risk factors are considered at the state level. As presented, policies, specifically state-level firearm violence prevention policies, are a determinant of a workplace homicide. Risk factors associated with the increased likelihood of having a fatal workplace violence incident or increased likelihood of a

firearm homicide contribute to the possible incidence of a workplace homicide. These risk factors exist at the victim, perpetrator, workplace, and policy/environment level.

Figure 1: A Social Ecological Model Considering the Role of Policy in Workplace Homicides.



Research Questions

The conceptual model aided in the identification of existing research gaps and formulation of specific aims. This dissertation fills gaps in the current literature to answer three key research questions:

1) How do perpetrators access firearms during a workplace homicide? While the role of firearms in workplace homicide is well established, information about how perpetrators access firearms during a workplace homicide has not been documented. There is a need to understand the situational context of how perpetrators access their firearms in a workplace homicide.

2) What is the policy landscape of Parking Lot Laws? Little is known about these laws. The number of laws, the time frame in which they were implemented, the differences and similarities between laws, and whether they were amended after implementation is not known. There is a need for greater understanding of these laws for future evaluations of their impact on workplace homicides.

3) What is the impact of changes in state-level laws on firearm-related workplace homicide incidence? It is currently unknown how right-to-carry laws, permit-to-purchase laws, stand your ground laws, domestic violence restraining order laws that cover dating partners and offer ex parte orders, and laws that prohibit individuals with any violent misdemeanor convictions from possessing and purchasing a firearm impact state-level workplace homicide rates.

Study Aims

This dissertation has several aims:

- Research Question 1
 - **Aim 1.1.** Identify how perpetrators access firearms preceding a workplace homicide.
 - **Aim 1.2.** Characterize firearm access points by workplace homicide typology, motivation, circumstance, gender of victim, and industry
 - **Aim 1.3.** Characterize firearm access points by perpetrator-victim relationship type for incidents in which multiple workers are killed by a firearm
- Research Question 2
 - **Aim 2.1.** Identify existing parking lot laws
 - **Aim 2.2.** Establish effective dates for each parking lot law
 - **Aim 2.3.** Describe the characteristics of current parking lot laws
 - **Aim 2.4.** Document any legislative actions to parking lot laws after they went into effect
- Research Question 3
 - **Aim 3.1.** Evaluate the impact of changes in state-level laws, including parking lot laws, right-to-carry laws, permit-to-purchase laws, stand your ground laws, firearm prohibition laws for violent misdemeanants, and domestic violence restraining order laws that cover dating partners and offer ex parte orders, on workplace homicide incidence across all 50 states.

Dissertation Organization

Chapters 2-4 of this dissertation contain three manuscripts. Chapter 5 is a methods chapter and Chapter 6 is a concluding chapter. Manuscript one is a descriptive epidemiologic study that describes how perpetrators access and use firearms in a

workplace homicide. Manuscript two provides a policy analysis of parking lot laws. Manuscript three is a longitudinal evaluation of the impact of changes in state-level laws on firearm-related workplace homicide incidence. Chapter 5 provides a detailed explanation of methods used for each manuscript. Chapter 6 contains a discussion of findings, future research areas, and implications.

Chapter 2: Manuscript One

How are Firearms Accessed During a Workplace Homicide?

An Epidemiologic Investigation

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Abstract

Introduction: Perpetrators use firearms to commit the majority (80%) of workplace homicides. As workplace homicides are a leading cause of occupational death, this study sought to identify and characterize firearm access preceding a workplace homicide.

Methods: We abstracted information on 2011-2015 firearm-related workplace homicides throughout the U.S. from the Census of Fatal Occupational Injuries. We classified workplace homicides by perpetrator's relationship to the workplace/victim, motive (robbery v. non-robbery), circumstance (argument v. other circumstance), and firearm access points using narrative text fields. These classifications were informed by the literature (relationship, motive, circumstance) and developed based on a random sample of the cases (firearm access points). Firearm-related characteristics were compared across relationship-type, motivation, circumstance, and gender.

Results: There were 1,553 firearm-related workplace homicides during the study period. Overall, how firearms were accessed was largely unknown (79.9%). Information on firearm access points was most available for non-robbery-motivated, argumentative workplace homicides (n =344) where 44.2% of perpetrators accessed their firearm on their person (n=152) and 15.4% of perpetrators retrieved their firearm in an unspecified manner (n=53). As part of arguments, male workers were most often killed by customers, after the customer accessed their firearm on-person; females were most often killed by someone they had a personal relationship with, predominantly an intimate partner, though how those perpetrators accessed their firearm was largely unknown.

Discussion: Among the firearm-related workplace homicides where firearm access points were able to be categorized, proximal and distal firearm access played a large role in

escalating arguments into argumentative workplace homicides, particularly between customers and workers. Workplaces looking to prevent fatal firearm violence for employees should restrict customer and employee firearm access in their establishments.

A way to prevent intimate partner homicides at work may be to provide legal assistance/education for how to obtain a domestic violence restraining order through employee assistance programs.

Introduction

Despite reductions in the incidence of workplace homicide over the past two decades, it remains a leading cause of occupational death.^{1,47} In 2015, workplace homicide was the fourth leading cause of occupational death overall as 8.6% of fatally injured workers were intentionally killed (n = 417).^{1,33} Further, from 2014 to 2015 workplace shootings increased 15% (from 307 to 354), the first increase since 2012.³³ From 1992-2001, the societal burden of workplace homicides on the U.S. economy, including direct and indirect costs, was estimated at \$6.4 billion.⁴¹

To understand trends in workplace homicides, researchers created a violence typology according to the perpetrator's relationship to the workplace and victim: Type I violence refers to someone with no prior relationship to the workplace/victim; Type II violence refers to a customer or client of the workplace; Type III violence refers to a current or former employee of the workplace; and Type IV violence refers to someone with a personal relationship with the victim.^{19,20,46,47,57,120,121}

Additional classification includes motivation (i.e. robbery or non-robbery), as around 60% of workplace homicides result as part of a robbery,⁴⁶ and circumstance (i.e. argument or other circumstance), as around 20% of workplace homicides result from an argument.^{47,58} Robbery-motivated crimes are primarily committed as part of Type I violence. Research conducted by Hendricks, Jenkins & Anderson (2007), concluded that overall declines in robbery-motivated workplace homicide likely drove workplace homicide decreases over time, mirroring a decline in general population violent crime.⁵⁷ Comparatively, non-robbery-motivated crimes are largely committed by customers (Type

II) and by someone with a personal relationship to the victim (Type IV). Around 50% of non-robbery-motivated crimes involve an argument.⁴⁷

Much of the prior research on preventing workplace homicides, and workplace violence more generally, focused on robbery-motivated crime/death. These prevention efforts, recommended by the National Institute for Occupational Safety and Health in 1996, advocated for environmental modifications, (e.g. improving visibility into the workplace, improving exterior lighting etc.) and administrative policies (e.g. limiting access to the workplace, implementing workplace violence prevention training etc.).¹⁸ Research suggests these prevention efforts had limited success in reducing the risk of robbery-motivated workplace homicide,¹²² non-robbery-motivated workplace homicide,²⁰ and argumentative workplace homicide.⁵⁵ Other prevention efforts focus on de-escalation techniques for verbal aggression as a means to control agitated patients, visitors, customers, or co-workers.⁴⁷

As a large portion of workplace homicides among female workers is committed by intimate partners, other prevention efforts center around training workplaces on preventing domestic violence, though intimate partner violence remains a complex issue for both employees and employers and best practices for training have not been robustly evaluated.^{19,23} Recent literature identified employee assistance programs, or programs that assist employees with personal issues that impact their job performance, as a possible means to prevent intimate partner violence in the workplace.¹⁹

In a 2015 guidance document on preventing workplace violence for the healthcare and social service workers, the Occupational Safety and Health Administration (OSHA) acknowledged customer/client firearm prevalence, or access, as a risk-factor for violence

in the workplace.³⁰ The guidance document cites the agitation that can sometimes accompany exposure to medical facilities as often the cause of violent behaviors.

Current prevention efforts, do not consider how state laws that impact firearm access might affect workplace homicides. Regardless of the violence typology, circumstance, and motivation, perpetrators use firearms around 80% of the time making workplace homicides a firearm issue.^{19,45,46} Workplaces that permitted employees to carry a firearm had nearly 5-times greater odds of having a workplace homicide compared to workplaces that prohibited all types of weapons in North Carolinian workplace deaths from 1994-1998.⁵¹ Further, the odds that a customer or a co-worker is armed have likely increased in recent years as a majority of U.S. states have passed right-to-carry laws.¹²³ States with right-to-carry laws issue concealed carry firearm permits on a ‘shall-issue’ basis, removing discretion from authorities over who is issued a permit, or do not require a permit to carry a concealed firearm. A nationally representative survey of gun owners found greater proportions of loaded handgun carrying in right-to-carry states.⁸⁴ It is more likely than not that loaded handgun carrying in right-to-carry states bleeds into the work environment, creating risk for deadly altercations. Some states have restricted firearm access for dangerous individuals, through laws that prohibit the purchase and possession of firearms for domestic violence restraining order respondents, showing reductions in rates of intimate partner homicide in the general population.^{79,96}

Further, research has yet to provide a description of workplace homicide incidents, or situations in which a perpetrator kills multiple workers. Previous epidemiologic investigations contextualize workplace homicides as fatalities, or the number of individuals killed. The unfortunate societal increase in multiple and mass

shootings seen in the U.S. recently¹²³ necessitates an examination of incidents in which multiple-workers are killed.

It is currently unclear how perpetrators access firearms prior to a firearm-related workplace homicide. The primary purpose of this manuscript is to identify and categorize workplace homicides' firearm-access points into the four types of workplace violence types using perpetrator data obtained from narrative text fields and describe firearm-access points by motivation, circumstance, gender, and industry in the U.S. from 2011-2015. Further, this study sought to identify the perpetrator-victim relationships among workplace homicide incidents with multiple worker deaths and characterize firearms access points for those incidents.

Methods

We identified workplace homicides committed by a firearm in the U.S. from 2011-2015 using the Census of Fatal Occupational Injuries (CFOI) restricted data file. The CFOI is a national injury surveillance system that has collected data on all fatal occupational injuries since 1992. The CFOI confirms workplace deaths via death certificates, workers' compensation reports, police reports, media reports, Occupational Safety and Health Administration Investigation reports, and medical examiner reports. All confirmed workplace deaths require at least two independent source documents indicating the death was related to work. We excluded all law enforcement officer deaths from the analysis.

Variable Definitions

The CFOI uses the Occupational Injury and Illness Classification System (OIICS) to classify occupational death events. The OIICS changed its coding in 2011¹²⁴ so our study period begins in 2011. For each death event, CFOI provides OIICS source codes for the nature of injury/illness, source of injury/illness, secondary source of injury/illness, and event or exposure. For this study, we identified firearm-related workplace homicides and workplace violence typology using OIICS source of injury and illness codes found in **Table 3** (below). For violence typology, OIICS source codes prioritize the perpetrators relationship to the workplace over the relationship with the victim (i.e. a husband who kills an intimate partner with whom he works would be considered a co-worker). For this study we used the North American Industry Classification System (NAICS) to categorized industry into several categories: 1) Labor, 2) Retail, 3) Transportation, 4) Health Care, 5) Professional, 6) Education/arts, 7) Public Administration, and 8) Other.^{xix}

The narrative text field provided in the CFOI restricted data file was used to categorize each event's violence typology, motivation, circumstance, and firearm access point. We reviewed the narrative text for each firearm-related workplace homicide. For violence Type I, if the narrative text specifically stated the assailant was unknown, the violence type was considered, 'unknown.' Else, OIICS source of injury/illness codes were used (see **Table 3**, below for source codes).

^{xix} See Chapter five for breakdown of industry categories

Table 3: OIICS Source Codes for Firearm-related Workplace Homicides and Typology

OIICS Source Codes				
Variable	Nature of Injury/illness	Event or Exposure	Source of Injury/illness	Secondary Source of Injury/illness
<i>Firearm-related Workplace Homicide</i>	1340, Open wound, Gunshot wounds	1111, Intentional Injury by other person – Shooting by other person, intentional	57*^ Persons, other than injured worker, unspecified	78*^^ Firearms, law enforcement, and other self-defense equipment
Type I	“”	“”	-5700, person, unspecified -5770, Assailant, unspecified -5771, Robber -5772, Inmate -5773, Suspect not apprehended -5779, Assailant, not elsewhere classified (n.e.c) -5790, Person, n.e.c.	“”
Type II	“”	“”	-5750, Other Client or Customer -5740, Patient -5730, Student	“”
Type III	“”	“”	-5720, Co-workers or work associates	“”
Type IV	“”	“”	-5710, Relative or Domestic Partner, unspecified -5711, Spouse or domestic partner -5712, Immediate Family Member other than Spouse -5719, Relative or domestic partner, n.e.c. -5760, Acquaintances	“”

^ Source code 57* excluding 578*(Bodily fluids or substance)

^^ Secondary Source code 78* excluding 7813 (Explosive devices)

We coded motivation according to existing literature which established robbery-motivated cases as deaths in which robbery was the primary motivation, confirmed by police reports.^{46,47} Non-robbery-motivated deaths in which events where robbery was known not to be the motive. If the narrative text specifically stated that the motivation for

the crime was uncertain but that robbery had been ruled out, the death was categorized as a non-robbery. If there was no known motivation for the homicide, motivation was coded as unknown.

We coded circumstance based on existing literature.⁴⁷ Konda, Tiesman, Hendricks and colleagues (2014) stratified workplace homicides into arguments and other circumstances using narrative text data and considered arguments to include, “incidents that involved verbal conflicts over merchandize, money, employment, a personal relationship, breaking up a fight, refusal of service, and denial of admission into establishments.” The authors did not consider the following scenarios to be arguments: 1) when an employee was killed by someone with a personal relationship under an unknown circumstance; 2) when an employee was killed by a co-worker or ex-coworker under an unknown circumstance; 3) or when an employee was killed as part of an act of revenge. The authors did not consider these circumstances to be arguments as the deaths did not directly stem from an observable argument. However, we classified circumstance into three strata; *Arguments*, where the workplace homicide resulted from a verbal conflict, as laid out by Konda and colleagues; *Conflicts*, where it is highly likely there was a past or current interaction between the perpetrator and the worker but a direct argument was not observed prior to the worker’s death; and *Other Circumstances*, where the worker was not killed as part of any kind of argument, (e.g. random gun firing, caught in cross fire, a mass shooting/terrorism event, or part of a drug deal (see **Table 14**, in the Appendix, for full list)). Classifying arguments in this fashion allowed for a more nuanced understanding of the circumstances surrounding workplace homicides; while a personal relationship homicide at work may not involve a direct and observable argument at the

time of death, it would be likely incorrect to assume that a past or current altercation did not influence the perpetrator's decision to commit murder. It is important to note, robberies were not classified into circumstance as they represent their own subset of crimes. Therefore, circumstance was coded among only non-robbery-motivated crimes.

To establish firearm access points, we performed a qualitative content analysis.¹²⁵ We sampled a random 20% subset of narrative text fields for the content analysis. We used a random number generator in Excel to generate random integers that corresponded to event identification numbers. Once produced, author MLD read all randomly selected death events and identified all of the possible ways a perpetrator accessed their firearm. Firearm access points were then coded throughout the dataset.

Workplace Homicide Incidents

As the CFOI database does not link deaths that occur as part of the same event, the authors used event date and year to identify deaths that possibility occurred as part of a multiple or mass-shooting of workers. After categorizing by date and year, author MLD read the narrative text fields to identify events involving more than one death. Author MLD coded perpetrator firearm access points for each event. Author MLD assigned each event an event number and determined whether it was a multiple shooting (3 or fewer workers killed) or a worker mass-shooting (4 or more workers killed).

Analysis

We tabulated frequencies and conducted chi-square (χ^2) tests for statistical independence to examine differences between firearm access points and workplace violence typology, motivation, and circumstance. When expected cell counts were less

than or equal to 5, we used Fisher’s Exact test. We used STATA version 15 for analysis.¹²⁶ The research was conducted with restricted access to Bureau of Labor Statistics (BLS) data. The views expressed here do not necessarily reflect the views of the BLS. The Johns Hopkins Bloomberg School of Public Health Institutional Review Board reviewed and approved this research.

Results:

The content analysis of narrative text fields identified 7 possible ways a perpetrator accessed a firearm: 1) on-person, 2) from a home, 3) from a car, 4) from a location within work (such as an office or locker), 5) stolen from victim, 6) retrieved in an unspecified way, 7) not enough information to determine.

Table 4: Number of Firearm-related Workplace Homicides among U.S. Workers by Workplace Violence Typology: CFOI, 2011-2015

Workplace Violence Type	N (%)
I, Assailant unknown, criminal intent	863 (55.6)
II, Customers or clients	176 (11.3)
III, Co-worker or work associate	216 (13.9)
IV, Personal relations	196 (12.6)
Intimate partner	107 (6.9)
Non-intimate partner^	89 (5.7)
Unknown Type*	102 (6.6)
Total	1,553

Note: Note: Fatal injury counts were generated by authors with restricted access to BLS CFOI microdata. Column may not add up to 100 due to rounding

*Unknown typology occurred when there was no information pertaining the perpetrator

-- Indicates no data or data that do not meet BLS publication criteria

intimate partners include immediate family members, relatives, and acquaintances

^ Non-

From 2011 through 2015, there were 1,553 reported firearm-related workplace homicides (**Table 4**, above). There were sufficient details in the narrative text to

categorize violence typology for 93.4% of these homicides (n = 1,451; **Table 4**, above). Of these homicides, 55.6% were Type I events (n = 863), 11.3% were Type II events (n = 176), 13.9% were Type III events (n = 216), and 12.6% were Type IV events (n = 196). Of the type IV events, 55% were perpetrated by an intimate partner (n = 107). The largest portion of the 1,553 workplace homicides occurred in the retail sector (n = 683) followed by labor industry (n = 248) and transportation (n = 172) (**Table 5**, below).

Table 5: Number of Firearm-related Workplace Homicides among U.S. Workers by Industry Type

Industry Type	N (%)
Labor	248 (15.9)
Retail	683 (43.9)
Transportation	172 (11.1)
Health Care	59 (3.8)
Professional	109 (7)
Education/Arts	51 (3.3)
Public Administration	91 (5.9)
Other	140 (9)
Total	1,553

Note: Note: Fatal injury counts were generated by authors with restricted access to BLS CFOI microdata. Column may not add up to 100 due to rounding

-- Indicates no data or data that do not meet BLS publication criteria

Firearm Access and Typology

Across firearm-related workplace homicides with a known typology (n = 1,451), we were unable to determine how perpetrators accessed their firearms 79.9% of the time (n = 1,102) (**Table 6**, below). Perpetrators accessed their firearms 13.1% of the time on-their-person (n=190), 4.2% of perpetrators retrieved their firearm in an unspecified manner (n=61), 1.4% of perpetrators retrieved their firearm from their car (n=20), 0.6% of perpetrators accessed their firearms from their home (n = 9), 0.6% of perpetrators

accessed their firearms by stealing them from their victim. Three times, a perpetrator accessed their firearm from an alternative location (0.2%).

Firearm access points varied by workplace typology (p-value <0.001) (**Table 6**, below). For crimes where the firearm access point was unknown, Type I homicides were most frequent (68.3%). Type II homicides were most frequent when the perpetrator accessed their firearm on-person (40%), retrieved their firearm from an unspecified location (45.9%), and retrieved their firearm from their car (55%) or home (44.4%). Eight times the perpetrator stole the firearm used to commit the workplace homicide from their victim. All eight were committed by an unknown assailant (Type I). Overall, there was sufficient narrative text richness to determine how perpetrators accessed their firearm in 292 of the 1,451 cases with a known violence typology (20.1%).

Firearm Access and Motivation

Of the 1,553 deaths, 39.6% were robbery-motivated (n = 619), 47.9% were non-robbery-motivated (n = 744), and 12.2% were of unknown motivation (n = 190) (**Table 7**, below). Firearm access points varied by motivation (p-value <0.001) (**Table 7** below). The majority (99.5%) of robbery-motivated firearm-related workplace homicides lacked information to determine how firearms were accessed (n = 616). However, how perpetrators accessed their firearms for non-robberies contained variation; the majority (61.6%) of non-robbery workplace homicides did not contain enough information to determine firearm access points (n = 458). However, 25.4% of perpetrators accessed their firearm on-their-person (n=185), 8% of perpetrators retrieved their firearm in an unspecified manner (n = 61), and 3% of perpetrators and 1% of perpetrators accessed their firearm from their car (n = 20) or home (n = 8). In 6 instances, the perpetrator stole

the firearm used to commit the firearm-related workplace homicide, all were non-robbery-motivated crimes. Overall, there was sufficient narrative text richness to determine how perpetrators accessed their firearm in 292 of the 1,553 cases (18.8%).

Table 6: Firearm Access Points by Workplace Homicide Violence Typology, CFOI, 2011-2015

Firearm access points n (%)	Workplace Violence Typology				Total n (%)	χ^2
	Type I	Type II	Type III	Type IV		
Prior to incident/unknown	791 (68.3)	56 (4.8)	145 (12.5)	167 (14.4)	1,159 (79.9)	p < 0.001
On-person	53 (27.9)	76 (40)	39 (20.5)	23 (11.6)	191 (13.1)	
Retrieved, unspecified	10 (16.4)	28 (45.9)	19 (31.2)	4 (6.6)	61 (4.2)	
From Car	-- (--)	11 (55)	9 (45)	-- (--)	20 (1.4)	
From Home	-- (--)	4 (44.4)	3 (33.3)	-- (--)	9 (0.6)	
Stolen by perpetrator	8 (1.0)	-- (--)	-- (--)	-- (--)	8 (0.6)	
From an alternative location**	-- (--)	-- (--)	-- (--)	-- (--)	3 (0.2)	
Total	867	176	216	196	1,451	

Note: Fatal injury counts were generated by authors with restricted access to BLS CFOI microdata.

*There were 102 'undetermined' fatalities removed from the table

** Alternative locations included an office or a locker at work

-- Indicates no data or data that do not meet BLS publication criteria

Of the 190 firearm-related workplace homicides without a known motivation, 102 (53.7%) also did not have enough information to determine a typology (Data not shown). Else, they were committed by an unknown assailant 31.6% of the time (n = 60), by a customer 9% of the time (n = 17), by a co-worker 2% of the time (n = 4), and by someone personally known to the worker 3.7% of the time (n = 7) (Data not shown).

Table 7: Firearm Access Points by Motivation, CFOI, 2011-2015

Firearm access points n (%)	Motivation			Total n (%)	χ^2
	Robbery	Non-robbery	Unknown motivation		
Prior to incident/unknown	616 (99.5)	458 (61.6)	187 (98.4)	1,261 (81.2)	p < 0.001
On-person	-- (--)	189 (25.4)	-- (--)	191 (12.3)	
Retrieved, unspecified	-- (--)	61 (8.2)	-- (--)	61 (3.9)	
From Car	-- (--)	20 (2.7)	-- (--)	20 (1.3)	
From Home	-- (--)	8 (1.1)	-- (--)	9 (0.6)	
Stolen by perpetrator	-- (--)	-- (--)	-- (--)	8 (0.5)	
From an alternative location*	-- (--)	-- (--)	-- (--)	3 (0.2)	
Total	619	744	190	1,553	

Note: Fatal injury counts were generated by authors with restricted access to BLS CFOI microdata.

-- Indicates no data or data that do not meet BLS publication criteria

* Alternative locations included an office or a locker at work

Firearm Access and Circumstance

Circumstance of firearm-related workplace homicides were examined among non-robbery-motivated crimes as robbery-motivated workplace homicides represent their own circumstance. Around half (46.2%, n = 344) of the non-robbery-motivated workplace homicides (n = 744) were associated with arguments (**Table 14**, in the Appendix).

Among arguments, the most common circumstance was other or unknown argument, followed by job-related arguments such as work hours, termination, and work conditions. Other arguments stemmed from incidents that involved disgruntled customers, unruly patrons, or asking customers to leave an establishment. Around 30% of the non-robbery-motivated firearm-related workplace homicides were conflicts (n = 220). Among this category, the most common circumstance was a personal relationship where the

circumstance surrounding the argument was unknown, followed by a co-worker relationship where the circumstance surrounding the argument was unknown. For the other circumstances (23.6%, n = 180), the most common circumstance a mass shootings/terrorism (n = 68).

