EXAMINING THE RECIDIVISM OF FIREARM OFFENDERS USING STATE CRIMINAL HISTORY AND MORTALITY DATA

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2018

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Suggested citation: Devitt Westley, C., Kang, B., Sheridan, E., & Specker, J. (2018). *Examining the recidivism of firearm offenders using state criminal history and mortality data.* Chicago, IL: Illinois Criminal Justice Information Authority.

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Key findings

The scourge of gun violence in our streets, schools, places of worship, workplaces, and entertainment venues around the nation has created a sense of urgency to find prevention and intervention strategies. Research is scarce, however, in part due to decades-long Congressional limits on federal funding to support U.S. Center for Disease Control and Prevention research on firearm-related topics (Sofer, 2017).

This study was conducted to demonstrate the usefulness of state criminal history records for examining recidivism of specific criminal justice populations, in this case, gun offenders. Besides gathering information on repeat offending through criminal history and prison records, Illinois Criminal Justice Information Authority (ICJIA) researchers obtained state death records of deceased individuals in the study sample. These records provided detail on the cause and manner of death not available in criminal justice administrative data. Together, these findings offer relevant insights into first-time firearm-involved arrestees, their recidivism patterns and mortality rates, and inform policy and practice on the issue of guns and violence.

Study design

This research project, funded by the U.S. Department of Justice Bureau of Justice Statistics through a cooperative agreement under the State Justice Statistics grant program, was designed to examine 10-year recidivism rates of firearm offenders using state criminal history records. Researchers specifically accounted for 'incapacitation time' during the follow-up period or time away from the community during which individuals are not able to reoffend. Excluding this incapacitation time produced more precise estimates of recidivism rates (Ferrante, Loh & Maller, 2010).

Researchers also gathered incapacitation information from Illinois Department of Corrections records and mortality information from civil death certificates maintained by the Illinois Department of Public Health. Individuals records garnered from these administrative data sources were matched to the criminal history records of the study sample to determine recidivism rates over the course of 10 years, based on re-arrests, reconvictions, and re-incarcerations.

Research sample

The study sample was constructed from a pool of 379,275 unique individuals whose arrests were recorded in the state's Criminal History Records Information (CHRI) System in 2003. The study design called for identifying individuals arrested for the first time for firearm-related crimes and matching their records to those also arrested that year, but never for a firearm-related charge. Every type of charge involving a firearm was included, from use in the commission of a violent crime (36 percent of firearm charges), to illegal possession, purchase, or selling (64 percent).

Using Coarsened Exact Matching techniques, 4,323 first-time firearm-involved (FI) arrestees were matched to 4,323 non-firearm-involved (NFI) arrestees by means of 16 demographic, geographic, criminal charge, and prior criminal history criteria. This matching ensured that any differences in recidivism rates observed between the FI and NFI group could be more confidently attributed to

the presence or absence of firearm involvement, as their primary differentiating characteristic. Another 1,774 first-time firearm-involved offenders remained without a suitable matching counterpart, as they were more serious offenders than any of the remaining non-firearm involved individuals arrested in 2003. This smaller unmatched firearm-involved group (Unmatched FI group) was kept in the study to further inform recidivism patterns of first-time firearm charge arrestees. The total sample included 10,420 individuals.

Demographics

The characteristics of the firearm-involved (FI) group essentially defined the composition of the overall study sample, since their attributes were used as the match criteria. Compared to both the Illinois general population and all persons with arrest records in 2003, the study sample was highly overrepresented by males (90 percent), Blacks (54 percent), arrests from Cook County (56 percent), and teens and young adults (ages 15-24) (56 percent). The study sample also had fewer adults over the age of 35 compared to either the 2003 population of arrested persons or the general Illinois population (19 percent).

The arrest charges of the FI group also defined the composition of the entire study sample. For example, the project sample had a much higher concentration of felony arrests (71 percent) than the larger pool of 2003 arrests from which the sample was drawn (15 percent). The study sample also contained a higher proportion of accompanying charges for violent offenses (41 percent), fewer drug charges (15 percent), and considerably fewer property charges (7 percent) than all arrests recorded in CHRI for 2003.

Outcome of the initial 2003 arrest event

Overall, 43 percent of the 10,420 individuals in the study were convicted of any charge related to their 2003 arrest, with more of the FI group convicted than the NFI group (48 percent compared to 33 percent, respectively). It is important to note that at least 20 percent of the court disposition records for these arrests were missing from CHRI, so the percentage of those convicted in any group could be higher. Individuals in the smaller Unmatched FI group, who were more serious offenders, were convicted of a firearm-related charge at a higher rate than those in the matched FI group (43 percent compared to 34 percent, respectively).

Based on incarceration records, 15 percent of the entire sample was sent to prison for their 2003 arrest. The matched FI and NFI groups were incarcerated at approximately the same rate (an average of 12 percent). In contrast, the Unmatched FI group was incarcerated at a much higher rate (28 percent).

Recidivism rates

The research sample was tracked over the next 10 years through their CHRI System records. Recidivism rates were determined based on new arrests for a new offense, new conviction after an initial conviction and re-incarceration after an initial incarceration. The matched FI and NFI groups had statistically significant different recidivism rates on all three measures, with higher percentages of the FI and Unmatched FI groups recidivating than the NFI group.

The Unmatched FI group was observed to recidivate at higher rates than the matched groups for any type of offense, and at a higher rate than the matched FI group for new firearm charges specifically.

Re-arrests

Any charge

Overall, 59 percent of the entire study sample was arrested again at least once during the 10-year period studied. More of the FI group were re-arrested than the matched NFI group (67 percent compared to 41 percent. respectively), with the Unmatched FI group re-arrested at the highest proportion (81 percent).

Firearm charge

Of the 6,112 individuals re-arrested at least once, 14 percent were re-arrested for another firearm-related charge, with the two firearm-involved groups re-arrested at about the same rate – 18 percent for the matched FI group, and 21 percent for the Unmatched FI group. Of these new firearm arrests, 45 percent were for the use of a firearm in the commission of a violent offense, an increase from the 36 percent recorded for the initial 2003 arrest.

A small number (3 percent) of the matched NFI group were arrested for a firearm-related crime for the first time over the next 10 years, including about half for violent use of a firearm. Conversely, 97 percent of the matched NFI group remained gun arrest-free over the next decade.

Reconvictions

Any charge

Thirty-nine percent of the 4,476 individuals experiencing an initial conviction during the study period were convicted after another arrest, with the FI group reconvicted at twice the rate of the matched NFI group (43 percent and 20 percent, respectively). More than half of the Unmatched FI group were convicted again at least once during the follow-up period. These rates are likely undercounts, due to missing court disposition information in the CHRI System data.

Firearm charge

Of the 863 individuals initially convicted of a firearm charge, 77 percent were convicted again for a new firearm offense. Again, proportionally more of the Unmatched FI group were reconvicted (83 percent), compared to the matched FI group (74 percent). Of matched NFI individuals that were arrested for a firearm for the first time during the follow-up period (n=46), 65 percent were convicted for another firearm offense, again a lower proportion than their matched FI peers.

Re-Incarcerations

Any charges

Few individuals sampled (15 percent) were incarcerated upon conviction for their 2003 arrests. Of these 1,552 incarcerated individuals, almost half (46 percent) were incarcerated again for a new offense during the follow-up period. The rank ordering of re-incarcerations by group was consistent with the other two recidivism measures – proportionally more of the matched FI group was re-incarcerated than the matched NFI group (53 percent compared to 43 percent), with 59 percent of the Unmatched FI group re-incarcerated.

Firearm charges

It was not possible to accurately determine re-incarcerations rate for solely firearm charges, as the IDOC files contain only the most serious charge in each case; any lesser-included firearm charges would be missed in the analysis.

Summary of Recidivism Findings

For every measure of recidivism - re-arrest, re-conviction, re-incarceration - the matched FI group recidivated at a higher rate than the matched NFI group. The more seriously criminal justice-involved Unmatched FI group recidivated at the highest rate on all measures, for all types of charges, including firearm-related charges.

Figure 1 shows the recidivism rates of the three groups on each measure, over the 10-year follow-up period. The largest difference in recidivism rates between the two matched groups was the degree to which they were ever arrested again for a new charge after the initial arrest incident in 2003.

Figure 1
Summary of recidivism rates within 10 years,
by recidivism measure and group membership

Chart data:

Recidivism measure	Unmatched Firearm-Involved*	Firearm Involved-Match	Non-Firearm Involved-Match
Rearrest-any charge	81%	67%	41%
Rearrest-firearm charge	21%	18%	3%
Reconviction-any	57%	43%	20%
Reconviction-firearm	83%	74%	65%
Re-incarceration-any	59%	53%	43%

Legend:
- Unmatched Firearm-Involved*
- Firearm Involved-Match
- Non-Firearm Involved-Match
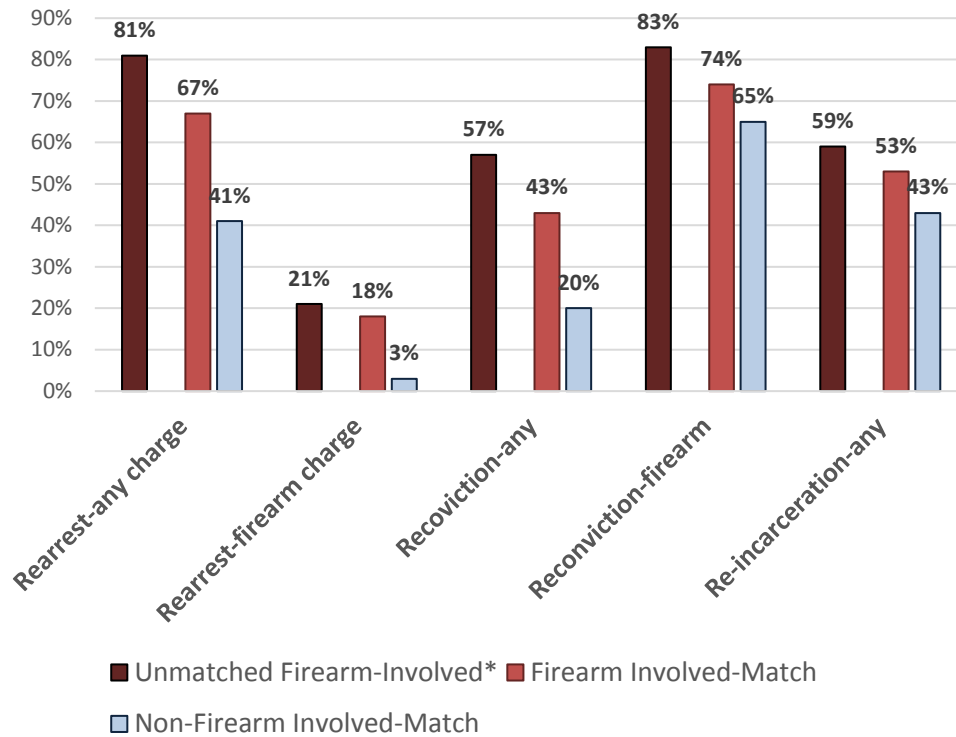
Time to First Arrest

The risk of a first re-arrest was determined using survival analysis techniques for the matched Firearm-Involved and Non-Firearm-Involved groups only. Time-to-event was defined as days from the 2003 arrest date to the end of the observation period (3,653 days, or 10 year). Here, times of incapacitation due to a prison stay and death were incorporated in the statistical models constructed for the analysis. No individual stayed in prison during the entire length of the 10-year follow-up period.

As anticipated, adding both measures of time away from the community reduced the time to the first re-arrest from an overall median of 5 years (1,852 days) to 3.6 years (1,320 days). That is, subtracting time during which the individual was not at risk of re-offending provided a more accurate picture of the pace at which a re-arrest occurred after the initial 2003 arrest incident.

Statistical tests on the resulting survival curves confirmed significant differences between the matched FI and NFI groups for both first re-arrest for any charge and first re-arrest for a firearm-related charge only. For re-arrests for any type of charge, the time to first re-arrest occurred at the same rate for both groups during the first year after the 2003 arrest incident, but continued at a faster pace for the FI group in the second and subsequent follow-up years. The first re-arrest for a firearm-related charge for a few individuals in the NFI group (n=46) occurred primarily during the first year after the initial 2003 arrest (*Figure 2*).

Figure 2
Survival curve for the first firearm arrest by group, 2003 to 2013
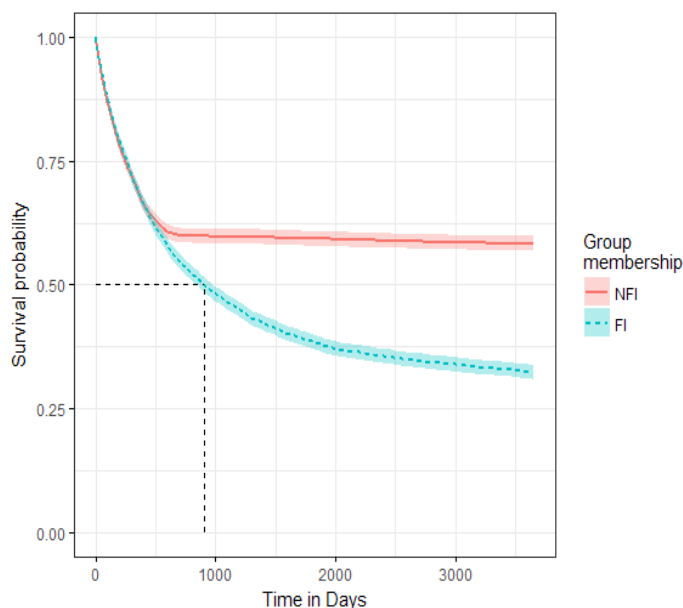
Factors associated with risk of re-arrest
Any charge

Statistical models were also fit to determine which, if any, of the demographic, geographic, and arrest charge variables available in the initial 2003 arrests records were predictive of subsequent re-arrest for any charge and firearm charges alone. For first re-arrests for any charge, the results indicated a 70-percent greater risk of re-arrest for the FI group than the NFI group. Group membership was such a strong factor that other covariates, such as being male, Black, and younger at the initial arrest added little more explanatory power regarding the different rates of recidivism between the two groups.

Firearm charge

The effect of group membership was even more evident when first re-arrest for a firearm charge was considered. The daily risk of a first firearm-related re-arrest was 800 percent higher for the matched FI group compared to the matched NFI group. Further, being male, Black, and younger at the time of initial arrest were positively correlated factors with the daily risk of a firearm re-arrest.

Interestingly, the place of initial arrest (Cook County vs. rest of the state) was not a significantly explanatory variable for the daily risk of re-arrest for either a firearm arrest charge or any arrest charge generally, notwithstanding that the study sample included proportionally more arrests from Cook County than the universe of arrests recorded in the CHRI System in 2003.

Mortality information

Death certificate records indicated that 448 individuals died during the study period, or 4 percent of the total study sample. These deceased individuals represented each of the three groups in equal proportions (an average of 4 percent of each group). Death records provided information on the cause and manner of death, information unavailable in the other criminal justice administrative datasets.

Causes of death are classified as natural (disease) and injury (non-natural). In Illinois from 2003 to 2013, unintentional accidents (including motor vehicle accidents, drug overdoses, and falls) accounted for 68 percent of all injury-related deaths, suicides accounted for 19 percent, and homicides accounted for 12 percent (WISQARS, 2015).

Individuals in the two firearm-involved groups died at a higher rate from homicide (41 percent combined) - almost exclusively by gunshot wound - than the NFI group (21 percent). Conversely, proportionally more individuals in the NFI group died from natural causes (48 percent) than the two firearm-involved groups combined (34 percent) (*Figure 3*).

