

Effects of Policies Designed to Keep Firearms from High-Risk Individuals

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Abstract

This article summarizes and critiques available evidence from studies published between 1999 and August 2014 on the effects of policies designed to keep firearms from high-risk individuals in the United States. Some prohibitions for high-risk individuals (e.g., those under domestic violence restraining orders, violent misdemeanants) and procedures for checking for more types of prohibiting conditions are associated with lower rates of violence. Certain laws intended to prevent prohibited persons from accessing firearms—rigorous permit-to-purchase, comprehensive background checks, strong regulation and oversight of gun dealers, and requiring gun owners to promptly report lost or stolen firearms—are negatively associated with the diversion of guns to criminals. Future research is needed to examine whether these laws curtail nonlethal gun violence and whether the effects of expanding prohibiting conditions for firearm possession are modified by the presence of policies to prevent diversion.

INTRODUCTION

The United States has an unusually high homicide rate for a high-income country—nearly six times higher than average. This discrepancy is observed only for homicides committed by firearms, for which the rate in the United States is nearly 20 times higher than the average of other high-income countries (32). Yet the United States is about average in its rate of nonfatal violent crime and aggressive behavior that do not involve firearms (18).

This disparity suggests that the availability of firearms in the United States, which is far greater than that in other high-income nations, plays an important role in the unusually high US homicide rate. Perhaps even more importantly, the United States stands out in terms of its relatively low standards for legal gun ownership and the weakness of its laws designed to prevent proscribed individuals from accessing firearms.

Many topics concerning guns in American society are contentious. These include whether widespread gun ownership serves on balance as a protection against violent crime or contributes to more violence, whether certain types of guns should be banned, and whether we should restrict legal gun owners from carrying guns—concealed or openly—in public. Yet, there is widespread support for policies designed to prevent high-risk individuals (e.g., felons, persons who are subject to a restraining order for domestic violence, individuals with serious mental illnesses) from having firearms (4). This support exists among gun owners and nonowners alike and across the spectrum of political party identification (4).

Given the lethal capacity of firearms (61) and evidence that access to firearms significantly increases risk of violence among individuals with a history of violence and criminality (8), policies designed to keep firearms from dangerous persons seem logical and have the potential to reduce violence, particularly lethal violence. The fact that a policy is logical or widely supported, of course, does not mean that it is effective or just. Sufficiently motivated and resourceful criminals could circumvent laws designed to prevent their access to firearms in a nation where gun ownership is widespread. Furthermore, firearm sales regulations could, theoretically, have harmful effects on public safety if their primary impact is to depress firearm acquisition among individuals who are at low risk for criminal misuse or suicide and who might incur safety benefits from having a firearm.

In 2005, Hahn et al. published a comprehensive review of studies on the effects of firearm laws that were published between 1979 and March 2001, which concluded that there was insufficient evidence to determine the effects of restricting firearm access for members of high-risk groups (17). More than a decade later, does this judgment stand? The current review summarizes and critiques the available evidence from studies published between 1999 and August 2014 on the effects of policies designed to keep firearms from high-risk individuals in the United States. It suggests directions for future research, given that the evidence currently available has shortcomings.

The impact of such policies is likely to be a function of two factors: how broadly policies identify and disqualify individuals at greatest risk for committing gun violence and how effective the policies are in preventing firearms from being diverted to prohibited individuals or to the underground market where criminals often acquire firearms. Thus, we have organized this review to consider, first, prohibitions for high-risk individuals, then, accountability measures to prevent guns from being diverted to prohibited persons, and finally, studies that simultaneously address both prohibitions for high-risk individuals and diversion prevention.

PROHIBITING CONDITIONS FOR FIREARM PURCHASE AND POSSESSION IN THE UNITED STATES

Federal law has established the following conditions, among others, that bar an individual from legal purchase or possession of a firearm: being convicted of any felony or a misdemeanor crime of

domestic violence; being subject to a final domestic violence restraining order; being a fugitive from justice; being adjudicated as mentally defective or involuntarily committed to a mental institution; and being addicted to or an unlawful user of controlled substances. Federal law also establishes 18 years as the minimum legal age for possessing a handgun and 21 years for purchasing a handgun from a federally licensed firearm dealer (persons ages 18–20 may purchase handguns from private parties, however).

Although each of the prohibiting conditions under federal law is defensible, in that the affected population is at elevated risk for committing violence, available evidence indicates that they would not disqualify the majority of individuals who commit gun violence. For example, in the 13 states with standards for legal gun ownership that essentially mirror or are in some cases weaker, than those set under federal law, only 40% of offenders imprisoned for crimes committed with a firearm were prohibited from possessing the type of gun they used to commit crimes (42). In these states and in many others, individuals who are under 21 years of age, who have committed serious crimes that were adjudicated in juvenile courts, or who have been convicted of misdemeanor crimes involving violence, firearms, drugs, or alcohol abuse can legally purchase and possess firearms.

Most states do have additional prohibiting conditions or stricter standards for legal gun ownership than are mandated under federal law. Many states have extended firearm prohibitions for persons subject to restraining orders for domestic violence to cover those involving dating partners and temporary restraining orders. Convictions for misdemeanor crimes of violence, extending beyond domestic partners, lead to firearm prohibitions in a few states, as can multiple convictions for alcohol-related offenses occurring within a span of 1–5 years. Most states now have temporary firearm prohibitions for individuals who committed serious crimes adjudicated in juvenile courts. Twelve states and the District of Columbia have established 21 as the minimum legal age for purchasing a handgun, even if the seller is not a licensed dealer (24).

Evidence on the Effects of Prohibiting Firearm Possession by High-Risk Individuals

Most of the available literature consists of cross-sectional or longitudinal studies of association. They have been conducted with widely varying degrees of attention to factors besides the policies under study that could have produced the observed effects. Few have incorporated any assessment of whether the policies were actively enforced. In fairness, doing so is often difficult or impossible.

Vigdor & Mercy published two studies to estimate the effects of laws designed to disarm perpetrators of domestic violence on rates of intimate partner homicides (IPHs) (40, 41). We focus on the more recent of these studies because it includes the most data, covering the years 1982 through 2002 for 46 states with complete data. The authors used state and year fixed effects and a broad range of covariates to estimate average treatment effects for 12 state laws disqualifying persons convicted of misdemeanor domestic battery from purchasing firearms, 21 state laws with domestic violence restraining order (DVRO) firearm restrictions, and 15 state laws authorizing or mandating firearm confiscation by police responding to domestic violence calls. The existence of any DVRO firearm prohibition was associated with an 8% reduction in IPH rates, and the seven state DVRO laws that prohibited both firearm purchase and possession were associated with a 10% reduction in IPH rates. Importantly, protective effects of these laws were evident only when states had sufficient records in criminal history databases used for background checks.