Table 8: Firearm Access points by Circumstance among Non-robbery-motivated Workplace Homicide, CFOI, 2011-2015

Firearm access points n (%)	Circumstance			Total n (%)	χ^2 p < 0.001
	Arguments	Conflicts	Other circumstances		
Prior to incident/unknown	111 (32.3)	201 (89.7)	146 (81.1)	458 (61.6)	
On-person	152 (44.2)	9 (5.6)	28 (15.6)	189 (25.4)	
Retrieved, unspecified	53 (15.4)	-- (--)	-- (--)	61 (8.2)	
From Car	20 (5.8)	-- (--)	-- (--)	20 (2.7)	
From Home	5 (1.5)	-- (--)	-- (--)	8 (1.1)	
Stolen by perpetrator	-- (--)	-- (--)	4 (2.2)	-- (--)	
From an alternative location*	-- (--)	-- (--)	-- (--)	-- (--)	
Total	344	220	180	744	

Note: Fatal injury counts were generated by authors with restricted access to BLS CFOI microdata. Table contains 744 non-robbery-motivated firearm-related workplace homicides.

-- Indicates no data or data that do not meet BLS publication criteria

* Alternative locations included an office or a locker at work

Firearm access points varied by circumstance (p-value <0.001) (**Table 8**, above). For conflicts (89.7%) and other circumstances (81.1%), firearm access points were predominately unknown. However, firearm access points for arguments contained variation. The largest percent of perpetrators (44.2%) accessed their firearm on their person (n = 152). Perpetrators retrieved their firearm in an unspecified way 15.4% of the time (n = 53), retrieved their firearm from a car 5.8% of the time (n = 5), and retrieved

their firearm from a home 1.5% of the time (n=5). Around 30% of the time, how perpetrators accessed firearms was unknown for arguments. Of the 344 argumentative deaths, there was sufficient narrative text richness to categorize how firearms were accessed in 233 cases (67.7%).

Firearm Access by Characteristics

Table 9 (below) provides a cross tabulation of firearm access points by gender and circumstance across workplace violence typology. Ten times more male workers (n=314), compared to female workers (n=30), were killed as part of a direct argument. During incidents in which the circumstances are known, male victims were most commonly killed by a customer/client who accessed the firearm on their person (n = 68), followed by a customer/customer who retrieved their firearm (n = 39). More female workers (n=117) were killed as part of a conflict compared to male workers (n=103) though firearm access points were largely unknown. Males were most often killed by a coworker. Of the 117 female workers killed in a conflict, 99 were killed by someone they had a personal relationship with (Type IV) (Data not shown). Of the 99 type IV homicides, 97 were committed by an intimate partner (Data not shown). How perpetrators accessed their firearms as part of a non-argument was largely unknown.

Table 9: Firearm Access Points by Victim Gender, Circumstance, and Workplace Violence Typology, among Non-robbery Workplace Homicides, CFOI, 2011-2015

	Workplace Violence Typology				
Circumstance	Type I	Type II	Type III	Type IV	Total
<hr/> <i>Arguments, (n=339)</i> <hr/>					
Male victim (n=314)					
On-person, <i>n (%)</i>	24 (17.3)	68 (48.9)	34 (24.5)	13 (9.4)	139
Retrieved, <i>n (%)</i>	--	39 (49.4)	27 (34.2)	--	79
Unknown, <i>n (%)</i>	13 (13.5)	24 (25)	44 (45.8)	15 (15.6)	96
Female victim (n=30)					
On-person, <i>n (%)</i>	--	5 (--)	--	3 (--)	--
Retrieved, <i>n (%)</i>	--	--	--	--	--
Unknown, <i>n (%)</i>	--	--	6 (40)	4 (26.7)	15
<hr/> <i>Conflicts, n (%) (n=204)</i> <hr/>					
Male victim (n=103)					
On-person, <i>n (%)</i>	-- (--)	--	--	--	5
Retrieved, <i>n (%)</i>	--	--	--	3 (50)	5
Unknown, <i>n (%)</i>	--	--	49 (52.5)	29 (31.2)	93
Female victim (n=117)					
On-person, <i>n (%)</i>	--	--	--	--	4
Retrieved, <i>n (%)</i>	--	--	3 (60)	--	5
Unknown, <i>n (%)</i>	--	-	10 (9.3)	93 (86.2)	108
<hr/> <i>Other circumstance, n (%) (n=180)</i> <hr/>					
Male victim (n=142)					
On-person, <i>n (%)</i>	21 (84)	--	--	--	25
Retrieved, <i>n (%)</i>	3 (75)	--	--	--	4
Unknown, <i>n (%)</i>	88 (77.9)	5 (4.5)	15 (13.2)	5 (4.4)	113
Female victim (n=38)					
On-person, <i>n (%)</i>	3 (--)	--	--	--	--
Retrieved, <i>n (%)</i>	--	--	--	--	--
Unknown, <i>n (%)</i>	22 (66.7)	--	5 (15.2)	--	33
<i>Total</i>					744
<i>Male victims</i>					559
<i>Female victims</i>					185

Note: Fatal injury counts were generated by authors with restricted access to BLS CFI microdata. Table contains 744 non-robbery-motivated firearm-related workplace homicides. For all categories of *retrieved*, note that all type of ways perpetrators retrieved firearms, (i.e., from a car, home etc.) were combined.
-- Indicates no data or data that do not meet BLS publication criteria

Further, we cross tabulated industry-type and workplace violence typology for the 233 argumentative workplace homicides with known firearm access points (See **Table 15**, in the Appendix). Of the 152 argumentative workplace deaths where the perpetrator accessed their firearm on-their-person, 55 occurred in the retail industry followed by 26 in the labor industry. Armed customers committed the majority of argumentative workplace deaths in the retail industry (n = 40). Of the 81 argumentative workplace homicide deaths where the perpetrator retrieved their firearm in some fashion, 36 occurred in the retail industry followed by 29 in the labor industry. Customers with nearby firearm access committed the majority of the retail industry deaths (n = 27) while [ex]co-workers committed the majority of labor industry deaths (n = 20).

Multiple-death Events

Of note, 12.4% of the 1,553 workplace deaths (n=193) occurred as part of 74 workplace homicide incidents involving more than one worker (**Table 16** in the Appendix). Of the 74 workplace multiple-death events, 7 were mass shootings with 3 of those mass shootings occurring as part of seemingly random violence by an unknown assailant, not motivated by robbery (Type I). [Ex]co-workers perpetrated the largest number of workplace multiple-homicide incidents (n=25) (Type III). How co-workers accessed their firearms was largely unknown. Customers committed 14 workplace multiple-homicide incidents (Type II). Of the 14 incidents, half of the time (n = 7) the customer accessed their firearm on-their-person. There were 5 instances where an intimate

partner killed their victim and then killed multiple other workers, resulting in 13 deaths (Type IV). Robbers committed 15 multiple-death events resulting in 34 deaths (Type I).

Discussion:

This research provides a description of how perpetrators accessed their firearms as part of a workplace homicide spanning a 5-year period, from 2011-2015 nationwide. Despite the fact that workplace homicides are by-in-large a firearms issue (firearms are used in around 80% of crimes), this is the first attempt to describe how perpetrators accessed their firearms.

We must note that how firearms were accessed, or the narrative text richness surrounding the nature of firearm violence, was largely unknown throughout our data as 1,261 of the 1,553 firearm-related workplace homicides (81.2%) did not contain enough narrative text to determine how exactly perpetrators accessed their firearms. This was largely driven by unknown firearm access points within robbery-motivated crimes and crimes with no known motivation. We have reason to believe robbers who committed a robbery-motivated homicide were armed during the commission of the crime. Robbery suspects are often not apprehended and thus, how these individuals accessed their firearm is not known. Further, workplace homicides with an unknown motivation imply a lack of narrative text richness concerning the overall crime as well as how perpetrators accessed their firearms.

Workplace homicides for which there was sufficient narrative text to assess how perpetrators accessed their firearms were largely arguments. Overall, there were 292 firearm-related workplace homicides for which perpetrator firearm access could be determined. Argumentative workplace deaths constituted 233 of the 292 cases (79.9%).

As arguments are likely impulsive crimes, there is reason to believe these actions were not planned and may have created additional sources of information for investigators to assess how perpetrators accessed their firearms (i.e., witnesses, security footage). This additional information may allow for more narrative text richness surrounding the violence compared to other types of workplace homicides. However, an alternative explanation of why firearm access points were most known for argumentative deaths could also be that their impulsive nature necessitated an alternative firearm access point other than the perpetrator simply being armed. When perpetrators retrieved their firearm in some fashion, the narrative text fields indicated the perpetrator likely did not intend on committing a workplace homicide up until the point of the argument. After which, the perpetrator left the workplace environment, retrieved their firearm, and used it against the employee with whom they had an argument with. Thus, the narrative text richness for how perpetrators accessed firearms as part of argumentative workplace homicides may be more a function of their impulsive nature, making these crimes fundamentally different from workplaces homicides of a more premeditated nature, such as robberies.

Similar to previous literature, we found that arguments were the most common circumstance among non-robbery-motivated workplace homicides.^{47,58} Previous literature identified, with the results here agreeing, that customer-employee and employee-employee altercations constitute a large portion of argumentative workplace homicides, particularly in the retail industry.⁴⁷ This paper further contextualized these relationships. Customers and employees either accessed their firearm directly on-their-person or retrieved their firearm in some fashion. Thus, among the firearm-related workplace homicides where firearm access points were able to be categorized, proximal and distal

firearm access played a large role in escalating arguments into argumentative workplace homicides, particularly for customers and employees. This finding supports the research from Loomis and colleagues (2005) that employee firearm access at work may lead to increased odds of having a workplace homicide and speaks to the large role firearm exposure plays in workplace deaths.⁵¹

In a 2015 guidance document for preventing workplace violence in the healthcare industry, OSHA acknowledged the risks associated with firearm access for clients.³⁰ The document cites patient/customer agitation as a potential cause, with access to firearms a particular risk for the violence to turn lethal. This study found agitated and armed customers, and customers with access to a nearby firearm, play a large role in workplace homicides overall. This suggests, for industries with customers or clients, restricting customer firearm access in workplaces is likely a strong prevention measure against having a firearm-related workplace homicide.

Restricting customer and employee firearm access could reduce argumentative workplace homicide incidence. Employers' rationale for allowing firearms in their workplace are not known, but protection is a likely motivation. Findings from this research offer a direct counterpoint. Allowing customers or employees to carry firearms may cause disagreements that might not have turned deadly to escalate into homicides. Previous literature noted de-escalation tactics training for employees as a possible prevention strategy for reducing argumentative workplace homicides.⁴⁷ This type of training includes teaching employees to identify warning signs of aggression and instructs employees on how to calm agitated individuals.¹²⁷ These prevention strategies have proved efficacious in the health care setting¹²⁸ but have not been widely examined

in general workforce. It is important to note that, as CFI contains only workplace deaths, the number of workplace homicides possibly prevented by an employee having a firearm is unknown and should be considered. However, the research presented suggests increased firearm exposure is likely problematic for argumentative workplace homicides.

We found intimate partner homicides constituted a significant portion of the female workplace homicide experience, consistent with previous literature.¹⁹ Ninety-seven of the one-hundred-seventeen (83%) female workers killed as part of a conflict were killed by an intimate partner. Here, conflicts, or deaths that were due in part to some past or current conflict, appear to be premeditated violence; these deaths did not contain an observable conflict prior to the death but rather seem to stem from the perpetrator's intention to kill their victim.

There is a need to consider state laws that impact firearm access within the context of workplace homicides. The odds that a customer is armed have likely increased with the increase of states with right-to-carry laws over the past decade.^{80,84} To lower the risk of having firearm violence within their establishments, businesses should take efforts to limit customer firearm carrying.⁸² Given the evidence presented above, it is unclear the legal ramifications of failing to prohibit firearms within establishments. States with laws that allow for temporary, or ex parte, domestic violence restraining orders and laws that allow domestic violence restraining orders to cover dating partners have shown to be protective against intimate partner homicides in the general population. While it is unclear if these laws are protective in the workplace setting, employers should offer their employees suffering from intimate partner violence guidance on legal options for stopping their abuse. Employee assistance programs are effective at promoting good

mental health and reducing drug use.^{25,26} These programs could be used to disseminate information regarding how one can obtain a domestic violence restraining order. Steps to prevent intimate partner homicides in the workplace may be protective not only for the individual suffering the abuse but for the workplace in general as we found several instances of where an intimate partner homicide involved multiple workers in addition to the intimate partner violence victim.

Additionally, this research is among the first to describe workplace homicide events where more than one worker was killed. We identified 193 of the 1,553 firearm-related workplace homicides (12.4%) resulted as part of 74 multiple-death events where more than one worker was killed by a firearm. Similar to workplace homicide incidents overall, the more impulsive types of multiple-death events (i.e., Type II violence, not motivated by robbery; Type III violence not motivated by robbery) contained narrative text richness to assess how perpetrators accessed their firearms. Results found suggest mass-death events, such as terrorism or active shooter situations, constitute a significant portion of firearm-related workplace homicides and as we start to think of ways to reduce mass-death events in general, we should consider worker safety and health.

Strengths and Limitations

How perpetrators accessed their firearms was largely unable to be determined, limiting the implications of this research. Firearm access points were mostly unknown for robbery-motivated and firearm-related workplace homicides with no known motivation, though it is highly likely that the premeditated nature of these crimes necessitated that the perpetrator was armed. Information on perpetrators' firearm access points were mainly related to argumentative workplace deaths. The impulsive nature of these argumentative

deaths likely created additional sources of information for authorities to understand firearm access points (such as witnesses) and made it more likely the perpetrator needed to retrieve their firearm in some fashion to commit the workplace homicide. As such, workplace homicides with sufficient narrative text richness to determine how the perpetrator accessed their firearms compared to workplace homicide without such detail may be fundamentally different from each other.

The CFOI is a well-established, national surveillance system that provides the most comprehensive counts of workplace deaths. However, the CFOI is not without limitations. We were unable to assign typology in 102 (6.2%) of the 1,553 deaths due to insufficient data, though this percentage of unassignable typology is lower than what has been previously reported by Gurka and colleagues (2009) (18% unknown typology) and Tiesman and colleagues (2012) (16% unknown typology).^{19,46} The effect of these unknown homicides on the proportions presented in this paper is unknown. As such, the proportions generated may not be 100% representative of the true firearm-related workplace homicide incidence from 2011-2015. While we used a systematic approach, often relying on existing literature, to classify motive, circumstance, typology, and firearm access points, misclassification may have occurred. To reduce the likelihood of misclassification, our methods mirrored those of past research using the CFOI Restricted Data File.^{19,45,47} This study likely underrepresents the true impact of firearm violence as CFOI data does not contain information for non-workers. As the CFOI pertains only to deaths, no data on protective uses of firearms were available and are unknown. Further, as firearm violence at work continues to be a public health issue, the CFOI should consider adopting new protocols for better understanding how perpetrator access firearms, or

firearm exposure in general. A larger emphasis on understanding the circumstances around firearm violence within the workplace will help to develop future prevention efforts.

Conclusion

This paper identified and characterized how perpetrators access firearms in a workplace homicide. This study found that, among the firearm-related workplace homicides where firearm access points were able to be categorized, proximal and distal firearm access played a large role in escalating arguments into argumentative workplace deaths, particularly by customers and co-workers. Firearm exposure, thus, may play a large role in escalating altercations into deadly arguments for workers. Workplaces looking to reduce their risk of having fatal firearm violence should ban customer and employee firearms from their establishments. A way to prevent intimate partner homicides at work may be to provide legal assistance/education for how to obtain a domestic violence restraining order through employee assistance programs.

Chapter 3: Manuscript Two

Parking Lot Laws in the United States

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Abstract

Introduction: Workplaces that allow employees to bring their personal firearms to work, compared to workplaces that do not, are at 5 times greater odds of having a workplace homicide. In recent years, states have enacted laws restricting employers from banning their employees from storing firearms in their motor vehicles while at work, referred to as parking lot laws.

Methods: To identify and describe these laws, we assembled an initial list from The Law Center to Prevent Gun Violence (now the Giffords Law Center to Prevent Gun Violence). We supplemented this information with legal research through Westlaw. We performed a content analysis of the laws, coding differences and similarities between states. We ascertained effective dates and examined changes to the laws over time through a review of their legislative history via Hein Online.

Results: A total of 16 states have parking lot laws, all of which went into effect from 2003-2013. In some states, employers retain the right to ban employee firearms in motor vehicles under certain conditions. Some specify how employees must store their firearms in their motor vehicles. More than half of all parking lot laws provide employers immunity from civil litigation resulting from events related to firearms stored in motor vehicles while at work.

Discussion: Sixteen states protect employees' ability to store firearms in their cars while at work despite evidence that workplaces with lenient firearm policies have increased odds of having a workplace homicide. Given the rapid enactment of these laws, there is a need to measure their impact on worker safety and health.

Introduction:

In 2015, perpetrators killed 417 individuals at work. In 85% of cases (n = 354), firearms were the mechanism of death. After several years of decline, 2015 marked the first increase (15%) in fatal workplace shootings since 2012.³³

Workplace homicide is the fourth leading cause of occupational death and the second leading cause of death among female workers. In the U.S., around 60% of workplace homicides are committed as part of a robbery.^{46,58} Strangers commit most robbery-motivated workplace homicides (73%).⁴⁶ The majority of robbery-motivated workplace homicides occur in the retail industry whereas non-robbery-motivated workplace homicides, where the perpetrator is either a customer, co-worker, or knows the victim outside of work through a personal relationship, are equally distributed across industry type.⁴⁶ Within personal-relationship workplace homicides, intimate partners constitute the majority of perpetrators (around 85%) for females killed at work.^{19,46}

Exposure to firearms at work matters. Loomis, Marshall, & Ta (2005) preformed a population-based case-control study of North Carolinian workplaces from 1994-1998, examining the association between employer policies on weapons and odds of having a workplace homicide.⁵¹ The study matched case workplaces, where a workplace homicide occurred (n=87), to control workplaces, without a workplace homicide (n=177), based on industry, location, and workplace characteristics, using medical examiner data to confirm workplace deaths for cases. Workplaces that allowed employees to carry firearms had almost 5 times greater odds of having a workplace homicide compared to workplaces that did not allow such behavior (95% Confidence Interval (CI): 1.70, 13.65). Workplaces that allowed weapons other than guns, such as a knife, had no significant difference in

homicide odds relative to workplaces that did not allow any weapons (Odds Ratio (OR) 1.39; 95% CI 0.53, 3.62).⁵¹ Chapter Two of this study investigated how perpetrators accessed a firearm during a workplace homicide. Among the firearm-related workplace homicides where firearm access points were able to be categorized, proximal and distal firearm access played a large role in escalating arguments into argumentative workplace homicides, particularly for customers and employees. Almost half of all argumentative workplace deaths of which circumstances were known (44.2%) resulted after a perpetrator brandished a weapon from their person and 15.4% involved the perpetrator retrieving their firearm from a nearby location, like a car. Those perpetrators were primarily customers and coworkers, committing the violence following a direct confrontation (Chapter Two).

Despite the role of firearms in the incidence of workplace fatalities, several states enacted legislation preventing employers from banning employees from storing guns in their cars while at work, referred to as Parking Lot laws. Oklahoma passed a parking lot law in 2004 following a high-profile court case in which several employees lost their jobs for violating their company's firearm policy that prohibited guns on the work site. In the following legislative session, the Oklahoma legislature amended the Oklahoma Self-Defense Act of 1995 (OSD) to restrict employers' ability to govern firearm storage by employees within their motor vehicles.¹²⁹

Several Oklahoma businesses filed suit seeking to enjoin enforcement of the amendments, citing occupational safety and health as one of their primary concerns.⁶⁶ Consequently, the Oklahoma legislature amended the Oklahoma Firearms Act of 1971 (OFA) in 2005 to provide immunity for businesses from civil action from, "occurrences

which result from the storing of firearms or ammunition in a locked motor vehicle on any property set aside for any motor vehicle...”¹³⁰ The 2005 amendment further stated employers would not be liable for civil action, “unless the person, property owner, tenant, employer, or owner of the business entity commits a criminal act involving the use of the firearms or ammunition.”¹³⁰ Despite the lead plaintiff, Whirlpool Corp. dropping out of the litigation,⁶⁰ the suit remained. ConocoPhillips, the new lead plaintiff, stated in a news release in the fall of 2005:

ConocoPhillips supports the Second Amendment and respects the rights of law abiding citizens to own guns...Our primary concern is the safety of all our employees. We are simply trying to provide a safe and secure working environment for our employees by keeping guns out of our facilities, including our company parking lots.⁶⁶

In 2007, the Northern District Court of Oklahoma ruled that the Occupational Health and Safety Act of 1970 (OSH Act) preempted the parking lot law amendment and permanently enjoined its enforcement.⁶⁵ The United States Court of Appeals, 10th circuit reversed the decision in 2009 holding the Occupational Safety and Health Administration’s (OSHA) website, guidelines, and citation history did not speak of such firearm prohibition.⁶⁰

Supporters of parking lot law amendments emphasize the need to protect employees’ right to bear arms and argue increased access to firearms through vehicles in parking lots act as a deterrent for would be criminals.^{62,63} This rationale runs counter to evidence that firearm exposure while at work is likely detrimental for worker safety and health (Chapter Two)⁵¹ and evidence that suggests certain interventions aimed at making the workplace less desirable as a criminal target have not reduced the odds of having a workplace homicide.²⁰ The effect of parking lot laws on workplace homicides must be

examined. However, the extent to which states have adopted parking lot laws has not previously been reported. As such, this study sought to accomplish several things: 1) identify existing parking lot laws; 2) establish when each parking lot law took effect; 3) describe current parking lot law's characteristics; and 4) document any legislative actions to the laws after they went into effect. Understanding these laws is essential for future evaluation efforts. Without a full description of these laws and a comparison across states, a study of their effect on workplace homicides would be unable to properly account for state variation.

Methods:

We obtained our initial list of states with possible parking lot laws from Law Center to Prevent Gun Violence (now the Giffords Law Center to Prevent Gun Violence) (Law Center).¹³¹ The Law Center is a source of federal and state firearm policy information used by gun violence prevention policy researchers.^{70,90} We then conducted legal research using Westlaw to ensure that all parking lot laws were identified. Initial search terms included "Parking lot," "Firearms," "Employer," and "Motor vehicles." We refined these search terms in an iterative fashion as we identified and reviewed additional laws, resulting in the final search terms: "(Parking AND Firearms) AND Employer," and "(Parking AND Firearms) AND Employer AND State."

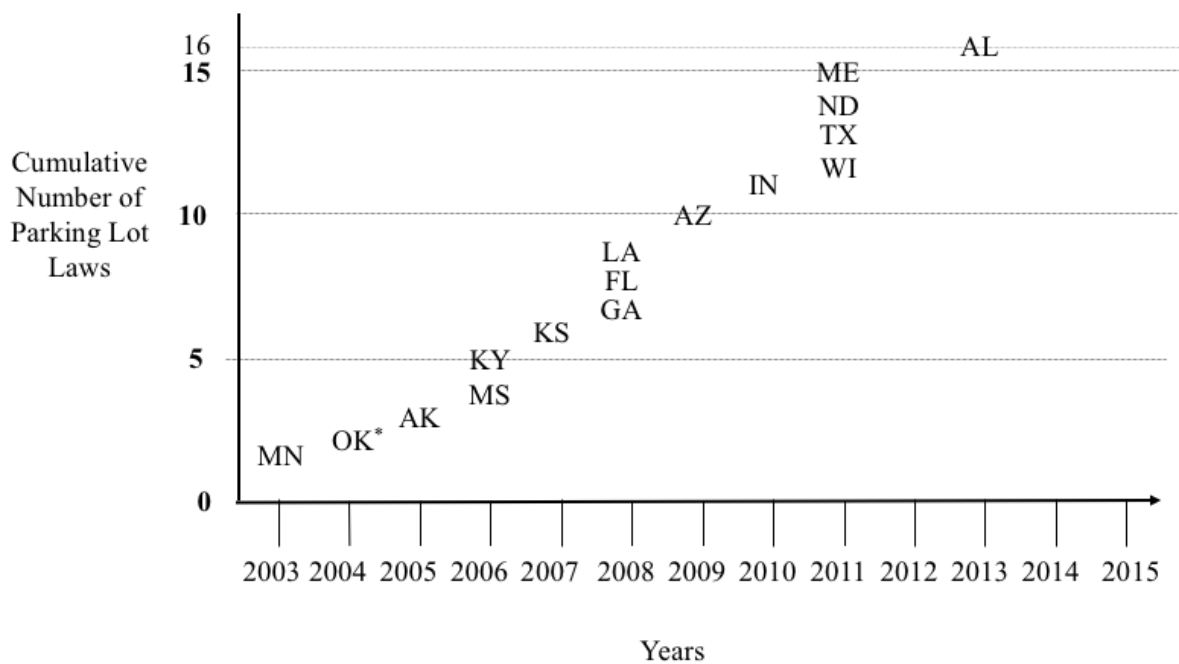
We downloaded the full text of the current parking lot laws for each state identified. We used Hein Online to download the full legislative history for each parking lot law to examine if significant changes to the laws occurred over time and identify dates the laws took effect in each state.