Figure 3
Proportion of homicide deaths during the 10-year follow-up period,
firearm-involved groups compared to non-firearm-involved group
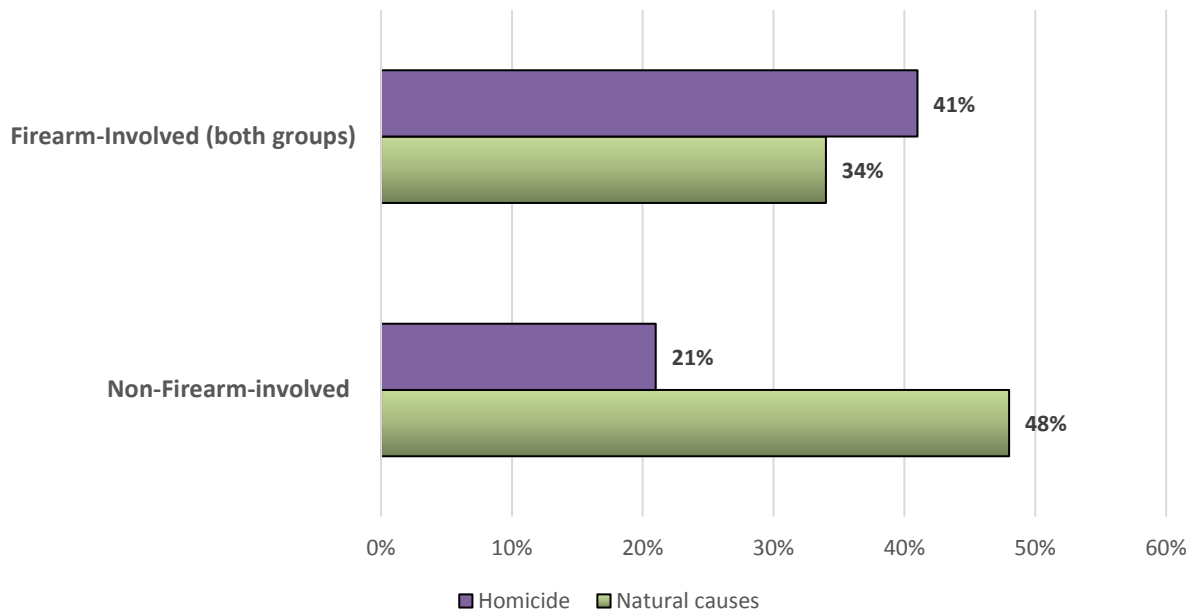
The most common age range at time of death by homicide was 15 to 24. This age group accounted for 61 percent of all deaths by homicide, followed by 25 to 34-year-olds (34 percent). In Illinois from 2003 to 2013, motor vehicle accidents were the leading cause of injury-related death among 15 to 24-year-olds, with firearm-related homicides ranked second (WISQARS, 2017). In this study of criminal justice-involved individuals, the reverse was true. Of the 15 to 24-year-olds in all three groups who died, 73 percent were killed in firearm-related homicides, and 22 percent were

involved in motor vehicle accidents.

Suicide was the least common cause of death in every group, accounting for fewer than 10 deaths per group (7 percent of all deaths). However, a firearm was involved in 80 percent of the suicides in the Unmatched Firearm-Involved group, 50 percent of the suicides in the matched Firearm-Involved group, and 36 percent of the Non-Firearm-Involved group.

Implications for policy and practice

The results of this study have implications for policy and practice regarding firearm-related crime and its consequences, as well as recommendations for further research.

Consider first-time firearm-related arrests as important predictors of recidivism and mortality risk of those arrested.

During the period studied, first arrests for gun-related offenses were highly predictive of future arrests, especially new firearm arrests. Further, this group of arrestees was at greater risk for homicidal death from a firearm than other criminal-justice involved individuals not arrested for firearm-related charges. A better understanding of the risk factors associated with initial gun involvement is needed to develop the most appropriate and effective intervention and prevention strategies. This study could not measure motivational factors for either firearm involvement or avoidance of firearms, except to document that these behaviors persisted over years. In the short term, those dealing with firearm-involved individuals should be aware that even minor initial illegal firearm involvement can signal risk of serious long-term consequences for both public safety and the involved individual, and should not be minimized as a risk factor.

Learn from the persistently non-firearm involved individuals

This study used statistical techniques that matched firearm-involved and non-firearm-involved individuals on a one-to-one basis using 16 demographic, geographic (county), arrest charge type, and prior criminal criteria. A surprising finding was the stability of the non-firearm group membership over time. That is, few, if any, of this group went on to be arrested for firearm-related charges over the next 10 years, although some became victims themselves of fatal firearm violence. This group was composed of an equal number of individuals with characteristics significantly associated with firearm recidivism (being male, Black, and at a young age at the time of arrest) (Wintermute, 2015) as the matched firearm-involved group, yet remained not involved with firearms for subsequent re-arrests. While county-level geography (Cook County vs. rest of the state) was not found to be related to recidivism in this study, other community factors not measured here, such as differences in gun availability, and gang or drug market presence, may help to explain this finding. The non-gun offenders also could possess more protective factors not measured in this study, such as better employment opportunities or access to social services. Further study of this group could produce valuable information for the development of new prevention strategies.

Apply a multidisciplinary approach to the state's social problems by leveraging agency collaboration and the capacity to match criminal history records with other data sources

In this study, researchers combined criminal history and prison records with public health data to

provide a unique perspective on firearm recidivism, an issue relevant to both criminal justice and public health systems. Success was achieved not only from a technical record matching standpoint, but from the broader perspective of a collaborative approach among the state agencies involved in this research.

Often, other agencies are not aware of the impact that criminal justice-involved sub-populations have on their specific areas of responsibility, and have no way to measure or evaluate this impact. For example, it could not be known how many of the study subjects were wounded by gun shots and hospitalized, only the number that did not survive. If hospitals and health care providers could learn of the likelihood of gunshot wound patients' future criminal justice-related incapacitation, such as imprisonment, that information could assist with more effective coordination of follow-up care, and expand knowledge about persons involved with firearms.

Success in understanding and tailoring solutions to important social issues will occur at a faster pace when policymakers bring multidisciplinary perspectives to data gathering and sharing initiatives. Currently, the state is planning the development and implementation of the new Incident-based Reporting / Uniform Crime Reporting (IBR/UCR) program (FBI, 2011) which will allow law enforcement agencies to report contextual information on each crime incident. Incorporation of information on the outcome of the incident, such as criminal justice identifiers of persons arrested for the crime, or the location of the hospital to which a victim was transported, will provide authorized users with enhanced capability to match records across systems, overcoming administrative and technical barriers to information sharing, for statewide benefit.

Conclusions

This study successfully combined CHRI records with other criminal justice and public health administrative records to improve knowledge about gun offender recidivism patterns and more precisely estimate recidivism rates. It was possible to demonstrate that, holding other characteristics constant, those facing the criminal justice system for the first time as firearm offenders persisted in criminal justice involvement for firearms at a much higher rate and for a longer period than their justice system-involved peers who were not engaged with firearms.

Finally, and most tragically, the mortality records showed that firearm-involved arrestees were themselves killed twice as often as non-firearm involved arrestees, most often because of a firearm injury. These homicide victims were predominately within the age range of 15 to 24-years old, a finding that urgently calls for implementation of prevention and intervention strategies tailored specifically to this age group to avert this premature loss of life.

Introduction

The Illinois Criminal Justice Information Authority (ICJIA) was awarded a cooperative agreement under the State Justice Statistics (SJS) Program for Statistical Analysis Centers in 2016 to build capacity for more precise estimates of recidivism using multiple data sources. ICJIA serves as a clearinghouse for criminal justice data and has electronic access to both the Illinois State Police's Illinois Criminal History Record Information (CHRI) System and Illinois Department of Corrections (IDOC) records for research purposes. These records have allowed ICJIA researchers to incorporate recidivism rate calculations in its research projects and program evaluations and to be a resource for policymakers seeking recidivism information on various justice-involved populations (Mock, et al, 2017; Reichert, et al, 2016; Boulger, et al, 2015; Bostwick, et al, 2013).

It is important to base public policy and program funding decisions on accurate analyses of offenders' re-offending behavior, particularly when measuring successful program outcomes or policy changes. This firearm study provided the opportunity to expand upon previous recidivism methodology through a critical assessment of the degree to which historically used statewide administrative data sources allow researchers to follow best practices in recidivism research. These best practices include using the appropriate measures (re-arrest, re-conviction, re-incarceration), allowing for sufficient follow-up periods, and accounting for time incapacitated away from the community during which there is little or no risk for reoffending (exposure time) (Maltz, 2001; Ferrante, Loh & Maller, 2010).

Of interest in this project was the measurement of offending exposure time, or the time during which individual is in the community and at risk for reoffending. There are many ways in which a person could be incapacitated and unable to reoffend, including incarceration, hospitalization, and death. Not accounting for time out of the community may lead to false conclusions about crime desistence. The central research question of this study was whether statewide data sources available to ICJIA researchers could be successfully linked to more precisely determine when persons were not in the community and therefore not at liberty to reoffend, and further, whether analyses of these sources would result in substantially different recidivism rates than those obtained without consideration of this time-at-risk.

While state incarceration data could provide much of the information on periods of incapacitation among persons sentenced to prison, the incapacitation of offenders for health reasons had never been systematically incorporated into ICJIA's recidivism analyses. This project afforded ICJIA researchers the opportunity to include an analysis of death records as a starting point for working with public health records of justice-involved individuals. Through a cooperative agreement with the Illinois Department of Public Health (IDPH), ICJIA researchers were granted direct electronic access to state death records for possible matching to individuals' arrest and incarceration data. Not only did these death records provide additional incapacitation information, they provided details on the cause and manner of death, information that is unavailable in other criminal justice data sources.

In keeping with a public health perspective, the study focused on a group of interest to public health officials – perpetrators of firearm violence. Public health directs its attention to the identification and prevention of significant levels of injury and death (Institute of Medicine &

National Research Council, 2013). Since the mid-2000's, homicides and suicides involving firearms have been leading causes of premature death in the nation (WISQARS, 2015). In response to the toll taken on the lives of thousands of individuals and families touched by gun violence, a Presidential Executive Order (2013) directed the Center for Disease Control to conduct and sponsor research into the causes and prevention of firearm mortality and morbidity. Recent mass shooting incidents around the country have accelerated the calls for more concerted public health attention and response to firearm violence (Branas, Flescher, et al, 2017; Surgeon General's Advisory Group on Prevention, Health Promotion, and Integrative and Public Health, 2015).

Using Illinois CHRI records as the primary data source, this study tracked the recidivism of first-time firearm offenders from 2003 to 2013 compared to a group of offenders identical in demographic and criminal history characteristics, except for being firearm involved. These study samples experienced the same criminal justice intervention of arrest and prosecution during the year 2003, after which the rapidity and severity of their subsequent criminal activity and incapacitation rates were observed in the available CHRI, IDOC, and death certificate records.

The entire spectrum of firearm-related arrest charges was considered in construction of the firearm offender cohort, both offenses related to use of a gun in the commission of violent offense and those related to the unlawful possession of a firearm. Conversely, the comparison group had no evidence of these charges in their criminal histories or their 2003 arrest charges. A smaller group of first-time firearm offenders for which a suitable firearm-uninvolved matching counterpart could not be identified were retained in the analysis. These were more serious offenders before their first firearm arrests in 2003 and analysis of their recidivism patterns could provide additional useful information for prevention and intervention efforts.

A 10-year recidivism period was utilized to maximize the likelihood of finding matches between the death certificate data and criminal history information for the study sample and maximize the observation of incapacitation effects due to lengthy prison sentences. The central research questions asked were:

- To what extent does the consideration of firearm offenders' incapacitation through incarceration or death improve recidivism estimates?
- Do the recidivism patterns of first-time firearm offenders differ from firearm-uninvolved individuals with the same demographic and criminal history characteristics?
- To what extent do first-time firearm offenders continue gun use after their initial arrest, and for how long?
- To what extent are deaths of firearm-involved individuals different in cause or manner from firearm-uninvolved individuals?

Background

Illinois firearm laws

Besides laws against using a firearm in the commission of a crime (considered a violent offense), Illinois has statutes that regulate gun possession and sale, which are considered "crimes against public order" [430 ILCS and 720 ILCS 24 et. seq.]. A person is eligible to lawfully purchase a

firearm and ammunition when issued a Firearm Owner's Identification (FOID) card by the Illinois State Police (ISP), and must have this card with them when in possession of the firearm [430 ILCS 65/2]. However, prior to 2014, even with a FOID card, it was unlawful for any person other than public safety personnel to carry an operable firearm in public or in a vehicle [720 ILCS 5/24-1(a), 4-11].

The purpose of the FOID card is to ensure that the person meets all the numerous federal and state criteria for firearm acquisition and possession [430 ILCS 65/1]. Before issuing the card, ISP must verify that the applicant has: 1) no felony conviction; 2) no documentation of narcotics addiction; 3) no in-patient admission to a mental health facility in the prior five years; 4) no documentation of intellectual disability; 6) legal immigration status; 7) is not subject to an order of protection prohibiting him or her from possessing a firearm; 8) no conviction within the past five years of battery, assault, aggravated assault, or a violation of an order of protection in which a firearm was used or possessed; 9) no conviction of domestic battery or aggravated domestic battery; 10) no delinquency adjudication for an offense that would be a felony; or (11) no mental condition that poses a clear and present danger to the applicant, any other person, or persons of the community.

ISP processed an average of 264,874 FOID applications each year between 2002 and 2011 for new or renewing applicants (Illinois.data.gov website, 2017). Each application required a check of state and federal criminal history records via the National Instant Criminal Background Check System maintained by the FBI, other Illinois law enforcement records regarding orders of protection and warrants, and mental health records supplied by other state agencies.

Criminal penalties imposed upon conviction for having a firearm without a valid FOID card range from a misdemeanor for having an expired card with no other disqualifications from renewing the card, to serious felonies for possession of a firearm without a FOID card due to not meeting the qualifications for issuance of the card enumerated above [430 ILCS 65/14].

During the period studied (prior to 2014), criminal penalties also were imposed upon conviction for carrying a firearm in public or in a vehicle. Depending on the lethality of the weapon and whether it was loaded (machine gun versus handgun, for example) and the location of the crime (school, courthouse, park, for example), the penalties could range from a misdemeanor for the first offense to the most serious Class X felony, mandating a minimum six-year prison sentence [720 ILCS 5/24 (b)].

State statutes also regulate firearm sales [720 ILCS 5/24-3, 4]. The buyer of a firearm or ammunition must present a valid FOID card and be over the age of 18. Both federal registered gun dealers and private sellers are required to verify the validity of the FOID card with ISP and must keep a register of all sales or gifts. Failure to do so carries a misdemeanor penalty.

Firearm-related recidivism

Much recidivism research conducted on the state or national level is based on examining entire groups of individuals exiting into the community in the same year from prison or onto probation (United States Sentencing Commission, 2016; Durose, et. al, 2014: Langan, & Levin, 2002). The post-release period is typically the focus of interest, often without consideration of the length of sentence served, or the length of community supervision served during the post-release

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observation period. These studies typically include all original conviction offenses and provide comparative recidivism rates for broad offense categories (violent, property, drug, etc.). Most studies distinguish between violent offenses (not all committed with a firearm) and public order weapons offenses related to illegal possession of a firearm. Further, these studies usually report on general qualifying recidivism events (re-arrest, reconviction, re-incarceration) for any type of crime, rather than narrowly focusing on re-offending with the same type of crime as the original conviction charge.

In a study on the recidivism of prisoners released in 30 states (Durose, Snyder, Cooper, 2014), at least 70 percent recidivated with any type of offense within five years. The cumulative recidivism rate for public order weapons offenders averaged 10 percent higher at each measured time interval (one year, three years, five years) than for violent offenders. Similarly, research on the recidivism of persons subject to Federal Sentencing Guidelines and released from federal prison or placed on federal probation found those sentenced for firearm possession offenses were re-arrested at the highest rates (68 percent within eight years) and at rates somewhat higher than violent offenders (64 percent) (U.S. Sentencing Commission, 2017).

A recidivism study conducted by the State of Connecticut in 2010 included prior offenses and found that prisoners with weapons-related offenses (including both violent and public order) in their criminal histories were arrested again for any type of offense at a greater rate than those without weapons-related charges in their backgrounds. This cohort was of interest to the Connecticut Board of Pardons and Paroles since weapons possession offenses are considered non-violent crimes eligible for early release options aimed at reducing prison crowding (Connecticut OMB, 2010).

