Elevated Rates of Urban Firearm Violence and Opportunities for Prevention—Wilmington, Delaware

Final Report

Prepared By:

Steven Sumner, MD, MSc – Epidemic Intelligence Service Officer
James Mercy, PhD – Director, Division of Violence Prevention
Susan Hillis, PhD – Senior Advisor, National Center for Injury Prevention and Control
Matthew Maenner, PhD – Epidemic Intelligence Service Officer
Christina Socias, DrPH – Epidemic Intelligence Service Officer

Division of Violence Prevention
National Center for Injury Prevention and Control
Centers for Disease Control and Prevention

November 3, 2015

Submitted to:
Secretary Rita Landgraf
Delaware Department of Health and Social Services

Background of the Field Investigation:

In 2013, Wilmington, Delaware, experienced 127 shooting incidents resulting in 154 victims.[1] This represented nearly a 45% increase in the number of shootings over the preceding two years.[1] Furthermore, rates of violent crime in Wilmington are higher than in nearby cities of Dover, Newark, and Philadelphia.[2] Indeed, although Wilmington is a moderately-sized city of approximately 71,525 residents, when compared to all large cities in the United States, its homicide rate in recent years has been reported to be as high as 4th overall.[3] In fact, in recent years, the growth in Delaware's homicide rate (Wilmington is the largest city in Delaware) has outpaced that of every other state (see Figure 1 below).