To rule out the possibility that DVRO firearm laws were confounded by other measures to reduce violent crime that could be affecting IPHs, Vigdor & Mercy examined whether the laws were associated with changes in stranger homicides and other measures of nonfatal violent crime,

and they found no such association. In contrast with the findings for DVRO restrictions, neither domestic violence misdemeanor prohibitions nor laws allowing or mandating police confiscation of firearms from the scenes of domestic violence incidents were associated with changes in IPH rates.

Zeoli & Webster used the same study design to examine the same set of gun laws but used city-level data for the 46 largest US cities (60). Importantly, this study controlled for other policies that were associated with reductions in IPHs. Similar to the findings from Vigdor & Mercy, DVRO firearm restrictions were associated with a 19% reduction in IPH rates, but no effects were associated with domestic violence misdemeanor restrictions or firearm confiscation laws.

One challenge to developing valid estimates of the effects of laws establishing prohibiting conditions for firearm possession is the absence of data on whether an offender had the prohibiting condition targeted by the laws under study. A few studies are exceptions. Using data from two cohorts in California that attempted to purchase a handgun from a licensed firearm dealer, Wright et al. (59) estimated the effects of denying felons the ability to legally purchase firearms: 2,470 individuals who had one or more prior felony arrests but no felony convictions were approved for purchase, and 170 were denied when attempting to purchase handguns due to prior felony convictions (59). After controlling for prior criminal history, age, sex, and race, those who were approved to purchase a handgun were 21% more likely to be subsequently arrested for a crime involving a gun [relative risk (RR) = 1.21, 95% confidence interval (CI) 1.08–1.36] and 24% more likely to be arrested for a violent crime (RR = 1.24, 95% CI 1.11–1.39) than would have been expected had their attempt to purchase a handgun been denied based on felons' likelihood of reoffense. Of course, these findings likely suffer from selection bias and may not generalize to the larger population of felons. Felons who attempt to purchase handguns from licensed firearm dealers may have fewer connections with suppliers in underground markets than is the case for most felons and therefore may be a lower risk for violent offending.

In 1991, a California law went into effect that extended firearm prohibitions to persons convicted of misdemeanor crimes of violence. Wintemute and colleagues collected criminal history data on a retrospective, population-based cohort of persons younger than 35 years of age who sought to purchase a handgun in California in 1991 but were denied as a result of this new disqualification (57). To estimate the effect of the law, investigators contrasted criminal offending in the newly denied cohort with that of a comparison group of persons younger than 35 years of age who had been convicted of a violent misdemeanor during the 10 years prior to legally purchasing handguns in California in 1989 or 1990, just before the new law went into effect. After adjusting for differences in age, sex, and prior criminal history, those approved for handgun purchases prior to the new law were 29% more likely to be arrested for new gun and/or violent crimes during the three years following the attempted purchase than were persons denied from purchasing a handgun based on the new law (relative hazard = 1.29, 95% CI 1.04–1.60). As would be expected if handgun purchase denial, and not some other factor, had reduced violent offending, investigators saw no difference between the groups in their risk for new offenses that did not involve firearms or violence.

Marvel (26) examined the effects of state laws that prohibited juveniles (ages <18 years of age) from possessing handguns on juveniles' involvement in homicides as victims and arrestees during 1970–1999. Juvenile handgun prohibitions were unrelated to juvenile involvement in homicides in regression analyses. Many of the juvenile handgun prohibitions were enacted during the early 1990s, a time when juvenile homicide rates were peaking after surging in the late 1980s and just before a steep decline in juvenile homicides from 1994 to 1999. These dramatic changes in juvenile homicides were believed to be driven by forces that were difficult to measure (e.g., changes in drug markets, gang involvement, changes in social norms) (5) and were likely to be uneven across the

50 states (1). Marvel's attempt to account for social forces that were not directly measured and that were unique to each state (state-specific linear terms to control for very nonlinear changes) was likely to be inadequate to avoid biases from omitted variables. Even if Marvel's null findings are valid, they may not be surprising. Risks that juveniles face when carrying handguns may not have changed significantly with the passage of juvenile handgun prohibitions. Prior to such prohibitions, juveniles could still be charged with possessing a gun outside the home without a permit to carry a concealed firearm.

Using state-level data for 50 states and the District of Columbia for the period 1979–1998, Rosengart and colleagues (33) estimated the effects of state laws that set age 21 as the minimum age for legal purchase and possession of a handgun on homicide and suicide victimization for victims under age 20. Handgun purchase and possession prohibitions for individuals under age 21 were not associated with risks for firearm-related homicides and suicides. The authors noted two limitations of the study, which may partly explain the null findings: First, only three purchase laws and one possession law had at least five years of postamendment enactment data, which limits the statistical power of the study; and second, the models are based on the assumption that the effect of each law was immediate and constant when more gradual effects may be more realistic.

Laws restricting firearm access by individuals deemed to be a threat to others or to themselves as a result of a serious mental illness have been in place for many decades. But the first rigorous study of the effects of such policies on violence was published in 2013. Swanson and colleagues obtained data for more than 23,000 individuals hospitalized in Connecticut for schizophrenia, bipolar disorder, or major depressive disorder during an eight-year period (2002–2009) and merged these records with criminal justice records for violent crime convictions. Roughly 40% of this group was found to be disqualified from legally purchasing or possessing firearms in Connecticut due to mental health adjudication, criminal offense, or both. Regression analysis, which controlled for individual risk factors, found that having a firearm-disqualifying condition was associated with a 60% increased odds of violent offending [odds ratio (OR) = 1.60, 95% CI 1.52–1.68]. However, having a disqualifying mental health condition during the period when the state was submitting relevant records to the FBI's National Instant Check System (NICS) was associated with a reduced likelihood of violent offending by a factor of 0.69 (OR = 0.69, 95% CI 0.57–0.82).

FIREARM SALES ACCOUNTABILITY POLICIES DESIGNED TO PREVENT DIVERSION OF GUNS TO PROHIBITED PERSONS

Federal Firearm Laws

Laws prohibiting firearm sales to and possession by high-risk persons may have limited impact on violence without complementary laws and regulations that provide sufficiently strong deterrents to illegal firearm transfers. The Federal Firearms Act of 1938 and the Gun Control Act (GCA) of 1968 created a rudimentary structure for accountability in the firearm industry by requiring those in the business of selling firearms to obtain a federal firearm license and by limiting interstate sales of firearms to federal firearm licensees (FFLs) (62). The GCA required firearms manufactured in or imported into the United States to have serial numbers imprinted on them and imposed record-keeping requirements that would allow law enforcement to trace firearm transfers involving licensed manufacturers, wholesalers, retailers, and retail purchasers. The GCA required individuals purchasing firearms from FFLs to sign a form stating that they were not convicted felons or otherwise disqualified under federal law. Prohibited individuals could be prosecuted for “lying and buying,” but gun dealers had no obligation to verify that a purchaser was not proscribed from possessing firearms. Under the GCA, firearm transfers by private gun owners are not regulated,

although the GCA made it a crime to transfer a firearm to someone known to be proscribed from possessing firearms (e.g., a felon).