Finally, a BJS study on the recidivism of those released onto probation (Markman, Durose, et al., 2016) found that the 1.5 percent of all first re-arrests by this group were for public order weapons charges. However, this study did not include public order weapons offenses as one of the original conviction charge categories. Therefore, this study, like the ones discussed above, are informative about the prevalence of weapons offenses as a recidivism charge, as well as providing information on the general recidivism rates (for any offense) of persons initially convicted of a weapons offense, but not as relevant for answering questions about specific firearm-related recidivism rates of initially firearm-involved offenders.

Other studies have focused on the onset of firearm offending to identify factors that may lead to successful prevention and intervention. Much of this research uses adolescents' self-reports regarding their criminal behavior rather than administrative criminal justice data. In a national survey of high school students, 9.4 percent of males reported carrying a gun in the past month, with a similar proportion found in both Illinois (9.2 percent) and Chicago alone (9.6 percent) (Kann, Kinchen, et. al, 2014). This percentage has not significantly decreased since 1997. Further, a common link in adolescents has been observed between drug selling, fighting in school, and gun carrying (Vaughn, et al, 2012; Steinman & Zimmerman, 2003). Consistent with early longitudinal research on the concept of career criminals (Piquero, 2003), recent studies have found significant links between early age of first arrest and later violent firearm offending, particularly among males (McClusky, McClusky & Bynum, 2006).

What little research that has been conducted on criminal specialization into adulthood has come

through work on the career criminal concept, where findings suggest that the commission of violent crimes will persist an average of 10 years after onset of the first recorded violent crime for most offenders (McDonald, et. al, 2014). However, little evidence exists for violent crime specialization other than the finding that the criminal records of frequent offenders are more likely to include a variety of offenses, including violent offenses (Piquero, 2003).

Gun availability

Another important aspect of firearm recidivism is the availability of a gun when subsequent crimes are committed. However, a Congressional ban on the creation of a national database of gun sellers and owners (Firearm Owners Protection Act of 1986 [Public Act 99-308]) strictly limits the amount of information that can be collected and shared by the U.S. Department of Justice Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) regarding gun ownership traces conducted on guns recovered in crime incidents and other circumstances. These traces are requested by law enforcement agencies to assist in determine the history of the firearm from manufacturer to last registered buyer using the serial number. Defacing that number to impede a trace or the possession of a defaced gun are felony offenses in Illinois.

Aggregate state numbers published annually by the ATF reveal that the agency traced an average of 12,000 guns in Illinois in each of the last nine years, representing 4 percent of all guns traced nationally. Approximately half of the trace requests were submitted by the Chicago Police Department. Most reasons for tracing were due to the firearm being under investigation, the illegal possession of the weapon, or a found firearm. One-third of the firearms were traced to an Illinois source, with another 10 percent traced to an Indiana source. Youth under 21 years of age accounted for an increasing percentage of those possessing the gun when it was confiscated, from 11 percent in 2013 to 14 percent in 2016, and an increasing percentage of guns had been purchased from a licensed dealer within three months of their presence at a crime scene, considered by the ATF to be an indication of gun trafficking (ATF, 2017).

For more specific detail on firearm offender gun acquisition, researchers must rely on self-report data from willing informants. In one recent study of detainees in Cook County Jail, respondents mentioned they acquired a gun through out-of-state purchases in states with more lenient gun sale laws, or from family, friends, and gang organizations. Guns were also acquired through more informal means of gun sharing or holding guns for others; theft or burglary was rarely mentioned (Cook, Parker, & Pollack, 2015). Thus, social networks are important sources of weapons, although such high-risk social networks come with added risk of members becoming gunshot victims themselves (Papachristos, Braga, & Hureau, 2012).

Firearm-related mortality and rates

The consideration of mortality becomes a significant concern when researching recidivism in populations at high risk for non-natural causes of death, since false conclusions regarding crime desistance rates are possible without that information (Laub, Sampson, & Eggleston, 2001). An abundance of research shows persons with criminal records have higher mortality rates than comparable persons without criminal records and that those with longer criminal histories (or more crimes in their criminal record) have higher mortality rates than those with shorter criminal

histories (or fewer crimes in their criminal record) (Tremblay & Paré, 2003). In terms of specific firearm offending, almost 30 percent of the Chicago homicide victims in 2016 had a prior conviction for a gun offense on their criminal record, and further, 40 percent of individuals arrested for homicide or shootings in the city had been previously arrested for a gun crime (Kapustin, et. al., 2017).

In order to quantify the actual rates of firearm-related mortality in Illinois during the 10-year period of this study (2003-2013), data from the Center for Disease Control (CDC) was analyzed for the state compared to the country. The Web-based Injury Statistics Query and Reporting System (WISQARS) data tool was used to extract data on the top 20 causes of death, and further, the top 15 causes of injury-related deaths.

WISQARS data includes firearms as a manner of death in injury-related causes of death (homicide and suicide). *Tables 1 and 2* present the totals for homicides and suicides by age groups in Illinois and the United States from 2003 to 2013. Their respective rankings for each age group can be compared to the top ranked cause of death for each age group.

As can be seen, homicides and suicides ranked just behind the top cause of death (accidents) for the young adults ages 15 to 34 both in Illinois and nationally. In addition, homicide deaths in Illinois and the United States ranked as the 15th leading cause of death for the overall population. The overall ranking for suicide deaths in the country and in Illinois ranked even higher as the 10th and 11th leading cause of death, respectively.

Injury-related deaths, as presented in *Tables 3 and 4*, are that subset of deaths caused by damage to the body from external forces (as differentiated from natural deaths due to disease processes). These deaths are further tabulated by the manner in which they occurred. This allowed for a count of the sub-set of firearm-related homicides and suicides, of the totals shown in *Tables 1 and 2*.

In Illinois, for the period of 2003 to 2013, firearm-related homicides ranked as the second leading cause of injury death for the youngest age groups and fourth for the overall population. For those ages 15 to 24, firearm-related homicides nearly outnumbered motor vehicle accidents as the leading cause. A similar, but not as pronounced, pattern occurred nationally (*Table 4*). In Illinois, suicides by firearm did not overtake firearm-related homicides until middle age (age category 45-54).

Taken together, firearm-related deaths are a significant cause of mortality in Illinois and nationally and should be considered a public health priority in the same vein as motor vehicle accidents and drug overdoses (unintentional poisoning). Determining the prevalence of firearm-related mortality on a group of individuals closely associated with firearm use was a goal of this study.

Table 1
Leading cause of death in Illinois, and homicide and suicide deaths, by age, 2003-2013

Leading causes of death, IL	10-14	15-24	25-34	35-44	45-54	55-64	65 +	Overall
Top ranked cause of death	Accidents	Accidents	Accidents	Accidents	Cancer	Cancer	Heart disease	Heart disease
Number of deaths	402	5,394	5,895	6,441	23,154	48,324	231,378	289,607
Homicides	127	3,514	2,542	1,229	826	339	478	9,055
Suicides	91	1,615	1,982	2,397	2,826	1,848	1,875	12,634
Total	218	5,129	4,524	3,626	3,652	2,187	2,353	21,689
Homicide rank of all death causes	3	2	2	5	13	18	20	15
Suicide rank of all death causes	4	3	3	4	5	10	19	11

Source: CDC WISQARS tool

Table 2
Leading cause of death in the United States, and homicide and suicide deaths, by age, 2003-2013

Leading causes of death – US	10-14	15-24	25-34	35-44	45-54	55-64	65 +	Overall
Top ranked cause of death	Accidents	Accidents	Accidents	Accidents	Cancer	Cancer	Heart disease	Heart disease
Number of deaths	12,129	153,345	160,302	176,198	544,609	1,155,960	5,527,566	6,858,692
Homicides	2,908	55,499	49,099	31,221	22,730	10,995	9,975	182,427
Suicides	2,105	48,686	60,411	72,962	87,607	59,958	64,361	396,090
Total	5,013	104,185	109,510	104,183	110,337	70,953	74,336	578,517
Homicide rank of all death causes	4	2	3	6	14	17	20	15

Suicide rank of all death causes	3	3	2	4	5	8	18	10

Source: CDC WISQARS tool

Table 3

Leading injury-related cause of death in Illinois, and firearm-related homicides and suicides, by age, 2003-2013

Causes of injury deaths - IL	10-14	15-24	25-34	35-44	45-54	55-64	65 +	Overall
Top ranked cause of injury death	MV accidents	MV accidents	Unintended poisoning	Unintended poisoning	Unintended poisoning	MV accidents	Falls	MV accidents
Number of deaths	208	3,091	2,783	3,323	3,456	1,351	6,471	13,211
Homicide with firearm	86	3,054	2,046	795	425	141	110	6,657
Suicide with firearm	16	493	619	710	941	799	1,161	4,739
Total	102	3,547	2,665	1,505	1,366	940	1,271	11,396
Firearm homicide rank of all injury deaths	2	2	3	4	7	11	14	4
Firearm suicide rank of all injury deaths	8	5	5	5	3	3	5	5

Source: CDC WISQARS tool

Table 4

Leading injury-related cause of death in the United States, and firearm-related homicides and suicides, by age, 2003-2013

Causes of injury deaths - US	10-14	15-24	25-34	35-44	45-54	55-64	65 +	Overall
Top ranked cause of injury death	MV Accidents	MV accidents	MV accidents	Unintended Poisoning	Unintended Poisoning	MV Accidents	Falls	MV accidents
Number of deaths	6,728	96,629	69,421	81,277	95,893	45,935	213,754	424,813
Homicide with firearm	1,440	46,326	38,654	20,827	12,494	5,431	3,553	128,725
Suicide with firearm	857	22,672	27,116	31,643	41,238	33,198	46,324	203,048
Total	2,297	68,998	65,770	52,470	53,732	38,629	49,877	331,773
Firearm homicide rank of all injury deaths	3	2	3	4	7	8	14	5
Firearm suicide rank of all injury deaths	5	4	4	3	3	3	4	4

Source: CDC WISQARS tool

Methodology

ICJIA researchers used three administrative data sources to determine the recidivism rates of those arrested for the first time for a firearm-related offense in 2003 and compared them to a matched sample of offenders arrested that year for offenses not involving firearms. This cohort was tracked for 10 years, through 2013.

Data sources

Illinois Criminal History Record Information (CHRI) data

Through a cooperative agreement with ISP, ICJIA researchers have access to all records posted to the CHRI Ad Hoc, or offline database of records queried from the CHRI System. These include all posted fingerprint-based arrests and associated arrest charges submitted by local arresting agencies, along with basic demographic information. Any subsequent court dispositions and sentencing information submitted by the circuit court clerk for those arrests also are accessible. Individuals in the CHRI System are assigned a unique state identification (SID) number used to identify all arrests associated with their fingerprints in the system.

These CHRI data comprised the primary data source from which the firearm and comparison samples were constructed for this project, and from which conviction information, subsequent arrest events, and death indicator information were obtained.

IDOC prison admissions and exit files

IDOC has provided ICJIA researchers annual datasets on prison admissions and exits for several decades. The datasets include individual records containing demographic, holding charge, and sentence information, and personal identifiers. Using SID numbers provided by IDOC and name searches when the number is unavailable, ICJIA researchers can link an individual's IDOC files with their corresponding CHRI files. These linked files were used to compute actual length of stay for those sampled who were sentenced to prison as a measure of time when they were not at risk for recidivating in the community.

IDPH death certificate files

ICJIA researchers entered into a data use agreement with IDPH that allowed electronic extraction of data fields related to cause and manner of death from death certificate records for individuals that were matched to the study sample CHRI data. Records were matched using names and dates of birth compiled from every permutation of subject name and date of birth found in the CHRI and IDOC files. This more extensive candidate list increased the likelihood of finding a death certificate record match.

Illinois Compiled Statutes

The CHRI files contain the statutes and literal descriptions of all arrest and court charges and

offense penalty classes. To construct the study samples of firearm-involved and non-firearm involved individuals, a list of relevant statutes was compiled. The Firearm Owners Identification Card Act [430 ILCS 65] provided the guiding statutory definition of a firearm: "any devise, by whatever name known, which is designed to expel a projectile by action of an explosion, expansion of gas or escape of gas" [430 ILCS 65/1.1(1)]. The Act also contains the offenses related to firearm possession, purchase and sale, which could be easily flagged.

Other firearm-related offenses took more effort to identify, as they are embedded throughout the Criminal Code [720 ILCS 5], primarily within each article for offenses directed against persons (kidnapping, sex offenses and bodily harm). An exception is the armed robbery statute, which is found within offenses against property. It should be noted that the statutes related to homicide [720 ILCS 9/1] reference "physical injuries inflicted" rather than the manner in which those injuries were inflicted (for example, shooting, stabbing, etc.). Therefore, murder charges were only included if some other charge indicated a firearm-related offense. For records with multiple charges, any firearm-related charge triggered a case to be included, although the samples were later categorized by the offense with the highest penalty class.

This statute search resulted in a master list of 219 separate statutes related to the use, possession, or purchase of a firearm. Of these, 94 were found in the 2003 CHRI data used as the starting point for this research. These 94 statutes were further dichotomized as *violent*, where the firearm was used against a person or discharged at a person (31 statutes), or *non-violent*, where the offense was related to the possession or purchase of a firearm (63 statutes). All statutes categorized as violent were felony offenses; approximately one-third (23) of the non-violent firearm charges were A or B misdemeanor offenses.

Research sample construction

A large portion of project time was spent identifying individuals with a first-time arrest for a firearm-related charge in 2003 in the CHRI files and then using various techniques to construct a matched comparison group of individuals who were not involved in a firearm-related crime.

Firearm group

The study design called for the firearm-related group to have experienced their first firearm arrest in the first study year (2003). In this way, the first firearm arrest event could be considered the 'treatment,' after which the recidivism rates would be observed.

The first step was to extract the 558,948 arrests recorded in the CHRI System during the year 2003, which accounted for 379,275 unique persons arrested. Using the master list of firearm statutes, 6,929 individuals were identified with a firearm-related offense. The complete criminal histories of this firearm-involved (FI) group were pulled and any arrests recorded prior to 2003 were examined for firearm-related charges on the master list. This process eliminated 424 individuals from the sample, or approximately 6 percent, for a new sample size of 6,505 first-time firearm arrestees.

Comparison group

The study design also called for construction of a non-firearm-involved comparison group. Starting with the remaining 368,077 individuals arrested in 2003, several procedures were conducted. First, persons arrested solely for lowest-level misdemeanor charges (Class C) or petty offenses were excluded from consideration, since all firearm-related charges in Illinois carry at least a Class B misdemeanor penalty. This reduced the pool almost by a quarter (n=289,078, 21 percent). The criminal history records of these remaining individuals were pulled to identify those without firearm-related arrests prior to their arrest in 2003. A total of 6,680 individuals with a prior firearm-related arrest were eliminated (2 percent) in this process. A final pool of 282,398 firearm-uninvolved individuals remained, from which the non-firearm-involved arrest (NFI) group could be constructed. This was a sufficiently large sample size for any matching technique.

Coarsened exact matching

In general, the aim in constructing a comparison group in non-randomized settings is to improve causal inference about the effect of the experimental treatment to that achieved through randomized control trials (Austin, 2011). Various techniques can be used to match subjects experiencing a program treatment to others in the same general population to control for the confounding effects of pre-existing factors (Iacus, King, & Porro, 2011).

Initially, a comparison group was constructed using propensity score matching (PSM), a statistical technique frequently used to create matched sets of subjects based on observable characteristics when random control trials are not feasible (Austin, 2011). However, further review of the literature determined that this technique might actually increase imbalance between the experimental and control group due to its reliance on one synthesized score derived from all included variables on which subjects are matched (King, & Nielsen, 2016). A different technique, coarsened exact Matching (CEM) was subsequently used, allowing the researcher to set the maximum level of imbalance between the two groups for each match criterion in isolation without affecting that maximum level for any of the other criterion variables (Iacus, King, & Porro, 2011). This approach results in an experimental and comparison group that is more equivalent on pre-existing factors.