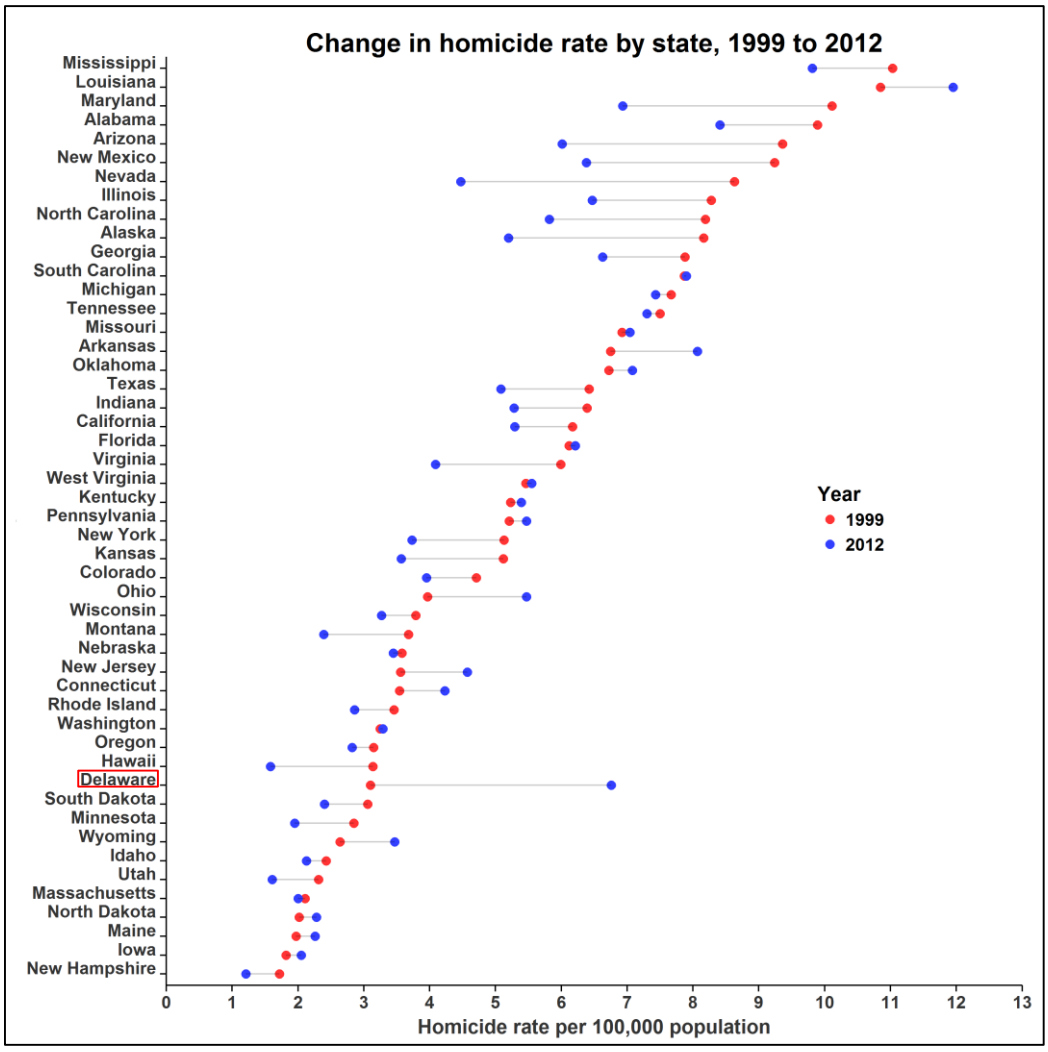


Figure 1. Note: Vermont not included as rates not reported for 2012

1. Delaware Online. Wilmington Shootings: Incidents by year. 2015. http://data.delawareonline.com/webapps/crime/.
2. Nolan J. Aggravated Assault and Homicide Incidents in Wilmington: 2010-2013. 2013.
3. Cornish A. Wilmington, Del., Struggles With Outsized Murder Rate January 1, 2014. http://www.npr.org/2014/01/01/258889969/wilmington-del-struggles-with-outsized-murder-rate

As a result of persistently elevated urban firearm violence rates, the Wilmington City Council passed a resolution to request the Centers for Disease Control and Prevention (CDC) to assist in an investigation and provide recommendations for preventive action.[4] The Delaware Division of Public Health, with concurrence from the City Council and Mayor's office, issued a formal invitation to CDC to provide epidemiologic assistance and make programmatic recommendations for a public health response.

Investigation Rationale and Objectives:

Urban firearm violence results in a substantial degree of fear among city residents, slowing of business growth, straining of city resources, and suffering among victims' families. However, in spite of the tremendous impacts of such violence on a city, only a relatively small number of individuals are actually responsible for committing these particular crimes. For example, in 2013, Wilmington experienced a reported 127 shooting incidents. If we assume one person committed each shooting, this equates to 127 individuals committing firearm violence out of a total population of about 71,000 residents, which is less than 1 out of every 500 residents. Because only a relatively small proportion of individuals are involved in firearm crimes, accurately focusing prevention efforts could have a significant impact on lethal violence in urban city centers and be an important component to a larger comprehensive approach to violence prevention.

CDC's investigation sought to utilize several Delaware administrative data sources to explore the feasibility of using public health resources in a more efficient manner, focusing comprehensive wrap-around services to individuals at the highest risk of violent crime involvement. Such services might include peer outreach/mentorship, medical care or counseling, educational support, economic assistance, or other services.

The objectives of this investigation were:

1. To assist the Delaware Division of Public Health and the City of Wilmington in examining the characteristics of persons involved in urban firearm crimes.

2. To provide epidemiologic information that can help the Delaware Division of Public Health focus educational, social, medical, and other assistance to populations at risk.

3. To identify strategies for Delaware officials to help monitor and prevent future violence.

Scientific Methods:

Individuals involved in firearm crimes

The primary analysis sought to develop a pilot tool that could potentially better identify the multiple risk factors of individuals at the highest risk of involvement in firearm crimes so that appropriate public health and social services could be provided more efficiently. To understand these characteristics, investigators first examined Delaware law enforcement records.