The Brady Handgun Violence Prevention Act of 1994 mandated background checks to determine whether individuals seeking to purchase firearms from licensed gun dealers were prohibited from possessing firearms. During the initial or interim phase of the law's implementation, the background check requirement applied only to sales of handguns and included a five-day waiting period between a purchase application and delivery to approved purchasers. In December 1998, the law was fully implemented for all firearms, but the five-day waiting period was replaced with the NICS. From 1994 through 2010, NICS received more than 118 million firearm purchase applications, and 2.1 million of those requests were denied either by the FBI or by state or local law enforcement agencies processing the applications (16).

The Firearm Owners Protection Act (FOPA) was signed into federal law in 1986. The provisions of this law substantially weakened the GCA by raising the legal standard for prosecuting gun dealers who violated firearm sales laws. Prosecutors had the burden of proving not only that a violation had occurred, but that the violation was willful. Penalties for firearm sales laws violations were reduced, and law compliance inspections of licensed firearm dealers were limited. This high standard for taking legal action against licensed firearm dealers makes it easier for scofflaw or negligent gun dealers to divert or allow the diversion of large numbers of guns to criminals without incurring corrective action. Separate provisions of the FOPA raised the bar for classifying someone as "in the business of selling firearms" and thus facilitated the unregulated sale of firearms by private parties who sell a large number of firearms without a formal business. These sales proceed in most states with purchasers remaining anonymous, without background checks, and/or without record keeping. The FOPA also specifically prohibited the federal government from establishing a registry of firearm purchasers. This limitation materially affects the ability of the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) to trace firearm sales using the records of out-of-business firearm dealers.

The FOPA is not the only federal policy that has reduced retailer accountability that might otherwise prevent the diversion of guns to prohibited persons. Congress passed an amendment to an appropriations bill in 2003 that exempted the ATF's crime gun trace data from Freedom of Information Act requests, whether from public agencies or from researchers. These Tiahrt Amendments, so known in reference to their sponsor Representative Todd Tiahrt (Republican from Kansas), also mandated that information from the FBI's background checks for gun purchasers be destroyed within 24 hours of the check's completion and prevented the ATF from requiring firearm dealers to perform physical inventories during compliance audits. Provisions added to the law in subsequent years prohibited the subpoena of the ATF's crime gun trace data for use in local or state license revocations, civil lawsuits, or other administrative proceedings unless filed by the ATF.

Prior to the passage of this legislation, researchers used data from the ATF tracing of firearms recovered by police from criminals and crime scenes and made the startling finding that 1% of licensed firearm dealers accounted for more than half of the crime guns traced by the ATF in the late 1990s (36). This concentration of crime gun sales among a small number of retailers persisted even when firearm sales volume was taken into account. For these retailers, crime gun sales were not just frequent; they were disproportionate (56). In some instances, the names of gun dealers connected with the most crime guns were released to the public (28). Cities highly affected by firearm violence began to rely on the crime gun trace data to identify gun dealers to target for undercover stings and lawsuits (51).

The Protection of Lawful Commerce in Arms Act (PLCAA) was enacted in 2005 in response to lawsuits brought against gun dealers and manufacturers on the basis of claims that, among

other things, negligent sales practices by licensed firearm dealers were enabling criminals to arm themselves and contributing to gun violence. The PCLAA protected gun makers and retailers against lawsuits “resulting from the criminal or unlawful misuse of a qualified product by the person or a third party.” Numerous lawsuits brought against the firearm industry were dismissed on the basis of the PCLAA (38).

Evidence on Federal Firearm Laws’ Ability to Prevent Diversions to Criminals and to Reduce Violence

Considerable evidence has demonstrated that criminals and firearm traffickers regularly exploit weaknesses in federal firearm laws. A 43-state survey of licensed retailers selling at least 50 firearms annually estimated that these retailers experienced 33,800 attempted surrogate (straw) purchases, and 37,000 attempted undocumented purchases, per year (54).

The most commonly discussed weakness is the Brady Act’s exemption of background checks and record keeping for firearm transfers by private gun owners. This omission hinders the ability of law enforcement to hold a gun owner accountable if he or she transfers a firearm to someone who is prohibited from owning guns. Nearly 8 out of 10 gun crime offenders participating in a national survey of state prison inmates conducted in 2004 reported that they obtained their guns from a friend, family member, or the underground gun market (50).

Firearm transactions between strangers without background checks or record keeping can be observed directly at gun shows in states that do not close the Brady Act loophole for private gun sales (52). Some unlicensed vendors at these events sell a substantial number of firearms such that it appears to be more of a livelihood than a hobby (53). It is important to emphasize that gun shows make up a small portion of the secondary gun market.

In fact, the importance of the private-seller exemption to the Brady Law in providing criminals and gun traffickers relatively low-risk access to firearms and customers is best exemplified by the enormous growth in Internet sites established to facilitate firearm sales (27). The number of guns for sale by a private seller on the popular website Armslist.com (<http://www.armslist.com>) grew more than sixfold (from 12,294 to 83,204) over a 20-month period from December 2011 to August 2013. New York City officials contracted with an investigative firm to call 125 private sellers of firearms identified on ten websites to see if they would sell their firearms when the caller said that he/she “probably couldn’t pass a background check.” Sixty-two percent verbally agreed to sell the firearm anyway (9). Certainly, actual criminals are using the Internet and lax or absent regulation of sales by private sellers to obtain their guns (53).

Ludwig & Cook estimated the effects of the first phase of the Brady Act using data from 1985 through 1997 with a difference-in-differences approach. They compared changes in homicide and suicide rates following the Brady Act between the 32 states directly affected by the law (Brady states) with changes in those outcomes for the 18 states that had preexisting state background check requirements (non-Brady states). Although rates of firearm-involved homicides in the United States declined following the law’s implementation, differences in the reductions experienced in Brady states did not differ significantly from declines experienced in non-Brady states. There was also no overall Brady-related change in suicide rates. The authors mention several plausible reasons for the null findings: (a) The law exempted sales by private gun owners; (b) many homicide offenders do not meet any of the disqualifying conditions prior to offense and therefore are not affected by the law (11); and (c) probably of lesser importance, records for background checks during the time period of the study were incomplete. These authors and others have also noted that the states affected by the law had been source states for guns used in crime elsewhere. Increasing restrictions in the Brady states could therefore have reduced homicides in the non-Brady states (10).

The FOPA may have introduced another important weakness. Firearm-related homicide rates increased dramatically, particularly among youth, in the years immediately following the enactment of the FOPA, fueled by the emergence of turbulent crack cocaine markets and a surge in gun carrying among youth (13). Many of the increasing number of guns recovered from youth connected to the illegal drug trade had likely been diverted from legal commerce. The effects of the FOPA on the diversion of guns to criminals and on gun violence have not been formally studied.