Match criteria used for comparison group construction were chosen to reflect all subject demographics available in CHRI, salient characteristics of the 2003 arrest that could be derived from the charges recorded in CHRI, and salient characteristics of subjects' prior criminal history recorded in CHRI. These included:

1. Sex
2. Race
3. County in which the 2003 arrest occurred
4. Age at the 2003 arrest
5. Highest charge (misdemeanor, felony, or unknown) for the 2003 arrest
6. Whether the 2003 arrest included a violent arrest charge (firearm-related or not)
7. Whether the 2003 arrest included a drug charge
8. Whether the 2003 arrest included a property charge
9. Whether the 2003 arrest included a murder charge

10. Age at first arrest recorded in CHRI
11. Number of prior arrests (prior to the 2003 arrest)
12. Number of prior felony arrests (prior to the 2003 arrest)
13. Number of prior violent arrests (prior to 2003 arrest)
14. Number of prior drug arrests (prior to 2003 arrest)
15. Number of prior property arrests (prior to 2003 arrest)
16. Number of prior convictions (prior to 2003 arrest)

The CEM procedure required a match on all 16 criteria to produce a one-to-one match of individuals in the NFI group to those in the FI group.

Somewhat surprisingly, given the large size of the NFI group, matches were found on all 16 criteria for only two-thirds of the FI group (n=4,323). Another 377 in the FI group were excluded from the study when they didn't meet enough of the criteria.

A total of 1,774 in the FI group could not be matched to anyone in the non-firearm group. An initial analysis revealed these subjects were arrested for more serious charges in 2003 and had more serious arrests at a younger age. This group remained in the study as a separate firearm-involved subgroup.

Final study sample composition

The total number of subjects in this study was 10,420. This included 8,646 individuals in the FI and NFI groups matched on one-to-one basis on 16 characteristics and the additional 1,774 individuals in the FI group for which no corresponding non-firearm involved individuals could be found (Unmatched FI group). This research sample accounted for approximately 3 percent of the initial universe of 379,275 unique individuals with a 2003 CHRI arrest.

Matching to IDOC data

Researchers also sought to identify individuals incarcerated at any point during the 10-year follow-up period and account for that incapacitation time in the recidivism analysis. Pre-trial detention in a county jail is not reported into the CHRI System and could not be included in incapacitation time.

Given the historic weakness inherent of missing court dispositions in the CHRI System as documented at the state and national level (ICJIA, 2010; Bureau of Justice Statistics, 2014), it was necessary to match the study sample CHRI records to IDOC administrative records to obtain more complete incarceration data for the study sample. In addition, reliance on CHRI data alone would result in over-estimation of incapacitation time, as sentence information recorded in CHRI records is limited to the length imposed, not the actual time served. Many serve less time than the imposed sentence in most cases, through various types of earned sentence credits.

Names and dates of birth of all 10,420 research subjects were matched against the annual IDOC datasets for the period of 2003 through 2013. Approximately 35 percent (n=3,685) were found incarcerated in a state prison facility at some point during those 10 years. Subjects' actual length

of stay was calculated based on IDOC files.

Matching to death certificate records

To increase the likelihood of matching the study subjects to the death certificate records, a file was compiled of every permutation of name and date of birth found in individual CHRI and IDOC records. This resulted in a candidate list of more than 40,000 unique combinations. Initially, 630 study subjects were matched to death certificate records, or 6 percent of the overall study sample. However, 182 of these subjects were discarded after further examination, mostly due to dates of death beyond the study period. In a few cases, dates of death were found before the study start date and in a few others, the gender (a variable not used in the matching process) did not correspond. A total of 448 death records were accepted as matches, accounting for about 4 percent of the overall study sample.

Cause and manner of death also was pulled from the matched death certificate records, along with information on decedent's characteristics and geographic location of the death. Additional details were gleaned from publicly available online sources, such as obituaries and news stories, for some of the deaths that occurred prior to 2007, as these "legacy" files did not include a narrative field where more information about the incident could be recorded.

Other sources of death information

In addition to the death certificate information, CHRI and IDOC records also offered evidence of deaths of the justice-involved individuals in this study. Court dispositions indicating that the case was closed due to the defendant's death ("death suggested/cause abated") are submitted into the CHRI System. A more definitive indicator is a Death Notice record posted in CHRI. This fingerprint-based record is to be submitted by law enforcement, corrections, or coroner's office upon the death of a person in custody, or of persons suspected to be homicide victims. Finally, a notation of death may be entered on an inmate's state correctional record. None of these criminal justice sources contain any details of the death, such as the cause and manner in which it occurred.

From 2003 to 2013, CHRI dispositions suggesting death were found for 68 cases, Death Notice fingerprint cards were submitted for 111 cases, and IDOC record notations of death were found for three cases. Only 14 cases had all three sources of death information.

The least reliable death indicator was the CHRI court disposition code suggesting death, as several individuals with that court disposition had subsequent arrests posted. This is not surprising given that little or no documentation of a death is required for the submission of that disposition to CHRI. It is possible that the death code was entered in error; code 222 for "death suggested/cause abated" may have been entered in place of the more commonly used code 221 for "stricken on leave to reinstate".

Of Death Notice cards submitted on study subjects, almost 20 percent did not include a date of death, rendering them for survival analysis censoring procedures. Illinois State Police indicated they are adding these dates to historic records, which will make Death Notice CHRI entries more

useful in future research projects.

The corresponding civil death certificate records were found for all but 12 individuals with these various criminal justice-related death indicators. Therefore, it could be concluded that the matching process between the CHRI and death certificate records had successfully identified most of the applicable records. Date of death information was accepted for these 12 additional cases, since their CHRI records did not contain any further criminal justice-related activity after that date. This brought the total number of matched death records to 460, or 4.5 percent of the total study sample.

In the end, the civil death certificate data was the most useful source of death information, as most of the study subjects were no longer in the justice system at the time of their death.

Research limitations

This study was designed to test the limits of Illinois CHRI data for conducting more precise recidivism studies on specific sub-populations. Of interest was the extent to which personal identifiers recorded in CHRI could be used to match to other administrative datasets to gain information on more exact estimates of time-at-risk for reoffending in the community. This project demonstrated that it is possible to use the CHRI data to carve out very specific subsets of individuals from a large pool possible study subjects, using multiple criteria. However, the resulting study sample is a true reflection of those subpopulation only to extent that the CHRI data contains complete and accurate information regarding the selection criteria, and only to the degree to which statutory definitions of firearm involvement were accurately created in identifying the first-arrest firearm group central to the study design.

Due diligence was done to check for accuracy, but inconsistencies are inevitable in a data collection system that relies on individual entries made by thousands of local and county mandated submitters over a long time span. For example, the demographics of study subjects as recorded in 2003 were found to be significantly different in their later CHRI entries in approximately 2 percent of records (such as birth dates in different decades, inconsistent gender codes, etc.). Further, the administrative data used here is limited to events occurring in the state. It cannot be known if persons were previously arrested for firearm-related offenses in other states prior to 2003 (and thus not first-time firearm arrestees) or if they ceased to have new arrests recorded in CHRI because they move out of Illinois.

In terms of accounting for incapacitation events, this study is limited to criminal justice events recorded in CHRI, state prison data, and information on fatalities that occurred in the state. There is no statewide data source to measure duration of individuals' pretrial detention in a county jail, which may add up to significant incapacitation time in some counties and for some serious offenses. This could not be accounted for here. Another limitation in incapacitation information is the lack of non-fatal injury data, particularly for the FI group. Hospitalization and disability due gunshot injuries may be a significant source of incapacitation and a motivation for crime desistance. These could not be measured here.

Finally, the study was limited in the number of independent variables that could be included. The

CHRI data is limited in the amount of demographic information recorded at the time of arrest. While both corrections data and death certificates contain more socioeconomic information, these were only available for a limited number of study subjects. The use of certain criminal history-related information also was limited by record completeness. Court dispositions were missing for a quarter of all felony arrests in the initial 2003 arrest sample.

The CHRI data used in this project was pulled at the beginning of 2017, just ahead of new automatic juvenile CHRI record expungement laws taking effect [705 ILCS 405/5-915]. Another law that will greatly enlarge the scope of charges that can be sealed (PA 100-0284) also went into effect in mid-2017. The effect of these laws on the composition of individuals' criminal histories is yet to be determined, but research that utilizes such criteria as age at first arrest and number of prior arrests likely will be affected, perhaps even to the extent of making each future pull of CHRI system data a unique, non-replicable snapshot.

Findings

Demographic characteristics

ICJIA researchers analyzed the complied data for the FI group and NFI comparison group using R, SPSS and Excel software. The following are the general descriptive characteristics of the various subgroups within the study sample.

General comparative context

To contextualize the composition of the study sample, the demographics of all 10,420 arrestees used in the study were compared to both the composition of the general population in Illinois and the larger pool of the 558,948 persons arrested in 2003 from which the sample was drawn. Using the Census Factfinder data collected in 2000, the year closest to the initial 2003 study period and county-level data from the IDPH website, *Table 5* shows how these groups compared on basic demographic characteristics.

Table 5
Comparison of study sample with Illinois' general population and all 2003 arrestees in CHRI

Characteristic	Illinois general pop (n=12,419,293)	2003 unique arrestees in CHRI (n=379,275)	Total study sample (n=10,420)
Male	49%	79%	90%
Female	51%	21%	10%
White	73%	57%	43%
Black	15%	41%	54%
Other	11%	2%	3%
Cook Co.	43%	54%	56%
Non-Cook Co.	57%	46%	44%
Ages 10-14	9%	3%	7%
15-24	16%	40%	56%
25-34	17%	26%	18%
35-44	19%	19%	11%
45-54	15%	9%	5%
55-64	10%	2%	2%
65 and over	14%	<1%	1%

Sources: 2000 Census Factfinder; ICJIA interpretation of Illinois CHRI data

As can be seen, the arrested population in 2003 was overrepresented by males, Blacks, location of Cook County, and those ages 15 to 34 when compared to Illinois' general population. Compared to both the Illinois general population and all persons with arrest records in 2003, the study sample is highly overrepresented by males (90 percent), much more overrepresented by Blacks (54 percent), overrepresented by location of arrest in Cook County (56 percent), and much more overrepresented by teens and young adults (ages 15 to 24). The study sample also had fewer adults over the age of 35 than either the 2003 population of arrested persons or the general Illinois population (19 percent).

Arrest charge characteristics

While the study sample was defined primarily by firearm charges and any other charges included in the 2003 arrest of the FI group, flags were created in the analysis dataset to preserve the presence of other salient arrest charges. These included flags for firearm, murder, violent offense (as defined by the Rights of Crime Victims and Witnesses Act [725 *ILCS* 120/et seq.]), drug, and property charges. Arrest incidents could have multiple offense type flags.

Table 6 shows how the 2003 arrest charge characteristics for the study sample compared to all 2003 arrestees from which the sample was drawn.

Table 6
Arrest charge comparison of all 2003 arrestees in CHRI compared to study sample

Characteristic	2003 arrest charges in CHRI (n=379,275)	Total study sample (n=10,420)
Felony	15%	71%
Class A or B misdemeanor	45%	17%
Class C or lower	22%	N/A
Unknown class	18%	10%
Firearm flag*	3%	59%
Murder flag	<1%	<1%
Violent offense flag	25%	41%
Drug charge flag	21%	15%
Property flag	26%	7%

Source: ICJIA interpretation of Illinois CHRI data
*Applies to the two firearm-involved groups only

Firearm offenses were noted in few (3 percent) of all arrests in 2003. One result of using firearm arrest charges for defining the study group was a much higher concentration of felony arrests (71 percent) compared to the overall group of 2003 arrestees in CHRI (15 percent). The study sample also contained a higher proportion of accompanying violent offenses (41 percent), fewer drug charges (15 percent), and considerably fewer property charges (7 percent) than the overall 2003 sample.

Group characteristics

The study sample was comprised of three groups:

1) A group of 4,323 individuals determined by CHRI records to be arrested for the first time in 2003 for a firearm-related offense (FI group).
2) A group of 4,323 matched to the FI group on a one-to one basis to 4,323 with no firearm-related arrests (NFI group).
3) An unmatched group of 1,774 first-time firearm arrested individuals that could not be matched to any candidates in the original comparison group pool (Unmatched FI group). These were kept in the final study sample but analyzed separately, as they provided additional information on firearm offender recidivism.

Table 7 shows the equivalent nature of the matched groups.

Table 7
Comparison of study sample FI and NFI groups

Characteristic	Matched FI group (n=4,323)	Matched NFI group (n=4,323)	Unmatched FI group (n=1,774)
Male	90%	90%	92%
Female	10%	10%	8%
White	46%	46%	26%
Black	52%	52%	66%
Other	2%	2%	8%
Min age in 2003	10	10	12
Median age	21	21	23
Mean age	25	25	27
Max age	90	85	77
Min age at first arrest	10	10	10
Median	18	18	17
Mean	22	22	18
Max	90	85	70
Prior arrests			
Minimum	1	1	1
Median	3	1	6
Mean	5	2	8
Max	36	33	76
2003 Felony charge	65%	65%	83%
Class A or B charge	23%	23%	6%
Unknown	11%	11%	8%

2003 Murder flag	<1%	<1%	2%
Violent charge flag	38%	38%	47%
Drug charge flag	16%	16%	13%
Property charge flag	7%	7%	6%

As can be seen, the Unmatched FI group had a slightly smaller proportion of women, included 14 percent more Blacks, and was slightly older, on average, than the two matched groups. This group also was arrested in 2003 for more serious offenses involving firearms (felonies, murder, and violent offenses) than the two matched groups.

2003 firearm offenses

Table 8 presents the distribution of first firearm offenses by violent and non-violent categories, based on most serious charge in each arrest. Here, "violent" firearm offenses were defined as use of a gun against a person in the commission of a crime or the discharge of a gun in the direction of a person. The "non-violent" firearm offenses include the illegal purchase, possession, or selling of a firearm.

Table 8
Distribution of 2003 firearm arrest charges, violent and non-violent

	Type of firearm offense			
Group	**Violent**	**Percent**	**Non-violent**	**Percent**
Matched FI (n=4,323)	1,440	33%	2,883	67%
Unmatched FI (n=1,774)	739	42%	1,035	58%
Total Firearm (n=6,097)	2,179	36%	3,918	64%

Source: ICJIA interpretation of Illinois CHRI data

As can be seen, approximately two-thirds of all first-time firearm arrests were for non-violent firearm offenses. However, as expected, the Unmatched FI group were charged with proportionally more violent firearm offenses for their first firearm-involved arrest than the matched FI group, at 42 percent and 33 percent, respectively.

Appendix A presents the specific distributions of violent and non-violent firearm charges for the two firearm groups. These two lists provide the total number of times each statute appears in the first firearm arrest charges to provide context regarding the types and volume of first-time firearm-related offenses for which the study subjects were arrested.

Appendix A shows that individuals in both FI groups were charged most often with the same three violent firearm charges in the same rank order – aggravated battery with a firearm, armed robbery with a firearm, and aggravated discharge of a firearm. However, that ranking did not hold true for non-violent firearm offenses. The Unmatched FI group was charged most often for unlawful possession of a weapon by a felon, while the matched FI group was charged most often for possession of a firearm with an invalid FOID card. This again highlights that the Unmatched FI

group had not just more numerous prior arrests, but also more serious prior criminal histories involving felony arrests than the matched FI group.

2003 Arrest Outcomes

Convictions

Most outcomes of the initial 2003 arrests were tracked with CHRI records. *Table 9* shows overall study sample conviction rate reflected in the CHRI data (43 percent), the overall conviction rate for felony charges, whether the arrest was firearm-related (32 percent), and the firearm-related conviction rate (37 percent) for the two FI groups. The table also shows that 21 percent of all study subject arrest records were missing court dispositions.

The arrest outcomes for each group can be compared to the overall rates and to each other. The matched NFI group consistently had the lowest conviction rates, at 33 percent for all arrests and 20 percent for felony arrests. However, this group also had the largest proportion of missing court dispositions at 25 percent.