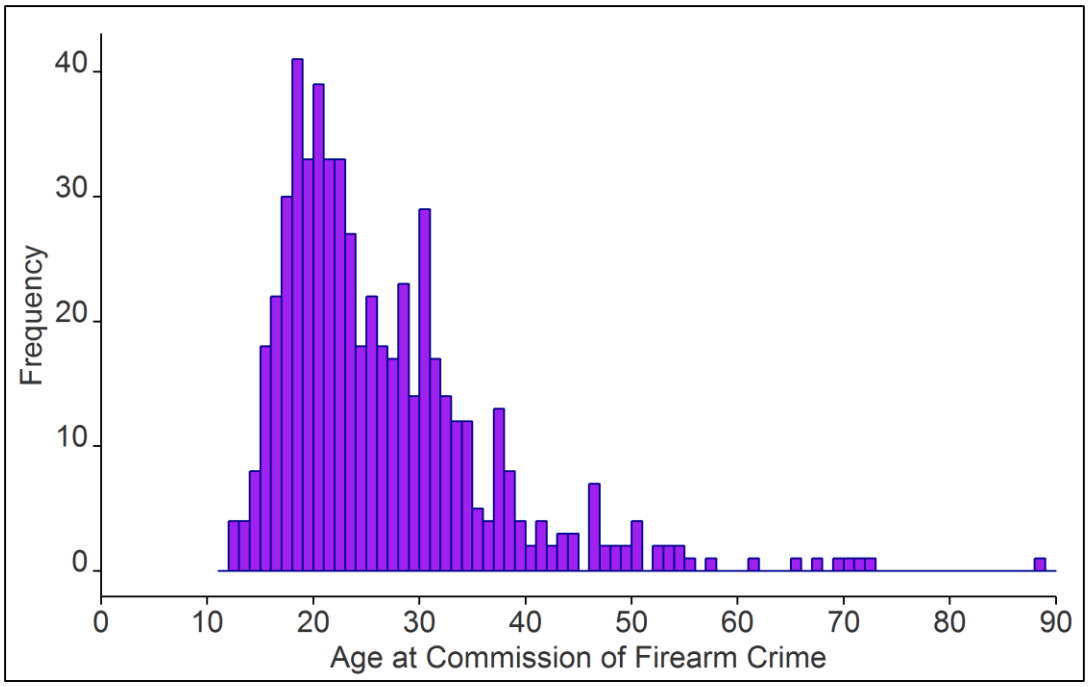
From a police database, Wilmington residents arrested for a violent firearm crime in the city of Wilmington between January 1st, 2009, and May 21st, 2014, were identified. A violent firearm crime was defined as homicide, attempted homicide, aggravated assault, robbery with a firearm, or possession of a firearm during the commission of a felony. Such events were identified based on crime codes and state statue violations.

This search yielded 569 individuals. Approximately 95% of these individuals were male. The age of individuals involved in firearm crimes at the time of the offense is as follows (totals may sum to more than 100% due to rounding):

- under age 18: 15.1%
- age 18 to <25: 39.4%
- age 25 to <30: 16.5%

- age 30 to <35: 14.8%
- age 35 to <40: 6.0%
- age 40 and older: 8.3%

Figure 2. Age distribution of individuals committing firearm crimes



Identification of risk factors for firearm crime involvement

To focus prevention services, risk factors for firearm crime involvement must be understood in Wilmington. Consequently, several local administrative data sources were used to explore preceding patterns of events in individuals' lives before they committed a firearm crime. These administrative data sources included the Delaware Department of Services for Children, Youth and their Families, Delaware Criminal Justice Information System, Delaware Department of Education, Delaware Department of Labor, and Christiana Care Health Care System. The prevalence of several major risk factors were examined for each of the individuals involved in

firearm crimes. The percent of individuals experiencing these risk factors are shown in table 1 below:

Table 1. Proportion of 569 individuals involved in firearm crimes who experienced each risk factor

Type of Risk Factor	Number	Percent (%)
Emergency Department Visit History		
Gunshot wound	72	13
Stabbing	27	5
Blunt weapon injury	36	6
Physical fight	107	19
Suicidal ideation/attempt, self-inflicted injury	46	8
Clinical encounter involves police(a)	113	20
Any emergency department event listed above	271	48
Labor Indicators		
Unemployed in quarter preceding the crime(b)	410	86
Application filed for unemployment benefits	100	18
Child Welfare Investigation History		
Investigated as victim of child maltreatment	159	28
Out of home placement	39	7
Any child welfare event listed above	167	29
State Juvenile Services Participation		
Community probation	284	50
Residential detention	215	38
Behavioral health services	91	16
Managed care services	160	28
Any juvenile service listed above	308	54
School System Events(c)		
Recipient of social assistance programs ever	327	73
Prior suspension/expulsion	186	42
Dropped out prior to high school graduation	105	24
≥10 unexcused absences in school year preceding crime(d)	57	58