Some evidence indicates that federal laws governing licensed firearm dealers, principally the FOPA, hinder the ATF's ability to hold scofflaw dealers accountable. A study of 1,530 federal firearm trafficking investigations in the late 1990s found that corrupt or negligent licensed dealers were the leading channel for guns diverted to criminals, in some cases accounting for more than 10,000 guns (37). Anthony Braga, a leading researcher studying illegal gun trafficking who helped the ATF conduct this study, and Peter Gagliardi, a former ATF agent, wrote that federal prosecutors were able to charge a defendant with one of these violations in fewer than 38% of the cases involving dealing without a license and fewer than 45% of straw purchasing cases (6). This is in spite of the fact that ATF gun-trafficking investigators reported that gun dealing and record-keeping violations occurred in most cases accepted for prosecution. Braga & Gagliardi also underscored the difficulty in getting prosecutors to bring cases against scofflaw gun dealers and traffickers after the FOPA weakened penalties for violating the record-keeping laws necessary for preventing firearm diversions.

These roadblocks had important practical effects. Drawing on data from 1996 through 2000, National Economic Research Associates identified 120 licensed gun dealers, each of which had sold at least 200 crime guns for which traces provided evidence suggesting gun trafficking. There were 54,694 such guns in total. Of the 35 dealers with more than 500 traces of guns with one or more trafficking indicators, 32 were still open for business through the end of 2003 (30). Prosecutions of gun dealers are very rare, and imprisonment for gun trafficking is even rarer (2).

Standardized measurement and tracking of the diversion of guns to criminals are challenging. Researchers and gun-trafficking investigators at the ATF have routinely used crime gun trace data and indicators of trafficking or diversion. The most commonly used indicator of gun diversion has been an unusually short interval—ranging from less than 1 year to less than 3 years—between a gun's retail sale and its subsequent recovery by police from criminal suspects or crime scenes, a metric known as time-to-crime (TTC). A short TTC is considered an indicator of diversion, especially when the criminal possessor is someone different from the purchaser of record. Other indicators include the gun having originated from a retail sale in another state or having an obliterated serial number.

Kleck & Wong challenged the use of short TTC intervals and out-of-state origins as indicators of gun trafficking and argued that many of the flagged guns are likely stolen (22). Braga and colleagues refute these claims and defend the use of short TTC and out-of-state origins as indicators of illegal gun diversion (7). Concerns about biased results from selective tracing of crime guns can also be minimized by limiting analyses to jurisdictions and times where comprehensive gun-tracing policies are in place.

A case study from Milwaukee, Wisconsin, suggests that public transparency with crime gun trace data could encourage greater vigilance by gun dealers to prevent gun diversion and that the Tiahrt Amendments may reduce incentives for gun dealers to prevent diversions. Working with pre-Tiahrt trace data obtained from the ATF and post-Tiahrt data supplied by Milwaukee Police Department, Webster and colleagues analyzed trends in the number of crime guns deemed likely to have been diverted that were recovered by police between 1996 and 2006 (48). In May 1999, it was publicly reported that a local gun shop, Badger Guns and Ammo, had sold more guns later

traced to crime than had any other gun store in the nation. Within days of this release, the gun store's owners announced voluntary measures to reduce the likelihood that the guns sold by the store would get into the hands of criminals. During the months just following this announcement, the number of guns sold by the store that were subsequently recovered within a year of sale by police from someone other than the purchaser of record dropped abruptly by 77% with minimal replacement by other dealers (46). But the implementation of the Tiahrt Amendments in 2003 was associated with a 200% increase in short sale-to-crime guns sold by the gun store in question, with no comparable increase for other gun dealers (46).

Law enforcement–researcher partnerships should examine whether the Tiahrt Amendments had similar effects in other US cities and whether the effects are muted in states that have their own laws for gun dealer regulation that are notably tougher than federal laws. Prior studies have shown that lawsuits brought against gun dealers facilitating blatantly illegal straw purchases significantly reduced the diversion of guns to criminals (45, 51). Now that the threat of lawsuits against gun dealers is likely to have been reduced by the PLCAA, research should examine whether gun diversions shortly following retail sales have increased.

Effects of State Gun Laws on the Diversion of Guns to Criminals and Criminal Access to Guns

The weakness in federal gun laws described above and summarized previously by Braga & Gagliardi (10) underscores the importance of studying the effects of state laws governing firearm sales. Seventeen states require individuals in the business of selling firearms to obtain licenses from state or local law enforcement agencies. Only 12 of these states and the District of Columbia also allow law enforcement to inspect gun dealers' records, however, which is a minimum requirement for firearm sales law compliance oversight (39). The number of states that have a more comprehensive set of laws and enforcement practices to promote accountability by federally licensed firearm dealers—licensing, record-keeping requirements, allowing audits of records, mandatory prompt reporting of firearm theft or loss, and conducting regular compliance audits—is dwindling to a handful (47).

Seventeen states and the District of Columbia have some requirement in place to regulate private sales of handguns, including mandatory purchaser background checks. Thirteen of these states have some form of permit-to-purchase (PTP) policies for handguns; however, these systems vary greatly in ways that are likely to affect their ability to curtail gun diversions and reduce violence. Two states allow permit seekers to apply through the mail or online, whereas all but one of the others require in-person applications with applicants being photographed and fingerprinted. Permits to purchase are valid for as long as 10 years in Illinois and Maryland and for as short as 10 days in Massachusetts and Michigan. Several states that issue permits that are valid for longer time periods have separate presale requirements for background checks, which is important because a significant percentage of those who pass a background check and purchase firearms legally become prohibited within a few years (58). Three states (Massachusetts, New Jersey, and New York) allow local law enforcement agencies issuing the permits to use discretion and to deny an applicant who does not have any explicitly stated disqualifying conditions (20).

State laws governing background check processes for firearm purchasers also differ with respect to the records that are checked. All states check the NICS; however, 19 states process background checks by state or local law enforcement agencies, which can access additional records kept by those agencies that may not be available in the NICS. The types and number of records that are available and used for background checks for firearm transfers also vary considerably across states and over time (34).

Beginning in the late 1990s, the ATF developed a Youth Crime Gun Interdiction Initiative (YCGII) to promote comprehensive crime gun tracing in cities around the United States and the use of the data in understanding and combating illegal gun trafficking (35). About 70% of crime gun traces are for guns that originated from a retail sale in the same state in which the gun was recovered in crime. A much lower than average share of crime guns that originated from within-state retail sales suggests that the state is preventing diversions to criminals. Webster et al. analyzed crime gun trace data from the first 25 YCGII cities to examine associations between a state's gun sales regulations and the proportion of its crime guns that originated from retail sales within the state (49). The share of crime guns that originated from in-state retail sales in states with both PTP policies and handgun registration was, on average, 37 percentage points lower relative to the comparison states lacking either policy, after controlling for differences in gun ownership, proximity to population centers in other states, the prevalence of guns recovered from drug arrests (because illegal drugs and guns travel together across state lines), and in-state migration.