In terms of the two firearm-involved groups, the Unmatched FI group surpassed the matched FI group in conviction rates, felony conviction rates, and firearm charge conviction rates. This group also had the lowest rate of missing court dispositions, making these results more certain than for the other groups with greater volumes of missing information.

Table 9
Conviction rates for the initial 2003 arrest

	Conviction for 2003 arrest			Felony conviction for 2003 arrest			Firearm conviction for 2003 arrest		
Group	Yes	No	Unk	Yes	No	Unk	Yes	No	Unk
Matched FI (n=4,323)	2,074	1,424	832	1,535	1,956	832	1,460	2,031	832
Percent	**48%**	**33%**	**19%**	**36%**	**45%**	**19%**	**34%**	**47%**	**19%**
Matched NFI (n=4,323)	1,407	1,821	1,095	861	2,367	1,095	N/A	N/A	N/A
Percent	**33%**	**42%**	**25%**	**20%**	**55%**	**25%**	**N/A**	**N/A**	**N/A**
Unmatched FI (n=1,774)	995	532	256	902	616	256	769	749	256
Percent	**56%**	**29%**	**14%**	**51%**	**35%**	**14%**	**43%**	**42%**	**14%**
Total (n=10,420)	4,476	3,786	2,183	3,298	4,939	2,183	2,229	2,780	1,088
Percent	**43%**	**36%**	**21%**	**32%**	**47%**	**21%**	**37%**	**46%**	**18%**

Source: ICJIA interpretation of Illinois CHRI data

Prison sentences

The number sentenced to prison (IDOC) was determined using IDOC records, to compensate for missing CHRI court disposition information. In fact, IDOC admission records were found for 339 persons that would have been missed had CHRI records been relied upon alone.

Table 10 shows the incarceration rates for the initial 2003 arrest (any charge type) for each group and the entire study sample. Incarceration rate for firearm-related offenses alone could not be determined, since IDOC records contain only the charge with the longest sentence imposed, thus excluding lesser-included firearm offenses.

Table 10
Incarceration rates for the initial 2003 arrest

| Group | Incarcerated for 2003 arrest | | | |
	Yes	Percent	No	Percent
Matched FI (n=4323)	563	13%	3,760	87%
Matched NFI (n=4323)	486	11%	3,837	89%
Unmatched FI (n=1774)	503	28%	1,271	72%
Total (n=10,420)	1,552	15%	8,868	85%

Source: ICJIA interpretation of IDOC admission files

No significant differences in incarceration rates were observed between the matched FI and NFI groups. Both groups were admitted to IDOC at low rates for their first conviction (12 percent, on average). In contrast, the Unmatched FI group was incarcerated at more than twice that rate (28 percent), reflecting the severity of their 2003 arrest offenses and their more extensive and serious prior criminal history.

Recidivism

The study group was tracked for recidivism through 2013, for a 10-year follow-up period. These included subsequent arrests, convictions, and prison incarcerations. Chi-squared tests were run to determine if differences observed between the matched FI and NFI groups were statistically significant using an alpha level of .05 for all tests.

Recidivism based on re-arrest for any charge

Table 11 presents recidivism findings for the entire follow-up period, based on new arrests for any charge recorded in the CHRI records. As can be seen, 59 percent of all study subjects recidivated by the end of the 10-year period, with the Unmatched FI group recidivating at the highest rate (81 percent). The matched FI group also recidivated at a significantly higher rate than the matched NFI group, at 67 percent and 41 percent, respectively.

Table 11
Re-arrest rate over the 10-year follow-up period

	Re-arrested at least once			
Group re-arrested	**Yes**	**Percent**	**No**	**Percent**
Matched FI (n=4,323)	2,879	67%*	1,444	33%
Matched NFI (n=4,323)	1,790	41%*	2,533	59%
Unmatched FI (n=1,774)	1,443	81%	331	19%
Total (n=10,420)	6,112	59%	4,308	41%

*X^2 (1, N=8,646) =552.194, p=.000
Source: ICJIA interpretation of Illinois CHRI data

Number of and pace of re-arrests over the 10 years

Table 12 shows the distribution of total re-arrest events among the three groups. The matched FI and NFI groups diverged significantly in terms of the total number of arrests experienced between 2003 and 2013 during the 10-year follow-up period, not just the proportion of each group that was ever rearrested. The re-arrested Unmatched FI group averaged the most re-arrest incidents per individual, compared to either matched group.

Table 12
Number of re-arrests between 2003 and 2013

Group re-arrested	**Min**	**Max**	**Mean**	**Median**	**Total**
Matched FI (n=2,879)	0	65	4.56	2	19,696
Matched NFI (n=1,790)	0	22	1.07	0	4,628
Unmatched FI (n=1,443)	0	57	7.00	5	12,408
Total (n=6,112)	0	65	3.53	1	36,732

Source: ICJIA interpretation of Illinois CHRI data

As can be seen in *Table 13,* the matched FI and NFI did not differ in terms of re-arrest rates within the first year of the follow-up period, at 30 percent. The Unmatched FI group re-arrest rate was 10 percent higher within the first year. Within three years, the two firearm-involved groups had considerably outpaced the NFI group in terms of re-arrest rates. By the end of the third year, 51 percent of the FI group and 66 percent of the Unmatched FI group had been arrested again, compared to 40 percent of the NFI group. The cumulative re-arrest rate for the NFI group stabilized at 40 percent for the remaining seven years of follow-up, while the cumulative arrest rates for the two firearm groups increased another 15 percent from the third to the tenth follow-up year, ending at 67 percent for the matched FI group, and 81 percent for the Unmatched FI group.

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Table 13
Cumulative re-arrests by group

Group re-arrested	Not re-arrested	Re-arrested within 1 year	Re-arrested within 3 years	Re-arrested within 5 years	Re-arrested within 10 years
Matched FI (n=2,879)	33%	30%	51%	59%	67%
Matched NFI (n=1,790)	59%	31%	40%	40%	41%
Unmatched FI (n=1,443)	19%	40%	66%	75%	81%
Total (n=6,112)	41%	32%	49%	54%	59%

Source: ICJIA interpretation of Illinois CHRI data

Re-arrest characteristics

For the two FI groups, the impact of facing the criminal justice system for a first firearm-related arrest event was of interest. Therefore, the first re-arrest was examined to determine the degree of further firearm involvement.

First re-arrest for a felony charge

While 66 percent of the matched groups and 83 percent of the unmatched FI group had been arrested for a felony offense in 2003 (*Table 7*), only 33 of all first re-arrests were for a felony offense. *Table 14* shows that the next arrest was predominantly for a misdemeanor offense for all three groups.

Table 14
First re-arrest, felony vs. misdemeanor, by group

Group re-arrested	First re-arrest			
	Felony	Percent	Misd.	Percent
Matched FI (n=2,879)	910	32%	1,969	68%
Matched NFI (n=1,790)	568	32%	1,222	68%
Unmatched FI (n=1,443)	552	38%	891	62%
Total (n=6,112)	2,030	33%	4,799	67%

Source: ICJIA interpretation of Illinois CHRI data

Ten-year re-arrest rate for a felony charge

The overall re-arrest rate for a felony charge was calculated for the 6,112 individuals re-arrested. *Table 15* presents these rates by group.

As can be seen, the pattern of severity of the new arrests shifted over the 10 years. While the first new arrest was more likely to be for a misdemeanor charge in all groups, close to two-thirds (62 percent) of the overall study group were re-arrested for a felony by the end the 10-year follow-up

period. The two firearm-involved groups drove this felony re-arrest rate.

The matched FI group long-term felony re-arrest rate was equivalent to their rate of felony arrest involvement at their initial 2003 arrest (at 65 percent) (*Table 7*), while the long-term felony arrest rate for the Unmatched FI group was slightly lower, at 78 percent and 81 percent, respectively. The long-term felony arrest rate for the NFI group was significantly lower than it was at their 2003 arrest, at 46 percent and 65 percent, respectively.

Table 15
Ten-year felony re-arrest rate by group

Group re-arrested	Any re-arrest			
	Felony	Percent	Misd.	Percent
Matched FI (n=2,879)	1,865	65%*	1,014	35%
Matched NFI (n=1,790)	817	46%*	973	54%
Unmatched FI (n=1,443)	1126	78%	317	22%
Total (n=6,112)	3,808	62%	2,304	38%

*X^2 (1, N=8,646) =593.665, p=.000
Source: ICJIA interpretation of Illinois CHRI data

First re-arrest for a firearm charge

Table 16 shows percentages of each group re-arrested for a firearm-related offense, including the few individuals in the NFI group, which was not firearm-involved at initial arrest in 2003.

Table 16
First re-arrest, any firearm charge and violent firearm charge, by group

Group re-arrested	Firearm charge at first re-arrest	Percent of all first re-arrests	Violent firearm charge at first re-arrest	Percent of all first re-arrests	Percent of first firearm re-arrests
Matched FI (n=2,879)	278	10%*	109	4%	39%**
Matched NFI (n=1,790)	34	2%*	14	1%	48%**
Unmatched FI (n=1,443)	134	9%	55	4%	39%
Total (n=6,112)	446	7%	178	3%	40%

*X^2 (1, N=8,646) =197.964, p=.000   **X^2 (1, N=8,646) =74.433, p=.000
Source: ICJIA interpretation of Illinois CHRI data

As can be seen, relatively few individuals in any group were re-arrested for firearm charges (7 percent). However, of those firearm-related arrests, a slightly larger proportion was for a violent use of a gun against a person when compared to the initial sample of 2003 arrests, at 40 percent and 36 percent, respectively (*Table 8*). The proportion of violent use of a firearm was consistent

across the two firearm-involved groups.

A total of 34 individuals (2 percent) of the NFI group experienced their first firearm arrest as the next arrest event after their 2003 arrest for a non-firearm related offense. While comprising a very small group, half (48 percent) were arrested for a violent firearm offense, which was at a rate even higher than the more seriously offending Unmatched FI group (39 percent). A further examination of their characteristics in 2003 revealed they were nearly all males, 70 percent Black, with a median age of 16 years.

Ten-year firearm arrest rate

Table 17 presents overall re-arrest rates for a firearm charge, for the 6,112 individuals ever re-arrested during the 10-year follow-up period, including the proportion accounted for by arrests for violent use of a firearm. Overall, 14 percent of the entire study group was arrested again for a firearm charge, and almost half of those arrests were for a violent firearm charge (45 percent).

Approximately 20 percent of the two firearm-involved groups were arrested again for at least one firearm charges within the 10-year follow-up period.

An additional 35 percent of the NFI group (n=46) first arrested for a firearm charge after their initial 2003 non-firearm-related arrest was arrested for yet another firearm charge over the 10 years. The individuals in the matched NFI group that became firearm-involved during the follow-up period were predominately male, Black, and at a median age of 16 at initial arrest in 2003.

Table 17
Ten-year re-arrest rate for any firearm and violent firearm charge, by group

Group re-arrested	Any firearm re-arrest	Percent of all re-arrests	Violent firearm re-arrest	Percent of all re-arrests	Percent of firearm re-arrests
Matched FI (n=2,879)	513	18%*	221	8%	43%**
Matched NFI (n=1,790)	46	3%*	22	1%	48%**
Unmatched FI (n=1,443)	304	21%	143	10%	47%
Total (n=6,112)	863	14%	386	6%	45%

*X^2 (1, N=8,646) =417.109, p=.000   **X^2 (1, N=8,646) =167.680, p=.000
Source: ICJIA interpretation of Illinois CHRI data

Recidivism based on new conviction for any charge

Overall reconviction rates for each subgroup were calculated with court disposition information on individuals whose CHRI records indicated a conviction for their 2003 arrest *and* a subsequent arrest for a new offense of any type. As a result, this recidivism measure is based on a sample size that is almost 25 percent smaller than the group of re-arrested persons presented in *Table 11* (n=4,476 persons convicted more than once compared to 6,122 re-arrested persons who were not all convicted for their 2003 arrest). Due to the volume of missing court disposition associated with both the initial 2003 arrest (*Table 9*) and later arrest events, this reconviction rate is likely an

underrepresentation of the true rate.

Table 18 shows the reconviction rate (for a new arrest incident of any type) that occurred at least once over the 10-year follow-up period. Overall, 39 percent of the study sample with evidence of a 2003 conviction experienced at least another conviction for a new arrest event within the 10-year follow-up period. This re-convicted group accounted for 17 percent of the entire study group.

The group rankings remained the same as for the re-arrest recidivism measure—CHRI records of more than half (57 percent) of the Unmatched FI group indicated another conviction for a new offense at a rate equivalent to the 2003 conviction rate (56 percent and 57 percent, respectively (*Table 9*). The matched FI group ranked second (43 percent) with a conviction rate slightly lower than the rate in 2003 (48 percent). This was also more than twice the reconviction rate of their matched NFI group counterparts (20 percent), who had been convicted at a rate of 33 percent in 2003. Again, this result may be an artifact of missing court disposition information in CHRI.

Table 18
Reconviction rate over the 10-year follow-up period

	Reconvicted at least once			
Group re-arrested	**Yes**	**Percent**	**No+**	**Percent**
Matched FI (n=2,178)	891	43%*	1,183	57%
Matched NFI (n=1,407)	284	20%*	1,123	80%
Unmatched FI (n=995)	564	57%	431	43%
Total (n=4,476)	1,739	39%	2,737	61%

*X^2 (1, N=8,646) =651.439, p=.000
 Source: ICJIA interpretation of Illinois CHRI data
 +Incudes cases with missing dispositions

Reconviction for a firearm offense

Table 19 presents the 10-year reconviction rate for a firearm charge for the 863 individuals re-arrested at least once for a new firearm charge during the 10-year follow-up period (*Table 17*).

Table 19
Reconviction rate for a firearm charge over the 10-year follow-up period

Group re-arrested for a firearm charge	Reconvicted for a new firearm charge at least once			
	Yes	**Percent**	**No+**	**Percent**
Matched FI (n=513)	381	74%*	132	26%
Matched NFI n=46)	30	65%*	16	35%
Unmatched FI (n=304)	251	83%	53	17%
Total (n=863)	662	77%	201	23%

*X^2 (1, N=8,646) =314.720, p=.000
 Source: ICJIA interpretation of Illinois CHRI data
 +Incudes cases with missing dispositions

As can be seen, the reconviction rate for new firearm arrests that occurred during the follow-up

period was high for all groups (77 percent) compared to the conviction rate for the initial firearm charge in 2003 (*Table 9*). This was true even for the NFI group who became firearm-involved after their initial 2003 arrest.

Recidivism based on re-incarceration for any charge

IDOC admission records were used to measure recidivism resulting from new periods of incarceration (occurring after completion of incarceration sentences resulting from 2003 arrests). (*Table 20), b*ased on an even smaller sample size (15 percent of the entire study sample). Re-incarceration rates for firearm charges alone could not be determined from available data. IDOC files include only the most serious (holding) charge, which may not have been firearm-related.

The Unmatched FI group again ranked first in this recidivism measure, with a 16 percent higher re-incarceration rate than the matched FI group, at 59 percent and 43 percent, respectively. In addition, the FI matched group was re-incarcerated at a higher rate than the matched NFI group. Approximately half (46 percent) of the initially incarcerated study group was incarcerated again for a new offense during the follow-up period.

Table 20
Re-incarceration rate over the 10-year follow-up period

	Re-incarcerated at least once			
Group incarcerated	**Yes**	**Percent**	**No**	**Percent**
Matched FI (n=563)	241	43%*	322	57%
Matched NFI (n=486)	170	35%*	316	65%
Unmatched FI (n=503)	299	59%	204	41%
Total (n=1,552)	710	46%	842	54%

*X^2 (1, N=8,646) =42.159, p=.000
Source: ICJIA interpretation of IDOC admission files

Table 21 shows the total proportion of study subjects experiencing any state prison incarceration over the entire study period, including any incarceration sentence imposed for the initial 2003 arrest. The matched FI and NFI groups had very similar overall incarceration rates (30 percent, on average), while the Unmatched FI group had a rate that was twice as high (63 percent). The unmatched FI group also spent three times as many days incarcerated as the two matched groups. No individual was incarcerated for the entire length of the study period.