(a) Injury from legal intervention or patient brought in/discharged to police
(b) Among those with wage data available
(c) Among those for whom school enrollment was confirmed
(d) Among individuals enrolled in school year preceding crime date

Note: Each risk factor or category is not mutually exclusive (an individual may have multiple risk factors in multiple categories). Emergency room data available since 2000; child welfare/juvenile services data available since 1992; labor data available since 2006; education data available since 2002

Using risk factors to focus efforts

Although some risk factors may be common in the lives of individuals involved in firearm crimes, they may not be the strongest signals of risk of firearm violence involvement. This is because some risk factors may also be very common in the general population. To further explore what are the strongest risk factors, investigators also examined the prevalence of the major risk factors among the Wilmington general population by randomly sampling approximately three non-firearm crime records for each firearm crime record. The strength of each risk factor was then assessed through logistic regression, a standard mathematical technique for examining risk factors.

Logistic regression provides an estimate of the strength of the association between a risk factor and an outcome, controlling for all other risk factors being considered. Consequently, scoring systems can be developed in medicine and public health using this technique that take into account a number of risk factors. As an example, a logistic regression model of the risk factors shown in Table 1 produces the following risk scoring system (Table 2). Point values are obtained by multiplying all regression coefficients by 5 and rounding to the nearest integer (multiplication by a factor of 5 is chosen as it makes the smallest regression coefficient [0.4] an integer after multiplication). Risk factors with more points indicate a stronger association with firearm violence involvement. This kind of procedure is used widely in medicine and public health to create scoring systems for conditions such as diabetes, heart attack, HIV, and many other conditions.

(Continued with table, next page)

Table 2. Example risk factor scoring system

Type of Risk Factor	Regression coefficient	Point value for risk score
Emergency Room Visit History		
Gun shot wound	2.4	12
Stabbing	2.3	12
Blunt weapon injury	1.0	5
Physical fight	0.6	3
Suicidal ideation/attempt, self-inflicted injury	0.4	2
Clinical encounter involves police	2.2	11
Labor Indicators		
Unemployed in quarter preceding the crime	1.1	6
Application filed for unemployment benefits	0.5	3
Child Welfare Investigation History		
Investigated as potential victim of child maltreatment	0.5	3
Out of home placement	0.8	4
State Juvenile ServicesParticipation		
Community probation	1.0	5
Residential detention	1.1	6
Behavioral health services	0.8	4
Managed care services	0.5	3
School System Events		
Recipient of social assistance programs ever	1.4	7
Prior suspension/expulsion	0.7	4
Dropped out prior to high school graduation	1.0	5
≥10 unexcused absences in school year preceding crime	0.6	3

Note: Point values are obtained by multiplying all regression coefficients by 5 and rounding to nearest integer. The model constitutes an example scoring system based on Wilmington data; further model refinement is needed before any actual implementation.

In clinical or public health settings, practitioners can assess the number of risk factors an individual has, add up the individual point values, and thereby determine risk of a particular outcome. For example, using just the sample point values from Table 2, a score for each person in our sample can be calculated. Higher scores are clearly associated with a higher risk of committing a firearm crime in our investigation sample (Table 3).

Table 3: Total point score and percent of individuals committing a firearm crime within investigation sample

Total point score	Percent committing a firearm crime
0	4.2%
1 to 10	8.2%
11 to 20	26.8%
21 to 30	43.4%
31 to 40	67.8%
41 to 50	83.3%
> 50	89.8%

Although calculating risk scores has often been done manually by doctors, counselors, or other practitioners, risk assessment tools can be automated when only administrative data are used, such as in our investigation in Wilmington. Automation allows more factors to be considered in the risk score, can incorporate more complex factors (such as timing of events), and permits the risk assessment tool to be low cost, so that the majority of project resources can be allocated to service provision.