In a recent national study, this combination of policies, along with a comprehensive background check requirement, was also associated with fewer crime guns having a short TTC. Pierce and colleagues (31) categorized California separately because its policies for regulating firearm sales are at least as rigorous as those in many states with PTP laws. The number of short TTC (<3 years) traced crime guns bought in state per 100,000 gun owners was four times higher in states that lacked PTP or handgun registration than in California or states that had both policies. These differences between crime gun sales rates and across these gun sales law categories were even more pronounced for guns diverted to criminals across state lines (31).

Economists have examined the flow of guns purchased in one state and recovered following their use in crime in another state as a function of the difference in the stringency of gun laws in the source (exporting) state and the destination (importing) state, while controlling for other factors. Using a simple additive index of 10 gun laws identified by Mayors Against Illegal Guns as important to preventing gun trafficking,¹ Knight (23) found that weaker gun laws in source states increased the export of crime guns, and stronger gun laws in destination states increased the import of crime guns. Firearm use in crime, as measured by the percentage of robberies committed with a firearm, increased in states with relatively strong gun laws when nearby states had relatively weak gun laws. Most strongly associated with preventing the export of crime guns were laws requiring gun owners to promptly report lost or stolen firearms to law enforcement, those that provided local discretion to adopt gun laws stronger than those adopted at the state level (much of this effect may be due to Chicago's longtime ban of handguns), and state statutes specifically prohibiting straw purchases (23).

Kahane (21) conducted a study using much of the data and theoretical underpinnings as Knight did but incorporated measures relevant to the demand for guns by criminals within a state (e.g., gang members and police per capita). His findings were similar to Knight's on measures of the relative strength of gun laws in aggregate. With respect to the effects of specific laws, both studies found strong protective effects of mandatory theft and loss reporting. But Kahane's findings differed from Knight's because he did not find that local discretion to regulate gun sales was protective against exporting crime guns and did find that laws requiring background checks for

¹The state laws examined established criminal violations for straw purchases, falsifying information on purchase applications, and firearms dealers failure to conduct background checks for firearm transfers; required background checks for all private handgun transfers or for all firearms transferred at gun shows, PTPs for handguns, and mandatory prompt reporting of lost or stolen firearms to law enforcement; allowed law enforcement inspections of firearms dealers; prohibited gun possession for violent misdemeanants; and allowed law enforcement discretion in issuing permits for concealed carry of firearms.

sales by private gun owners and allowing law enforcement discretion in issuing permits to carry concealed firearms were protective (21).

Webster and colleagues (50) studied state differences in exporting guns to criminals in other states and found that PTP laws for handguns, when law enforcement retained discretion to deny applications if deemed to be in the interest of public safety, were strongly associated with lower per capita exporting of crime guns. Nondiscretionary PTP laws that required purchasers to be fingerprinted, other requirements for background checks for private sales, mandatory reporting of theft or loss of firearms, and junk gun bans were also independently associated with fewer guns exported per capita. These analyses controlled for gun ownership, proximity to states with stronger gun laws, borders with Canada or Mexico, and out-of-state migration (50).

In another study, researchers used data from crime gun traces from 2000 to 2002 in 54 US cities with comprehensive crime gun trace policies to examine associations between the number of guns likely diverted (TTC <1 year and the criminal possessor of the gun was not the purchaser of record) and gun sales laws. Strong gun dealer regulations and oversight, required purchaser background checks for handgun sales by private owners, and PTP laws with law enforcement discretion were each independently associated with fewer diversions to criminals. Discretionary PTP laws were not independently associated with levels of gun diversions when gun ownership levels were controlled for (48).

Findings from these studies are generally consistent with economic theories relevant to regulation and market forces (12, 34, 35). Comprehensive regulations that should promote firearm seller and purchaser accountability—rigorous PTP systems, comprehensive background checks, and mandatory theft and loss reporting—appear to curtail diversions of guns to criminals, but they also lead to criminals importing guns from states with weaker gun laws. States with the strongest gun sales regulations experienced reduced availability of guns for criminal use, despite the influx of guns from other states where regulations were weaker (49).

These findings suggest that the real price of guns for criminals in states with the strongest gun laws is elevated by these states' gun policies and that criminals' demand for guns is at least somewhat elastic. This conclusion is consistent with data from an in-depth study of Chicago's underground gun market prior to the city's handgun ban being overturned by the US Supreme Court. While thousands of guns are recovered by the Chicago Police Department each year, those guns are recovered from a small fraction of the city's 2.7 million population, and a survey of adult arrestees found that only 1 in 5 male arrestees—44% of whom reported current or past gang membership—reported ever owning a handgun (12). Through hundreds of interviews with a broad range of actors in the underground economy in a high-crime Chicago neighborhood, researchers found that trusted suppliers of firearms were in short supply, and gang leaders rationed gun access among their members. There were substantial transaction costs (search time, risk encountered connecting with a supplier or purchaser), and prices paid for typically low-quality handguns were twice as high as would be found in advertisements for private sales in states with weaker gun laws than those in Illinois.

Effects on Violence of Laws Designed to Prevent the Diversion of Guns to Prohibited Persons

There are few rigorous studies of the effects of US gun policies designed to prevent the diversion of guns to prohibited persons. Most published research has examined associations between the presence of various state gun policies and rates of homicide or other violent crimes after controlling for numerous potential confounders. Most studies, however, do not estimate policy effects on the basis of changes in outcomes following changes in policy using fixed effects regression models.

Because the most relevant gun laws (e.g., PTP handgun laws, gun dealer regulations, comprehensive background checks) have changed very little for decades, the studies are principally cross-sectional.

For example, in a state-level panel study, Irvin et al. examined the association between state laws and regulations governing firearm dealers and firearm homicide rates (19). Although the data examined spanned 1995–2010, the policies did not change over the study period. Regression analyses controlled for social and demographic characteristics, gun ownership, rates of burglaries and drug crimes (trends in these crimes would not be expected to be affected directly by firearm policies), and a global scale of gun law restrictiveness. State licensing requirements and laws requiring or allowing inspections or audits of gun dealers were independently associated with significantly lower firearm homicide rates, and these two policies combined were associated with firearm homicide rates that were 51% lower than would be expected without the policies. Although a measure of the strictness of gun laws was included in the regression models, it is likely that this factor would not completely control for confounding with the most important gun laws (e.g., PTP handgun laws, comprehensive background checks) that are correlated with gun dealer regulations.

Fleegler and colleagues analyzed the association between state firearm laws—measured as quintiles along an overall gun law strength scale developed by the Brady Campaign to Prevent Gun Violence—and firearm mortality using annual data for the years 2007–2010 (15). Poisson regression analyses controlled for population composition by age, race/ethnicity, sex, poverty, unemployment, educational attainment, population density, and rates of nonfirearm homicide and nonfirearm suicide. Compared with states in the lowest quintile on gun regulations, states in the highest quintile had firearm homicide and firearm suicide rates roughly 40% lower than would be predicted. But the only single category of gun laws that was significantly associated with firearm homicide and firearm suicide rates was for laws strengthening background checks. This subscale was weighted mostly by the presence and strength of PTP handgun laws. In addition, almost all the observed effect was on firearm suicide, though the laws under study were directed at interpersonal violence.