Table 21
Average amount of time incarcerated over the 10-year follow-up period

Group	Number ever incarcerated	Percent ever incarcerated	Mean days incarcerated
Matched FI (n=4,323)	1,427	33%	277.86
Matched NFI (n=4,323)	1,167	27%	200.42
Unmatched FI (n=1,774)	1,118	63%	606.74
Total (n=10,420)	3,751	36%	301.72

Source: ICJIA interpretation of IDOC admission files

Summary of recidivism findings

Table 22 presents the findings for the three recidivism measures. The two FI groups fared the worst on every measure, with the Unmatched FI group recidivating at the highest rate. Statistically significant were differences between the matched FI and NFI group recidivism rates, indicating that the initial firearm involvement was a risk factor for future recidivism.

Table 22
Ten-year recidivism rates, matched groups and firearm groups

Matched groups only any charges (n=8,646)	Two firearm-involved groups any charges (n=6,097)	Two firearm-involved groups firearm charges only (n=6,097)
Ten-year re-arrest rate 54% FI group=67% NFI group=41%	Ten-year re-arrest rate 71% Matched FI group=67% Unmatched FI group=81%	Ten-year re-arrest rate 19% Matched FI group=18% Unmatched FI group=21%
Ten-year reconviction rate 33% FI group=43% NFI group=20%	Ten-year reconviction rate 46% Matched FI group=43% Unmatched FI group=57%	Ten-year reconviction rate 77% Matched FI group=74% Unmatched FI group=83%
Ten-year re-incarceration rate 39% FI group=43% NFI group=35%	Ten-year re-incarceration rate 59% Matched FI group=43% Unmatched FI group=59%	Ten-year re-incarceration rate for firearm charges unable to be determined due to data limitations

Mortality information

Two sources were analyzed to measure incapacitation from further opportunity to offend in the community: IDOC records to identify periods of incarceration and death certificates. Based on individuals' last names, first names and dates of birth, 448 death certificate records were accepted as matches with individuals in the study sample during the 10-year follow-up period. Another 12

records indicating individuals' deaths were found in CHRI System records alone. Together, these 460 records accounted for 4 percent of the study sample.

The three study groups accounted for equivalent proportions of death records, although the proportion for the Unmatched FI group was just slightly higher (*Table 23*). Of the death records identified, 8 percent more were found for the matched FI group than the matched NFI group.

Table 23
Death records found by firearm group

| Group | Death record found | | |
	Yes	Percent of entire study sample	Percent of death records
Matched FI (n=4,323)	197	5%	43%*
Matched NFI (n=4,323)	160	4%	35%*
Unmatched FI (n=1,774)	103	6%	22%
Total (n=10,420)	460	4%	100%

*X^2 (1, N=8,646) =4.000, *p*=.046
Source: IDPH death certificate records; ICJIA interpretation of CHRI data

Demographics of deceased individuals

Table 24 presents the demographic characteristics of the 448 individuals for which a death certificate was dated within the study period, based on information in their 2003 arrest records.

Table 24
Demographics of deceased individuals (n=460)

Characteristic	Matched FI group (n=4,323)	Deceased FI group (n=197)	Matched NFI group (n=4,323)	Deceased NFI group (n=160)	Unmatched FI group (n=1,774)	Deceased unmatched FI group (n=103)
Male	90%	95%	90%	94%	92%	93%
Female	10%	5%	10%	5%	8%	7%
White	46%	50%	46%	43%	26%	32%
Black	52%	49%	52%	56%	66%	67%
Other	2%	<1%	2%	1%	8%	1%
Min age in 2003*	10	15.8	10	16.5	12	17.5
Median age	21	28.8	21	34.2	23	28.6
Mean age	25	36.9	25	41.2	27	37.0
Max age	90	94.2	85	93.0	77	75.1
2003 Felony charge	65%	56%	65%	57%	83%	88%
Class A or B charge	23%	32%	23%	27%	6%	6%
Unknown	11%	12%	11%	15%	8%	6%
2003 Murder flag	<1%	0%	<1%	0%	2%	0%
Violent charge flag	38%	39%	38%	38%	47%	47%
Drug charge flag	16%	20%	16%	16%	13%	12%
Property charge flag	7%	4%	7%	4%	6%	8%

*Age at death
Source: IDPH death certificate records

As can be seen, proportionally more men died within the following 10 years than women across every group. Proportionally more Whites died in the matched FI group, while proportionally more Blacks died in the matched NFI group. In the Unmatched FI group, proportionally more Whites died.

Proportionally fewer individuals in the matched FI and NFI groups with a 2003 felony arrest died within the next 10 years, while the reverse was true for the Unmatched FI group (which was already highly overrepresented by persons arrested for a felony).

No person charged with murder in 2003 died within the next 10 years. Proportionally more persons in the matched FI group charged with a drug offense along with their first gun charge died during the follow-up period.

Cause and manner of death

One significant value of obtaining mortality information from civil death certificates was the availability of detail on the cause and manner of death. Up to three immediate causes of death were

enumerated on these records. Information also could be gained from a field that recorded significant conditions contributing to the death. This information was available on the 448 death certificates used in the study, but not from those garnered from the CHRI System.

Table 25 presents the primary causes of death among the deceased in each of the study groups, based on death certificate record entries.

Table 25
Primary cause of death by study group (n=448)

Cause of death	FI matched group*	NFI matched group*	FI Unmatched group	Total
Natural	37%	48%	32%	40%
Accident	20%	23%	16%	20%
Suicide	7%	7%	5%	7%
Homicide	35%	21%	47%	33%

*X^2 (4, N=348) =10.500, p=.033
Source: IDPH death certificate records

For the entire sample, natural causes were responsible for the highest proportion of deaths (40 percent), followed by homicide (33 percent). Some variation was observed among the study groups. The Unmatched FI group ranked highest in homicide deaths (47 percent), while the NFI matched group ranked highest in deaths from natural causes (48 percent).

Age at death for each mortality cause

As illustrated by the mortality data presented in *Tables 1-4,* in Illinois and nationally, the likelihood of death from the four major causes varied by age. Generally, injury-related deaths (non-natural causes) are more prevalent for younger ages, while deaths from disease processes are most likely for older populations. *Table 26* presents the age range at which each cause of death was most prevalent, within each of the groups.

In Illinois during the period studied (*Table 1*), natural causes were the most prevalent cause of death by ages 45-54. This was found to be true for deaths from natural causes in the two firearm groups, while the most prevalent age for natural death in the matched NFI group was much later (65 or older).

In Illinois during the period studied (*Table 1)*, the most common cause of death due to injury (non-natural death) was accidents across all age groups. This also was true for the matched NFI group, but not the two firearm-involved groups. Homicide was the most prevalent cause of all deaths for the Unmatched FI group (outpacing even natural deaths) and the most prevalent of non-natural causes for the matched FI group. Like Illinois generally (*Table 1*), the most common age range for homicide deaths was 15-24 for all groups in the study. In Illinois (*Table 1*), suicides were more

prevalent in the general population than homicides; however, it was the least prevalent cause of death in every group here, accounting for 6 percent of all deaths.

Table 26
Most common age at death, for each cause of death, by group (n=448)

Group deceased	Volume Ranking	Cause of death	Age at death					
			15-24	25-34	35-44	45-54	55-64	65+
Matched FI group	1	Natural				26%		
	3	Accident	79%					
	4	Suicide		40%				
	2	Homicide	83%					
Matched NFI group	2	Natural						36%
	3	Accident	61%					
	4	Suicide	50%					
	1	Homicide	82%					
Unmatched FI group	1	Natural				58%		
	2	Accident	50%					
	4	Suicide			50%			
	3	Homicide	88%					
Total	1	Natural				27%		
	3	Accident	66%					
	4	Suicide		28%				
	2	Homicide	85%					

Source: IDPH death certificate records

Firearm-related deaths

Information was available also on manners of death. For injury-related deaths (those from non-natural causes), the involvement of a firearm could be ascertained. In the entire study sample, firearm deaths occurred solely for homicides and suicides; there were none for accidents. *Table 27* presents the number of firearm-related deaths that occurred within each group.

Table 27
Firearm-related deaths by group (n=448)

Group deceased	Homicide Firearm deaths	Homicide Percent	Suicide Firearm deaths	Suicide Percent	Percent of all deaths
Matched FI (n=197)	64	94%*	<10	50%	37%
Matched NFI (n=160)	29	88%*	<10	36%	21%
Unmatched FI (n=130)	45	96%	<10	80%	49%
Total (n=448)	138	93%	15	50%	34%

*X^2 (1, N=8,646) =11.338, p=.001
Source: IDPH death certificate records

As might be expected, the two firearm-involved groups experienced more deaths by firearms, whether for homicide or the rare suicides. The matched FI group experienced deaths due to firearms at a higher rate than the matched NFI group, at 37 percent and 21 percent, respectively, although almost all homicides involved firearms in every group.

Approximately 15 percent of the entire study sample had been arrested for a drug charge in addition to a firearm-related charge for the two FI groups. Information on illegal drug use and alcohol abuse was collected from cause of death and circumstances information.

Table 28 presents the proportions of deaths that were firearm-involved alone, the proportions where substance use disorders (SUD), including alcohol, were indicated as contributing factors alone, and where both firearms and substances were indicated in the death.

Table 28
Manner of injury-related deaths involving firearms and substance use disorders (SUD)*, by study group (n=448)

Cause of death*	Matched FI group Firearm Alone	Matched FI group SUD	Matched FI group Both	Matched NFI group Firearm alone	Matched NFI group SUD	Matched NFI group Both	Unmatched FI group Firearm alone	Unmatched FI group SUD	Unmatched FI group Both	Total Firearm alone	Total SUD	Total Both
Natural	N/A	11%	N/A	N/A	8%	N/A	N/A	12%	N/A	N/A	10%	N/A
Accident	0%	44%	0%	0%	66%	0%	0%	69%	0%	0%	57%	0%
Suicide	43%	29%	57%	50%	14%	50%	50%	0%	50%	47%	20%	53%
Homicide	48%	0%	52%	62%	0%	38%	32%	0%	68%	46%	0%	54%
Total	48%	22%	52%	61%	26%	39%	33%	29%	67%	46%	25%	54%

Source: IDPH death certificate records
*Includes alcohol involvement

Approximately half (54 percent) of all deaths involved both firearms and drugs/alcohol. The matched NFI group exhibited a different pattern than the two firearm-involved groups. Of those deaths where the cause was homicide, the NFI group had a much greater proportion involving firearms alone (62 percent) than the matched FI group (48 percent) or the Unmatched FI group (32

percent). Conversely, drugs or alcohol alone were more likely to be a factor in NFI group accident deaths (66 percent) compared to their matched FI group (44 percent) whether through car accidents or accidental drug overdoses.

Recidivist vs. non-recidivist deaths

Obtaining information on study subject deaths added confidence that the non-recidivating rate was due to no further contact with the criminal justice system and not due to some incapacitation limiting offending opportunity. A total of 4,308 study subjects (41 percent) had no further arrests recorded in their criminal histories after 2003 (*Table 11*). Since no individual was incarcerated during the entire follow-up period, the only other incapacitation information that could cause a revision to this rate in this study was mortality.

Table 29 shows the number of individuals who were deceased before the end of the study period in 2013 and their recidivism status. A total of 206 (45 percent) of those deceased had no arrests in their CHRI history beyond the 2003 arrest. Here, the NFI group comprised a much larger proportion than either of the two firearm related groups, especially when compared to the Unmatched FI group, at 61 percent and 29 percent, respectively. Thus, the value of obtaining additional death information when conducting recidivism studies may depend on the types of offenders being examined.

Table 29
Death records found by recidivism status

| Group deceased | Recidivism status | | | |
	Yes: Death record found	Percent	No: Death record found	Percent
Matched FI (n=197)	119	60%	78	40%
Matched NFI (n=160)	62	39%	98	61%
Unmatched FI (n=103)	73	71%	30	29%
Total (n=460)	254	55%	206	45%

Source: IDPH death certificate records; ICJIA interpretation of CHRI data

The overall 10-year re-arrest rates were re-calculated based on the information on mortality for non-recidivists. *Table 30* shows what the rates would look like if the 206 deceased individuals were excluded. The mortality-adjusted rate was minimally different (1 percent in each direction) compared to the results without this adjustment (*Table 11*).

Table 30
Re-arrest rate over the 10-year follow-up period, adjusted for mortality

| | Re-arrested at least once | | | |
Group	Yes	Percent	No	Percent
Matched FI (n=4,245)	2,879	68%	1,366	32%
Matched NFI (n=4,225)	1,790	42%	2,435	58%
Unmatched FI (n=1,744)	1,443	83%	301	17%
Total (n=10,224)	6,122	60%	4,102	40%

*X^2 (1, N=8,646) =538.651, p=.000
Source: ICJIA interpretation of Illinois CHRI data; IDPH death certificate records

Timing of study subject deaths

Recidivism studies are often limited to a three-year follow-up period for practical and policy reasons (Maltz, 1984). *Table 31* shows how many of the deaths occurred within that time frame, and how many occurred beyond three years, up to the end of the 10-year follow-up period used in this study.

Table 31
Timing of deaths within the 10-year follow-up period, by recidivism status

| | Recidivism status | | | | | |
Group	Yes: Death record found	Percent	No: Death record found	Percent	Total	Percent
Matched FI (n=197)	119	60%	78	40%	197	100%
Death within 3 years	36	44%	45	56%	81	41%
Death beyond 3 years	83	72%	33	28%	116	59%
Matched NFI (n=160)	62	39%	98	61%	160	100%
Death within 3 years	24	39%	38	61%	62	39%
Death beyond 3 years	62	39%	98	61%	98	61%
Unmatched FI (n=103)	73	71%	30	29%	103	100%
Death within 3 years	28	57%	21	43%	49	48%
Death beyond 3 years	44	81%	10	19%	54	52%
Total (n=460)	254	55%	206	45%	460	100%
Death within 3 years	88	46%	104	54%	192	42%
Death beyond 3 years	166	62%	102	38%	268	58%

Source: IDPH death certificate records; ICJIA interpretation of CHRI data

More of the 460 deaths occurred beyond the usual three-year follow-up period (58 percent) than within that time frame (42 percent). Had the period of the study been extended even further, another 170 deceased individuals would have been included up through May 2017.

When considering recidivism status, the reverse was true. In both firearm groups and the overall study group, more non-recidivists were deceased within three years of their 2003 arrest than beyond three years (56 percent of the matched FI group, 43 percent of the Unmatched FI group, and 54 percent for the overall study group). The matched NFI group had more deceased persons with *non-recidivist* status (61 percent) (*Table 19*). Interestingly, there was no differentiation by time frame for this group– an equally high proportion of deaths of the NFI group with non-recidivism status occurred within three years and after three years (61 percent).

Summary of mortality information

Death certificate records indicated that 448 individuals, or 4 percent of the entire study sample, died within the 10-year follow-up period, with an additional 12 records indicating individuals' deaths verified in CHRI records. These 460 individuals died most often of natural causes (40 percent), followed by homicide (33 percent) and accidents (20 percent). Very few died of suicidal causes (7 percent).

A higher proportion of men died in all three groups than women. Proportionally more Whites died in the matched FI group, while proportionally more Blacks died in the matched NFI group. The minimum and average ages at death were younger for the matched FI group (age 15.8 years) than the other two groups.

While misdemeanor arrests accounted for only 23 percent of initial arrests for the matched FI and NFI groups, proportionally more of these persons died than those initially charged with a felony offense. Misdemeanor charges are less likely to result in pretrial or sentenced incarceration than felonies, perhaps suggesting an incapacitation effect on the risk of death besides the risk of recidivism.

Of those who died in the Unmatched FI group, almost half (47 percent) died of homicide, a higher rate than for the matched FI group (35 percent) or the matched NFI group (21 percent). Conversely, the matched NFI group died at a higher rate of natural cause (48 percent), and at predominantly older ages (65 +) than the two FI groups. In all three groups, persons dying from injury-related causes were most often in the youngest age group (15 to 24).