Further increases in classification accuracy can be achieved by restricting analyses to the highest risk populations. We see that the majority of individuals involved in firearm crimes are young males. As a test of potential population level estimates, we now focus on males approximately age 15-29, the highest risk population for violence involvement. Incorporating all of the factors in Table 2 as well as census tract yields excellent risk classification ability.

Figure 3. Estimated Risk of Firearm Crime Involvement Based on Risk Factors and Subsequent Involvement in Firearm Crimes

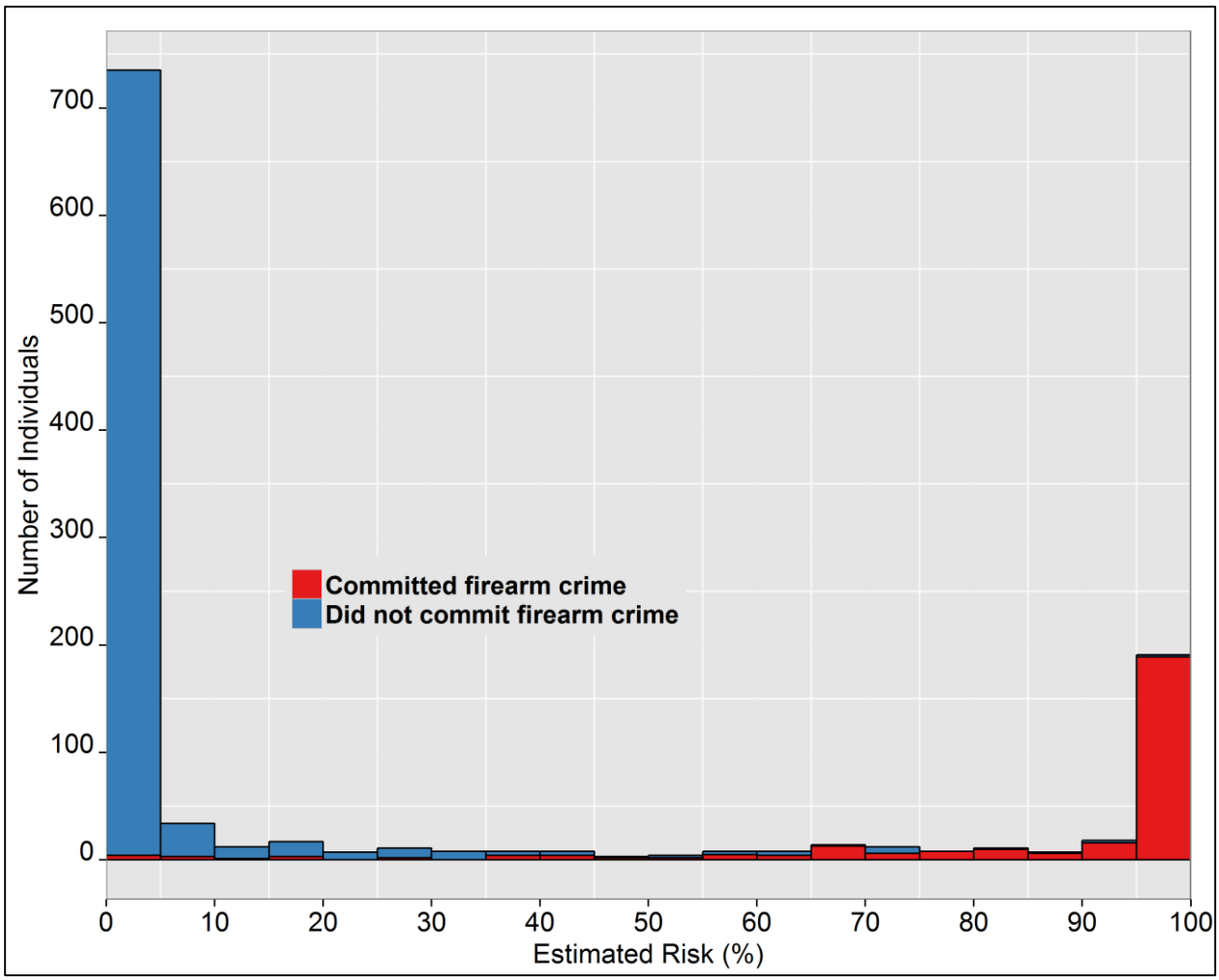


Figure 3 demonstrates that considering multiple risk factors does lead to excellent classification accuracy within our sample—individuals with a high, estimated risk for violence involvement based on the presence of multiple, strong risk factors were often subsequently involved in firearm crimes. For example, in our sample of 15-29 year old males, there were 209 individuals who had an estimated risk of 90% or greater based on multiple risk factors. Ultimately, 205 of these young men were involved in firearm crimes over the study period.