Independent effects of the total firearm regulation score were eliminated when the regression analyses controlled for gun ownership levels. Fleegler and colleagues interpret the findings to indicate that firearm regulation effects on firearm homicide and suicide were mediated by the laws depressing population gun ownership. But interpreting cross-sectional associations between gun laws, gun ownership, and firearm violence is difficult (55). Population gun ownership levels affect the probability of certain gun laws being enacted and few gun laws are designed, or are likely, to have significant effects on population gun ownership (discretionary PTP laws are a likely exception). Thus, the absence of firearm regulations' associations with firearm homicide and firearm suicide when gun ownership was controlled for could mean that gun ownership levels affect firearm homicide and suicide rates, and gun laws provide no protective benefits and are only spuriously associated with lower firearm mortality. This and other flaws in the Fleegler study leave much uncertainty about the utility of its findings (55).

Moorhouse & Wanner examined associations between the restrictiveness of a state's gun laws in 1998 and crime rates in 1999 and 2001 (29). Although the policies were measured prior to the outcomes, this study examined cross-sectional associations rather than changes in crime in response to changes in policies. Using similar covariates as did Fleegler et al. but adding per capita income, arrest rates, and average sentences for criminal convictions, but not controlling for gun ownership, Moorhouse & Wanner report no association between the Open Society Institute's global score for each state's gun laws and any of the violent crimes examined (murder, rape, robbery, assaults).

The reasons for the discrepant findings between the report by Fleegler et al. and the report by Moorhouse & Wanner [and similar prior studies finding no associations between gun control and violent crime (14, 25)] are not obvious. Here we focus on differences between the outcome measures and how gun regulations were measured. Moorhouse & Wanner examined violent crimes that, all but murder, typically do not involve use of a firearm. In contrast, Fleegler et al. and Irvin et al. focused exclusively on lethal violence committed with firearms. It is not surprising that outcomes that exclusively measure firearm violence would be more closely correlated with firearm policies than would outcomes where most incidents do not involve a firearm.

The measures of gun policies used in each study are also problematic. These studies and many others used scales purporting to measure the restrictiveness of gun laws. These scales generally reflect the political priorities of gun control advocates rather than a scientifically valid measure of a construct. The scales are often not weighted to reflect the size of the effect each element is expected to have. Furthermore, using such a blunt measure does not allow researchers to examine whether the effectiveness of certain policies (e.g., prohibitions for violent misdemeanants) depends on the presence of other policies (e.g., comprehensive background checks). For example, an index made up of 20 largely ineffective policies and 3 effective policies is likely to produce null findings. Findings from global measures of gun laws also prevent inferences about the effects of any single policy.

One of the stronger studies to consider both the type and the breadth of disqualifications for firearm possession as well as the strength of regulations designed to prevent transfers to prohibited persons is Andres & Hempstead's study of the effects of state gun policies on suicide rates for males (3).² In a 50-state panel study covering 1995–2004, they found that an index of behavioral (versus criminal) prohibitions relevant to risk for suicide (e.g., restrictions for mental illness, domestic violence, alcohol and drug convictions) and a measure that combined PTP requirements and minimum purchase age 21 were each associated with lower suicide rates. There was no association between criminal prohibitions and suicides. These analyses controlled for social and economic variables, alcohol consumption, and a proxy for firearm ownership. The researchers used state and year fixed effects to control for time-invariant omitted variables specific to states and omitted variables over time nationally.

Although there has been relatively little change in key state policies designed to prevent guns from being diverted to prohibited persons in recent decades, there have been some expansions to prohibiting conditions and improvements in the databases used to determine firearm purchaser eligibility. Sen & Panjapirrom examined state-level associations between variations in the types of records for prohibiting conditions that were accessed for pre-gun-sale background checks and firearm deaths for the period 1996–2005 (39). Analyses controlled for changes in population demographics, poverty, unemployment, divorce, hunting licenses (a proxy for gun ownership), alcohol consumption, whether a state required background checks prior to the Brady Act, year and region fixed effects, and a lagged value of the outcome variable for 1990. More extensive background checks were associated with lower rates of homicide overall, firearm homicide, and firearm suicide. Expanded checks for domestic violence restraining orders, fugitive status, and mental illness disqualifiers were each independently associated with lower rates of firearm homicides and all homicides. Expanded checks for mental illness disqualifications and fugitive status were each associated with lower rates of firearm suicides and all suicides. The magnitude of the estimated effects was greatest among outcomes for firearm homicide. The size of these estimated effects, however, seems questionably large. For example, restraining order laws are principally

²The analyses were limited to males because the vast majority of firearm suicides are by males.

applicable to domestic violence, which accounts for less than 10% of murders, yet background checks for restraining orders were associated with a 13% lower risk for firearm homicides. The study's exclusive focus on categories of background checks without controlling for other policies is likely to have inflated estimates of the effects of background checks.

For the research reviewed above, the type of firearm policy most consistently associated with curtailing the diversion of guns to criminals and for which some evidence indicates protective effects against gun violence is PTP for handguns. Most states with PTP laws have had them in place for many decades. The most recent change was Missouri's 2007 repeal of its PTP handgun law. Webster et al. studied the effects of this policy on lethal violence with a 50-state panel study using data for the period 1999–2012 (43). Regression analyses controlled for state and year fixed effects and changes in unemployment, poverty, policing levels, incarceration, burglary rates (as a general measure of crime), and policies concerning the ease of getting concealed weapons permits, junk gun bans, and so-called "Stand Your Ground" laws. Homicide rates based on vital records and murder rates based on police reports showed diverging trends immediately following the PTP repeal; rates rose sharply in Missouri but declined in the rest of the nation. Missouri's PTP repeal was associated with a 14% increase in murder rates over 5 years following the policy change and a 25% increase in firearm homicide rates. Additional evidence bolstered causal inference between the policy change and increased murders: (a) Increases in firearm homicide rates were widespread and relatively even across metropolitan counties in the state (ruling out the possibility that the increase was due to some change in one large jurisdiction); (b) there was no policy-related change in nonfirearm homicides; and (c) there was a twofold increase in short TTC guns and a relatively large shift from out-of-state sources of crime guns to within-state crime guns immediately following the repeal.

CONCLUSION

The weaknesses in US federal firearm policies are well documented and result in many high-risk individuals having access to and using firearms to commit violent crimes. Roughly half or more of those who commit gun crimes do not meet any of the prohibiting conditions under federal law. Weak federal laws and declining resources for federal gun law enforcement limit the ATF's ability to curtail illegal firearm trafficking. The enactment of the Brady Handgun Violence Prevention Act was a step in the direction of increased accountability to prevent prohibited persons from obtaining firearms, but it did not have a significant impact on population homicide or suicide rates during the first four years it was in place. Yet on a more micro level, it appears that criminals who attempt to purchase firearms from licensed gun dealers and are denied are less likely to engage in violent crime. Expansions in the types of background checks performed may also have protective effects against lethal violence. Some expansions in the conditions that disqualify someone from legally possessing firearms—restraining orders for domestic violence and convictions for misdemeanor crimes of violence—seem to reduce violence. Others (e.g., minimum age for purchase or possession of handguns, misdemeanors for domestic violence) have not influenced violent crime.