To identify difference and similarities between parking lot laws, we read all the current parking lot law statutes and derived codes from the text using content analysis methodology. The authors made no assumptions about the content of the laws and coded all differences and similarities, including changes to the law over time.

Results:

As of January 2018, 16 states passed a parking lot law. All 16 contain specific language preventing public and private employers from prohibiting their employees from storing firearms in their cars at work. We present a timeline of states' parking lot laws in **Figure 2** (below). Minnesota had the first effective parking lot law in 2003. Oklahoma followed in 2004, though the aforementioned litigation delayed the law's effective date until 2009. The latest parking lot law went into effect in 2013 in Alabama.

Figure 2: Implementation of Parking Lot Laws by Effective Dates, 2003-2015



Parking lot laws have 5 distinct characteristics: 1) exemptions allowing employers to prohibit employee gun storage; 2) restrictions for how and where employees must store their firearms; 3) provisions that prohibit employers from conditioning employment on lawful employee gun ownership or storage; 4) provisions releasing employers from liability for events stemming from an employee storing a firearm in their car at work, and 5) provisions establishing civil standing for employees related to firearm storage in their motor vehicles. These characteristics are not mutually exclusive. **Table 13** (in the Appendix) provides a comprehensive accounting of the parking lot laws characteristics by state and provides parking lot law effective dates.

Exemptions for Employers

Some parking lot laws contain employer exemptions. In these states, while the central tenants of these laws prohibit employers from disallowing gun storage in cars while employees are at work, the laws do provide certain criteria that permit employers to prohibit gun storage. We identified 2 types of exemptions. Five states (AK, AZ, GA, LA, & MS) allow employers to restrict firearm storage in motor vehicles if the parking lot has restricted access (i.e. does not contain common areas of ingress or egress open to the general public or is guarded by security). Seven states (AK, AZ, FL, GA, LA, MS, & ND) provide an exemption if the employer owns the car (i.e., it is a "company car" provided for the employee's use).

In addition to the 2 identified employer exemptions, Georgia's parking lot law also provides exemptions in a crisis situation, stating the employer restriction shall not apply, "To any situation in which a reasonable person would believe that accessing a locked vehicle of an employee is necessary to prevent an immediate threat to human

health, life, or safety.” Arizona’s and Louisiana’s parking lot laws allow employers to restrict their employees’ motor vehicle firearm storage if the employer provides a firearm storage area while at work or if employers provide a reasonable alternative parking space for those who want to store firearms in their vehicle. The laws do not provide additional context for how these laws are operationalized.

Restrictions on Employees

There were 5 specific restrictions for employees. Eight states (AL, AZ, FL, GA, LA, ND, TX, & WI) specifically allow storage only in an employee’s privately owned motor vehicle. Nine states (AL, AZ, FL, GA, IN, LA, ME, OK, & TX) require employees to lock their cars when storing firearms inside; seven states (AL, AK, GA, IN, LA, MS, & ND) further specify that any firearm stored in the car must be secured within the vehicle, either in a lock box or glove box. Seven states (AL, AZ, GA, IN, KY, LA, & ME) require employees to store firearms so they are not visible from outside the car. Five states (AZ, FL, GA, IN, & ND) have location restrictions for employees of specific workplaces such as energy producing facilities/manufacturing plants (AZ, FL, GA, IN, & ND), schools (IN, FL, & ND), and detention facilities (KY, IN, GA, ND, & WI), meaning employers in these industries are not prohibited from banning employee firearms in motor vehicles.

Two states (AL & GA) specify the employee must have a valid permit to carry a concealed weapon to store a firearm in their vehicle at work. Alabama’s law further specifies that if an employee does not have a valid permit, he or she can store a long gun in their motor vehicle at work if the firearm is legal for hunting. The law further stipulates that the hunting firearm must be unloaded, it must be hunting season, the

employee must possess a valid Alabama hunting license, have no violent crime convictions or subject to a domestic violence order, and have no “documented prior workplace incidents involving the threat of physical injury or which resulted in physical injury.”¹³²

Additional Provisions for Employers

There were 3 additional provisions that prohibit employers from conditioning employment on lawful employee gun ownership or storage. These provisions are independent of how employees can store their firearms. Employers cannot condition employment based on firearm ownership status under the parking lot laws in four states (FL, GA, ND, & WI). Three parking lot laws (AL, FL, & ND) specify employers cannot terminate an employee who is compliant with state firearm law. Two parking lot laws restrict employers from searching employees’ cars for the purpose of finding firearms (FL & ND).

Liability and Duty to Care

Several parking lot laws provide immunity for employers from liability arising from events related to storing a firearm in the employer's parking lot (AK, FL, GA, LA, ME, MS, ND, & OK). Georgia and Maine offer additional specificity, stating employers are not liable in civil actions for damages related to the theft of a firearm from an employee’s motor vehicle. Three states (FL, GA, & ND) specifically state employers have no additional duty to care related to the actions prohibited by the parking lot law. Here, the actions prohibited by the parking lot law are the ability of employers to restrict employee firearm access via their motor vehicle.

Civil Standing for Employees

In four states (AL, KY, ND, & OK), if employers wrongfully take action against an employee, for example by searching a car or terminating their employment because of a suspected firearm, the employee has standing to bring a civil suit for wrongful termination. Alabama's parking lot law specifies, if the employee is compliant with the law, the employee is entitled to recovery in the form of lost wages/benefits and compensation resulting from any adverse employment action.

Legislative Actions After the Laws Went into Effect

With few exceptions, parking lot laws were not amended once passed. Indiana changed their parking lot law by removing location exemption language in 2014. From 2010 to 2014, employees working in schools were not allowed to store firearms in their motor vehicles at work. In 2014, Indiana enacted P.L. 157-2014, "An ACT to amend the Indiana Code Concerning Public Safety," removing firearm storage restrictions for non-college or university school employees. Oklahoma amended their parking lot law in 2012 to include protection for ammunition as well as firearms.¹³³

Discussion

Sixteen states passed parking lot laws from 2003-2013, which restricted employers' ability to dictate employee firearm storage while at work. All parking lot laws apply state-wide. Analyzing these laws revealed a number of differences among states. Differences included exemptions for employers, restrictions on employers, restrictions on employees, and liability. Despite these differences, each of the 16 parking lot laws aim to ensure worker access to their lawfully owned firearms via their motor vehicle.

Supporters of parking lot laws argue they reduce the risk of workplace violence as increased access to firearms at work is a deterrent for would-be criminals.⁶³ This runs counter to evidence that suggests workplace homicide prevention interventions focused on making workplaces less desirable targets for would be criminals are ineffective⁵⁵ and evidence that when employees are allowed to carry firearms at work, the risk of having a workplace homicide increased 5-fold.⁵¹ A recent epidemiologic investigation found, from 2011-2015 in the United States, there were 27 instances where an employee had an argument with another employee, retrieved their firearm, and preceded to kill the other employee (Chapter two). This suggests restricting employers' ability to ban firearms in their parking lots may be detrimental to worker safety and health. However, it is important to note that this research contained only worker fatality data and did not contain information on possible examples where a firearm was used to preventative ends. The frequency with which, under threat of armed violence, an employee leaves their workplace, retrieves their firearm from their car, and returns to thwart armed violence is unknown.

More than half of parking lot laws provide employers immunity from civil liability stemming from events related to firearms stored in motor vehicles. Oklahoma added immunity protections for employers to their parking lot law after several businesses brought litigation seeking to enjoin the laws' enforcement, citing concerns for worker safety.⁶⁶ The notoriety of the case may have prompted other states to include similar provisions to avoid pushback from their business communities. It is difficult to read these provisions as anything other than a means to quell businesses' fear of potential violence, and thus liability, stemming from increased firearm access at work. As access

to firearms at work increases the risk of having a workplace homicide,⁵¹ businesses' anxieties are warranted.

A majority of states (n = 9) specify employees must lock the motor vehicle they are using to store their firearm. Five of those nine states, and two other states, go further to specify the firearm itself must be secured within the car. An additional 7 states include a provision mandating the firearm not be visible from the outside. While the true purpose of these provision is not known, they make firearm theft less likely. Parking lot laws' emphasis on locking cars with firearms and locking firearms within cars is crucial given the importance of preventing firearm theft.^{70,134} Firearm theft is a prevalent source of guns used by youth and criminals.¹³⁵ Additionally, theft is also considered a prominent source for how firearms initially enter the illegal market.¹³⁵

Interestingly, one state, Alabama, included a provision stating an employee with a prior history of causing workplace injuries could be subject to firearm restrictions. Further, Georgia provided exemptions on employer's ability to dictate firearm storage in employee motor vehicles in a crisis situation. These provisions are consistent with prior literature concerning risk factors for having a workplace homicide.¹¹⁴ Allowing employers discretion over previously violent employees, or employees those in management believe may become violent to self or others, is warranted given the increased risk of future violence.

Conclusion

Despite slight variation among parking lot laws, these laws accomplish the same thing; they ensure workers can access their lawfully-owned firearms while at work via a

motor vehicle. Our research helps to describe these laws and provides a basis for their evaluation.

Chapter 4: Manuscript Three

Do changes in state-level policies impact homicides in the workplace? A pooled, cross-sectional time series analysis using generalized linear mixed models

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Abstract

Introduction: The number of fatal, intentional workplace shootings rose 15% in 2015.

Workplaces that allow employees to carry firearms at work are at 5-times greater odds of having a homicide. In almost half of all argumentative workplace homicides committed with a firearm from 2011-2015, the firearm was located on the perpetrator who used it in an impulsive act of aggression. This study sought to examine the relationship between state-level policies that affect firearm access (and therefore exposure) and the incidence of workplace homicide committed by firearms.

Methods: We conducted a pooled, cross sectional time-series analysis using annual state-level incidence of firearm-related workplace homicide from 1992-2015 in the United States. Outcome data were obtained via public information data request from the Census of Fatal Occupational Injuries. Our analysis used generalized linear mixed models with state and year fixed effects. We examined the impact of right-to-carry laws and 5 other state-level firearm policies on firearm-related workplace homicide incidence within a 50-state panel.

Results: There were 12,767 firearm-related workplace homicides during the study period. Right-to-carry laws were significantly associated with a 32% (95% confidence interval: 1.15, 1.49) higher rate of firearm-related workplace homicides. No other state-level policies affected firearm-related workplace homicide incidence in the 50-state panel. Sensitivity analyses suggest robust findings.

Discussion: This is the first study to examine the link between state-level laws and firearm-related workplace homicides. This research indicates right-to-carry laws likely pose a threat to worker safety and health as states with such laws had a 32% higher

firearm-related workplace homicide rate over a 24-year period compared to states without such laws.

Introduction:

Workplace homicides continue to be a leading cause of occupational death, responsible for 417 of the 4,836 deaths in 2015.³³ Fatal workplace shootings increased 15% from 2014 to 2015, the first such increase since 2012.³³ Since 2002, workplace homicide has been either the first or second leading cause of death among female workers.^{19,136} In 2015, 43% of female workplace homicide victims were killed by intimate partners or relatives.³³ In contrast, 2% of male workplace homicide victims were killed by intimate partners or relatives.³³ Firearms are used to commit approximately 80% of workplace homicides.^{19,45,46} In one study of workplaces in North Carolina from 1994-1998, workplaces that permitted employees to carry a firearm had nearly 5-times greater odds of having a workplace homicide compared to workplaces that prohibited weapons.⁵¹

To address workplace homicides, researchers created a violence typology consisting of four types according to the perpetrator's relationship with the workplace and victim.^{19,46,47} The four types are Type I (no prior relationship to the workplace or victim, criminal-intent), Type II (customer or client of workplace), Type III (current or former employee of workplace), Type IV (personal relationship to the victim, no prior relationship to the workplace). Workplace homicides are also categorized by motivation and circumstance. Motivation is stratified into robbery-motivated workplace homicides and non-robbery-motivated workplace homicides. Workplace homicides are motivated by robbery around 55-60% of the time.⁴⁶ Within non-robbery-motivated workplace homicides, circumstance is stratified into arguments or other circumstances. Arguments account for around 50% of non-robbery-motivated workplace homicides and are largely committed by customers (Type II) and coworkers (Type III).⁴⁷

Past prevention efforts primarily centered around Crime Prevention Through Environmental Design (CPTED) or modifying the workplace environment and adopting administrative policies to make the workplace less susceptible/appealing to would-be assailants.¹⁸ These prevention efforts have had mixed success in reducing the odds a workplace experiences an employee homicide.^{20,55,122} Preventing workers from working alone at night reduces the odds of having a workplace homicide, though effectiveness of this prevention measure is reduced when workplace homicides are stratified by motivation.⁵⁵ Other CPTED measure were not particularly effective at reducing non-robbery-motivated workplace homicides.²⁰

Other prevention efforts, such as de-escalation tactics to reduce the likelihood of a violent dispute between a customer and co-worker, and training workplaces to improve their response to intimate partner violence exist but lack scientifically robust evaluation,^{19,47} though de-escalation tactics have been developed and implemented in the health care industry with some success.⁴⁷ While there have been significant decreases in workplace homicides over the past 20 years, reductions in robbery-motivated workplace homicides have driven overall declines, mirroring the downward trend in violent crime in the U.S. population.⁵⁷ During this time, non-robbery-motivated workplace homicides have declined less.

Direct and proximal firearm access is a factor in firearm-related workplace homicides, particularly between customers and workers. Chapter Two of this investigation contextualized workplace homicides committed by firearms from 2011-2015 in the United States. For non-robbery-motivated workplace homicides (n = 744), more than a quarter (25.4%) of deaths occurred after the perpetrator accessed his/her

firearm directly on their person. Of all the non-robbery-motivated workplace homicides based in an argument, perpetrators accessed their firearms directly on their person in 44.2% of the cases. Argumentative crimes were most often committed by customers or current/former co-workers. The authors also noted 97 of the 117 (83%) female workers killed as part of an argument were killed by an intimate partner.

Several types of state-level policies influence firearm exposure. Right-to-carry laws likely increase the number of firearms being carried in the population. Right-to-carry states either issue permits to carry a concealed firearm on a ‘shall’ issue basis, giving no discretion to authorities over who can carry a concealed firearm, or do not require a permit to carry a concealed firearm. The debate over whether right-to-carry laws increase violent crime in the general population is on-going. This is despite the fact that research by Lott & Mustard, suggesting a positive impact on violent crime and widely reported in the media,⁸⁷ has largely been debunked by studies using more advanced statistical techniques.^{101,102} Current research using the most up-to-date analytic methods suggests right-to-carry laws are likely associated with more violent crimes, especially aggravated assaults.^{71,80,123,137,138} Yet more and more states have adopted “permitless” concealed carry weapon laws, requiring virtually no oversight for who can legally carry a concealed firearm.^{81,107,123} Right-to-carry laws are likely relevant to firearm-related workplace homicides as they may increase the number of firearms carried in public, and thus the workplace. One nationally representative survey of gun owners found greater proportions of loaded handgun carrying in right-to-carry states compared to non-right-to-carry states,⁸⁴ though where that carrying happened was not examined. Right-to-carry laws generally allow businesses to declare that civilians and employees are not permitted

to carry a firearm onto their premises.⁸² The extent to which such employer policies exist and affect whether a workplace is firearm-free is unknown.

Stand your ground laws weaken legal consequences for using lethal force for self-defense, which may accelerate aggressive interactions. These laws have displayed significant increased relationship with homicide rates,⁹⁰ as well as unlawful homicides and justifiable homicide rates separately.⁹¹ These laws are likely relevant to firearm-related workplace homicides as disputes play a significant role in such incidents,^{46,50} with close to half of all argument-related workplace homicides occurring after the perpetrator accessed a firearm they were carrying (Chapter Two). Further, from 2003-2013, 16 states passed laws specifically aimed at securing employee firearm access while at work via their motor vehicles, referred to as parking lot laws (Chapter Three). These laws are particularly relevant to firearm-related workplace homicides as they limit an employer's ability to create a gun-free workplace.

Other types of state-level policies affect firearm access for prohibited individuals. Federal firearm policy requires a background check for firearms purchased from a federally licensed dealer. States have broadened the scope of required background checks through permit-to-purchase handgun licensing laws. These laws make obtaining a firearm more difficult for prohibited individuals by requiring a permit to purchase a firearm. States that have permit-to-purchase laws often enact stricter firearm ownership standards and more expansive background checks.¹³⁹ Missouri repealed their permit-to-purchase law in 2007 and a 23% increase in firearm homicides followed.⁷⁸ Firearm prohibitions for people convicted of violent misdemeanors (Violent Misdemeanor Prohibitions) have been shown to reduce subsequent firearm-related crime for prohibited individuals.⁹⁷

States with domestic violence restraining order laws that cover dating partners (Domestic violence restraining order, Dating Partners) and states that issue ex parte domestic violence restraining orders (Domestic violence restraining orders, Ex Parte) and prohibit gun purchase and possession by respondents to those orders are associated with reduced rates of intimate partner homicides. States with firearm permit-to-purchase laws and domestic violence restraining order laws that prohibit gun purchase and possession are also associated with reductions in intimate partner homicides.^{79,96} These laws likely impact workplace homicides as states with these prohibitions make it less likely that dangerous individuals have access to firearms.

The previously discussed laws—right-to-carry laws, permit-to-purchase, parking lot laws, stand your ground laws, domestic violence restraining order-dating partners laws, domestic violence restraining order-ex parte laws, and violent misdemeanor prohibitions—all have a plausible impact on worker safety and health. These laws have the potential to affect firearm exposure at work and to impact firearm access for dangerous individuals who may use the workplace as a means to locate their victims or attempt to rob the workplace with a firearm. No evaluation of the impact of these laws on firearm-related workplace homicides exists. This study evaluated the effect of changes in state-level firearm policies on firearm-related workplace homicides.

Methods:

Design

We conducted a pooled, cross sectional time-series analysis using annual state-level incidence of firearm-related workplace homicides from 1992-2015. All data were state and year indexed.

Variables and Data Sources

Our dependent variable was the count of firearm-related workplace homicides by state and year. We obtained these data via request from the Census of Fatal Occupational Injuries (CFOI), maintained by the Bureau of Labor Statistics (BLS). The CFOI is the most comprehensive database of workplace deaths within the United States. For inclusion in the CFOI, each occupational death must be verified with at least two independent source documents (e.g. medical examiners report, police report, workplace injury report, media, etc.).

We included presence or absence of the following state-level statutes as predictors in our analysis: right-to-carry laws, permit-to-purchase laws, parking lot laws; stand your ground laws; domestic violence restraining order laws that cover dating partners; domestic violence restraining order laws that allow ex parte restraining orders; and violent misdemeanor firearm prohibitions laws. These laws were included in the analysis as they have either; 1) previously displayed significant associates with homicides in the general population; or 2), in the case of parking lot laws, may directly impact firearm exposure in the workplace. To analyze the effect of these laws over time, we coded each law as ‘0’ in the years before the law took effect, as a fraction of months the law was ‘in-effect’ in its first year, and as ‘1’ for all subsequent years. Research described in Chapter three identified effective dates of parking lot laws. Research by Zeoli and colleagues (2017) provided effective dates for violent misdemeanor firearm prohibition laws, domestic violence restraining order laws that cover dating partners, and domestic violence restraining order laws that allow ex parte restraining orders.¹⁴⁰ Research by Crifasi, Pollack, & Webster (2016) provided effective dates for permit-to-purchase

laws.¹³⁹ Donohue, Aneja, & Weber (2017) along with the Giffords Law Center to Prevent Gun Violence provided effective dates for right-to-carry laws.^{138,141} Effective dates for stand your ground laws were identified by retrieving state statutes via WestlawNext Legal database and determining effective dates via the statutes' corresponding state sessions laws through Hein Online. **Table 18** in the Appendix presents the effective dates for all 7 laws.

We included a number of covariates associated with violent crime and workplace violence in our statistical models. These included a proxy for household gun availability, calculated as the ratio of firearm suicides to overall suicides,¹⁴² state expenditure on law enforcement,^{77,139} percentage of the population living in a Metropolitan Statistical Area (MSA),¹³⁹ and homicide rates.⁷⁰ Gun availability is the ratio of firearm suicides to overall suicides and was calculated using data from the Centers for Disease Control's Web-based Injury Statistics Query and Reporting System,⁶⁷ law enforcement expenditure was obtained via the U.S. Census Bureau,¹⁴³ and homicide rates and MSA were obtained via the Uniform Crime Reports.¹⁴⁴ Other state-level demographic covariates included number of individuals employed, number of individuals employed in the retail industry, percent of state population that reported being white, and percent of state population that reported being married.⁷⁹ We obtained data for number of individuals employed and number of individuals employed in retail from Current Employment Survey through the BLS.¹⁴⁵ We used the percent employed persons working in retail to account for the difference in size of states' retail employment. We obtained data for percent population that reported being white and percent population that reported being married via the U.S. Census Bureau's Current Population Survey (CPS). We accessed CPS data through the Integrated Public

Use Microdata Series: Version 7.0, a data source collaboration between the University of Minnesota and the U.S. Census Bureau which provides access to de-identified microdata.¹⁴⁶ We obtained census regions, stratified into Northeast, Midwest, West, and South from the U.S. Census Bureau.¹⁴³ Variables representing percent population with high school degree, percent population black, percent population in a union, median household income, poverty rate, aggravated assault rates, robbery rates, violent crime rates, property crime rates, burglary rates, larceny and theft rates, and motor vehicle theft rate were included in the initial analysis but proved either collinear or to have an insignificant bi-variate relationship with firearm-related workplace homicides.

Analysis

We analyzed the data using a generalized linear mixed model (GLMM) specifying a negative binomial distribution, clustered robust sandwich estimators of the variance within each state, and state and year fixed-effects. We used the natural log of employment level as our population offset, interpreting results as incidence rate ratios (IRR). We specified an independent correlation structure to model the intra-state correlation over time.

This study considered whether to include a random intercept term and a random slope term for the relationship between right-to-carry laws and workplace homicide rates given previous literature from French & Heagarty (2008), which found a heterogeneous policy effect of right-to-carry laws on population-level homicide rates. First, we considered a model that included random intercepts, allowing the firearm-related workplace homicide rate to vary across states. Second, we considered a model that included random intercepts and random effects of passing a right-to-carry law, allowing

the firearm-related workplace homicide rate and the effect of passing a right-to-carry law to vary across states. Third, we considered the possible duplicative effect of having a random policy effect term in addition to state fixed-effects, eliminating state fixed-effects from the model. We identified the best performing model as having random intercepts, random effects of passing a right-to-carry law, and state fixed-effects via goodness of fit tests using AIC.^{xx} Using a random intercept and a random slope term addresses variation in firearm-related workplace homicide within states and the law's heterogeneous effect across states. Using state fixed-effects controls for observable and unobservable differences across states, such as state attitudes towards gun ownership. Using a random intercept and random slope term within a GLMM produces an average state-specific effect of enacting right-to-carry laws on firearm-related workplace homicide.^{147,148} We checked model diagnostics using Pearson residuals, finding approximately normally distributed residuals, indicating model validity.^{xxi}

For laws significantly related to change in the firearm-related workplace homicide rate, we checked the robustness of our results through several sensitivity analyses including: 1) Lagging the effective dates of right-to-carry laws to the first full year the law was in effect (modeling a delayed, sudden transition);⁸⁷ 2) Restricting the analysis to the years 1998-2015 to avoid possible confounding related to the crack cocaine epidemic and firearm-related workplace homicide trends;⁸⁸ 3) Modifying the model to exclude all variables related to violent crime which could potentially confound the outcome;⁸⁸ 4) Restricting the modified model to the years 1998-2015; and 5) Conducting the main

^{xx} See Chapter 5, Manuscript Three for additional detail concerning the model testing

^{xxi} See Chapter 5, Manuscript Three for additional detail concerning the model diagnostics

analysis and sensitivity analyses restricted to the 24 states that passed right-to-carry laws during the study period (see **Table 18** for list of states that passed right-to-carry laws). We chose to use 1998 as the cut point for addressing confounding related to the crack cocaine epidemic and firearm-related workplace homicide trends as this was the first year the average number of workplace homicides per state leveled off after steep declines starting in 1994 (see **Figure 3**, below). All statistical analyses were conducted via STATA version 15.0.¹²⁶

State and year indexed data requests from the CFOI contain a potential limitation. In accordance with a federal-state cooperative agreement with all 50 states, BLS only releases aggregate data, and only for cells with counts greater than one, unless the single death is a matter of public record, i.e., the CFOI did not confirm the death through private documents only. For this study, 12,429 of the 12,767 (97.4%) firearm-related workplace homicides from 1992-2015 were included. Those 12,429 deaths were presented across 822 of the possible 1200 state-year records.^{xxii} As a check, we ran all models two ways: 1) a complete case analysis, using only the positive integer counts provided in the data requests, and 2) as a total population analysis, assuming all censored state and year data points to be '0,' ignoring the missing 2.6% of data. Consistent coefficients of interest across both analyses would imply the missing 2.6% of data plays a negligible role in assessing the impact of changes in state-level policies on workplace homicides.