Because the total population of males age 15 to 29 can be estimated from census data, we can attempt to extrapolate from our sample to make rough population level estimates of how useful such a risk assessment tool could be. Using a risk level of 90% or greater could have up to

an approximate 66% accuracy (i.e., 66% of those having a greater than 90% risk would subsequently be involved in firearm crimes in the time period we assessed). Another important metric to consider is sensitivity, which refers to the proportion of individuals committing firearm crimes that the risk assessment tool identifies among our population of 15-29 year old males. Estimated sensitivity could be up to 73% (i.e., out of all male youth committing firearm crimes in Wilmington over the 5 year period studied, this risk assessment tool could have allowed an estimated 73% to receive social services they may have been lacking). For example, these young men have often experienced multiple exposures to violence and challenges in their family, educational, and employment backgrounds. Assistance in multiple areas could help reduce risk for violence involvement and a range of other health and social problems.

Our fieldwork demonstrates that data across Delaware agencies can be linked and that linking data has value in allowing service providers to better understand the multiple risk factors for violence involvement that need to be addressed, particularly among young men. Linked data systems have the potential to allow practitioners to provide more comprehensive services to youth at the highest risk of violence involvement and coordinate services to a greater degree with other agencies. Linked data systems also provide a valuable feedback loop which allows local governments to better assess the impact of programs.

Limitations

This investigation provides a proof-of-concept of the powerful risk classification ability of certain risk factors and the potential for the development of a low-cost risk assessment tool using administrative data. This information can then be used to improve programs and services. However, several steps would need to occur before actual implementation of such a tool. First, this test was conducted using a limited sample; further testing and refinement of the risk scores should occur with the full administrative datasets. The mathematical procedures used to control for the matching in the study design may affect estimates; the population level estimates provided should only be considered a rough approximation. Many factors will affect actual population estimates. However, it should be noted that the population estimates

provided here may be an underestimate. The risk scoring system demonstrated here is a basic model and in the real-world context, many additional items should be included in the scoring system, such as other risk factors, the frequency/magnitude of risk factors, and timing of risk factors. These adjustments would increase classification accuracy. Further increases in classification accuracy can be achieved by setting point values or cut-off scores even higher. With additional testing on a larger dataset, an optimal risk assessment tool can be developed and evaluated. Lastly, it should be noted that certain data systems may have unique legal requirements to be considered; partners may benefit from consulting with other cities or states who have already linked diverse data systems to improve programs. Nonetheless, scoring systems, such as the one we have demonstrated, are widely used in medicine and public health and provide marked improvements in risk classification ability and subsequent care for individuals.

Risk assessment tool implementation and violence prevention services

This investigation was focused on determining the feasibility of linking data across administrative data sources to develop an accurate risk assessment tool that would facilitate violence prevention efforts in Wilmington. Further testing can help determine optimal implementation of such a tool, such as timing and location of service provision, but the potential value of such a tool is clear. For example, imagine a 17 year old boy who is suspended for carrying a knife at school. A linked data system could help service providers see that 2 months ago the boy was treated for a gunshot wound at a local hospital; at the age of 14 the boy spent 6 months in a juvenile detention facility for a violent crime; and now the boy lives in the census tract of the city with the highest rate of violent crime. With this information, social service providers better understand this young man's elevated risk for violence involvement and can better provide comprehensive services to prevent future violence involvement and to promote positive and healthy development. The tool is to be used by social service providers to inform violence prevention efforts, and provisions should be established to preclude use as a

tool for law enforcement action. Implementation and management of such a tool should likely be performed by the Delaware Department of Health and Social Services.