Firearms were the predominate weapon used in almost all homicide-related deaths and half of the suicides. Evidence showed that both firearms and drugs/alcohol (substance abuse disorders) were involved in about half of the injury-related deaths. Proportionally more of the deaths in the matched FI group involved both firearms and substance abuse disorders than the matched NFI group, including the homicides. Deaths in the Unmatched FI group involved both firearms and substance abuse disorders at the highest rate, including homicides (68 percent).

The mortality data added little information about non-recidivists within the study period. While 45 percent of all death records applied to those not recidivating, the exclusion of these 206 individuals from recidivism calculations changed the overall recidivism rates negligibly (by 1 percent). In terms of timing of the deaths, proportionally more deaths of non-recidivists occurred within three years of the initial arrest event compared to recidivists, at 54 percent and 46 percent, respectively. This finding on the timing of deaths within a study period may have implications for future recidivism study designs where mortality records are sought for censoring observations.

Multivariate analyses
Matched FI and NFI groups

To further investigate the sample data and gain additional insights into the implication of continued arrests with firearm-related charges, the following two classes of statistical analysis were conducted: survival analysis and regression analysis for count data. Each class of statistical analysis targeted a different aspect of the sample data; that is, survival analysis focused on the risk of the first re-arrest event for the sample and the regression analysis for count data examined the total number of re-arrests. Throughout the analysis, the CHRI data was supplemented by the incapacitation information derived from IDOC files (time spent in prison and away from community) and IDPH files (death certificates). For these analyses, the Unmatched FI group was excluded due to lack of a suitable comparison group.

Survival analysis

Survival analysis refers to "a collection of statistical procedures for data analysis, for which the outcome variable of interest is time until an event occurs" (Singh & Mukhopadhyay, 2011). To begin, an event (often called failure) must be defined, which becomes the key subject of the survival analysis. In this study, the event of interest was the first occurrence of an arrest for a new offense after the initial 2003 arrest. It would have been ideal to use the date of adjudication of the initial 2003 arrest as the analysis starting point, but the volume of missing disposition information (at least 20 percent) in the CHRI records would have resulted in the exclusion of too many cases and potentially skewed results.

There were at least two ways to determine the time to recidivism event. The first was to calculate the days between the first arrest and the first re-arrest without consideration of the individual's opportunity to reoffend due to incapacitation; the second was to exclude from that calculation any days during which the individual was found to be incapacitated and unable to be re-arrested.

The analysis also accounted for "censored events", or situations that limited the observation of occurrence of the event of interest for each given data point. The sample data had at least two sources of right censoring. The first was associated with the study design, in that no event was observed beyond the 10 years of study period. Here, the time-to-event was the 3,653 days from the first arrest date to the end date of the observation period. The second source of the right censoring was death of the individual within the observation period. As previously mentioned, approximately one-quarter of the death certificates originally matched to study subjects were excluded due to the deaths occurring beyond the study period.

Combining these two factors, the study compared three different versions of time-to-event for conducting the survival analysis. The first time-to-event analysis was based on the CHRI files alone, with no consideration of excluded or censored data points. The second version incorporated the incarcerated time for each offender, as determined from IDOC files. The third version of the time-to-event integrated the first two data sources (CHRI and IDOC records) with death information, as an additional source of withdrawal from the study.

These three versions of survival analysis also were duplicated for an analysis of time to recidivism for firearm charges alone. Here, non-firearm first-time arrests were an additional source of right-censoring.

Descriptive summary of survival data

Table 32 presents summary statistics of all three versions of time to event. It can be observed that, with additional factors (time in prison and death), the median and mean days to recidivate decreased slightly. Also, the difference between the mean and median values suggested a right-skewed distribution for each time-to-event measure.

Table 32
Summary of time-to-event measures

Summary statistics (in days)	Time to event (1) CHRI only	Time to event (2) CHRI and IDOC data	Time to event (3) CHRI, IDOC, IDPH data
Minimum	1	1	1
1st quartile	269	252	249
Median	1,852	1,497	1,320
Mean	1,986	1,908	1,868
3rd quartile	3,653	3,653	3,653
Maximum	3,653	3,653	3,653

Model estimation strategy

The one-to-one matched sample (FI group and NFI group) was fitted to a variety of survival analysis models. More specifically, two different approaches were taken - the Kaplan-Meier estimator for survival rates and Cox's proportional hazards regression models. For each approach, the three versions of time-to-event were used to fit the models for the total 8,646 observations.

For the Kaplan-Meier estimator, two separate curves were fitted, one for the FI group and the other for the NFI group, for each time-to-event measure. Log-rank tests were then conducted with the null hypothesis of no difference between two survival curves.

For the Cox proportional hazards models, three sets of explanatory variables based on information at the time of the 2003 arrest were used as the response variable, for each version of time-to-event. *Table 33* presents a summary of these three sets of explanatory variables.

Table 33
Explanatory variables used in the Cox proportional hazards models

Explanatory variable (at initial 2003 arrest)	Values	Set 1	Set 2	Set 3
Group membership	FI, NFI	Yes	Yes	Yes
Sex	Female, male	No	Yes	Yes
Race	Black, White, other	No	Yes	Yes
Age at first arrest	10 to 90	No	Yes	Yes
Location at first arrest	Cook County, other Illinois counties	No	Yes	Yes
Highest class of offense	Felony, Non-felony, unknown	No	No	Yes
Murder charge present	Yes, No	No	No	Yes
Violent offense present	Yes, No	No	No	Yes
Drug charge present	Yes, No	No	No	Yes
Property charge present	Yes, No	No	No	Yes

Explanatory variable Set 1 included the group membership only (FI or NFI). Set 2 added demographic and geographical variables, including sex, race, age at the first arrest in 2003, and the location of the first arrest (Cook County or others). Finally, Set 3 incorporated the characteristics of the 2003 arrest, including the highest charge class, murder flag, violent offense flag, drug flag, and property flag.

The same three explanatory variable sets were also used for the models of firearm re-arrests.

The goodness of fit of models were compared using the Akaike Informational Criterion, $AIC = 2k - 2\ln(L)$, where k is the number of estimated parameters and L is the maximum likelihood function value of the model.

Model results

Kaplan-Meier estimator for any re-arrest and FI re-arrest

The key objective of estimating survival curves was to determine whether the group membership (FI or NFI) had impact on the survival rate. The results indicated that the survival curve for the FI group that was significantly different from that for the NFI group.

For a first re-arrest for any charge, the log-rank test results for all three time-to-event measures reject the null hypothesis ($p < 0.01$) that there is no statistically significant difference between the two survival curves. The same held true for the survival curves for the first firearm re-arrest only, for all three time-to-event measures.

It must be noted that in case of the first firearm re-arrest only, non-firearm recidivism arrests were considered as another source of right censoring. However, while estimating a survival curve assumes that the censoring of data is non-informative, in this context, such an assumption may not hold. See Clark et al. (2003) for key requirements for analyzing survival data.

The following two figures, *Figure 4* and *Figure 5*, illustrate the survival curves based on the third time-to-event measure for any first re-arrest and the first firearm re-arrest only, respectively. This measure included incapacitation information available in both the IDOC and death certificate records. The y axis of the second figure was adjusted for a better visibility. In both cases, the survival rate of the FI group decreases at a much faster rate than the NFI group.

Figure 4
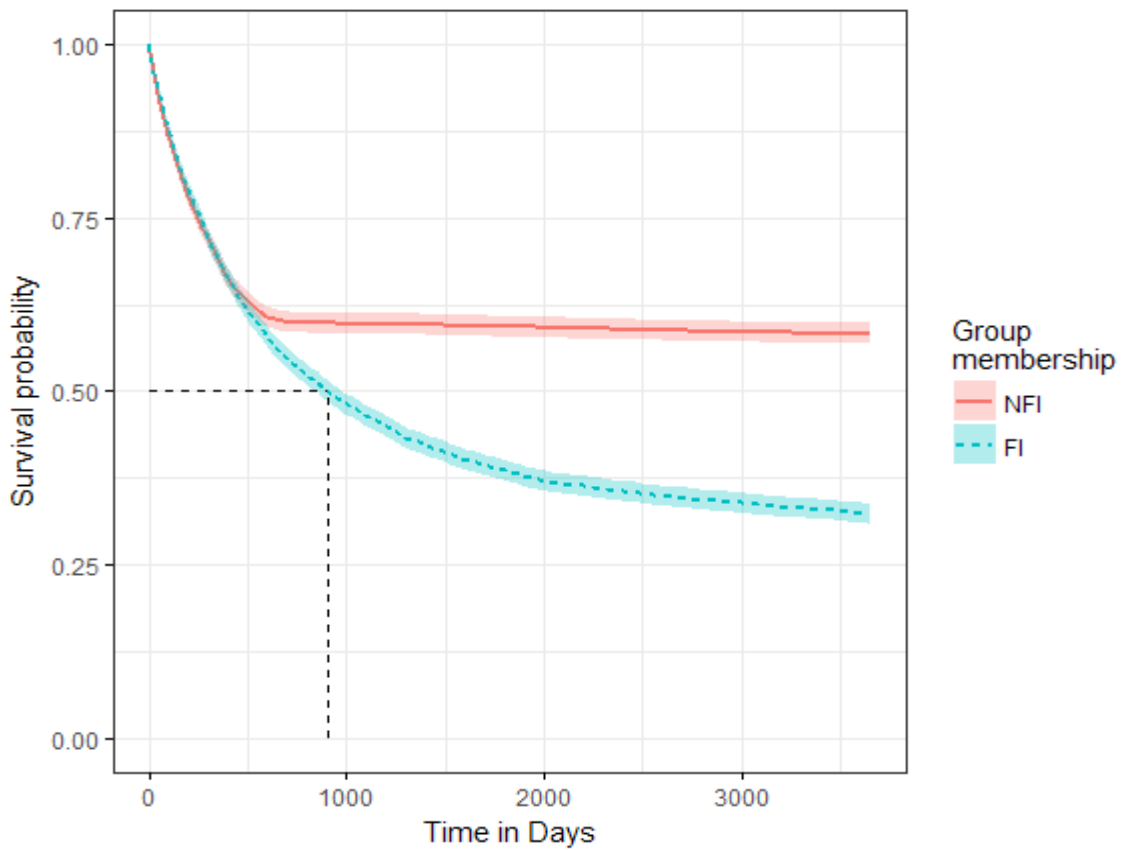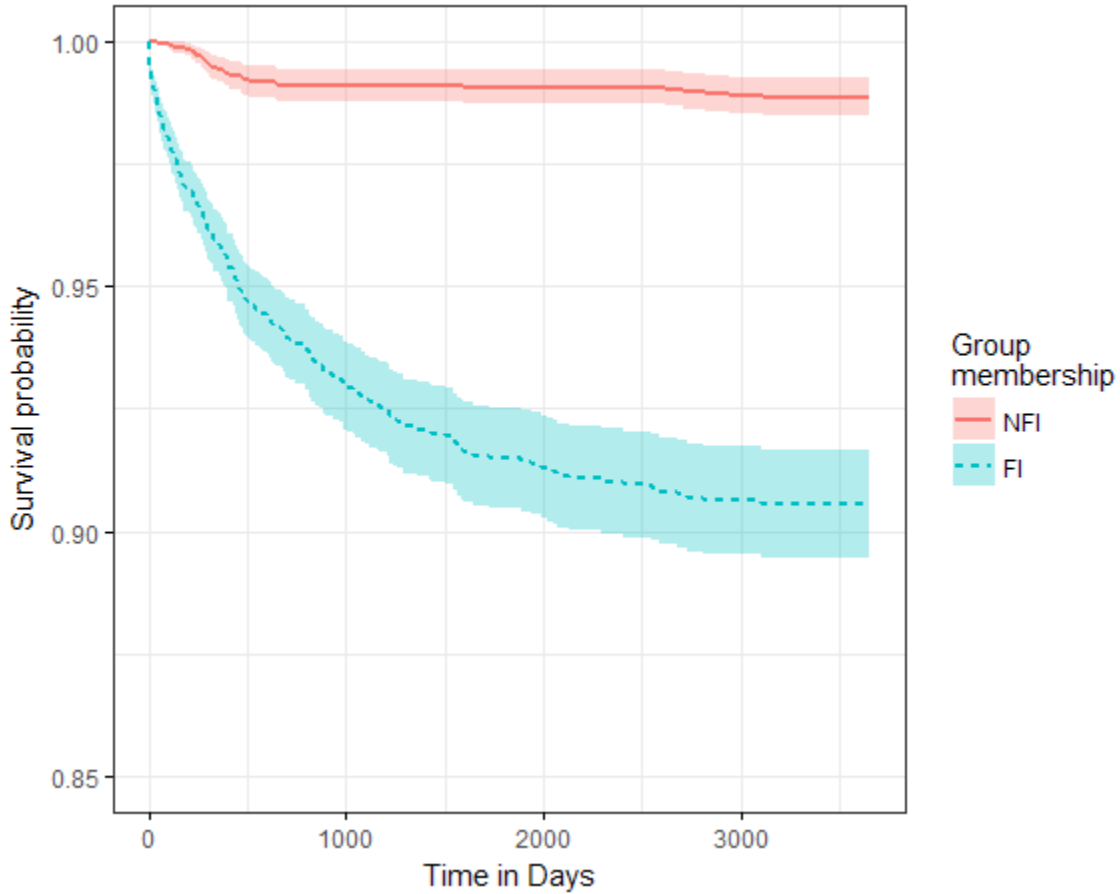**Survival curve for first re-arrest for any charge, by group membership**

Figure 5
Survival curve for the first firearm re-arrest only, by group membership

Proportional hazards for any re-arrest

Models with more variables generally improve the model fit. However, in this study, only small improvement was observed across all time-to-event measures as explanatory variables were added. Incorporating demographic and geographical variables lead to an approximately 1.25 decrease in AIC value (Set 2). Including the characteristics of the first arrest (Set 3) lead to minimally smaller AIC values (less than 0.05). Similarly, across all covariate sets, including more information into the time-to-event measure tended to minimally improve the model fit.

In terms of the estimated coefficients, the analysis focused on the group membership variable, i.e., being in the FI group as opposed to the NFI group. The point estimate of the coefficient of the group membership was very large, ranging from 0.54 to 0.57. In other words, the risk of re-arrest

was, on average, 70 percent higher for the FI group, controlling for the effect of other covariates. In general, adding more covariates (Set 3) and adding more incapacitation information (CHRI, IDOC and IDPH) to the time-to-event measure increased the coefficient size. In addition, the coefficient estimate for the group membership was statistically significant ($p < 0.01$) in all fitted models.

Table 34 shows the best model results with the lowest AIC value: a Cox model with the third time-to-event measure and the third covariate set.

Table 34
Best Cox proportional hazards model results on any first re-arrest

Explanatory variable	B	SE	Exp (B)	p-value
Covariate Set 1				
FI (ref. NFI)	2.252	0.183	9.509	0.000
Covariate Set 2				
Male (ref. female)	0.929	0.244	2.532	0.000
Race (ref. Black)				
White	-0.539	0.127	0.583	0.000
Other	-0125	0.325	0.882	0.701
Age	-0.049	0.007	0.953	0.000
Cook County (ref. non-Cook County)	-0.152	0.121	0.859	0.210
Covariate Set 3				
Highest class of offense (ref. felony)				
Not felony	-0.013	0.039	0.987	0.740
Unknown	-0.045	0.052	0.956	0.388
Offense type				
Murder	-0.864	0.355	0.421	0.015
Violent	0.049	0.033	1.050	0.148
Drug	0.183	0.043	1.200	0.000
Property	0.006	0.066	1.006	0.925

Besides group membership, the coefficient estimates for being male and the drug offense flag appear to be positively correlated with the daily hazard of re-arrest. Conversely, being of a race other than Black, being older at age of first arrest, and being arrested for murder appeared negatively correlated with the risk of re-arrest. The other covariates, such as location of the initial arrest within the state, or being arrested for a violent offense, were not statistically significant or even suggestive across the models.

Lastly, the global proportionality test results indicated that all the fitted regression models were violating the proportional hazards assumption ($p < 0.001$).