^{xxii} 50 states times 24 years = 1,200 indices

Results

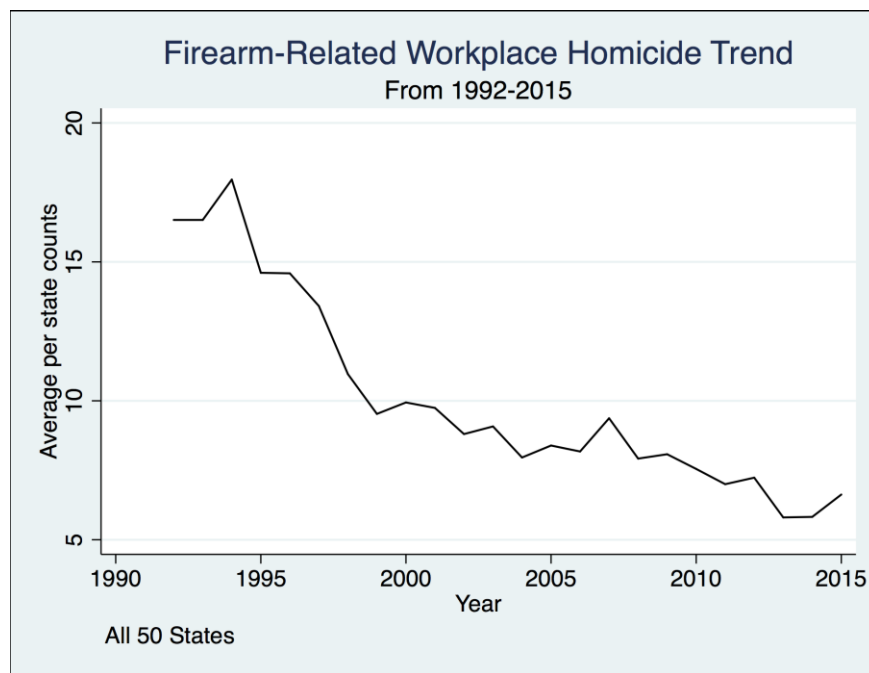
Table 10 (Below) presents the results of the main model. The results for the complete case analysis (CCA) and the total population analysis (TPA) followed a similar pattern. States with right-to-carry laws had a 1.32 times greater rate of firearm-related workplace homicide, controlling for all other confounders, within both analyses. The 95% confidence interval (CI) for the TPA was slightly larger (1.16, 1.50) compared to the CCA (1.19, 1.47), though quite similar. No other firearm policies displayed significant associations with firearm-related workplace homicides rates across both types of analyses. Model coefficients for the expected rate of workplace homicides associated with other firearm policies were nearly identical across the two analyses ((permit-to-purchase laws IRR, 95% CI: CCA = 0.982 (0.72, 1.34), TPA = 0.969 (0.72, 1.30); parking lot laws IRR, 95% CI: CCA = 0.985 (0.82, 1.18), TPA = 0.969 (0.75, 1.08); stand your ground laws IRR, 95% CI: CC = 0.907 (0.81, 1.03), TPA = 0.921 (0.86, 1.10); domestic violence restraining order, dating partners laws IRR, 95 % CI: CCA = 0.979 (0.88, 1.10), TPA = 0.969 (0.86, 1.10); domestic violence restraining order, ex parte laws IRR, 95% CI: CCA = 0.926 (0.79, 1.08), TPA = 0.945 (0.81, 1.10); and violent misdemeanor prohibition laws IRR, 95% CI: CCA = 1.121 (0.99, 1.27), TPA = 1.118, 0.97, 1.28)). Results of the sensitivity analyses were similar, displaying a significant association between right-to-carry laws and firearm-related workplace homicide incidence (**Table 17** in the Appendix).

Sensitivity Analyses

When right-to-carry effective dates were lagged to the year after implementation, right-to-carry laws were associated with 25.5% higher firearm-related workplace

homicide rates compared to non-right-to-carry states (95% CI: 1.12 1.41). Restricting the original model to 1998-2015 maintained a significant relationship between right-to-carry laws and firearm-related workplace homicides (IRR = 1.273; 95% CI: 1.04, 1.56). The modified model found right-to-carry states had a 36.4% greater rate of firearm-related workplace homicides (95% CI: 1.13, 1.65). Restricting the modified model to 1998 to 2015 displayed significant relationships between right-to-carry states and increased firearm-related workplace homicide rates (IRR = 1.338, 95% CI: 1.14, 1.57).

Figure 3: Firearm-related Workplace Homicide Trend, 1992-2015



The association between right-to-carry laws and greater firearm-related workplace homicide rates remained when we restricted the analysis to only states that adopted right-to-carry laws during the study period (**Table 17** in the Appendix). As all of these states decided to pass a right-to-carry laws over the same time period, it is possible the subset offers a better counterfactual to quantify the impact of passing a right-to-carry law on firearm-related workplace homicides. Within states that passed a right-to-carry law from

1992-2015, passing a right-to-carry law was associated with a 18.6% greater firearm-related workplace homicide rate (95% CI: 1.02, 1.38). The relationship held when restricting the study period to 1998-2015 and after eliminating covariates with potential confounding relationships with the outcome. Restricted to 1998-2015, passing a right-to-carry law was associated with a 29.4% increase in the firearm-related workplace homicide rate (95% CI: 1.05, 1.59). After removing variables that could potentially bias the relationship between passing a right-to-carry law and firearm-related workplace homicides, passing a right-to-carry law was associated with a 26.7% greater rate of firearm-related workplace homicides between 1992-2015 (95% CI: 1.09, 1.47) and was associated with a 35.9% greater rate of firearm-related workplace homicide between 1998 to 2015 (95% CI: 1.13, 1.63) (**Table 17** in the Appendix).

Discussion

This research constitutes a comprehensive examination of the associations between state-level policies and firearm-related workplace homicide over a 24-year period. This is the first study to consider the role of state-level policy in workplace homicide incidence. States with right-to-carry laws displayed a 32% increase in the expected firearm-related workplace homicide rate compared to non-right-to-carry states, having large implications for worker safety and health. This research is a logical extension of findings from Loomis, Marshall, and Ta (2005) that found workplaces which allowed their employees to carry a firearm, compared to those that did not, had a 5-fold increase in workplace homicide odds.⁵¹ It also agrees with findings from Chapter Two of this investigation that noted direct proximal and distal firearm access is a large contributor in escalating arguments to argumentative workplace deaths (Chapter Two).

Further, results from this study agree with other analyses which posit right-to-carry laws are associated with greater rates of violent crimes.^{71,80,138}

Table 10: Effect of State Firearm Policies on Firearm-related Workplace Homicides, all 50 states 1992-2015

	Complete Case Analysis (State-year indices = 822)		Total Population Assumption (State-year indices = 1,200) [^]	
	IRR	95% CI	IRR	95%CI
<i>Firearm Violence Laws</i>				
Right to Carry	1.324	1.19, 1.47	1.323	1.16, 1.50
Permit-to-purchase	0.982	0.72, 1.34	0.969	0.72, 1.30
Parking lot laws	0.985	0.82, 1.18	0.901	0.75, 1.08
Stand your ground	0.907	0.81, 1.03	0.921	0.79, 1.06
Domestic violence restraining order-Dating Partners	0.979	0.88, 1.10	0.969	0.86, 1.10
Domestic violence restraining order-Ex parte orders	0.926	0.79, 1.08	0.945	0.81, 1.10
Violent Misdemeanor	1.121	0.99, 1.27	1.118	0.97, 1.28
<i>Violent Crime characteristics</i>				
Homicide Rate	1.112	1.07, 1.16	1.10	1.06, 1.15
Law Enforcement Expenditure	0.999	0.99, 1.00	0.999	0.99, 1.00
Gun Availability	1.19	0.43, 3.25	0.905	0.23, 3.67
<i>Region*</i>				
Mid-West	1.111	0.48, 2.59	0.953	0.39, 2.32
West	2.50	0.96, 6.50	0.086	0.04, 0.21
South	1.538	0.80, 2.95	1.849	0.99, 3.45

Note: Model also includes state and year fixed effects, percent population married, white, living in a metropolitan statistical area, and retail labor force as a percentage of total state-year labor force; natural log of employment as offset, random intercepts and random policy effect, and an independent correlation structure for intra-state correlation over time. Estimates were generated by authors using a data request from the Bureau of labor statistics' Census of fatal occupational injury data. The views expressed here do not necessarily reflect the views of the BLS.

[^] 50 states * 24-time periods

* North east as reference

As we debate the impact of right-to-carry laws, and the consequences of increased firearm exposure in general, we must also consider the impact on worker safety and

health. The debate surrounding right-to-carry centers on whether the legal carrying of a concealed weapon increases or decreases violent crime.⁷⁰ Often those in favor of right-to-carry laws state the laws create an environment where, as more people are theoretically carrying a weapon, criminals are less inclined to commit violent acts, as their criminal behavior may be met with lethal force.⁸⁷ An alternative consequence of right-to-carry laws is that as more people carry a weapon, bringing that weapon to work or into a business they frequent, the more gun owners will use their weapons impulsively in disputes that might otherwise not have turned deadly. In almost half of all argumentative workplace deaths from 2011-2015, perpetrators accessed their firearms directly on their person and used them against their victim (Chapter Two). The majority of these disputes were between customers and employees or fellow co-workers. That is significant as it suggests, had the perpetrator not been armed, the customer-employee or employee-employee dispute may not have been fatal. It is the concept of exposure that is key. Not having a firearm readily available reduces the lethality of the confrontation.

Law makers considering the issue of state reciprocity for right-to-carry laws should consider information provided here. As we demonstrated that right-to-carry laws are associated with increased rates of firearm-related workplace homicides, mandating state reciprocity could negatively impact worker safety and health. Mandating that states with stringent concealed carry permitting laws allow individuals from states with less stringent or non-existing concealed carry permitting laws be allowed to carry a concealed weapon likely places workers at increased risk of violence and erodes the rights of states.

No other state laws proved to be significantly related to changes in firearm-related workplace homicides. There was no association between parking lot laws and firearm-

related workplace homicides, but this is not surprising as recent evidence suggests only a small portion of workplace homicides occurred after an employee retrieved his/her firearm from their car (Chapter two). The workplace, compared to the home or general public spaces, is a far more public arena. Stand your ground laws increase homicides in the general population, but the very public nature of a workplace or a store may decrease the likelihood an individual chooses to draw and fire their weapon when threatened, muting the laws impact on the workplace population. As far more males are killed in firearm-related workplace homicides (Chapter two), the effects of domestic violence restraining order laws that extend to dating partners and that can be issued ex parte may be muted by the lack of a female-specific outcome. Permit-to-purchase laws require a prospective gun owner to apply for a permit from law enforcement prior to purchasing a firearm, potentially discouraging prohibited individuals from attempting to buy a firearm. However, from 2011-2015 in the United States, co-workers or customers committed the majority of argumentative firearm-related workplace homicides. It is plausible these individuals may not have possessed prohibiting characteristic at the time of firearm acquisition and their crimes may be more a function of firearm exposure related to right-to-carry laws.

Future research should further the understanding of firearm exposure in workplace violence. Right-to-carry laws allow private employers to prohibit customer and employee firearms from their premises.⁸² The penetration of these prohibitions and whether these businesses' prohibitions succeed in prohibiting customer and employee firearms is not known. Answers to these questions will further the knowledge base around the impact of firearm exposure on violent workplace deaths.

What is also currently unknown is how workplaces deal with legally and illegally armed workers and customers. Understanding, from a qualitative perspective, how workplaces view injury risk associated with firearm exposure is necessary to contextualize firearm exposure at work. Currently, it is unclear how employers consider employing armed workers, or workers with nearby access to firearms, or how they weigh the potential risks and benefits associated with armed customers in their establishments. It is also unclear if those sentiments differ by state and/or industry. Further examination into the relationship between state-level policies explored here and workplace homicide is also needed. Individual state changes to laws give researchers avenues to explore the impact of a given policy on a specific state's workplace homicide incidence. There is need to explore the state-specific effects of the policies examined here to fully understand their impact of workplace homicides. Synthetic control models are an advanced statistical methodology well suited to examine these changes.⁷⁶

Strengths and Limitations

This study is not without limitations. The nature of CFOI data request created the need to perform the analysis as a complete case analysis, using only the available data, and as a total population analysis, setting the censored data equal to '0'. It is important to note the complete case analysis utilized 97.6% of all available firearm-related workplace homicides from 1992-2015, but failed to acknowledge when states had '0' firearm-related workplace homicides in a given year. We wanted to account for states that had '0' firearm-related workplace homicides as this is a significant number of interest. Doing so, and setting missing values to '0' in the total population analysis, likely underestimated the true incidence of firearm-related workplace homicides as we classified 2.6% of states-

year indices with ‘1’ censored workplace homicide as having ‘0’ deaths. However, the coefficient estimates for state policies were nearly identical across both analyses types. We are therefore confident that the estimates produced are accurate and that the 2.6% of censored workplace homicides from 1992-2015 played a negligible role in estimating the effect of state-level policy.

While the CFOI provides the most comprehensive accounting of fatal occupational injuries, it contains reporting limitations. The census of fatal occupational injury does not contain information on potential confounding factors such as life-style, work conditions, and whether the place of employment was in an urban or rural setting.¹⁴⁹ While the CFOI uses at least two documents to verify death characteristics, homicides that occur in the workplace can be prone to misclassification, underestimating the true count. CFOI relies partially on law enforcement reports to classify workplace homicides. Often, supplemental information used for classification cannot be provided for cases being adjudicated, affecting more recent cases. As our outcome of interest was firearm-related workplace homicides, the need for supplemental information to classify a workplace homicide as firearm-related or not is likely low, suggesting a low possibility for misclassification. It is also possible the passage of these laws is endogenous with workplace homicides, which would result in a biased estimate of each law’s effect. However, the passing of state policy based on fluctuations in workplace homicide incidence is highly unlikely. As with most studies of the effect of state laws there is potential for selection bias and omitted variable bias. Controlling for state level factors across time that may have prompted the passing of state laws, such as homicide rates, reduces the potential influence of selection bias. To address omitted variable bias, the

study began with a number of covariates, using variance inflated factor analysis and bivariate analysis to find, and ultimately include, covariates associated with increased rates of workplace homicide. Using state and year fixed effects also combats the effect of omitted variable bias as they control for unaccounted time-invariant factors and state-invariant factors. It is also important to note CFI only presents data on workers, meaning non-employees could have been killed during a workplace homicide event and are not accounted for in these data. As such, our results likely underestimate the true effect of these policies as it does not fully account for the total number of deaths related to violent crime in the workplace.

Conclusion

This study fills an important knowledge gap by producing the first estimates of the effect of state-level policies on workplace homicide incidence. We found right-to-carry laws were associated with approximately a 32% increase in the risk of firearm-related workplace homicide. The ongoing debate over right-to-carry law's impact on safety and health does not consider workers. As our study shows states with right-to-carry laws have greater expected firearm-related workplace homicide, there is reason to introduce worker safety and health into the conversation.

Chapter 5: Methods

Manuscript One Methods

Census of Fatal Occupational Injuries

The primary data source for Chapter two is the Census of Fatal Occupational Injuries (CFOI) database. The Bureau of Labor Statistics (BLS) aggregates this database. The scope of the CFOI includes individuals killed at work via traumatic injury.^{150,151} Data in the CFOI is presented as counts and is available from 1992-2015.¹⁵¹ The CFOI compiles count data of fatal occupational injuries by aggregating and cross-referencing several records including death certificates, workers' compensation reports, and federal and state agency administrative reports to identify and validate fatal worker injuries. The CFOI verifies fatal injuries through at least two source documents and follow-up questionnaires when necessary. The National Safety Council deemed the CFOI the authoritative count of work-related deaths in the U.S. in 1992.¹⁵¹

I submitted a request for access to the CFOI's Restricted Data file in July of 2017. The BLS approved my request and sent the restricted data file fall of 2017. The Restricted Data file provided data for all workplace deaths that occurred from 1992 to 2015. The data file contained a number of different variables, for example, injuries: year, day, time, month, worker activity, industrial code, gender, race, region, and size of establishment. Each death also contained a narrative, which provided detail into the circumstance surrounding the deaths.

Since 1992, the CFOI has used the Occupational Injury and Illness Classification System (OIICS) to characterize fatal workplace deaths. OIICS classifies the nature of injury or illness (e.g. traumatic injuries and disorders; systematic diseases or disorders; infectious and parasitic disease; neoplasms, tumorous, and cancers; other), part of body

affected (e.g. neck; trunk; upper extremities; lower extremities; body systems; multiple body parts; other body parts), source of injury or illness (e.g. chemicals and chemical products, containers; furniture and fixtures; machinery; parts and materials; persons, plants, animals, and minerals; structures and surfaces; tools, instruments, and equipment; vehicles; other), event or exposure (e.g. falls; bodily reaction and exertion; exposure to harmful substances; transportation accidents; fires and explosions; assaults and violent acts; other), and secondary source of injury or illness. There was a series break in 2011, when the OIICS classification system changed. Given the differences in the two classification systems, the CFOI considers 2011 to be a break in the series for case characteristics. As such, this study used 2011-2015 data.

The aims of this study were threefold: The first aim was to identify how perpetrators access firearms preceding a workplace homicide. The second aim was to characterize firearm access points by workplace homicide typology, motivation, circumstance, gender and industry. The third aim was to characterize firearm access points by perpetrator-victim relationship types for incidents where multiple workers are killed by a firearm. **Table 3** (Chapter two) provides an in-depth definition of how I defined firearm-related workplace homicides. After excluding all law enforcement deaths that occurred in the line of duty, there were 1,553 firearm-related workplace homicides from 2011-2015.

I used the narrative text fields for each of the 1,553 deaths to identify the typology, motivation, circumstance, and firearm access point. **Table 1** (Chapter one) provides a detailed definition of typology.¹²⁰ **Table 3** (Chapter two) provides a detailed definition of how I defined typology within the study. To code homicide motivation,

circumstance, and firearm access point, I utilized a content analysis methodology to review and characterize deaths.

I used the North American Industry Classification System (NAICS) to categorize industry types.¹⁵² The NAICS is the standard used by all federal agencies for classifying businesses in the U.S. and is maintained through the Office of Management and Budget of the Executive Office of the President. The NAICS contains 20 specific categories. I grouped the 20 categories into 8 specific industry types: 1) Labor, 2) Retail, 3) Transportation, 4) Health Care, 5) Professional, 6) Education/arts, 7) Public Administration, 8) Other.^{xxiii}

Content Analysis: Definition and Methods

A content analysis is a methodology used to code and quantify the presence of characteristics from qualitative data.¹²⁵ This data analysis method is typically systematic with a sampling frame and coding definitions that quantify a set of characteristics. For the data presented in Chapter two, we did not establish a sampling frame; rather, we analyzed the entire population of firearm-related workplace homicide from 2011-2015. I established coding definitions for each characteristic either using existing literature or the narrative text.

Typology. If there were two possible types of violence typology, OIICS source codes prioritize the perpetrators relationship to the workplace over the relationship with the victim (i.e. a husband who kills an intimate partner with whom he works with would

^{xxiii} 1) Agriculture, Mining, Utilities, Construction, Manufacturing, Wholesale, and Waste Management; 2) Retail and Accommodations/food services; 3) Transportation; 4) Health Care; 5) Finance/insurance, Information, Real Estate, Professional Scientific Services, Managers; 6) Education services, Arts; 7) Public Administration, 8) Other (excluding public administration)

be considered a co-worker). For violence type I, if the narrative text specifically stated the assailant was unknown, the violence type was considered, 'unknown.' All other violence types were coded based on OIICS source codes (see **Table 3**, Chapter Two).

Motivation. I coded motivation similar to Konda, Tiesman, Hendricks and colleagues (2014) and Gurka, Marshall, Runyan and colleague (2009) which established robbery-motivated cases were deaths in which robbery was the primary motivation.^{46,47} For motivation, I coded robbery-motivated deaths, '1' non-robbery-motivated deaths, '0' and deaths where motivation could not be determined as '99'. Narrative texts that stated there was no clear motivation for the crime but ruled out robbery were considered non-robbery-motivated. Cases for which narrative text did not produce a clear motivation and robbery was not ruled out were classified as undetermined, or unknown motivation.

I coded circumstance based on existing literature.⁴⁷ Konda, Tiesman, Hendricks and colleagues (2014) was the first study to provide a nuanced understanding of the many circumstances surrounding a workplace homicide. Among non-robbery-motivated workplace homicides, the authors stratified workplace homicides into arguments and other circumstances using narrative text data and considered arguments to include, "incidents that involved verbal conflicts over merchandize, money, employment, a personal relationship, breaking up a fight, refusal of service, and denial of admission into establishments." The authors did not consider the following scenarios to be arguments: 1) when an employee was killed by someone with a personal relationship under an unknown circumstance; 2) when an employee was killed by a co-workers or ex-coworker under an unknown circumstance; 3) or when an employee was killed as part of act of revenge. The

authors did not consider these circumstances to be arguments as the deaths did not directly stem from an observable argument.

I have classified circumstance into three strata; arguments, where the workplace homicide resulted from a verbal conflict, as laid out by Konda and colleagues; conflicts, where it is highly likely there was a past or current conflict between the perpetrator and the worker but a direct argument was not observed prior to the worker's death; and other circumstances, where the worker was not killed as part of any kind of argument, (e.g. random gun firing, caught in cross fire, a mass shooting/terrorism event, or part of a drug deal. Qualifying circumstance in this fashion allowed for a more nuanced understanding of the circumstances surrounding workplace homicides; while a personal relationship homicide at work may not involve a direct and observable argument at the time of death, it would be likely incorrect to assume that a past or current altercation did not influence the perpetrator's decision to commit murder given the personal nature of their relationship. Additionally, Konda et al., did not consider an employee killed by a disgruntled customer to be part of an argument. For this study, I considered employees killed by a disgruntled customer to be part of an argument. **Table 14** (in the Appendix) provides the exact coding scheme for circumstance as well as workplace homicide frequencies by circumstance type. It is important to note, for circumstance, robberies were not classified into circumstance as they represent their own subset of circumstance. Therefore, circumstance was coded among only non-robbery-motivated crimes.

Firearm Access Points. No previous research examined how perpetrators access their firearms prior to a workplace homicide. To accomplish this, I assigned a study ID number, 1 through 1,553, to each death. I then sampled a random 20% subset of narrative

text fields (n = 310). I used a random number generator in excel to generator a list of 310 random integers from 1 to 1,553, and selected the matching study ID number for analysis. I read all 310 death events and identified all of the possible ways a perpetrator accessed their firearm. This process identified 7 possible ways a perpetrator accessed a firearm in the lead up to the workplace homicide: 1) on their person, 2) from a home, 3) from a car, 4) from a location within work (such as an office or locker), 5) stolen from victim during the event, 6) retrieved in an unspecified way, 7) not enough information to determine. I used these 7 categories to code the death events.

Multiple-death Events. The CFOI database does not link death events. As such I used event date and year to identify possible deaths part of a multiple or mass-shooting of workers. After categorizing by date and year, I read the narrative text fields to identify incidents that involved more than one death. In addition to coding workplace violence type, motivation, circumstance, and firearm access for each of the individual fatalities, I assigned each event an incident number and determined whether it was a multiple shooting (3 or less workers killed) or a worker mass-shooting (4 or more workers killed).

Data Analysis

I tabulated frequencies and conducted chi-square (χ^2) tests for statistical independence. I used STATA version 15 for analysis.¹²⁶

Manuscript Two Methods

Chapter three sought to identify and describe existing parking lot laws within the United States. To do so, I engaged in legal research to identify existing parking lot law statutes, their effective dates, and characterize the laws. I obtained an initial list of states

with possible parking lot laws from the Law Center to Prevent Gun Violence (now the Giffords law Center to Prevent Gun Violence) (Law Center).¹³¹ The Law Center is a source of federal and state firearm policy information used by gun violence prevention policy researchers.⁹⁰

I then used WestlawNext to identify all parking lot laws using legal research. Initial search terms within WestlawNext included “Parking lot,” “Firearms,” “Employer,” and “Motor vehicles” based on the description of the law provided by the Law Center and were searched across all 50 states. We refined these search terms in an iterative fashion as we identified and reviewed additional laws, resulting in the final search terms: “(Parking AND Firearms) AND Employer,” and “(Parking AND Firearms) AND Employer AND State.”