For youth and individuals who are at an elevated risk of violence involvement, multiple programs and services exist to help enhance skills, promote opportunities for success, and prevent future violence involvement. These range from jobs programs, peer outreach/mentorship, educational or school-based programs, counseling, family focused programs, or other approaches. Resources to help communities understand the full spectrum of violence prevention programs include:

- CDC's STRYVE program selector tool: https://vetoviolence.cdc.gov/apps/stryve/strategy_selector.html
- CDC's Opportunities for Action publication: http://www.cdc.gov/violenceprevention/youthviolence/opportunities-for-action.html
- Washington State Institute for Public Policy cost/benefit: http://www.wsipp.wa.gov/BenefitCost?topicId=
- The University of Colorado Blueprints program registry: http://www.blueprintsprograms.com/
- National Institute of Justice's program reviews: http://www.crimesolutions.gov/
- The Community Guide to Preventive Services reviews: http://www.thecommunityguide.org/index.html

It is important for communities to focus resources on evidence-based practices that have demonstrated or promising results. The table below provides examples of demonstrated or promising approaches, though should not be considered a complete or proposed package; program selection will need to be tailored to priorities and local factors demonstrated from city data.

Problem Focus	Approach	Example program
• Emergency department visits for violence	• Street outreach • Linkage to social services through hospital interactions	• Cure Violence • Hospital-based violence intervention programs (HVIP)

• Unemployment	• Job placement and assistance • Conditional cash transfers	• Individual Placement and Support (IPS)
• Trauma from child abuse victimization	• Therapeutic support / counseling	• Trauma-focused cognitive behavioral therapy
• Juvenile criminal involvement	• Individual or family-focused programs and placement strategies	• Multidimensional Treatment Foster Care • Functional Family Therapy
• School problems	• Individual or group school-based social and emotional learning (SEL) and other programs	• Coping Power • Life Skills Training

Summary and Recommendations

This investigation highlights the potential of a risk assessment tool and linked data systems to guide violence prevention efforts. The majority of individuals involved in urban firearm violence are young men with substantial violence involvement preceding the more serious offense of a firearm crime. Our findings suggest that integrating data systems could help these individuals better receive the early, comprehensive help that they need to prevent violence involvement. This could potentially help prevent the subsequent violent crime that affects individuals, families, and neighborhoods throughout Wilmington. Such an approach can be an important component of community-wide efforts to prevent multiple forms of violence. Improved information systems can also help communities measure the impact of other strategies, such as interventions to address poverty, housing, education, or other underlying risk factors. Linked

administrative data systems have the potential to improve the efficiency and impact of social service provision in Delaware. Our primary recommendations include:

1. Increase collaboration between Delaware social service agencies in preventing violence by developing the capacity to link and share data between Delaware's various social service agencies in an ongoing fashion. This should involve consultation of agency technical and legal counsel to develop the appropriate policies and procedures to protect the privacy of individuals and data. Delaware partners may also consider consulting with other cities/states who have created local inter-agency data sharing agreements to learn from best practices.

2. Further refine the pilot risk assessment tool by using the full administrative dataset. Focusing the risk assessment on youth is likely to be the most feasible approach and youth are most likely to experience lifelong benefits from prevention programs. The proposed tool is to be used by social service providers to inform violence prevention efforts, and provisions should be established to preclude use by law enforcement. Use of the tool and program delivery should be managed by a Delaware social service/health agency.

3. Establish a community advisory board to provide recommendations on proposed evidence-based, wrap-around services/programs to be provided for high risk youth in conjunction with the recommended risk assessment tool.

Acknowledgements

- Delaware Department of Health and Social Services and Division of Public Health
- City of Wilmington
- Delaware Department of Safety and Homeland Security
- Delaware Criminal Justice Information System
- Delaware Department of Services for Children, Youth and their Families
- Delaware Department of Education
- Delaware Department of Labor
- Christiana Care Health Care System
- University of Delaware, Center for Drug and Health Studies
- Delaware Statistical Analysis Center, Criminal Justice Council