Proportional hazards for firearm-related re-arrest only

The fitted proportional hazards models with the first firearm re-arrest as the event of interest show somewhat different results than the models with the any first re-arrest. In terms of the model fit, including the demographic and geographical variables (Set 2) lead to a modest improvement, while further adding the characteristics of the first arrest (Set 3) worsened the model fit. Incorporating more information into the time-to-event measure (IDOC and IDPH) also hurts the model fit. Importantly, only a few of the fitted models with firearm re-arrest as the event of interest violated the assumption of proportional hazards, thereby providing some justification for the use of the model.

The coefficient estimate for the group membership (FI and NFI) was considerably larger in the firearm re-arrest models, running from 2.19 to 2.25. That is, the risk of the first firearm re-arrest is, on average, roughly 800 percent higher with the FI group. Adding more covariates led to an increase in the effect size. However, with respect to adding more information to the time-to-event measure, incorporating the incarceration time information led to an increase, while further including death information decreased the coefficient size.

Table 35 shows the best model results with the lowest AIC value: a Cox model with the third time-to-event measure (CHRI, IDOC and IDPH) and covariate set 2.

Table 35
Best Cox proportional hazards model results for firearm first re-arrest

Explanatory variable	B	SE	Exp (B)	p-value
Covariate Set 1				
FI (ref. NFI)	2.252	0.183	9.509	0.000
Covariate Set 2				
Male (ref. female)	0.929	0.244	2.532	0.000
Race (ref. Black)				
White	-0.539	0.127	0.583	0.000
Other	-0125	0.325	0.882	0.701
Age	-0.049	0.007	0.953	0.000
Cook County (ref. non-Cook County)	-0.152	0.121	0.859	0.210

As can be seen, besides group membership (FI, NFI) the coefficient estimates for being male is positively correlated with the daily hazard of re-arrest for a new firearm charge, while being of a race other than black, and being older at the first arrest appear negatively correlated with the risk of re-arrest for a new firearm charge. As to the other covariates, the coefficient estimates for sex, race, and age variables appear statistically significant again. As with the model for first re-arrest for any charge type (above), having been first arrested in Cook County was not a statistically significant explanatory variable.

Summary

The survival analysis models indicate that the presence of firearm-related charges has statistically significant implications regarding the daily risk of re-arrest, both for any crime type, and new firearm offenses specifically. Besides being arrested for a firearm-related charge (regardless of severity of that charge, short of murder), other factors that are likely to increase the risk of re-arrest include being male and younger at age of first arrest. In contrast, being White is associated with a decrease in the risk of re-arrest with firearm charges.

Regression Analysis for Count Data

Regression analysis of recidivism arrest counts provided additional insight into the implication of arrests with firearm offense charges.

The target or response variable for this analysis was the number of re-arrests for each individual. The distribution of the number of re-arrests in the one-to-one match sample (FI and NFI groups) was highly skewed to the right with a sizable number of zeroes (n=3,977 or approximately 46 percent of the 8,646 observation points) and a few extreme values to the right. The median value was 1 and the mean was 2.81. The distribution was highly over-dispersed, with the variance of 24.21, which is more than eight times the mean value.

Additional observations could be made across the FI and NFI groups. The distribution of re-arrest events for the FI group has a greater mean and a considerably larger variance than the distribution of number of re-arrests for the control group. As a result, the NFI group distribution was much more over-dispersed. In addition, approximately two-thirds of all zeroes (n=2,533 or 63.69 percent) were from the control group, which accounts for more than the half of the in-group observations. In contrast, less than a third of the observations (n=1,444 or 27.55 percent) are zeroes for the FI group.

Similar findings can be made about the distribution of firearm re-arrests, except for the fact that there are significantly more zeroes (no re-arrest with any firearm offense charges) in this case (n=7,816).

Table 36 presents the count data summary statistics for both cases of any arrests and firearm re-arrests.

Table 36
Summary of number of re-arrests and firearm re-arrests

Summary statistics (in days)	Any re-arrest		Firearm-involved re-arrest	
	FI group	NFI group	FI group	NFI group
Minimum	0	0	0	0
1st quartile	0	0	0	0
Median	1	2	0	0
Mean	4.65	1.07	0.38	0.02
3rd quartile	7	1	0	0
Maximum	65	22	12	3

Model estimation strategy

The one-to-one matched sample of 8,646 observations was fitted to a variety of regression models for count data. More specifically, three different types of Poisson and negative binomial models were fitted and compared: regular, hurdle, and zero-inflated models.

As in the survival analysis, each kind of model was fitted using the same three measures for time to re-arrest and the three sets of explanatory variables (*Tables 32* and *33*). In addition to these combinations of covariates, models were also fitted without time-to-event variables, to measure the effect of including such variables for the same combinations of model types and covariate sets. When fitting zero-adjusted models (hurdle or zero-inflated), the same sets of explanatory variables were used for both zero and count models.

Model results

Re-arrest for any type of charge

In all cases, negative binomial models showed a remarkably better fit than Poisson models (i.e., a maximum of 33 percent decrease in AIC value) for the relevant covariate set and time-to-event variable. This is likely because of considerable over-dispersion in the response variable, i.e., the number of re-arrests. Accounting for zeros in the data with hurdle and zero-inflated models also showed a sizable improvement in model fit. More specifically, hurdle models tended to give better estimation results than zero-inflated models.

Also, incorporating more information into the time-to-event variable (CHRI, IDOC, IDPH) improved the model fit overall. For example, the lowest AIC score with time-to-event was 32 percent lower than the lowest AIC score without time-to-event. As to the comparison across different covariate sets, adding demo-geographic variables lead to a sizeable improvement in model fit (approximately 5 percent lower in AIC score), while further incorporating first arrest characteristics resulted in little, if any, improvement.

Across all successfully fitted models, the coefficient estimate for being in the FI group, which was the focus of our analysis, was statistically significant ($p < 0.01$), or at least statistically suggestive ($p < 0.05$), and positively correlated with the expected log counts of recidivism arrests for any crime type. The coefficient size was also large, ranging from 1.2 to 1.5 in models with time-to-event variables. Adding more information to time-to-event measure, as well as adding any more covariates to the model has little effect on the coefficient size for the FI group membership.

Table 37 shows the best model results with the lowest AIC value: a hurdle negative binomial model with the first time-to-event measure (CHRI data alone) and the covariate Set 1 (Group membership alone).

Table 37
**Best count regression model (hurdle negative binomial) results for the number of
re-arrests for any crime type**

Explanatory variable	B	SE	Exp (B)	p-value
(intercept)	0.674	0.034	1.963	0.000
Time to event (CHRI only)	-0.001	0.000	0.999	0.000
Covariate Set 1				
FI (ref. NFI)	1.523	0.037	4.588	0.000
Log (theta)	0.157	0.048	1.171	0.001

As for other covariates (not shown), being male, additional days in the time-to-event measure, being white as opposed to black, and additional years in the first arrest age consistently appeared to be at least statistically suggestive ($p < 0.05$) in other successfully fitted models. Only being male was positively correlated with the expected log counts of re-arrest for any crime; the rest were negatively correlated with any re-arrest.

Firearm-related re-arrest

Model estimation results using the firearm re-arrest counts as the response variable were similar to estimation results from the analysis of any type of re-arrest counts described above. There were some notable differences, however. In the case of firearm re-arrests, either Poisson or negative binomial, hurdle models generally showed worse model fits than zero-inflated models. This observation may be consistent with the assumptions of hurdle and zero-inflation models; that is, in the firearm re-arrest counts models, the possibility of non-firearm recidivism arrests presents another source of zeroes for the count (Hu, Pavlicova & Nunes, 2011).

Another difference can be found in the effect of incorporating more information into the time-to-event variable on the model fit. While incorporating the incarcerated days into the time-to-event improved the model fit, the further addition of information on death did not. The effect on the model fit of adding more covariates was similar to that in the count models for any type of arrest, as described above.

The coefficient estimate for being in the FI group, as before, appears statistically significant ($p < 0.01$) across all models. The size of coefficient estimates is much larger in firearm re-arrest models than in any re-arrest models, in cases of regular Poisson and negative binomial models. This was not observed with the hurdle and zero-inflated models. However, since the adjusted models better accounted for the distribution of firearm re-arrests in the sample data, which is also supported by their better model fits, it would be more reasonable to conclude that the size of the effect of FI group membership is similar between the cases of any re-arrest and firearm re-arrest counts.

Table 38 shows the best model results with the lowest AIC value: a zero-inflated negative binomial model with the first time-to-event measure (CHRI alone) and covariate Set 2.

Table 38
Best count regression model (zero-inflated negative binomial) results for the number of firearm-involved re-arrests

Explanatory variable	B	SE	Exp (B)	p-value
(intercept)	-1.406	0.485	0.245	0.004
Time* (CHRI only)	-0.002	0.001	0.998	0.017
Covariate Set 1				
FI (ref. NFI)	1.456	0.278	4.290	0.000
Covariate Set 2				
Male (ref. female)	10.30	0.359	2.800	0.004
Race (ref. Black)				
White	-0.171	0.112	0.843	0.128
Other	0.053	0.345	1.054	0.878
Age	-0.042	0.008	0.959	0.000
Location at first arrest				
Cook (ref. non-Cook County)	0.027	0.108	1.027	0.949
Log (theta)	0.014	0.221	1.014	0.949

*Intervals of 10 days instead of daily

For covariates besides membership in the FI group, being male and younger at the initial arrest were the only characteristics positively correlated with the expected log counts of re-arrest for a firearm charge. Here, neither race nor geographic location was statistically significant or even suggestive. Further, the shorter the time between initial arrest and re-arrest, the more likely that re-arrest was to be for a firearm arrest.

Summary of count data regression findings

The best model estimation results for count data suggested, in general, that whether the total number of re-arrests involves firearm offenses or other types of charges, that young males are more likely to get re-arrested than those with different demographic characteristics. Geographic area and characteristics of the first arrest were not predictive of the number of future re-arrests, especially for firearms.

Implications for policy and practice

The results of this study have implications for policy and practice regarding firearm-related crime and its consequences, as well as recommendations for further research.

Consider first-time firearm-related arrests as important predictors of recidivism and mortality risk of those arrested.

During the period studied, first arrests for gun-related offenses were highly predictive of future arrests, especially new firearm arrests. Further, this group of arrestees was at greater risk for homicidal death from a firearm than other criminal-justice involved individuals not arrested for firearm-related charges. A better understanding of the risk factors associated with initial gun involvement is needed to develop the most appropriate and effective intervention and prevention strategies. This study could not measure motivational factors for either firearm involvement or avoidance of firearms, except to document that these behaviors persisted over years. In the short term, those dealing with firearm-involved individuals should be aware that even minor initial illegal firearm involvement can signal risk of serious long-term consequences for both public safety and the involved individual, and should not be minimized as a risk factor.

Learn from the persistently non-firearm involved individuals

This study used statistical techniques that matched firearm-involved and non-firearm-involved individuals on a one-to-one basis using 16 demographic, geographic (county), arrest charge type, and prior criminal criteria. A surprising finding was the stability of the non-firearm group membership over time. That is, few, if any, of this group went on to be arrested for firearm-related charges over the next 10 years, although some became victims themselves of fatal firearm violence. This group was composed of an equal number of individuals with characteristics significantly associated with firearm recidivism (being male, Black, and at a young age at the time of arrest) (Wintermute, 2015) as the matched firearm-involved group, yet remained not involved with firearms for subsequent re-arrests. While county-level geography (Cook County vs. rest of the state) was not found to be related to recidivism in this study, other community factors not measured here, such as differences in gun availability, and gang or drug market presence, may help to explain this finding. The non-gun offenders also could possess more protective factors not measured in this study, such as better employment opportunities or access to social services. Further study of this group could produce valuable information for the development of new prevention strategies.

Apply a multidisciplinary approach to the state's social problems by leveraging agency collaboration and the capacity to match criminal history records with other data sources

In this study, researchers combined criminal history and prison records with public health data to provide a unique perspective on firearm recidivism, an issue relevant to both criminal justice and public health systems. Success was achieved not only from a technical record matching standpoint, but from the broader perspective of a collaborative approach among the state agencies involved in

this research.

Often, other agencies are not aware of the impact that criminal justice-involved sub-populations have on their specific areas of responsibility, and have no way to measure or evaluate this impact. For example, it could not be known how many of the study subjects were wounded by gun shots and hospitalized, only the number that did not survive. If hospitals and health care providers could learn of the likelihood of gunshot wound patients' future criminal justice-related incapacitation, such as imprisonment, that information could assist with more effective coordination of follow-up care, and expand knowledge about persons involved with firearms.

Success in understanding and tailoring solutions to important social issues will occur at a faster pace when policymakers bring multidisciplinary perspectives to data gathering and sharing initiatives. Currently, the state is planning the development and implementation of the new Incident-based Reporting / Uniform Crime Reporting (IBR/UCR) program (Uniform Crime Reporting Program, 2011) which will allow law enforcement agencies to report contextual information on each crime incident. Incorporation of information on the outcome of the incident, such as criminal justice identifiers of persons arrested for the crime, or the location of the hospital to which a victim was transported, will provide authorized users with enhanced capability to match records across systems, overcoming administrative and technical barriers to information sharing, for statewide benefit.

Conclusion

This study successfully combined CHRI records with other criminal justice and public health administrative records to improve knowledge about gun offender recidivism patterns and more precisely estimate recidivism rates. It was possible to demonstrate that, holding other characteristics constant, those facing the criminal justice system for the first time as firearm offenders persisted in criminal justice involvement for firearms at a much higher rate and for a longer period than their justice system-involved peers who were not engaged with firearms.

Finally, and most tragically, the mortality records showed that firearm-involved arrestees were themselves killed twice as often as non-firearm involved arrestees, most often because of a firearm injury. These homicide victims were predominately within the age range of 15 to 24-years old, a finding that urgently calls for implementation of prevention and intervention strategies tailored specifically to this age group to avert this premature loss of life.

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Appendix A: Distribution of firearm charges

Distribution of violent firearm charges by group

Violent firearm arrest charges	Matched FI group (n=4,337)	Unmatched FI group (n=1,791)
Aggravated battery w/firearm	1,085	389
Armed robbery w/firearm	748	336
Aggravated discharge of firearm	273	90
Reckless discharge firearm	150	35
Armed violence	124	43
Aggravated vehicular hijacking w/firearm	76	42
Aggravated assault/discharge firearm	59	22
Aggravated unlawful restraint	24	<10
Home invasion w/firearm	20	<10
Aggravated battery/firearm/school employee	19	<10
Aggravated sexual assault w/firearm	<10	<10
Aggravated battery/silencer/officer	<10	<10
Aggravated discharge firearm/police/fire personnel	<10	<10
Aggravated discharge firearm/school employee	<10	<10
Illegal discharge metal piercing bullet	<10	<10
Kidnapping armed w/firearm	<10	<10
Aggravated discharge firearm/first aid personnel	<10	<10
Total arrest charges*	2,613	948

*Individuals were charged with multiple firearm offenses, both violent and non-violent

Distribution of non-violent firearm charges by group

Violent firearm arrest charges	Matched FI group (n=4,323)	Unmatched FI group (n=1,774)
Possess firearm/invalid FOID ID Card	1,545	425
Unlawfully carry weapon	1,033	246
Unlawful possession of weapon by a felon	982	**513**
Aggravated unlawful use of weapon/vehicle	690	269
Aggravated unlawful use of weapon/on person	579	261
Unlawful use of weapon	243	44
Aggravated unlawful use of weapon	221	65
Illegally possess ammunition/no FOID ID Card	219	56
Unlawful possession handgun/under age 18	166	40
Deface firearm ID markings	156	73
Possession stolen firearms	107	25
Unlawful possession firearm	73	25
Unlawful possession firearms/ammunition	66	12
Illegally possess/store weapons in public housing	63	<10
Unlawful sale firearms/Fail to keep registry	47	<10
Uncased gun	20	<10
Unlawful use of weapon/silencer/machine gun/exploding bullet	20	<10
Board plane w/dangerous weapon	19	<10
Violate bail bond/escape/possess firearm	16	<10
Total arrest charges*	6,265	2,080

*Individuals were charged with multiple firearm offenses, both violent and non-violent

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