I downloaded the full text of the current parking lot law statute for each state. Each parking lot law contained restrictive language regarding employers. I then used Hein Online to download the full statutory history for each parking lot law to examine if significant changes to the laws occurred over time and identify effective dates. Where effective dates were not available, we used state rules from StateScape¹⁵³ to note when the law took effect. For quality control, we checked the laws found in WestlawNext against the original list provided on the Law Center.

To identify differences and similarities between parking lot laws, I read all the current parking lot law statutes to achieve emersion and derived codes from the text using content analysis methodology.¹²⁵ As understanding of parking lot laws was not known a priori, I made no assumptions about the content of the laws and coded all differences and

similarities. Once I coded, I read each parking lot law's legislative actions after the law went into effect to understand possible changes to the laws.

Manuscript Three Methods

Chapter four sought to understand the impact of state-level policies on firearm-related workplace homicide incidence. Generating inference for how passing a law affects a health outcome is common across disciplines, including injury prevention, econometrics, and biomedical research. Examples include evaluating the effect of passing mandatory bicycle helmet laws on child cyclist fatalities,⁷³ examining the effect to mandatory interlocks for all drunk driving offenses reduced alcohol-involved fatal crashes,⁷⁴ and examining the effect of legalizing medical marijuana on opioid-related overdose.¹⁵⁴

Society institutes policies at several levels of governance, i.e. federal, state, local, creating opportunity for large variance even among similar laws. Each state decides if and when it passes a given law, the effective date of that law, and the regulatory agency overseeing that law's implementation. There is a lack of a uniform process for evaluating policy change.¹⁴⁸ When appropriate, researchers rely on the difference-in-difference (DID) methodology which first finds differences in the observed outcome, y , within each study unit over time and then, second, finds differences between a 'treatment' and 'control' group. The methodology uses the pre-policy time trend in the control group to represent the post-policy time trend in the treatment group. As an example of a DID for state-level policy, pre-policy trends in the control group, say state A, represent what state B's post-policy trends would have been had State B not implemented a given policy. This

is also referred to as the parallel line trend assumption.^{xxiv} By exploiting pre-policy control trends to estimate the counterfactual, or what would have occurred in the treatment group had the treatment group not implemented the policy, the DID approach attempts to mirror an experimental research design, where treatment and control are assigned at random, using observational data. Hence, we refer to the statistical technique as quasi-experimental. This statistical technique makes inference at the population level. It uses all available information to define a treatment and control group and inference arising from the DID estimate is stated as the difference in the annual rate of Y associated with the presence of policy X , within the given study population.^{148,155}

The DID approach requires pre-and post-outcome data in order to calculate the effect of a policy's implementation. As such, DID employs panel data, or data where one study unit contains many observations. The DID approach is ideal for evaluating the effect of implementing a policy when there is a reasonable comparison group that did not implement the same policy. Defining what a reasonable comparison group consists of is ultimately paramount to the inference made when using a DID approach as it represents the post-policy counterfactual.

Other challenges to policy researchers concern the more advanced nuances of modeling the effect of policy change. Strong temporal trends may exist in a given health outcome. Therefore, researchers must understand how much variability in a health outcome of interest is due to temporal trends and how much variability is due to the

^{xxiv} The parallel trend assumption posits that the average change in the control, or comparison group, represents the counterfactual change in the treatment group had the treatment group not received the treatment. Therefore, if the two groups had parallel trend lines prior to the treatment, the average change in the control group would stand to reason as a viable counterfactual change in the treatment group given the similarities prior to treatment.

policy effect. Study units are likely unique unto themselves, and therefore it is likely that the effect of passing a given policy is not identical across study units. In cases where the policy effect is not homogenous across study units, there is need to account for study-unit specific policy effects. As panel data consists of multiple observations over time, there is a high likelihood of correlated data within study units. Within panel data, there is a need to examine outcome data for autocorrelation, or correlation between an outcome across a given interval, and adjust accordingly. Gauging whether the impact of a policy is felt immediately or over-time is necessary to understand the true policy effect. For example, is the impact of a given policy felt the day it becomes law or is there a lag which accounts for the time between a given policy's implementation and the resulting changes in social norms/public acknowledgement? Ignoring these potential concerns can lead to confounding and biased estimates of the true policy effect. Given these challenges, when appropriate, it is necessary to utilize a statistical model that allows for a correlation structure within the given outcome as well unit-specific policy effects. Generalized Linear Mixed Models are a robust methodology for modeling the DID policy effect, allowing for within-subject correlation and a heterogeneous policy effect.

Notation

For addressing panel data with multiple observations across one study unit, it is typical to let y_{ij} denote the observed outcome for unit $i = 1, \dots, n$ during time period $j = 1, \dots, m_i$. Similar, we denote \mathbf{x}_{ij} represent the set of covariates for study unit i during time period j . We denote population size as N_{ij} or the total amount of study units, i , at time period, j . Ultimately, we seek to make inferences based on the cross-sectional model for u_{ij} , or the population mean, based on the expectation of y_{ij} given covariates \mathbf{x}_{ij} and the

estimated values of parameters β . This model contains two frameworks, marginal and conditional.

For this study, the outcome of interest is the number of firearm-related workplace homicides. Initial investigation into the distribution model for firearm-related workplace homicides indicates the outcome likely follows a negative binomial distribution as the mean and variance of were not equal. When variance is greater than the mean, there is overdispersion and a negative binomial regression distribution is ideal. As our outcome of interest is a count, there is need to include a log N_{ij} as a population offset. This makes the expectations of y_{ij} given x_{ij} express as a log link function:

$$\text{Log } \mu_{ij} = x_{ij}\beta + \text{Log } N_{ij}$$

In this marginal model for the log of expected outcome y , the variance of y_{ij} is considered a known function of $\phi V(u_{ij})$. Here ϕ denotes a variation dispersion parameter in need of estimation. The model additionally assumes a correlation between y_{ij} and $y_{ij'}$ where j represents a separate unit of time and i represents the same study unit. Otherwise stated, we assume a correlation within a given study unit, i , across, j , time points. We assume the correlation to be a known function, $\rho(\alpha)$ with α representing an estimated correlation parameter. Within the marginal framework, estimates of β are fixed parameters representing the relationship between covariates, x_{ij} , and outcome, y_{ij} .

The conditional model assumes the effect of a given covariate, x_{ij} , varies across study units, i , and includes a set of covariates Z_{ij} . These covariates may be equivalent to x_{ij} , or a subset of, x_{ij} , like a group. The conditional model thus related to the expected y_{ij} , x_{ij} , through a log link function:

$$\text{Log } \mu_{ij}^* = \mathbf{x}_{ij}\boldsymbol{\beta}^* + \mathbf{Z}_{ij}\boldsymbol{\gamma}_i + \text{Log } N_{ij}$$

Within the conditional model, $\boldsymbol{\gamma}_i$ represents a vector of independent and study unit specific random effects with a similar distribution. As the random effects exist within study unit, i , there is an induced correlation structure between y_{ij} and $y_{ij'}$.

Do changes in state-level policies impact homicides in the workplace? A pooled, cross-sectional time series analysis using generalized linear mixed models

The purpose of Chapter four was to measure the impact of changes in state-level policies on firearm-related workplace homicide incidence. To do this, I used state and year indexed counts of workplace homicides from the CFOI between 1992-2015. To understand potential covariate factors, state and year indexed demographics, violent crime trends, work-related demographics, and gun violence prevention laws were considered for inclusion in the model (see *Covariate* section below for more detail). The study contained one aim:

- **Aim 3.1.** Evaluate the impact of changes in state-level laws, including parking lot laws, right-to-carry laws, permit-to-purchase laws, stand your ground laws, firearm prohibition laws for violent misdemeanants, and domestic violence restraining order laws that cover dating partners and offer ex parte orders, on workplace homicide incidence across all 50 states

To investigate Aim 3.1, this study used the DID statistical approach using Generalized Linear Mixed Models (GLMM) with random effects. GLMM with random effects allow researchers to account for within subject correlation and unit-specific random effects.

I first conducted exploratory data analysis to examine temporal trends in workplace homicides. **Figure 3** (in the Chapter four) represents the temporal trends in yearly average workplace homicide counts between 1992-2015 per state. From the graph, it is clear there is a large downward trend in workplace homicides overall and a need to control for temporal changes over time. Next, I sought to understand if correlation was present in workplace homicides. To do this, I used the autocor command in STATA. **Figure 6** (in the Appendix) presents the results of the autocorrelation command. **Figure 6** reveals likely an independent intra-state autocorrelation structure for workplace homicides.

The main effect model represents the mean difference in outcome y_{ij} associated with a given x_{ij} . In this dissertation, the main effect model represents the mean difference, expressed as a difference in incidence rate, in annual firearm-related workplace homicides, associated with changes in state-level policy. This model assumes the effect of policy change is immediate and similar time trends between treatment and control groups pre-policy to relay an accurate counterfactual for the treatment group post-implementation. The main effect mean model presents the difference in firearm-related workplace homicide incidence by presence of each state-level policy, or, for example, the overall effect of having or passing a right-to-carry law compared to not having a right-to-carry law. This is the DID estimation.

I tested model assumptions for appropriate use of a GLMM model. First, I examined the variance in workplace homicide caused at the state-level to understand the variance between states. To do this, I used a simple multi-level model without

coefficients specifying a random intercept model for each state with an independent correlation structure. I specified an independent correlation structure.

Random-effects Parameters	Estimate	Std. Err.	[95% Conf. Interval]
id: Identity			
var(_cons)	170.2683	35.77226	112.7981 257.0192
var(Residual)	128.0561	6.501227	115.9273 141.4538

LR test vs. linear model: $\chi^2(01) = 635.23$ Prob $\geq \chi^2 = 0.0000$

The results indicate that 57% of the variance in observed workplace homicide was represented at the state-level.^{xxv} Typically, levels that contribute 10% or greater variance are expected to be included in the multi-level analysis.

French and Heagarty (2008) identified a heterogeneous policy effect for right-to-carry laws on population-level homicide rates and included random slope terms in their analysis. Random slope terms allow the effect of right-to-carry to vary across states. I tested if this relationship existed within firearm-related workplace homicide rates. To do this, I first ran a simple multi-level model without coefficients specifying a random intercept model for each state with an independent correlation structure and stored the model estimates. I then ran the same model, adding a random coefficient for the heterogeneous policy effect of right-to-carry and stored the model estimates. I then ran a likelihood ratio test (LRT) comparing the estimates of the random intercept *null* model and the random intercept plus random slope *alternative* model. The output below indicates the difference is greater than 0, indicating the random intercept plus random slope model represents a better model fit.

^{xxv} This calculation was made by dividing the variance for the constant, ID (the state identification variation) by the total variance present in the model (variance for the constant + variance for the residuals)

STATA CODE: lrtest randint randcoeff

Likelihood-ratio test	LR chi2(1) = 9.38
(Assumption: randint nested in randcoeff)	Prob > chi2 = 0.0022

I included time fixed-effects via a categorical dummy variable representing 24 years and state fixed-effects via a categorical dummy variable representing 50 states. State fixed-effects controls for average differences across states on any observable or unobservable predictors, such as state-attitude towards firearm ownership. Year fixed-effect controls for average difference over time on any observable or unobservable predictors, such as changes in firearm ownership attitudes over time. Over time and across states, there are likely observable and unobservable characteristics capable of influencing a predictor, x . Using fixed-effects controls for the average differences across states and over time on observable and unobservable characteristics, reducing the likelihood of bias.

Covariates

I used data from a publicly available data request with the CFOI for Chapter four. The CFOI's data is publicly available and the BLS aggregates the data by state and year upon request. In some cases, where the number of fatalities is small, CFOI may censor their responses to data requests due to publishability criteria.

As CFOI is a federal-state cooperative program, the BLS has data-use agreements with all 50 states and the District of Columbia. Each state sets the publishability criteria of their data, meaning tabulated data by state and year could contain censored data based on whether a reported death could be identifiable (personal communication, October 19, 2016). It is not possible to track censored data in request forms. However, aggregated

data requests which collapse counts into higher order groups significantly increase the likelihood that a count would meet publishability criteria (person communication, November 21, 2016). For Chapter four, I submitted a data request that produced state and year specific counts from 1992-2015.

State and year indexed data requests from the CFOI contain a potential limitation. Data requests from CFOI do not produce state and year specific counts of ‘0’ workplace homicide, or counts of ‘1’ workplace homicides when the single death is not a matter of public record, i.e. the CFOI confirms the death through private documents only. However, the data request used for this study produced 12,429 of the 12,767 (97.4%) firearm-related workplace homicides from 1992-2015, meaning, despite the strict publishability criteria, the vast majority of firearm-related workplace homicides were accounted for. As a sensitivity analysis, though, all models were conducted as 1) a complete case analysis, using only the positive integer counts provided in the data requests, and 2) as a total population analysis, assuming all ‘missing’ state and year indexed values to be true ‘0,’ ignoring the missing 2.6% of data.

Other covariates. A list of all covariates is located in **Table 19** in the Appendix. All covariates are state and year indexed from 1992 to 2015. I included 7 state-level policies in the analysis. Manuscript two identified effective dates of Parking Lot Laws. Research by Zeoli and Colleagues (2017) provided effective dates for Violent Misdemeanor Prohibition laws, domestic violence restraining order, dating partner laws, domestic violence restraining order, ex parte laws, and permit-to-purchase laws.¹⁴⁰ Donohue, Aneja, & Weber (2017), along with the Giffords Law Center to Prevent Gun Violence provided effective dates for right-to-carry laws.^{86,141} I conducted legal research

to establish effective dates for stand your ground laws. I identified and retrieved state statutes via WestlawNext Legal database. I determined effective dates via the statute's corresponding state sessions laws through Hein Online (**Table 11** below). All other effective dates for included laws can be found in **Table 18** (in the Appendix).

Table 11: Stand Your Ground Laws, Effective Dates

State	Effective date	State	Effective date
Alabama	6/1/2006	New Hampshire	5/19/2011
Alaska	9/13/2006	North Carolina	12/1/2011
Arizona	4/24/2006	North Dakota	8/1/2007
Florida	10/1/2005	Ohio	9/9/2008
Georgia	7/1/2006	Oklahoma	11/1/2006
Indiana	7/1/2006	Pennsylvania	8/29/2011
Kansas	5/25/2006	South Carolina	6/9/2006
Kentucky	7/12/2006	South Dakota	7/1/2006
Louisiana	8/15/2006	Tennessee	5/22/2007
Michigan	10/1/2006	Texas	9/1/2007
Mississippi	7/1/2006	Utah	3/2/1994
Missouri	8/28/2007	West Virginia	2/28/2008
Montana	4/27/2009		

I obtained data on the number of employed persons and the number of female employed persons from the Current Population Survey (CPS).¹⁵⁶ I obtained data on law enforcement expenditure from the U.S. Census Bureau's annual survey of state and local government finances.¹⁵⁷ I obtained data on the number of persons employed in the retail industry from the U.S. Bureau of Labor Statistics' Current Employment Statistics.¹⁴⁵ Other population data and percent population union representation came from the CPS via the Integrated Public Use Microdata Series (IPUMS). IPUMS provides access to several nationally representative surveys' microdata.¹⁴⁶ IPUMS is recognized and supported by the National Institutes of Health and many longitudinal panel surveys of

states, such as the U.S. Census Bureau's CPS, the National Health Interview Survey, the American Community Survey, and the Time Use survey. Microdata is accessible by ID or at the state level. I collected the following data from IPUMS, poverty rate, median income, and percent population: male; white; black; with high school education or more; and married.

The Uniform Crime Report (UCR) includes information and statistics on crime, arrests, and homicides to the FBI at the state-level. I collected rates of incarceration, violent crime, aggravated assault, robbery, property crime, burglary, larceny and theft, motor vehicle theft, and homicide via UCR as well as population density data, calculated as the metropolitan statistical area.¹⁴⁴ Variables from the UCR were available until 2014. All violent crime data were linearly interpolated for 2015.

Data from the Centers for Disease Control and Prevention's Web-based Injury Statistics and Query and Reporting System (WISQARS) provided data for the calculation of gun availability.⁶⁷ I calculated gun availability as the number of firearm suicides divided by all-type suicides. This measure approximates house gun prevalence and was created and validated by Azrael, Cook, and Miller (2004).¹⁵⁸ It is commonly used in evaluations of gun violence prevention policies to control for a gun availability.^{77,96}

Collinearity of Variables:

To understand potentially collinear variables, the study calculated variance inflated factors (VIF)^{xxvi} scores for each year and averaged the scores over the study

^{xxvi} VIF scores offer a score which measures how much of the variance of a given regression coefficient is due to collinearity, or how much a given coefficient is a perfect linear predictor of another coefficient. Including collinear variables in regression analyses may not produce valid estimates of the relationship between coefficients and your outcome of interest. Therefore, eliminating collinear variables is of utmost importance.

period for state-level demographics and state-level violent crime rates separately. As VIF scores must use a continuous outcome, I calculated a per million worker workplace homicide rate using the total population analysis model. For state-level demographics, I withheld the variable metropolitan statistical area from VIF analysis due to a priori importance. For state-level violent crime rates, I withheld gun availability and law enforcement expenditure from the VIF analysis due to a priori importance.

Table 20 (in the Appendix) provides VIF scores for state-level demographics. I kept all variables with a VIF score under 5 for bivariate analyses. Seven covariates had a VIF score under 5 including black (Average VIF = 3.68), white (Average VIF = 2.20), median income (Average VIF = 4.53), education (Average VIF = 4.59), union (Average VIF = 2.04), male (Average VIF = 2.12), married (Average VIF = 2.12), retail (Average VIF = 1.80).

Table 21 (in the Appendix) provides VIF scores for state-level violent-crime rate variables. All other violent crime rates, other than homicide rate (Average VIF = 6.26) were collinear.

Bivariate Analysis

Table 22 (in the Appendix) presents bivariate analysis for the 7 state-level demographic covariates with VIF scores lower than 5 and the 1 state-level violent crime rate covariate. Each bivariate model included state and year fixed effects and a population offset of the natural log of state and year indexed employment size. Of the 8 covariates examined, 4 contained significant relationships with workplace homicide incidence: percent population white (p-value = 0.006); percent population married (p-

value = 0.003); percent labor force in retail sector (p-value = 0.022); homicide rate (p-value <0.001). I considered those variables for inclusion in the final model.

Model Building

To determine the final model, I examined Akaike Information Criterion^{xxvii} scores (**Table 23**, in the Appendix). The original model contained only covariates of interest a priori (right-to-carry laws, permit-to-purchase laws, parking lot law, domestic violence restraining order, ex parte, domestic violence restraining order, dating partners, Violent misdemeanor firearm prohibition laws, law enforcement expenditure, MSA, gun availability, and region). From there, I added the 4 covariates with significant bivariate relationships to workplace homicide incidence to the model and used the STATA command to produce AIC statistics. The best model fit included the a priori variables and all 4 additional covariates (AIC score = 5404.571).

Further, I used AIC scores to determine the overall goodness of fit of a random intercept term and a random slope term in tandem with state fixed-effects. To do this, I ran four model versions using the total population analysis and the complete case analysis: the full model (with random intercepts, random slopes and state fixed-effects); the random intercept model (random intercept without random slope and without state fixed-effects); the random intercept + random slope model (no state fixed-effects; and the

^{xxvii} Akaike Information Criterion (AIC) is an estimator of the quality of a statistical model based on the data present. Given a collection of models, AIC estimates the quality of each model relative to the other models. Given a set of models, the preferred model is the one with the smallest AIC value. AIC values goodness of fit measured by the likelihood function while including a penalty that increases as the number of parameter estimates increases. The formula for is:

$$AIC = 2k - 2\ln(L)$$

Where k is the number of parameters and L is the likelihood function of the model.

random intercept + state fixed effects (no random slope term). Across both the total population analysis and the complete case analysis, the full model performed best, indicating the need for a random intercept and a random slope term as well as state fixed-effects. **Table 24** (in the Appendix) displays the AIC scores for all models.

Aim 3.1

To address **Aim 3.1**, I used the `meglm` (mixed effect generalized linear model) command in STATA version 15 specifying a population offset of the natural log of state and year indexed employment, a negative binomial distribution (due to over dispersion), a log link function, and clustered robust sandwich estimators of the standard errors within each state and an independent correlation structure of the intra-class correlation. Further I included state and year temporal trends to control for fluctuations over time. I included unit specific estimates of the policy effect of right-to-carry laws to account for the possible heterogeneity in the policy effect across states.

I tested the assumption of normally distributed model residuals using Pearson's residuals.^{xxviii} I ran the complete case analysis and the total population analysis, predicted Pearson's residuals and created histograms for each analysis-type. **Figure 7**, in the Appendix displays the Pearson's residuals for the total population analysis. **Figure 8**, in the Appendix. displays the Pearson's residuals for the complete case analysis. Both models produced normally distributed residuals, centered around '0'. However, there were several residual points greater than two in absolute value and merited further exploration. In the total population analysis, there were 67 residuals greater than 2 and 8

^{xxviii} Pearson's residuals are the difference between observed and fitted values divided by an estimate of the standard deviation of the observed values. Typically, observations with Pearson's residuals greater than 2 in absolute value need be examined.

residuals less than negative 2. In the complete case analysis, there were 30 residuals greater than 2 and 3 residuals less than negative 2. I dropped these data points and conducted both analyses again. **Table 25** (in the Appendix) presents results for right-to-carry laws for both types of analysis, both showing a significantly increased relationship between right-to-carry laws and workplace homicides committed by firearms. Withholding the potentially outlier residuals did not affect our outcome of interest and therefore I left them in the final model.

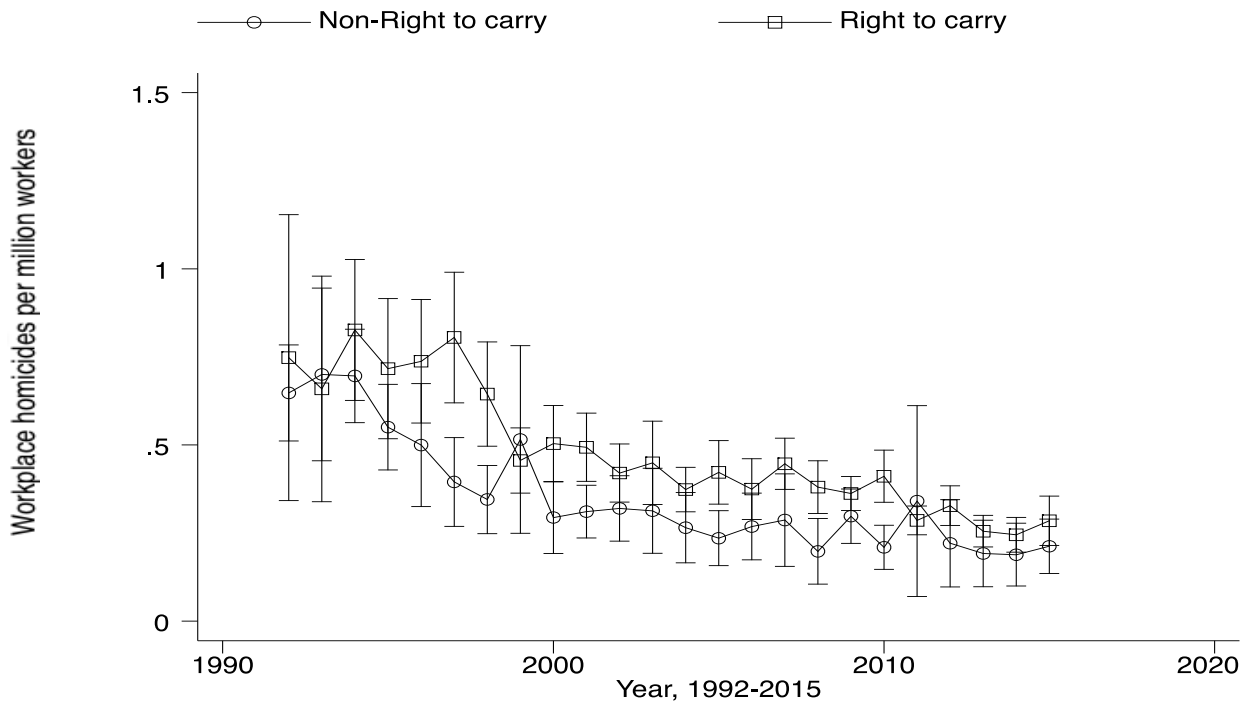
Further, I wanted to examine if the assumption of parallel line trends held for the significant relationship between right-to-carry states and non-right-to-carry law states. If this assumption held true, it would strengthen the findings under the difference-in-difference approach. To do this, I graphed workplace homicides per million workers for right-to-carry states compared to non-right-to-carry states from 1992-2015. I did this under the complete case analysis and the theoretical population analysis. **Figure 4** below reveals the results for the complete case analysis. **Figure 5** below reveals the results for the theoretical population analysis. For both cases, it is clear the parallel line assumption holds from 1992-2015.