Mounting evidence indicates that certain laws intended to increase the accountability of firearm sellers to avoid risky transfers of firearms are effective in curtailing the diversion of guns to criminals, in particular the more rigorous PTP handgun laws, comprehensive background checks, strong regulation and oversight of gun dealers, and laws requiring gun owners to promptly report lost or stolen firearms. Evidence that lower levels of guns being diverted to criminals will translate into less gun violence is less robust, but it appears that rigorous PTP handgun laws are protective against homicides and suicides. Future research should examine whether these laws also curtail nonlethal gun violence. Laws mandating comprehensive background check requirements

for firearm purchasers through means other than PTP laws should be studied with respect to both their enforcement as well as their impact on violence. Such studies should consider the effects of complementary policies such as penalties for failure to comply with firearm sales laws, explicit prohibitions on straw purchases, and mandatory loss and theft reporting. Finally, it is surprising that prior studies have not systematically examined if and how policy effects are modified by the presence of other policies. For example, the impact of a law expanding firearm prohibitions to violent misdemeanants may depend on whether the state has a robust system of laws in place to prevent diversions. Similarly, the impact of antidiversion laws such as comprehensive background checks should depend on the breadth of the prohibitions for high-risk individuals. Given the importance of gun violence to public safety in the United States, greater investment in and commitment to rigorous research are needed to answer these and other important questions relevant to the prevention of gun violence.

DISCLOSURE STATEMENT

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LITERATURE CITED

1. Abhay A, Donohue JJ III, Zhang A. 2011. The impact of right-to-carry laws and the NRC report: lessons for the empirical evaluation of law and policy. *Am. Law Econ. Rev.* 13:565–632
2. Am. for Gun Saf. Found. 2004. *Selling Crime: A Handful of Gun Stores Fuel Criminals*. Washington, DC: Am. For Gun Saf. Found.
3. Andres AR, Hempstead K. 2011. Gun control and suicide: the impact of state firearm regulations in the United States, 1995–2004. *Health Policy* 101:95–103
4. Barry CL, McGinty EE, Vernick JS, Webster DW. 2013. After Newtown—public opinion on gun policy and mental illness. *N. Engl. J. Med.* 368:1077–81
5. Blumstein A, Wallman J, eds. 2006. *The Crime Drop in America*. Cambridge, UK: Cambridge Univ. Press. Revis. ed.
6. Braga AA, Gagliardi PL. 2013. Enforcing federal laws against firearms traffickers: raising operational effectiveness by lowering enforcement obstacles. See Ref. 44, pp. 143–56
7. Braga AA, Wintemute GJ, Pierce GL, Cook PJ, Ridgeway G. 2012. Interpreting the empirical evidence on illegal gun market dynamics. *J. Urban Health* 89:779–93
8. Campbell JC, Webster DW, Koziol-McLain J, Block C, Campbell D, et al. 2003. Risk factors for femicide in abusive relationships: results from a multisite case control study. *Am. J. Public Health* 93:1089–97
9. City of N.Y. 2011. *Point, Click, Fire: An Investigation of Illegal Online Gun Sales*. New York: City of N.Y. <http://on.nyc.gov/tYPRrF>
10. Cook PJ, Ludwig J. 2013. The limited impact of the Brady Act: evaluation and implications. See Ref. 44, pp. 21–32
11. Cook PJ, Ludwig J, Braga AA. 2005. Criminal records of homicide offenders. *JAMA* 294:598–601
12. Cook PJ, Ludwig J, Venkatesh S, Braga AA. 2007. Underground gun markets. *Econ. J.* 117:F588–618
13. Cork D. 1999. Examining time-space interaction in city-level homicide data: crack markets and the diffusion of guns to youth. *J. Quant. Criminol.* 15:379–406
14. Dezee MR. 1983. Gun control legislation: impact and ideology. *Law Policy Q.* 5:367–79
15. Fleegler EW, Lee LK, Monuteaux MC, Hemenway D, Mannix R. 2013. Firearm legislation and firearm-related fatalities in the United States. *JAMA Intern. Med.* 173:732–40
16. Frandsen RJ, Naglich D, Lauer GA, Lee AD. 2013. *Background checks for firearm transfers, 2010—statistical tables*. NCJ 238226, Feb. Bur. Justice Stat., Off. Justice Progr., U.S. Dep. Justice, Washington, DC
17. Hahn RA, Bilukha O, Crosby A, Fullilove MT, Liberman A, et al., Task Force on Community Prev. Serv. 2005. Firearms laws and the reduction of violence: a systematic review. *Am. J. Prev. Med.* 28(2S1):40–64