Limitations of Manuscript Three

Chapter four contained several limitations and threats to validity. While CFOI provides the most comprehensive accounting of fatal occupational injuries, it contains reporting limitations. The CFOI does not contain information on potential confounding factors such as life-style, work conditions, and whether the place of employment was in an urban or rural setting.¹⁴⁹ While CFOI uses at least two documents to verify death characteristics, homicides that occur in the workplace are prone to misclassification,

underestimating the true count. The CFOI data is limited to deaths that occur at work meaning deaths on the way to and from work likely go underreported.¹⁴⁹

Figure 4: Test of Parallel Line Assumption for Relationship Between Right-to-carry laws and Firearm-related Workplace Homicide, Complete Case analysis from 1992-2015

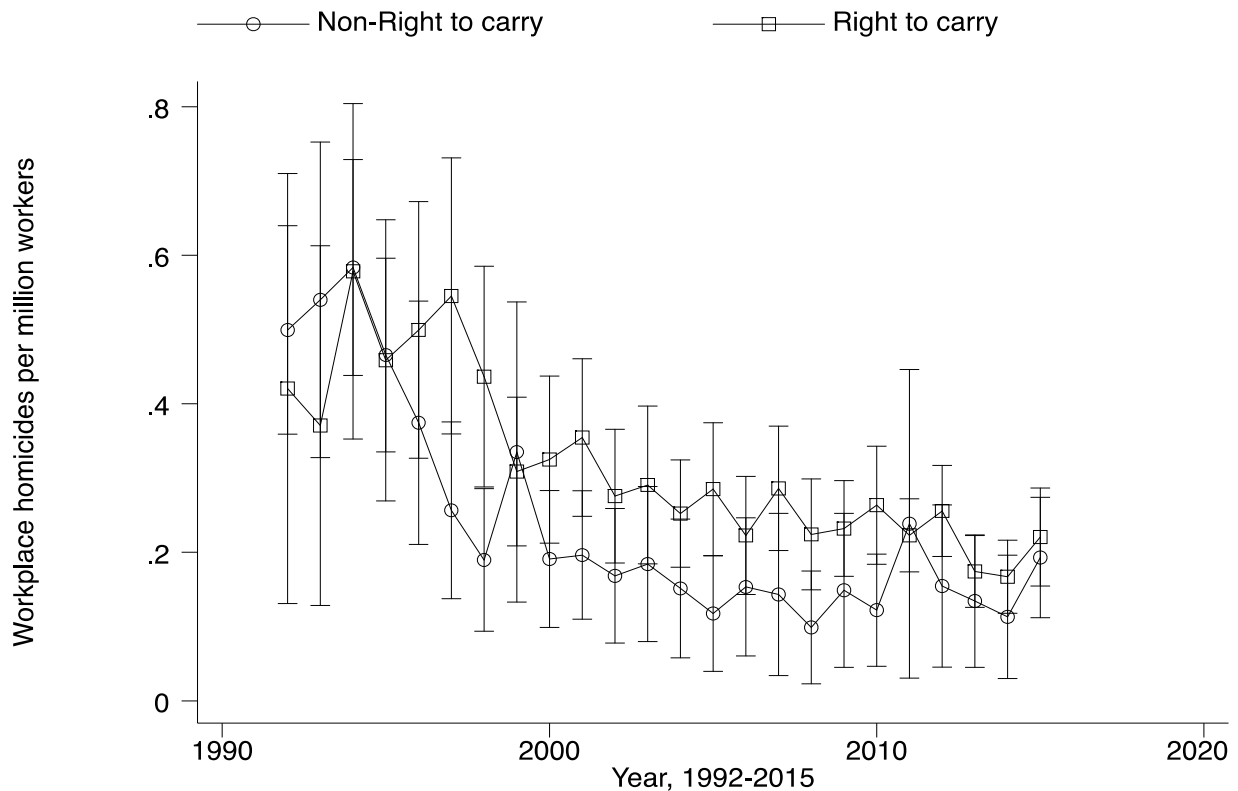


The UCR is one of the most important sources of crime data available in the U.S. The UCR represents a nationwide effort as 17,000 law enforcement agencies voluntarily report crime data, or around 95% of law enforcement agencies. However, it may contain several sources of measurement error.¹⁵⁹ First, the UCR is subject to response errors as it relies on self-reported information. Police may misclassify or fail to report crimes. Second, the use of UCR as a proxy variable for actual crime incidence could be problematic as individual's propensity to report crimes is influenced by a variety of factors including the way victims are treated, police presence, and policing tactics. Therefore, trends in UCR may represent trends in the reporting of crime to police rather

than rates of actual crime incidence. Third, as local agencies' voluntary reporting compiles the UCR, there is reason to believe missing values are not systematic and thus the data suffers from imputation errors. Additionally, the voluntariness of the system means some agencies may decide not to participate. In almost all surveys, some participants inevitably do not answer all questions, creating the need to impute responses to particular questions based on values from the complete records within that dataset. Likely, survey response level is dependent on resources meaning differences in imputation may exist across size and capacity of agencies.¹⁵⁹

Another limitation for Chapter four, which is present in most state-level policy analyses is the inability to control for policy enforcement. States' enforcement of laws, moreover, how a states' population interacts with new societal norms resulting from legislation, is unknowable. To help control for differences in how each state enforces and interacts with right-to-carry laws, we allowed for a heterogeneous policy effect across states by including a random policy effect in the model. Further, time and state fixed-effects help to control for time- and-state invariant and factors possibly associated with how states' implement new policies. Additionally, we were unable to control for the state-level counts of concealed carry permits issued during 1992-2015 as this information is not readily available. Further, the CFI contains data on worker death and does not provided information for non-workers that may have died as part of a death event. Therefore, using the CFI data does not allow for a true understanding of the relationship between state-level laws and firearm violence in a workplace. However, it does estimate the effect of state-level laws on firearm violence for workers, which is why the implications of this work pertain specifically to that population.

Figure 5: Test of Parallel Line Assumption for Relationship Between Right-to-carry laws and Firearm-related Workplace Homicide, Theoretical Population analysis from 1992-2015



Chapter four faces several threats to validity. First, this study suffers from selection bias among states that have chosen to implement the policies of interest.¹⁶⁰ States self-select conditions with potential to affect health outcomes. When factors cause the selection into these conditions and affect the outcome of interest, a bias estimate of the relationship between the independent and dependent variables emerges if factors/characteristics that influenced the decision are not controlled for. Some amount of selection bias is inevitable within non-experimental studies. I attempted to address selection bias by controlling for a wide host of covariates associated with workplace homicides, violent crimes, and other firearm policies through VIF analysis, bivariate

analyses and AIC model selection procedures. Doing so limits the influence of selection bias.

Chapter four further faces threats from omitted variable bias. I have attempted to control the degree to which omitted variable bias effects our results through rigorous model building techniques as well as including time- and-state fixed-effects. Time and state fixed-effects control for time- and-state invariant factors possibly not controlled for in the model. Including time and state fixed-effects decreases the likelihood that time trends and state-related characteristics not included in the analysis would bias our findings.

Another potential threat to validity is co-intervention bias. This study considers co-intervention bias as a possible threat to validity because state and local firearm policy is ever changing. To address this possible source of bias, I accounted for 7 state-level policies that affect either firearm exposure or access for prohibited individuals through longitudinal methods. These state laws previously displayed significant relationships with rates of firearm-related homicides. As with most evaluations of public policy, we cannot rule out the possibility that unmeasured determinants of homicide rates associated with changes in the laws confound our estimates of the associations between state-level policies and workplace homicides. Our thorough analysis of covariates reduces the effect of co-intervention bias.

It is also possible that the relationship between the workplace homicides and state-laws are endogenous, meaning the incidence of workplace homicide caused the passing of each state law. However, creating policy is untimely as creation and adoption

of legislation is a slow-moving process, therefore limiting the potential for reverse causality between incidence of workplace homicide and laws in general. Moreover, the role of state-policy in workplace homicides had not been considered until this examination, suggesting a lack of public connection between workplace homicide incidence and state laws. Also, the use of state and year fixed-effects limit the impact of potential endogeneity between workplace homicides and state laws.

Other sources of internal validity bias could affect the findings from Manuscript Three. First, historical event bias; as the violent crack cocaine epidemic brought with it increased rates of violent crime, there is reason to expect confounding to be introduced when using data from the early 1990s. As such, I restricted the analysis from 1998 to 2015 to avoid this confounding, maintaining significant results of similar magnitude (**Table 17** in the Appendix). Regression to the mean bias can be introduced when a study does not contain many observations within each subject. However, Chapter four included 24 years of data for each state, reducing greatly the potential impact of regression to the mean bias. Further, ambiguous temporal sequence bias, or the issue of reverse causation is present, though the quasi-experimental design of Chapter four does not allow for much alleviation. However, Chapter four includes 24 years of study observations noting each law's effective date, establishing a temporal order of law passage within each state decreasing the likelihood ambiguous temporal sequence bias effects the results. Further, I restricted the analysis to only states that passed right-to-carry laws from 1992-2015, examining the temporal effect of passing the law within similar states. Results from this analysis (**Table 17** in the Appendix) were similar to the overall model, indicating low ambiguous temporal sequence bias.

Chapter 6: Conclusions

Summary of Findings

Research Question 1): How Do Perpetrators Access Firearms During a Workplace Homicide?

The results of Chapter two indicated perpetrators access their firearms in multiple ways. Content analysis of narrative text revealed 7 possible ways a perpetrator accessed their firearm preceding a workplace homicide, 1) on-person, 2) from their home, 3) from their car, 4) from an alternative location at work, 5) stolen from the victim, 6) retrieved in an unspecified manner, and 7) unable to be determined/accessed prior (see **Table 6** in Chapter two).

For robbery-motivated workplace homicides, firearm access was largely unknowable as narrative text for these crimes did not contain information pertaining to how perpetrators accessed their firearms. However, it is overwhelmingly likely that the firearm was in the robber's possession prior to the crime. Firearm access points were more available among non-robbery-motivated workplace homicides, likely due to the more personal nature of their crimes. Overall, 189 perpetrators directly accessed their firearm, 8 accessed from their home, 20 accessed from their car, 6 stole the firearm from their victim, 61 accessed via retrieval in an unspecified way, and in 458 cases, firearm access could not be determined/accessed prior to the event (see **Table 6** in Chapter two).

How perpetrators accessed their firearms was most knowable for arguments, where only 32.3% (n = 111) of the 344 workplace deaths did not have enough information to determine firearm access. For arguments, firearms were accessed predominately on-person (44.2%, n = 152). Among males, the majority of victims of

arguments, customers (48.9%, n = 68) and coworkers (24.5%, n = 34) committed the highest portions of crimes accessing their firearm on-person (n=139).

Of the 185 female workers killed as part of a non-robbery-motivated homicide, most (n=117) were killed as part of a conflict that did not include an observable argument prior to death but involved persons who had reason to be involved in an argument, such as domestic partners or work associates. Primarily, those deaths were committed by intimate partners (n = 97).

Also, as part of Chapter two, we characterized these firearm access points for multiple-death events. There were 74 incidents between 2011 and 2015 that involved more than one worker death, of the 74, 7 were mass shootings. Three of those mass shootings occurred as part of seemingly random violence by an unknown assailant, not motivated by robbery. Coworkers committed the largest number of incidents (n = 25) though how they accessed their firearms was largely unknown. Customers committed 14 of the 74 incidents, half of the time with the firearm located directly on the perpetrator.

Research Question 2): What is the Policy Landscape of Parking Lot Laws?

By-and-large, state parking lot laws contained similarities to one another and were relatively unchanged over time. As part of the laws, we identified 5 non-mutually exclusive characteristics: 1) exemptions allowing employers to prohibit employee gun storage; 2) restrictions for how and where employees must store their firearms; 3) provisions that speak to the relationship between employers and their gun owning employees; 4) provisions releasing employers from liability for events stemming from an employee storing a motor vehicle in their car at work, and 5) provisions establishing civil standing for employees related to firearm storage in their motor vehicles. We also

identified limited legislative actions after the laws went into effect. With a few exceptions, these laws were not amended after being passed aside from Indiana's parking lot law, which removed place restrictions for school employees, and Oklahoma's parking lot law, which added protections for ammunition. While there are a number of components (see **Table 13** in the Appendix for full detail), the laws all aim to accomplish the same thing; ensure firearm owners have access to their firearms at work in their motor vehicle.

Research question 3): What is the Impact of Changes in State-level Laws on Firearm-related Workplace Homicide Incidence?

The results from Chapter four revealed right-to-carry laws impact firearm-related workplace homicide incidence while other state-level firearm policies displayed non-significant relationships. Right-to-carry laws were associated with 32% greater rates of firearm-related workplace homicides from 1992 to 2015 (see **Table 10**, in the Chapter four). The magnitude of association between right-to-carry laws and firearm-related workplace homicides remained steady across a number of sensitivity analyses (see **Table 17**, in the Appendix). I restricted the model in time, in covariates, and in population. When restricting the analysis to the population of states that passed right-to-carry laws from 1992-2015, adopting a right-to-carry law was associated with a 18.6% greater firearm-related workplace homicide rates. Restricting that analysis to ignore possible years that might confound with the violent crack cocaine epidemic displayed increased associations as right-to-carry laws were associated with 29.4% greater firearm-related workplace homicide rates from 1998-2015. The modified model displayed similar increases when restricted over time. Right-to-carry laws were associated with 26.7%

greater rates of firearm-related workplace homicide from 1992-2015 and 35.9% greater rates from 1998-2015 using the modified model. Ultimately, right-to-carry laws are likely associate with increased rates of workplace homicides committed by firearms supported by numerous sensitivity analyses.

Future Research Priorities

Future research on the role of firearms in the workplace should focus on several areas. Chapter two established a cross-sectional accounting of how perpetrators accessed firearms to commit workplace homicides. Future research should examine perpetrator firearm access in several different manners. For example, what is currently unknown is whether the proportion of argumentative workplace homicides that involved a perpetrator directly accessing or retrieving their firearm has changed over time. As noted in Chapter four, 24 states passed right-to-carry laws from 1992 to 2015. As research indicates individuals in ‘shall’ issue states and no permitting states report greater rates of loaded hand gun carrying compared to ‘may’ issue states,⁸⁴ it is unclear what impact changes in right-to-carry laws have had on the proportion of argumentative workplace homicides committed by a perpetrator with direct access to their firearm over time.⁸⁴ Whether that proportion is different based on concealed carry weapons permitting issuing status is also not known. Answers to these research questions will help cement the knowledge based around the role of firearm exposure in the workplace.

Right-to-carry states generally grant private property owners or persons legally in control of private property through a lease, rental agreement, or contract to control access to private property.^{82,83} These laws typically extend private property owners’ ability to ban customers’ firearms in their establishment as well as ban employee firearm access.

Much is unknown about these aspects of right-to-carry laws. Currently, we do not know the number of businesses in right-to-carry states that prohibit customer and employee firearms. We do not know, within those businesses, the extent firearm prohibitions decrease customer and employee firearm carrying. Further, in businesses that do not contain firearm prohibitions for customers and employers; 1) it is unknown if the presence of firearms in a workplace affects interpersonal relationships among employees and between employees and customers/clients; 2) it is unclear how employers view the injury risk associated with firearms; and 3) it is unclear how parking lot laws affect employers' decision making around firearms in the workplace. Research is needed to understand what percent of businesses in right-to-carry states prohibit customer and employee firearms, how businesses establish firearm prohibitions, and whether those prohibitions are successful.

Identifying best practices for reducing intimate partner violence at work and assisting employees suffering intimate partner violence outside of work is necessary. Intimate partner violence at work remains a complex issue. Managerial level employers are often untrained on how to deal with a worker who reports or is known to be in an abusive relationship.²² While employees potentially stand to gain from disclosing intimate partner violence to their employers, as protections could be afforded, major barriers for reporting exist.¹⁹ One possible entry point, and an area of future research, is the use of employee assistance programs to intervene with workers. Employee assistance programs are a workplace resource for employees suffering from problems impacting their work performance. A recent purposeful sample of 28 employee assistance programs across the United States found most did not report having a standardized approach for

dealing with intimate partner violence.²⁷ Future research is needed to establish best practices for how employee assistance programs could deal with intimate partner violence. This research should take into account the needs of intimate partner violence victims and employee assistance programs.

Further analysis of the relationship between state firearm policies and firearm-related workplace homicides is warranted. Future analyses should consist of several aspects. First, analyses should seek to produce state-level estimates of the impact of changes to laws on workplace homicides. To do this, researchers should consider using random effects meta analyses, or synthetic control models. These models will produce estimates for individual states, further specifying the relationship between state-laws and workplace homicides. Second, these analyses should seek to disaggregate workplace homicides by characteristics to better specify statistical models. For example, future examinations of stand your ground laws should isolate workplace homicides committed during an argument; examinations of firearm prohibition laws for dangerous intimate partners should use intimate partner workplace homicides.

Implications

Firearm exposure at work is problematic. State laws that promote firearm exposure in the general population, such as right-to-carry laws, appear to impact workplace homicides. Right-to-carry laws were associated with 32% greater incidence of firearm-related workplace homicides from 1992-2015.

Reciprocity is perhaps the biggest political issue surrounding right-to-carry laws. Given the evidence presented in Chapter four, creating a federal-level right-to-carry law reciprocity will likely negatively impact non-right-to-carry states. Right-to-carry laws

negatively impact worker safety and health, as states with right-to-carry laws had a 32% greater rate of firearm-related workplace homicides. A federal reciprocity law would make states honor concealed carry firearms permit from another state. As each state contains differing qualifications for who is allowed to carry a concealed firearm, this is problematic. A may-issue state, like Massachusetts, would be required to allow individuals from Vermont, a state that does not require a permit to carry a concealed firearm, to carry a concealed weapon. Policy makers need to consider the negative health ramifications for workers associated with a federal right-to-carry reciprocity bill.

Right-to-carry laws generally allow private property owners to prohibit customer and employee firearms from their businesses. Chapter two found direct firearm access played a large role in escalating arguments to argumentative workplace deaths, particularly between customers and workers. Chapter three found 16 existing parking lot laws restrict the ability of private business owners to maintain a gun-free environment within their company's parking lot. Chapter four found right-to-carry laws were associated with 32% greater rates of firearm-related workplace homicides. This evidence suggests businesses in right-to-carry states, where there is an increased proclivity for loaded handgun carrying,⁸⁴ should undertake efforts to prohibit firearms in their workplaces.

This research raises the question: does customer and employee firearm access constitute a recognizable hazard for workers? The research presented here notes firearm exposure plays a large role in argumentative workplace homicides. This has multiple implications. If customer and employee firearm access is a recognizable hazard, businesses would need to take steps to ensure, to the best of their ability, a firearm free

work environment. Failing to do so would likely risk an OSHA violation of the general duty clause for failing to protect against a recognized hazard. Failing to do so may also expose businesses to litigation from employees or their families. For businesses where workplace violence is a recognized hazard, such as health care, the findings here suggest workplaces likely have a duty, to the best of their ability, to prohibit customer/client and employee firearms and a failure to do so would constitute an OSHA violation of the general duty clause.

State policy makers in states with right-to-carry laws should specify how employers are to prohibit firearms from their establishments. Providing standardized language for how employers are to prohibit firearms, such as provided in Texas, is one possible avenue. Standardized language would have the effect of creating a recognizable and comprehensible standard across all businesses. This could potentially help businesses and firearm-owners alike; a standardized statement would eliminate potential confusion over which establishments do or do not allow firearms. Though, the impact of such messaging is unclear and needs be evaluated before wide-spread adoption.

State policy makers considering laws that increase firearm exposure in the general population should consider worker safety and health implications. Increased firearm exposure in the general population likely in-turn leads to increased firearm exposure for workers. We demonstrated here that firearm exposure for workers, particularly workers that interact with armed customers, is problematic. Passing laws that increase firearm exposure in the general population is likely detrimental to worker safety and health.

This research determined how perpetrators access firearms during a workplace homicide, identified the frequency and characteristics of parking lot laws in the U.S., and

examined the impact of state-level laws on firearm-related workplace homicides.

Findings indicate: 1) direct firearm access plays a large role in escalating arguments to argumentative workplace deaths, particularly between customers and workers; 2) parking lot laws limit the ability of employers to prohibit employee firearms within their parking lots; and 3) right-to-carry laws are associated with 32% greater rates of firearm-related workplace homicides. Overall, firearm exposure within the workplace is likely detrimental to workers' safety and health and efforts to restrict employee firearm exposure are needed.

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Appendix

Tables:

Table 12: Haddon Matrix for Firearm-related Workplace Violence

Phases	Human Factors (victim and Perpetrator)	Agent (firearm)	Factors:	
			Physical environment	Social environment
Pre-event	<p>Victim:</p> <ul style="list-style-type: none"> Race,^{19,20,47,48} Ethnicity,^{19,47,48} Gender^{47,108}, Age,^{47,108} Geographic location⁴⁸, Foreign born⁴⁸, Disclosure of intimate partner violence to workplace supervisor,⁴⁶ <p><u>Perpetrator:</u></p> <ul style="list-style-type: none"> Access to the workplace⁴⁶, Restricted access to partners automobile and/or driver's license¹⁹, Anger¹¹⁴, History of violent behavior, Access to gun¹⁰⁸, provide oversight of potentially volatile employees (perpetrator)¹¹⁶ 	<ul style="list-style-type: none"> Personalized gun technology Use of gun locks Restrict ammunition allowed in workplace (pellets) 	<ul style="list-style-type: none"> Locked doors,^{20,51} Open at night or 24 hours,^{48,51} Majority male workers,⁵¹ Alarms,⁵¹ Bright lights,⁵¹ Multiple workers on duty,⁵¹ Type of industry,⁴⁶ Time of day (shift),¹⁹ Maintaining lighting in parking lot,⁴⁵ Perimeter control of building or parking lot,⁴⁵ Separation of employee parking from the general public,⁴⁵ Presence of security guards,^{20,45} Presence of metal detectors,¹² Number of employees²⁰ History of violence at workplace²⁰ Staffing practices (not working alone)²⁰ Union representation,¹⁶¹ Manager attitude,^{114,115} Allowing firearms in the workplace,^{46,51} Workplace cultures¹¹⁴ 	<ul style="list-style-type: none"> Gun violence prevention policies, Access to social services (including TANF),^{93,115} Gender inequality,⁹³ Population density,⁷⁰ Population composition by age,⁷⁰ Unemployment rates,⁷⁰ Educational attainment,⁷⁰ Poverty level/deprivation,¹⁰⁹ Lack of institutional responsiveness to workplace violence¹¹⁴

Event	<ul style="list-style-type: none"> • Wearing protective material (i.e. bullet-proof vest) • Train employee to use self-protection measures 	<ul style="list-style-type: none"> • Magazine size • Type of ammunition • Caliber 	-	<ul style="list-style-type: none"> • Restrictions on magazine size
Post-Event	<ul style="list-style-type: none"> • Comorbidities • Train employees in first aid¹¹⁶ • Provide worker with crisis intervention counseling¹¹⁶ 	<ul style="list-style-type: none"> • Improve ability to trace firearms and apprehend suspects 	<ul style="list-style-type: none"> • Layout of the workplace (i.e. proximity to and ease of exit), • Time of arrival for EMS services 	<ul style="list-style-type: none"> • Access to EMS services, • Police staffing levels,⁹³

Table 13: Parking Lot Laws in the United States, as of April 1st, 2018

State (statue)	Employer exemptions ^Φ		Restrictions on Employees ^Δ					Restrictions on Employers			Liability ^Π	Employee standing	Effective Dates
	Parking lot has restrict ed access	Em- ployer owns, leases, or rents car	Must be employee owned vehicle	Vehicle must be locked	Firearm secured in MV ^δ	Firearm not visible	Location exemp- tions ^Ψ	Cannot condition employ- ment	Cannot terminate if compliant with state law	May not search car for purpose of finding firearms	Employ- ers cannot be held liable for civil action	Employee has grounds for civil recourse	-
Alabama (Ala. Code 1975 § 13A-11- 90)*			X	X	X	X			X			X	August 1, 2013
Alaska (A.K. St. § 18.65.800)	X**	X			X						X		Oct. 19, 2005
Arizona (A.R.S. § 12-781)	X	X	X	X		X	X						July 13, 2009
Florida (Fl. St. § 790.251)		X	X	X			X	X	X	X	X		July 1, 2008
Georgia (Ga. Code Ann. §16- 11-135)***	X	X	X	X	X	X	X	X			X		July 1, 2008
Indiana (I.C. § 34- 28-7-2)****				X	X	X	X						July 1, 2010
Kansas (K. S. A. 75-7C10)													May 3, 2007

Kentucky (K.R.S. § 237.106)						X						X	July 12, 2006
Louisiana (LSA-R.S. 32:292.1)	X	X	X	X	X	X						X	August 15, 2008
Maine (26 M.R.S.A. § 600)				X		X						X	Sep. 28, 2011
Minnesota (M.S.A. § 624.714)^													April 29 2003
Mississippi (Miss. Code Ann. § 45-9-55)	X	X			X							X	July 1, 2006
North Dakota (N.D.C.C. § 62.1-02-13)		X	X		X		X	X	X	X	X	X	August 1, 2011
Oklahoma (Okl. St. Ann. §1289.7a)^^				X								X	Nov. 1, 2004 ⁺
Texas (V.T.C.A., Labor Code §52.061)			X	X									Sept. 1, 2011
Wisconsin (W.S.A. §175.60)			X					X					Nov. 4, 2011

* For AL, the employee can store a firearm in their vehicle while at work as long as the firearm is *either*, while attended by the employee, kept from ordinary observation within the person's motor vehicle *or* while unattended by the employee, kept from ordinary observation and locked within a compartment, container, or in the interior of the person's privately owned motor vehicle or in a compartment or container securely affixed to the motor vehicle. Also, if the employee has fully complied with the parking lot law and existing AL firearms laws, the employment is entitled to recovery, such as compensation in wages or remuneration for any adverse employment action against the employee.

**For AK, definition of secured area refers to AS 29.35.145(e)(2), “means the area beyond a secure point where visitors are screened and does not include common areas of ingress and egress open to the general public.”

***GA’s parking lot law does not explicitly preempt employers from banning employee firearms, though it has the desired effect. The law prohibits employers from searching employees locked privately owned vehicles. For GA, the law is only applicable for those with a CCW permit

**** In 2014, IN changed their parking lot law, by removing language for location exemptions. Up until 2014, school employers *could* ban employees, including bus drivers, from storing firearms on school property. That provision was removed in 2014, preempting school employers from implementing such a ban. The preemption is for schools below post-secondary.

^ MN’s parking lot law predates the much publicized OK parking lot law. Therefore, the language of the MN parking lot law is simpler and without much consideration of other provisions found in later parking lot law. Section (c) subdivision 18 of M.S.A. Ch. 624.714, states, “...an employer or a postsecondary institution may not prohibit the lawful carry or possession of firearms in a parking facility or parking area.” We interpret this section as a valid parking lot law as it pertains to parking facilities or areas and therefore motor vehicles parked within those facilities or areas. It also provides specific employer prohibitions.

^^ In 2012, OK changed the language of 21 Okla. St. Ann. Ch. 1289.7a to including preemptive language for ammunition as well as firearms. Specifically, states claim section does not apply to claims pursuant to Workers Compensation.

+ Due to a court case, law did not go into effect until February 18th, 2009

Φ Additionally, GA allows employers to restrict firearm storage in motor vehicles at work if there is a need to prevent an immediate threat. They also allow employers to search cars as long as the employee consents to the search based on loss-prevention premises. AZ and LA allow employers that provide a firearm storage area or a reasonable alternative parking space to restrict firearm storage at work.

Δ Two states (AL & GA) specify the employee must have a valid permit to carry a concealed weapon to store a firearm in their motor vehicle at work.

δ the following states (GA & IN) specify the firearm can be stored in the car’s trunk, the glove box etc. GA states, for motor cycles, the firearms must be kept in an enclosed compartment. IN also specifies the employee is lawful as long as the firearm is stored out of plain sight in the employee’s locked vehicle.

Ψ Location exemption varied from state to state: energy producing plants/manufacturing facilities (AZ, FL, GA, IN, & ND); Schools (IN, FL, ND); Detention facilities (KY, IN, GA, ND, & WI)

Π GA and ME specifically state employers are not liable for a firearm that is stolen from an employee’s car. FL, GA, and ND, specifically state employers have no additional duty to care related to actions resulting from the parking lot laws.

Table 14: Firearm-related Workplace Homicides by Circumstance among Non-robbery-Motivated Crimes, CFOI, 2011-2015

Circumstance	N	%
Arguments		
Asked to leave establishment	23	3.1
Breaking up a fight	23	3.1
Job related (work hours, employee fired, work conditions)	47	6.3
Denied access to establishment	13	1.8
Over personal relationship	13	1.8
Over sale of merchandise	24	3.2
Escorting unruly patrons	--	--
Refused service	--	--
Arguments, other/unknown	165	22.2
Disgruntled customer	31	4.2
<i>Total</i>	<i>344</i>	<i>46.2</i>
Conflicts		
Personal relation, unknown circumstance	136	18.3
Coworker/ex-coworker, unknown circumstance	64	8.6
Act of revenge	20	2.7
<i>Total</i>	<i>220</i>	<i>29.6</i>
Other Circumstances		
Random gun firing	12	1.6
Caught in crossfire	15	2
Trying to get away (suspect)	4	0.5
Legal intervention	8	1.1
Active shooter respondent	4	0.5
Intervening in situation (civilian)	13	1.8
Gang related	6	0.8
Mass shooting/terrorism/shooting rampage	68	9.1
Drug deal	4	0.5
Unknown, robbery ruled out	19	2.6
Other	27	3.6
<i>Total</i>	<i>180</i>	<i>23.6</i>
Total	744	100

Note: Fatal injury counts were generated by authors with restricted access to BLS CFOI microdata.
Table include 744 non-robbery-motivated workplace homicides
Percent may not add up to 100 due to rounding

Table 15: Cross-tabulation of Industry and Workplace Violence Typology among Argumentative Firearm-related Workplace Homicides with Known Firearm Access Points

Workplace Violence Typology					
Arguments (n = 233)	Type I	Type II	Type III	Type IV	Total
On-person (n = 152)					
Labor	5	4	14	3	26
Retail	--	40	7	--	55
Transportation	--	10	6	--	22
Health Care	--	--	3	--	6
Professional	--	7	3	--	14
Education/arts	--	--	--	3	4
Public Administration	3	--	3	--	6
Other	7	10	--	--	26
Total	26	73	37	16	152
Retrieved, in some fashion (n = 81)					
Labor	--	6	20	--	29
Retail	7	27	--	--	36
Transportation	--	--	--	--	--
Health Care	--	--	--	--	--
Professional	--	--	--	--	3
Education/arts	--	--	--	--	3
Public Administration	--	--	--	--	--
Other	--	4	3	--	7
Total	--	41	27	--	81

Note: Fatal injury counts were generated by authors with restricted access to BLS CFOI microdata. Table contains 233 argumentative firearm-related workplace homicides with known firearm access points. For all categories of *retrieved*, note that all type of ways perpetrators retrieved firearms, (i.e., from a car, home etc.) were combined.

-- Indicates no data or data that do not meet BLS publication criteria

Table 16: Description of Workplace Homicide Incidents and Firearm-related Characteristics

Perpetrator – Victim relationship (<i>motivation</i>)	Workplace Homicide Incident			Firearm Access Points [^]				Total n (%)
	Number of Incidents <i>n (%)</i>	Number of Deaths <i>n (%)</i>	Number Mass shootings* <i>n (%)</i>	Retrieved, Unspecified <i>n (%)</i>	Retrieved, Car or home <i>n (%)</i>	On person <i>n (%)</i>	Accessed Prior/ Unknown <i>n (%)</i>	
Type I								
Robbery	15 (20.3)	34 (17.6)	--	--	--	--	15 (30.4)	15 (20.3)
Non-Robbery	10 (13.5)	29 (15)	3 (42.9)	--	--	--	10 (19.6)	10 (13.5)
Type II (Non-robbery)	14 (8.97)	29 (15)	--	3 (42.9)	--	7 (46.7)	--	14 (8.97)
Type III (Non-robbery)	25 (33.7)	77 (39.9)	-	--	--	7 (46.7)	13 (28.3)	25 (33.7)
Type IV								
Other** (Non-Robbery)	5 (6.8)	11 (5.7)	--	--	--	--	--	5 (6.8)
Intimate partner homicide*** (Non-robbery)	5 (6.7)	13 (6.7)	--	--	--	--	5 (8.7)	5 (6.7)
Total	74 (100)	193 (100)	7 (100)	7 (100)	3 (100)	15 (100)	49 (100)	74 (100)

Note: Fatal injury counts were generated by authors with restricted access to BLS CFOI microdata.

-- Indicates no data or data that do not meet BLS publication criteria

* Mass Shooting defined as 4 or more deaths

** Other defined as family or friends

*** The intimate partner homicide was followed by killing of other workers

[^]Firearm access points are for listed for the incident

Table 17: Sensitivity Analyses of Relationship Between Right-to-Carry Laws and Firearm-related Workplace Homicides in the United States, using Complete Case Analysis

Analysis Model	Complete Case Analysis (State-year indices = 822)	
	Beta Coefficients	95% CI
Right-to-carry laws lagged to year after effective date	1.255	1.12, 1.41
Original model, 1998-2015*	1.273	1.04, 1.56
Modified model**	1.364	1.13, 1.65
Modified model, 1998-2015	1.338	1.14, 1.57
Original model, restricted to states that passed right-to-carry laws during study period,	1.186	1.02, 1.38
Original model, restricted to states that passed right-to-carry laws during study period, 1998-2015	1.294	1.05, 1.59
Modified model, restricted to states that passed right-to-carry laws during study period	1.267	1.09, 1.47
Modified model, restricted to states that passed right-to-carry laws during study period, 1998-2015	1.359	1.13 1.63

Note: Where else noted, models include state and year fixed effects, percent population married, white, living in a metropolitan statistical area, and retail labor force as a percentage of total state-year labor force; natural log of employment as offset, random intercepts and random policy effects of right-to-carry laws, and an independent correlation structure for intra-state correlation over time from, 1992 to 2015. Bold indicates significance at $P < 0.05$. Estimates were generated by authors using a data request from the Bureau of labor statistics' Census of fatal occupational injury data. The views expressed here do not necessarily reflect the views of the BLS.

* 1998 represents the first year that declines in workplace homicides leveled off. It also represents a cut point to reduce bias from the violent crack cocaine epidemic

**Other gun policy variables, household gun availability, homicide rate, and law enforcement expenditure withheld due to potential confounding

Table 18: Laws and Effect dates for State Panel Analysis, 1992-2015

Laws and Effective Dates							
State	Right-to-Carry	Permit-to-Purchase	Parking Lot Laws	Stand your Ground Laws	Dating Partners Domestic violence restraining order	Ex parte Domestic violence restraining order	Any Violent Misdemeanors **
Alabama	Pre-1992	---	8/1/2013	6/1/2006	---	---	---
Alaska	10/1/1994	---	10/19/2005	9/13/2006	7/1/1996	---	---
Arizona	7/17/1994	---	7/13/2009	4/24/2006	9/1/2009	8/21/1998	7/18/2000 (DV Only)
Arkansas	7/27/1995	---	---	---	---	---	---
California	---	---	---	---	1/1/1991	1/1/1995	1/1/1991 02/28/1994– 02/28/1999,
Colorado	5/17/2003	---	---	---	2/26/1994	---	7/1/2000 (DV Only)
Connecticut	---	10/1/1995	---	---	6/23/1999	---	10/1/1994 (DV Only)
Delaware	---	---	---	---	3/20/2008	1/16/1994	7/24/99 (DV Only)
Florida	Pre-1992	---	7/1/2008	10/1/2005	---	---	---
Georgia	Pre-1992	---	7/1/2008	7/1/2006	---	---	---
Hawaii	---	Pre-1992	---	---	6/7/2000	7/1/1994	Pre-1992
Idaho	Pre-1992	---	---	---	---	---	---
Illinois	12/3/2013	Pre-1992	---	---	1/1/1996	1/1/1996	Pre-1992
Indiana	Pre-1992	---	7/1/2010	7/1/2006	7/1/2002	---	7/1/03 (DV Only)
Iowa	1/1/2011	Pre-1992	---	---	---	---	1/1/2011(DV Only)
Kansas	1/1/2007	---	5/3/2007	5/25/2006	---	---	---
Kentucky	10/1/1996	---	7/12/2006	7/12/2006	---	---	---
Louisiana	4/19/1996	---	8/15/2008	8/15/2006	---	---	---
Maine	Pre-1992	---	9/28/2011	---	---	---	---

Maryland	---	---	---	---	---	---	10/1/1996 (DV Only); 10/1/2003
Massachusetts	---	Pre-1992	---	---	6/7/1994	6/7/1994	---
Michigan	7/1/2001	Pre-1992	---	10/1/2006	4/1/1996	---	---
Minnesota	5/28/2003	Pre-1992	4/29/2003	---	---	---	8/1/1993 (DV Only); 10/1/2003
Mississippi	Pre-1992	---	7/1/2006	7/1/2006	---	---	---
Missouri	2/26/2004	Pre-1992 to 8/28/2007	---	8/28/2007	---	---	---
Montana	Pre-1992	---	---	4/27/2009	---	---	---
Nebraska	1/1/2007	---	---	---	---	---	---
Nevada	10/1/1995	---	---	---	10/1/2007	---	---
New Hampshire	Pre-1992	---	---	11/13/2011	1/1/2000	1/1/2000	---
New Jersey	---	Pre-1992	---	---	8/11/1994	11/11/1991	1/14/2004 (DV Only)
New Mexico	1/1/2004	---	---	---	---	---	---
New York	---	Pre-1992	---	---	7/21/2008	11/1/1996	Pre-1992
North Carolina	12/1/1995	Pre-1992	---	12/1/2011	12/1/1997	12/1/2003	---
North Dakota	Pre-1992	---	8/1/2011	8/1/2007	---	---	Pre-1992
Ohio	4/8/2004	---	---	9/9/2008	---	---	---
Oklahoma	1/1/1996	---	11/1/2004*	11/1/2006	---	---	---
Oregon	Pre-1992	---	---	---	---	---	---
Pennsylvania	Pre-1992	---	---	8/29/2011	8/12/1995	5/9/2006	Pre-1992 (DV Only)
Rhode Island	---	---	---	---	7/1/2005	---	---
South Carolina	8/23/1996	---	---	---	---	---	---
South Dakota	Pre-1992	---	---	6/9/2006	---	---	3/15/2005 (DV Only)
Tennessee	10/1/1996	---	---	7/1/2006	---	---	7/1/2009 (DV Only)
Texas	1/1/1996	---	9/1/2011	5/22/2007	9/1/2001	1/1/2008	9/1/2001 (DV Only)
Utah	5/1/1995	---	---	9/1/2007	---	7/1/1995	---

Vermont	Pre-1992	---	---	3/2/1994	2/2/2001		---
Virginia	5/5/9195	---	---	---	---	7/1/1994	---
Washington	Pre-1992	---	---	---	---	7/1/1994	7/1/1994 (DV Only)
West Virginia	Pre-1992	---	---	---	6/2/98	4/14/2001	6/7/2000 (DV Only)
Wisconsin	11/1/2011	---	11/4/2011	2/28/2008	2/1/03	---	---
Wyoming	10/1/1994	---	---	---	---	---	---

Note:

*Court date made effective February 18th, 2009

** Any violent misdemeanor here refers to firearm prohibition for someone either convicted of any violent misdemeanor or someone convicted for a domestic violence misdemeanor (DV)

Table 19: List of Covariates and Outcomes

Category	Variable name	Purpose
Outcome		
State	<i>state</i>	State is text name
Year	<i>year</i>	Study period is from 1992-2015
Id	<i>id</i>	id is equivalent to state
Workplace homicides-firearm	<i>wphfr</i>	Counts of workplace homicides
State laws		
Parking lot laws	<i>pll</i>	Restricts employers' ability to ban employee firearm storage in motor vehicles
Any Violent misdemeanor	<i>violentmis</i>	Firearm possession is prohibited for people who have committed any type of violent misdemeanor
Right to carry laws	<i>rtc</i>	State issue concealed carry weapons permits on a 'shall 'issue basis or do not require a permit for an individual to carry a concealed weapon
Stand your ground law	<i>syg</i>	Stand your ground law constitute no duty to retreat to individuals who are threatened
Restraining order – domestic violence restraining order for dating partners	<i>datingpartners</i>	Domestic violence restraining orders are automatically prohibiting if the subject is a dating partner of the petitioner
Restraining order – exparte	<i>exparte</i>	Ex parte (temporary) domestic violence restraining order subjects are automatically prohibited from possessing firearms
Permit-to-purchase	<i>ptp</i>	Individuals must apply for a permit to purchase a handgun for both transfers and sales
Occupational		
Number of employed	<i>employed</i>	Number of employees, both genders
Service and sales labor force	<i>relabor</i>	Number of labor force employees participating in retail industry, both genders

female employment Percent population union representation	<i>femaleemploy union</i>	Female employment rate Percent of the population represented by union
Population data		
Poverty rate	<i>poverty</i>	Percent below federal poverty line
Population density	<i>msa</i>	Percent living in metropolitan area
Population male	<i>male</i>	Percent population male
Population white	<i>white</i>	Percent population white
Population black	<i>black</i>	Percent population black
Percent population obtained high school or more	<i>education</i>	Percent population obtained high school or more
Percent married with spouse present	<i>married</i>	Percent married with spouse present
Median income	<i>income</i>	Total median income
Violent crime data		
Aggravated assault	<i>aggassault</i>	Rates of aggravated assault
Homicide rate	<i>homicide</i>	Rates of homicide
Robbery rate	<i>robbery</i>	Robber rates
Violent crime rate	<i>violentcrime</i>	Violent crime rates
LEO expenditure	<i>leoexp</i>	State expenditure on law enforcement
Property crime rate	<i>property</i>	Property crime rates
Burglary rate	<i>burglary</i>	Burglary rates
Larceny and theft rate	<i>theft</i>	Larceny and theft rates
Motor vehicle theft rate	<i>mvctheft</i>	MV theft rate
Firearm availability	<i>firearmavail</i>	Number of firearm suicides divided by total suicides

Note: All variables indexed at the state and year level fro1992-2015.

Table 20: Variance Inflated Factor analysis for State-level Demographics

Year	Population	Female employment	Poverty	Black	Median Income	Education	White	Union	Male	Married	Retail Labor
1992	326.22	320.47	4.95	4.36	4.35	4	2.7	2.11	1.94	1.9	1.54
1993	421.26	410.46	6.01	4.53	4.09	3.94	2.1	1.59	1.39	1.79	1.43
1994	321.51	315.31	3.47	3.29	3.87	4.19	1.96	1.5	1.51	1.6	1.36
1995	285.14	281.48	4.46	2.54	3.3	4	1.88	1.61	1.69	1.78	1.45
1996	336.96	333.74	3.73	3.48	4.99	3.61	2.13	2.3	2.09	1.7	1.55
1997	382.56	378.54	4.53	3.43	3.7	3.6	2.19	2.44	2.02	1.67	1.83
1998	471.92	469.57	4.72	3.42	3.95	4.52	1.96	3.21	2.05	1.55	2.05
1999	684.93	679.83	3.38	4.06	4.49	3.68	2.15	1.66	1.84	1.42	1.57
2000	626.22	620.52	6.38	4.06	6.95	3.53	2.33	1.62	1.68	2	2.96
2001	574.6	568.24	4.69	4.46	5.4	4.12	2.57	2.29	2.47	2.38	1.94
2002	733.5	726.77	5.72	4.98	5.36	6.38	2.68	2.79	2.31	1.77	2.26
2003	835.1	825.99	7.02	4.27	6.29	6.41	2.1	2.53	2.46	1.78	2
2004	849.82	838.63	4.89	3.42	4.07	6.03	1.98	1.82	2.38	2.09	1.65
2005	675.02	662.48	6.07	3.51	5.06	5.7	1.98	2.43	2.1	2.37	1.79
2006	522.54	516.46	4.63	3.36	4.21	5.65	2.04	1.69	1.93	2.26	1.58
2007	720.69	714.45	5.3	3.58	4.07	5.49	2.4	1.62	1.82	2	1.88
2008	591.96	578.53	4.18	3.24	3.99	6.15	2.04	1.83	1.75	2.25	2
2009	461.78	454.73	4.43	3.03	3.9	4.14	2.14	1.77	2.39	2	1.8
2010	395.81	389.7	6.78	2.96	4.76	4.25	2.27	1.85	2.87	2.41	1.68
2011	489.75	481.78	4.94	3.53	4.71	4.55	2.24	2.32	2.28	4.16	1.72
2012	460.59	452.63	6.49	3.84	5.06	3.68	2.11	1.95	2.11	2.67	1.59
2013	480.17	476.16	2.41	3.46	2.79	3.57	1.99	1.67	2.04	2.15	1.68
2014	620.84	616.32	6.26	3.72	4.84	4.36	2.68	2.25	3.68	3.09	2.1
Total	12268.89	12112.79	115.44	84.53	104.2	105.55	50.62	46.85	48.8	48.79	41.41
Avg.	533.43	526.64	5.02	3.68	4.53	4.59	2.20	2.04	2.12	2.12	1.80

Table 21: Variance Inflated Factor Analysis for Violent-crime Covariates

Year	Property	Theft	Burglary	MVC Theft	Violent crime	Aggravated Assault	Robbery	Homicide
1992	4.56E+08	1.81E+08	3.78E+07	2.80E+07	946.44	329.03	203.77	7.23
1993	5.19E+08	2.05E+08	4.02E+07	2.55E+07	1432.94	527.2	286.19	7.69
1994	6.55E+08	2.69E+08	4.28E+07	3.12E+07	1522.36	576.66	278.25	7.95
1995	8.71E+08	3.68E+08	4.61E+07	4.25E+07	1207.3	416.16	260.86	6.81
1996	3.10E+08	1.28E+08	1.70E+07	1.46E+07	1621.52	547.27	338.82	9.55
1997	7.31E+08	3.15E+08	4.26E+07	3.10E+07	1124.85	447.81	185.21	4.85
1998	3.76E+08	1.61E+08	2.37E+07	1.52E+07	972.71	440.13	134.32	4.28
1999	4.17E+08	1.77E+08	2.63E+07	1.96E+07	597.22	270.53	80.42	4.99
2000	17031.17	7372.13	1105.5	808.43	624.79	277.95	90.8	5.42
2001	3.77E+08	1.56E+08	2.35E+07	2.25E+07	635.94	285.28	87.76	6.8
2002	2.81E+08	1.09E+08	2.08E+07	1.59E+07	677.98	298.94	95.82	7.26
2003	3.47E+08	1.30E+08	2.99E+07	2.14E+07	542.61	229.81	88.1	7
2004	2.25E+08	8.52E+07	1.90E+07	1.65E+07	554.28	266.46	75.6	5.85
2005	2.62E+06	975060.25	227755.61	204693.02	591.23	271.72	93.58	7.04
2006	3.46E+08	1.18E+08	3.24E+07	3.15E+07	810.05	376.97	123.95	6.26
2007	3.56E+08	1.24E+08	3.43E+07	2.67E+07	688.2	290.45	127.72	6.17
2008	2.00E+08	6.83E+07	2.33E+07	1.06E+07	559.76	223.13	113.29	6.95
2009	1.71E+08	6.11E+07	2.33E+07	6.89E+06	509.04	205.13	110.04	6.13
2010	2.09E+08	7.94E+07	2.77E+07	7.55E+06	548.51	217.89	135.37	7.15
2011	1.50E+08	6.08E+07	2.11E+07	4.12E+06	428.29	176.44	107.79	4.87
2012	1.30E+08	6.02E+07	1.61E+07	3.27E+06	345.16	145.88	75.67	3.93
2013	1.06E+08	5.22E+07	1.04E+07	2.33E+06	206.08	91.24	40.5	4.85
2014	1.61E+08	8.23E+07	1.15E+07	3.37E+06	307.19	145.81	47.13	4.8
Total	73966031	29912432	570028861.1	380435501.5	17454.45	7057.89	3180.96	143.83
Avg.	3292914.4	1304453.6	24783863.53	16540673.98	758.889	306.864	138.302	6.253

Table 22: Bivariate Analysis for Manuscript Three

Significant Variables for VIF Analysis	Beta (IRR)	P-value	Number Observations
% Population Black	0.517	0.492	1,200
% Population white	8.719	0.006	1,200
Median income	1.000	0.279	1,200
% Population with High School education or more	1.76	0.564	1,200
% Population reporting being in a Union	0.802	0.734	1,200
% Population Male	37.493	0.101	1,200
% Population Married	0.025	0.003	1,200
Size of Retail industry	1.24E-06	0.018	1,200
Homicide rate	1.11	<0.001	1,200

Note: Each bivariate model conducted separately. Each model included state and year fixed effects and a population offset of the natural log of employment

Table 23: Model Specifications, Negative Binomial Regression Models for Workplace Homicides –Theoretical population, 1992-2015

A priori variables	Model Estimates							
	1	2	3	4	5	6	7	8
<i>State-level Policies</i>								
Right-to-carry	1.413	1.354	1.337	1.346	1.342	1.329	1.330	1.319
Permit-to-purchase	0.989	0.982	0.965	0.988	0.982	0.968	0.989	0.976
Parking lot law	0.860	0.894	0.881	0.897	0.890	0.880	0.895	0.885
Stand your ground	0.985	0.961	0.956	0.959	0.934	0.932	0.929	0.927
Dating Partners	0.949	0.940	0.944	0.943	0.940	0.943	0.944	0.947
Ex-Parte	0.876	0.960	0.962	0.958	0.944	0.947	0.940	0.942
Violent Misdemeanor	1.170	1.130	1.121	1.121	1.151	1.142	1.141	1.134
<i>Violent Crime</i>								
Law Enforcement Expenditure	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Gun Availability	1.269	0.852	0.820	0.873	0.817	0.794	0.842	0.819
<i>State-level Demographics</i>								
Metropolitan statistical Area	1.616	1.898	2.006	1.944	1.752	1.844	1.799	1.877
Region	1.797	1.969	1.934	1.908	1.916	1.893	1.830	1.817
VIF and Bivariate Variables								
Homicide rate		1.101	1.100	1.099	1.098	1.098	1.095	1.095
% of Workforce in Retail			0.000			0.000		0.001
% Population White				2.395			3.402	3.052
% Population Married					0.042	0.053	0.031	0.039
AIC	5448.40	5410.26	5416.84	5414.76	5408.73	5404.68	5408.03	5404.47
BIC	5626.52	5593.47	5615.32	5603.06	5597.03	5598.07	5601.42	5602.95
Number of Observations	1199.00	1199.00	1199.00	1199.00	1199.00	1199.00	1199.00	1199.00
Log Likelihood	-2689.20	-2669.13	-2669.42	-2670.38	-2667.36	-2664.34	-2666.01	-2663.23

Note: All models include state and year fixed effects with population offset of the natural log of employment. Outcome is theoretical population.