18. Hemenway D. 2006. *Private Guns, Public Health*. Ann Arbor: Univ. Mich. Press
19. Irvin N, Rhodes K, Cheney R, Wiebe D. 2014. Evaluating the effects of state regulation of federally licensed firearms dealers on firearm homicide. *Am. J. Public Health* 104:1384–86
20. Johns Hopkins Cent. Gun Policy Res. 2013. *Permit-to-purchase licensing for handguns*. Fact Sheet, Johns Hopkins Bloomberg Sch. Public Health, Baltimore, Md. http://www.jhsph.edu/research/centers-and-institutes/johns-hopkins-center-for-gun-policy-and-research/publications/FactSheet_PermittoPurchaseLicensing.pdf
21. Kahane LH. 2013. Understanding the interstate export of crime guns: a gravity model approach. *Contemp. Econ. Policy* 31:618–34
22. Kleck G, Wang SYK. 2009. The myth of big-time gun trafficking and the overinterpretation of gun tracing data. *UCLA Law Rev.* 56:1233–94
23. Knight B. 2013. State gun policy and cross-state externalities: evidence from crime gun tracing. *Am. Econ. J. Econ. Policy* 5:200–29
24. Law Center to Prevent Gun Violence. 2013. *Categories of prohibited people policy summary*. Posted Sept. 29. Law Cent. Prevent Gun Violence, San Francisco. <http://smartgunlaws.org/prohibited-people-gun-purchaser-policy-summary/>
25. Magaddino JP, Medoff MH. 1984. An empirical analysis of federal and state firearm control laws. In *Firearms and Violence: Issues of Public Policy*, ed. DB Kates Jr., pp. 225–58. Cambridge, MA: Ballinger
26. Marvel TB. 2001. The impact of banning juvenile gun possession. *J. Law Econ.* 44:691–713
27. Mayors Against Illegal Guns. 2013. *Felon Seeks Firearm: No Strings Attached. How Dangerous People Evade Background Checks and Buy Illegal Firearms Online*. Washington, DC: Mayors Against Illegal Guns
28. McBride J. 1999. Local store leads U.S. in ‘crime guns.’ *Milwaukee Journal Sentinel* May 9. <http://www.jsonline.com/news/may99/0509gun.asp>
29. Moorhouse JC, Wanner B. 2006. Does gun control reduce crime or does crime increase gun control? *CATO J.* 26:103–24
30. *Natl. Econ. Res. Assoc. Natl. Assoc. Adv. Colored People v. Acusport et al.* 99 CV 399 (JBW) and 99 CV 7037 (JBW), US Dist. Court for the East. Dist. of N.Y. (testimony of Lucy Allen)
31. Pierce G, Braga A, Wintemute G, Dolliver M. 2013. *New approaches to understanding and regulating primary and secondary illegal firearms*. Report prepared for the Natl. Inst. Justice, 2007-IJ-CX-0030, Washington, DC
32. Richardson EG, Hemenway D. 2011. Homicide, suicide, an unintentional firearm fatality: comparing the United States with other high-income countries. *J. Trauma Inj. Infect. Crit. Care* 70:238–43
33. Rosengart M, Cummings P, Nathens A, Heagerty P, Maier R, Rivara F. 2005. An evaluation of state firearm regulations and homicide and suicide death rates. *Inj. Prev.* 11:77–83
34. Sen B, Panjamapirom A. 2012. State background checks for gun purchase and firearm deaths: an exploratory study. *Prev. Med.* 55:346–50
35. U.S. Bur. Alcohol, Tob. Firearms. 1999. *Youth Crime Gun Interdiction Initiative. Crime Gun Trace Analysis Reports: The Illegal Youth Firearms Market in Seattle*. Washington, DC: U.S. Dep. Treas.
36. U.S. Bur. Alcohol, Tob. Firearms. 2000. *Commerce in Firearms in the United States*. Washington, DC: U.S. Dep. Treas.
37. U.S. Bur. Alcohol, Tob. Firearms. 2000. *Following the Gun: Enforcing Federal Laws Against Firearms Trafficking*. Washington, DC: U.S. Dep. Treas.
38. Vernick JS, Rutkow L, Salmon DA. 2007. Availability of litigation as a public health tool for firearm injury prevention: comparison of guns, vaccines, and motor vehicles. *Am. J. Public Health* 97:1991–97
39. Vernick JS, Webster DW, Bulzacchelli MT, Mair JS. 2006. Regulation of firearm dealers in the United States: an analysis of state law and opportunities for improvement. *J. Law Med. Ethics* 765–75
40. Vigdor ER, Mercy JA. 2003. Disarming batterers: the impact of laws restricting access to firearms by domestic violence offenders. In *Evaluating Gun Policy: Effects on Crime and Violence*, ed. J Ludwig, PJ Cook, pp. 157–204. Washington, DC: Brookings Inst.
41. Vigdor ER, Mercy JA. 2006. Do laws restricting access to firearms by domestic violence offenders prevent intimate partner homicides? *Eval. Rev.* 30:313–46
42. Vittes KA, Vernick JS, Webster DW. 2013. Legal status and source of offenders’ firearms in states with the least stringent criteria for gun ownership. *Inj. Prev.* 19:26–31

43. Webster DW, Crifasi CK, Vernick JS. 2014. Effects of the repeal of Missouri's handgun purchaser licensing law on homicides. *J. Urban Health* 91:293–302. Erratum: *J. Urban Health* 91:598–601
44. Webster DW, Vernick JS, eds. 2013. *Reducing Gun Violence in America: Informing Policy with Evidence and Analysis*. Baltimore, MD: Johns Hopkins Univ. Press
45. Webster DW, Vernick JS. 2013. Spurring responsible firearms sales practices through litigation: the impact of New York City's lawsuits against gun dealers on interstate gun trafficking. See Ref. 44, pp. 123–32
46. Webster DW, Vernick JS, Bulzacchelli MT. 2006. Effects of a gun dealer's change in sales practices on the supply of guns to criminals. *J. Urban Health* 83:778–87
47. Webster DW, Vernick JS, Bulzacchelli MT. 2009. Effects of state-level firearm seller accountability policies on firearms trafficking. *J. Urban Health* 86:525–37
48. Webster DW, Vernick JS, Bulzacchelli MT, Vittes KA. 2012. Recent federal gun laws, gun dealer accountability and the diversion of guns to criminals in Milwaukee. *J. Urban Health* 89:87–97
49. Webster DW, Vernick JS, Hepburn LM. 2001. The relationship between licensing, registration and other state gun sales laws and the source state of crime guns. *Inj. Prev.* 7:184–89
50. Webster DW, Vernick JS, McGinty EE, Alcorn T. 2013. Preventing the diversion of guns to criminals through effective firearm sales laws. See Ref. 44, pp. 109–22
51. Webster DW, Zeoli AM, Bulzacchelli MT, Vernick JS. 2006. Effects of police stings of gun dealers on the supply of new guns to criminals. *Inj. Prev.* 12:225–30
52. Wintemute GJ. 2007. Gun shows across a multistate American gun market: observational evidence of the effects of regulatory policies. *Inj. Prev.* 13:150–56
53. Wintemute GJ. 2009. *Inside Gun Shows: What Goes on When Everybody Thinks Nobody's Watching*. Sacramento, CA: Violence Prev. Res. Progr.
54. Wintemute GJ. 2013. Frequency of and responses to illegal activity related to commerce in firearms: findings from the Firearms Licensee Survey. *Inj. Prev.* 19:412–20
55. Wintemute GJ. 2013. Responding to the crisis of firearm violence in the United States: comment on "Firearm Legislation and Firearm-Related Fatalities in the United States." *JAMA Intern. Med.* 173:740–42
56. Wintemute GJ, Cook PJ, Wright MA. 2005. Risk factors among handgun retailers for frequent and disproportionate sales of guns used in violent and firearm-related crimes. *Inj. Prev.* 11:357–63
57. Wintemute GJ, Wright MA, Drake C, Beaumont JJ. 2001. Subsequent criminal activity among violent misdemeanants who seek to purchase handguns. *JAMA* 285:1019–26
58. Wright MA, Wintemute GJ. 2010. Felonious or violent criminal activity that prohibits gun ownership among prior purchasers of handguns. *J. Trauma* 87:352–64
59. Wright MA, Wintemute GJ, Rivara FP. 1999. Effectiveness of denial of handgun purchase to persons believed to be at high risk for firearm violence. *Am. J. Public Health* 89:88–90
60. Zeoli AM, Webster DW. 2010. Effects of domestic violence policies, alcohol taxes and police staffing levels on intimate partner homicide in large U.S. cities. *Inj. Prev.* 16:90–95
61. Zimring FE. 1968. Is gun control likely to reduce violent killings? *Univ. Chicago Law Rev.* 35:721–37
62. Zimring FE. 1975. Firearms and federal law: the Gun Control Act of 1938. *J. Legal Stud.* 4:133–98



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