Bold Signifies significant at P <0.05

*Value for South compared to North east is presented as Region is categorical dummy variable with Northeast as reference

Table 24: Final Model Specification Comparing Random Intercepts, Slopes, and State Fixed-effects

	Complete Case Analysis		Total Population Assumption	
	AIC	No. Observations	AIC	No. Observations
Model types				
Full Model (Random intercept + Random slope + State fixed-effects)	4397.726	822	5404.727	1200
Random Intercept Only	4598.059	822	5653.022	1200
Random Intercept + Random Slope	4530.265	822	5602.774	1200
Random Intercept + State fixed effects	4448.319	822	5455.32	1200

Note: Where else notes, models include year fixed effects, percent population married, white, living in a metropolitan statistical area, and retail labor force as a percentage of total state-year labor force, firearm policy laws, homicide rate, gun availability, law enforcement expenditure, and firearm laws; natural log and an independent correlation structure for intra-state correlation over time from, 1992 to 2015. Estimates were generated by authors using a data request from the Bureau of labor statistics' Census of fatal occupational injury data. The views expressed here do not necessarily reflect the views of the BLS. Bold indicates best model fit.

Table 25: Final Model Restricting Outlier Pearson's Residuals, for Outcome of Interest

	Complete Case Analysis (state and year indices = 822)		Total Population Assumption (state and year indices = 1,200) [^]	
	IRR	95% CI	IRR	95%CI
Outcome of interest				
Right to Carry	1.318	1.20, 1.43	1.291	1.18, 1.41

Note: Where else noted, models include state and year fixed effects, percent population married, white, living in a metropolitan statistical area, and retail labor force as a percentage of total state-year labor force, firearm policy laws, homicide rate, gun availability, and law enforcement expenditure; natural log of employment as offset, random intercepts, random policy effect of CCW laws, and an independent correlation structure for intra-state correlation over time from, 1992 to 2015. Estimates were generated by authors using a data request from the Bureau of labor statistics' Census of fatal occupational injury data. The views expressed here do not necessarily reflect the views of the BLS. Bold indicates significance at $P < 0.05$.

Figures

Figure 6: Autocorrelation Function

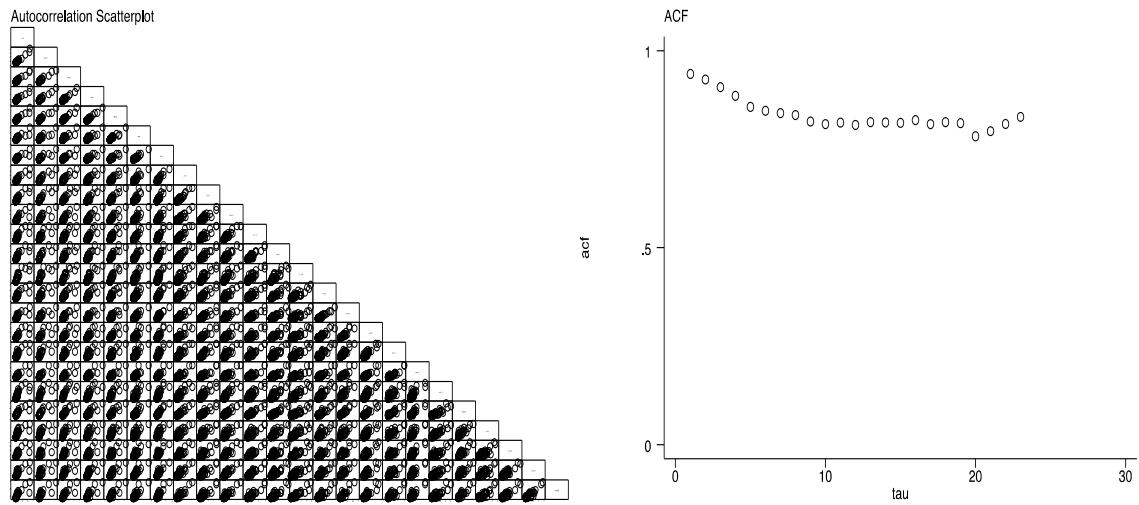


Figure 7: Pearson's Residuals for Theoretical Population Analysis, Final Model

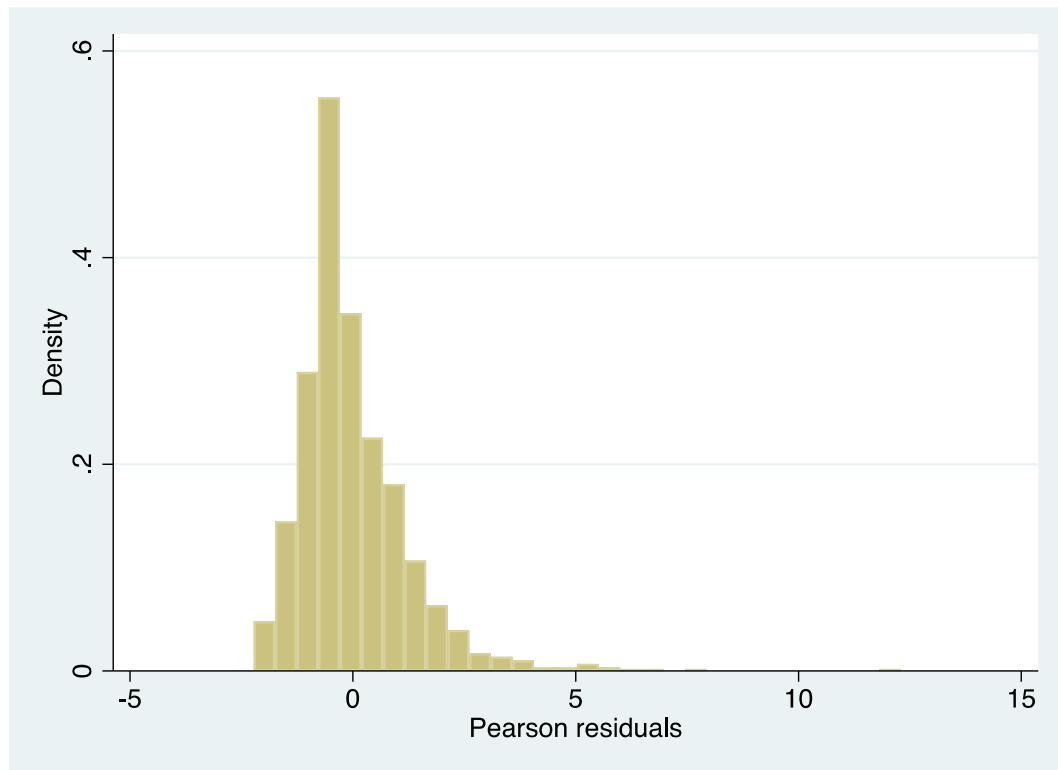
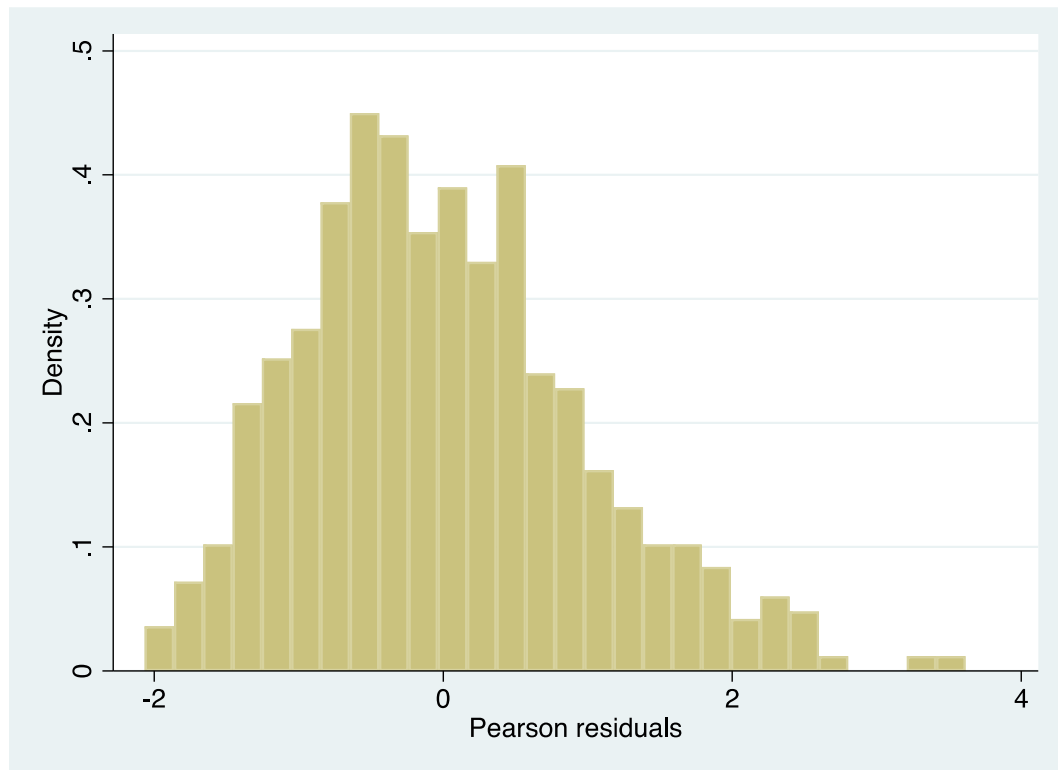


Figure 8: Pearson's Residuals for the Complete Case Analysis, Final Model



Curriculum Vitae

Mitchell L. Doucette, MS

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Baltimore, MD 21202 **Phone:** (508) 320 2796
E-mail: mdoucet3@jhu.edu

EDUCATION AND TRAINING (All categories in chronological order):

Undergraduate **BS, Public Health & Economics**
2008-2012 University of Massachusetts Amherst, Amherst, MA

Graduate **MS, Public Health**
2012-2015 University of Massachusetts Amherst, Amherst, MA
Concentration: Health Policy and Management
Department of Health Promotion and Policy
Thesis title: Examining the Implementation of a Regulation
Governing Head Injuries in High School Athletics (Sessions
Laws: Chapter 166 of the Acts of 2010): A Multiple-case
study
Advisor: Maria T. Bulzacchelli, PhD

2015-2018 **Ph.D., Health Policy and Management**
(Expected,
May) Johns Hopkins Bloomberg School of Public Health, Baltimore, MD
Concentration: Health and Public Policy
Department of Health Policy and Management
Dissertation title: Workplace Homicides: Reconsidering the
Role of Firearms
Advisor: Shannon Frattaroli, PhD, MPH

PROFESSIONAL EXPERIENCE

1/2013-
5/2013 *Graduate Research Assistant* –School of Public Health and Health
Sciences, University of Massachusetts Amherst, Amherst, MA

- Conducted systematic literature review of the impact of generic
pediatric oncology drug availability on health outcomes

2013
(summer) *Summer Intern* - Massachusetts Department of Public Health Summer
Internship

Athol, MA

- Worked with a local public health department to create a pamphlet/informational handout to reduce play-ground injuries
- Contributed to monthly public forum regarding public health activities

1/2015 –
5/2015

Graduate Research Assistant – Department of Health Promotion and Policy, School of Public Health and Health Sciences, University of Massachusetts Amherst, Amherst, MA

- Conducted a systematic literature review examining risk factors associated with drugged driving
- Designed a survey-based cross-sectional study examining risk factors associated with drugged driving among a diverse sample of young adults, age 18-30
- Drafted, edited, and submitted IRB application for above project

5/2015 –
9/2015

Study Coordinator – Department of Health Promotion and Policy, School of Public Health and Health Sciences, University of Massachusetts Amherst, Amherst, MA

- Lead data collection effort for a project examining prevalence of and risk factors related-to driving and riding after recent marijuana use
- Inputted, cleaned, and prepared survey data for analysis
- Conducted survey analysis in STATA using *svy* command
- Contributed to study team which authored the manuscript, “Driving and riding under the influence of recent marijuana use: Risk factors among a racially diverse sample of young adults,” To be published in the *Journal of Ethnicity in Substance Abuse*

1/1/2016 –
10/1/2016

Graduate Research Assistant – Center of Gun Policy and Research, Johns Hopkins Bloomberg School of Public Health Baltimore, MD

- Qualitatively analyzed, through thematic analysis, focus group data of firearm owners based in Texas
- Drafted manuscripts regarding firearm owners’ experience with firearm storage and transfer
- Devised a data collection strategy of employment records for the Baltimore Police Department

- Contributed to study team which authored the manuscript, “Storage Practices of U.S. Gun Owners,” published in the *American Journal of Public Health*
- 1/15/2016 -
Current
- Graduate Research Assistant* – Center of Injury Research and Policy, Johns Hopkins Bloomberg School of Public Health
Baltimore, MD
- Conducted systematic literature reviews on academic and government collaborations as well as physician use of prescription drug monitoring programs (PDMPs) for use in NIH grant applications. Conducted in-depth interviews with physicians via phone and in-person. Analyzed results for internally disseminated report
 - Designed a novel data collection strategy to examine safe storage and disposal messaging available through prescription opioid analgesics’ prescription drug labels. Extracted and analyzed data available at www.dailymed.org. Lead study team which authored the manuscript, “Storage and Disposal information for Prescription Opioids: What does our medications tell us?” under review at the academic journal, *Annals of Internal medicine*
 - Analyzed National Electronic Injury Surveillance System (NEISS) data regarding opioid-related poisons in under 5-year olds. Report for internal use
 - Conducted a state and local review of Maryland sprinkler system legislation. Manuscript is in progress
 - Performed literature review of the legal implications of using an on-site oral fluid device for the detection of marijuana intoxication. Lead study team which authored the manuscript, “Oral Fluid Testing for Marijuana Intoxication: Enhancing Objectivity for Roadside DUI Testing,” published in the academic journal, *Injury Prevention*
- 1/1/2017 –
9/1/2017
- Program manager* – Maryland Department of Health and Mental Hygiene, Violence and Injury Prevention Program
Baltimore, MD
- Developed 5-year evaluation plan for a CDC funded core-State Violence and Injury Prevention Program (Maryland)
 - Created and distributed a process-evaluation survey for an intervention aimed at reducing sexual assault on college campuses (*Brining in the bystander*). Analyzed results of a

process-evaluation survey and produced internal and external memo of results

- Developed legislative 2-pager regarding policy landscape of firearm violence prevention policies in Maryland as well as epidemiology of firearm violence in Maryland. Document used internally for review
- Editorially contributed to an informational fact sheet related to child abuse and neglect used by upper management to allocate funds for fiscal year 2018.
- Oversaw a team of three students

5/15/2017-
Current

Graduate Research Assistant –Johnathon Ehsani, PhD, Johns Hopkins
Bloomberg School of Public Health
Baltimore, MD

- Created research plan for evaluating an intervention for increasing practice driving diversity among new drivers.
- Drafted, edited, and submitted, IRB proposal for project titled, “Supervised Practice Driver Logbook Study.” Funded by the Urban Institute of health. Study is a prospective cohort study examining the effect of a mobile application on supervised practice driving for teenager learning to drive and their parents.

Peer Review

American Journal of Public Health
Injury Prevention
Injury Epidemiology
Accident Analysis

PUBLICATIONS

Peer-reviewed Original Research

Gillum TL, **Doucette M**, Mwanza M, Munala L. Exploring Kenyan Women's Perceptions of Intimate Partner Violence. *Journal of interpersonal violence*. 2016 Jan 6. Epub ahead of print.

Doucette, M. L., Bulzacchelli T. M., Gillum, T. L., Whitehill, J. M. The Massachusetts School Sports Concussions Law: A Qualitative study of Local Implementation Experiences. 2016, *Journal of Law, Medicine, and Ethics*, 44; 503-513

Doucette, M. L., Frattaroli, S., Vernick, J.S. Oral Fluid Testing for Marijuana Intoxication: Enhancing Objectivity for Roadside DUI Testing. 2017, *Injury Prevention*, Published Online First: 01 June 2017

Crifasi, C.K., **Doucette, M.L.,** McGinty, E.E., Webster, D.W, Barry, C.L. Storage Practices of U.S. Gun Owners. *American Journal of Public Health*. (In press)

Whitehill JM, Rodriguez-Monguio R, **Doucette M,** Flom EA. Driving and riding under the influence of recent marijuana use: Risk factors among a racially diverse sample of young adults. *Journal of Ethnicity in Substance Abuse*. (In Press)

Doucette, M.L., Frattaroli, S., Haring, R. S., Shields, W. S. Storage and Disposal Information for Prescription Opioids: What Does our Medication Tells Us? *Annals of Internal Medicine*. (In Press)

PRESENTATIONS

Scientific Meetings

Doucette, M. L., Bulzacchelli T. M., Gillum, L. T., Whitehill, M. J. Local Implementation of a Massachusetts Regulation Governing Head Injuries in High School Athletics: A Multiple-Case Study. American Public Health Association October-November 2015 Annual Meeting Proceedings. (*Oral Presentation*)

Whitehill, J.M., Rodriguez-Monuiio, R., **Doucette, M.L.,** Flom, E. Driving and riding after recent marijuana use: Prevalence and risk factors among a diverse sample of young adults. Poster Presentation – American Public Health Association October-November 2016 Annual Meeting Proceedings. (*Poster Presentation*)

Doucette, M. L., Crifasi, C., Frattaroli, S. Measuring the effect of changes in Parking Lot Laws on Workplace firearm Homicides: A longitudinal analysis. American Public Health Association November 2017 Annual Meeting Proceedings. (*Poster Presentation*)

Doucette, M. L., Frattaroli, S., Bulzacchelli, M., T., Pollack, K. How do we protect out workers from firearm violence? A systematic review. American Public Health Association November 2017 Annual Meeting Proceedings. (*Poster Presentation*)

Doucette, M. L., Frattaroli, S. Dispossessing firearms from domestic violence perpetrators: Does it matter for workplace intimate partner homicides? Society

for the Advance of Injury and Violence Research—6th National conference, September 18-20, 2017. (*Poster Presentation*)

Crifasi, C., **Doucette, M. L.**, Webster D., McGinty, B. Storage Practices of U.S. Gun Owners. American Public Health Association November 2017 Annual Meeting Proceedings. (*Oral Presentation*)

Invited Lectures

Doucette, M. L. Oral Fluid Testing for Marijuana Intoxication: Enhancing Objectivity for Roadside DUI Testing. The Johns Hopkins' Graduate Seminar in Injury Research and Policy: Current Issues in Driving Policy and Research; February, 20th 2017

Doucette, M.L. Firearm-related Homicides at Work: Current research and Policy Implications. The Johns Hopkins' Graduate Seminar in Injury Research and Policy: Occupational Health and Safety; November 20th, 2017

GRANTS/FELLOWSHIPS

9/1/15 – Current	Traineeship in Occupational Injury Epidemiology Johns Hopkins Education and Research Center for Occupational Safety and Health
9/1/2015 – 8/31/2016	The Nancy R. Robertson Scholarship in Injury Prevention
1/1/2017- 5/31/2017	Measuring the Effect of Parking Lot Laws on Workplace Homicides: A Longitudinal Analysis Role: Student PI Source: National Institute for Occupational Safety and Health, Education and Research Center, Pilot Project Research Training Award
9/1/2017 – 5/31/2018	The Nancy R. Robertson Scholarship in Injury Prevention
9/1/2017 – 5/31/2018	The William Haddon Jr Fellowship in Injury Prevention

TEACHING EXPERIENCE:

Fall semester, 2013- Spring semester, 2015	Lead Teaching Assistant - School of Public Health and Health Sciences, University of Massachusetts Amherst, Amherst, MA Course Title: <i>“Introduction to Public Health: Health Care for All”</i> Instructor: Michael Begay, PhD
Spring semester, 5/2015	Teaching Assistant - School of Public Health and Health Sciences, University of Massachusetts Amherst, Amherst, MA Course Title: <i>“Public Health Capstone”</i> Instructor: Jennifer M. Whitehill, PhD
Term 1, 2016 & Term 1, 2017	Teaching Assistant – Department of Health Policy and Management The Bloomberg School of Public Health Course Title: <i>“Issues in Injury and Violence Prevention”</i> Instructor: Jon S. Vernick, JD, MPH
Term 2, 2016 & Term 2, 2017	Teaching Assistant – Department of Health Policy and Management The Bloomberg School of Public Health Course Title: <i>“Formulating Policy: Strategies and Systems of Policymaking in the 21st Century (Section 01)”</i> Instructor: Shannon Frattaroli, PhD, MPH
Term 2, 2016 & Term 2, 2017	Teaching Assistant – Department of Health Policy and Management The Bloomberg School of Public Health Course Title: <i>“Formulating Policy: Strategies and Systems of Policymaking in the 21st Century (Section 02)”</i> Instructor: Shannon Frattaroli, PhD, MPH
Term 2, 2016	Teaching Assistant– Department of Health Policy and Management The Bloomberg School of Public Health Course Title: <i>“Graduate Seminar in Injury Prevention: Occupational Health and Safety”</i> Instructor: Cassandra K. Crifasi, PhD, MPH
Term 3, 2017	Teaching Assistant – Department of Health Policy and Management

The Bloomberg School of Public Health
 Course Title: “*Public Health and the Law*”
 Instructors: Jon S. Vernick, JD, MPH and Lanie Rutkow, JD,
 PhD, MPH

Term 3, 2017
 Term 3, 2018

Teaching Assistant – Department of Health Policy and
 Management
 The Bloomberg School of Public Health
 Course Title: “*Graduate Seminar in Injury Prevention:
 Motor Vehicle Safety*”
 Instructors: Jonathan Ehsani, PhD, MPH and Vanya Jones, PhD

Lecturer

2013 (Summer)

Summer Instructor & Curriculum Developer - Pioneer Valley
 Area Health Education Center, Springfield, MA
 Course Title: Bioethics in Public health

PROFESSIONAL ACTIVITIES:

2015- Present

American Public Health Association (APHA) - Student
 Member

2016-2017

Honors and Awards, Chair
 Student Coordinating Committee

2017-Present

Society for Advancement of Violence and Injury
 Research (SAVIR) – Student Member