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Evaluation of NIBIN-Generated Leads and Whether They Contribute to Solving Violent Crimes

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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Walden University

2025

Abstract

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MS, Saint Joseph's University, 2007

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Professional Administrative Study Submitted in Partial Fulfillment

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Doctor of Public Administration

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Abstract

The client organization had not previously analyzed the impact of its NIBIN program. This lack of analysis potentially impeded informed decision-making regarding staffing and resource allocation. The purpose of this study was to address the practice-focused research question: What impact do NIBIN leads have on case closure rates for aggravated assaults and homicides involving firearms? A Cox proportional hazards regression model, a type of survival analysis, was used to analyze the data, which was based on the Locard exchange principle. Data were collected from the organization’s record management system. The findings were that NIBIN leads significantly contributed to faster case closures compared to cases without NIBIN leads. The recommendations were that the client organization should continue to streamline the comparison process to expedite lead generation and conduct additional research to explore aspects not covered in this study. The client organization was provided with an executive summary that outlined the findings and recommendations. The findings can potentially impact public administrative practices by promoting inter-agency cooperation, resulting in faster identification of offenders and their connections to criminal incidents, ultimately helping to remove violent offenders from the community. The implications for positive social change include increasing program resources, thereby enhancing the public organization's effectiveness, and reducing crime through offender identification.

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Dedication

This achievement is dedicated to my late mother, Carrie L. Martin, whose unwavering encouragement and support throughout my life and academic journey made this incredible feat, as well as every significant milestone I have reached, possible.

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First and foremost, I want to thank my Lord and my Savior, Jesus Christ, for the special grace that has guided me through this journey. I extend my heartfelt gratitude to everyone who has contributed to my educational path, from elementary school to graduate school, for their encouragement, support, and unwavering positivity.

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Lastly, I want to thank Jermaine Olds-Martin (my ex-wife) for helping me grow into a better man and father to our two wonderful children, Naiya R. Martin and Jahan A. Martin, without whom this journey would hold little meaning.

Table of Contents

List of Tables

Section 1: Introduction to the Study

The National Integrated Ballistic Information Network (NIBIN) offers law enforcement valuable crime gun intelligence by linking firearms and ballistic evidence to violent crimes involving guns. This can significantly assist in solving violent crimes such as aggravated assaults and homicides involving firearms and prosecuting offenders, but its effectiveness hinges on timely collection, examination, comparison, and dissemination of findings to law enforcement investigators.

Established in 1997 by the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), the NIBIN was designed to help local, state, and federal law enforcement agencies address firearm-related offenses. It features an automated ballistic imaging network that connects offenders, activities, and locations with violent gun crimes.

The client organization in this study was a forensic laboratory in Pennsylvania that offers a wide range of forensic services, including firearms identification, and participates in the NIBIN program. In 2021, the laboratory partnered with the ATF to launch an initiative aimed at expediting the processing of ballistic evidence, providing actionable crime gun intelligence to combat violent crimes involving firearms.

Through this study, I sought to address a gap in practice by examining NIBIN-generated leads and their role in closing crime gun investigations. NIBIN hits refer to matches between two or more digital image acquisitions within networks, which trained firearms examiners then verify through a process called correlation review (ATF, 2024). When this process is carried out in a timely manner, crime gun intelligence can provide investigators with crucial information, resulting in faster and more effective case closures (De Biasi, 2024).

Findings of this study contribute to positive social change by providing laboratory management with an actionable evaluation of the NIBIN program. This evaluation resulted in recommendations for enhancing the efficient allocation of personnel and technical resources that are required for processing firearms and ballistic evidence. As a result, it can lead to quicker NIBIN leads, which can help resolve investigations related to crime guns.

In this section, I provide brief background information regarding the NIBIN program, explain how the client organization administers the program, and outline the administrative challenge that the organization aims to address. Additionally, I discuss key variables of interest, data sources, and analysis methods to examine this administrative issue. To ensure clarity, I define relevant terms and processes and highlight the significance of addressing the organization’s program. Finally, I summarize Section 1 as well as the remaining sections.

Organization Background

Confidence in forensic science has significantly increased over the past 25 years, largely due to popular television shows like *CSI: Crime Scene Investigations*, which emphasize the importance of forensic evidence at crime scenes (Baranowski et al., 2018; Biven et al., 2024). Forensic evidence is grounded in the Locard exchange principle, which states that when two objects come into contact, they leave behind trace evidence that can be detected, collected, preserved, and scientifically analyzed to support legal decisions involving both criminal and civil law (Fish et al., 2011; Steele, 2020).

The client organization was an internationally accredited forensic laboratory in Pennsylvania that provides a variety of technical and scientific services, including firearms and ballistic examinations. The NIBIN uses Integrated Ballistic Identification System (IBIS) technology to compare firearms and ballistic evidence that is submitted to forensic labs, generating actionable investigative leads (ATF, 2024; Pierce & Lambert, 2023).

In 2021, the client organization renewed its partnership with the ATF to combat violent crimes in local communities through expedited analysis and automated linking of crime gun firearms and ballistic imaging evidence from crime scenes and other sources to evidence from previous incidents in different jurisdictions.

Reliance on unbiased forensic evidence is heavily influenced by testimonies of forensic experts, particularly given rising skepticism about law enforcement's motives during criminal investigations. As a result, there is often hesitation to fully trust the credibility of testimonies provided by law enforcement officials (Baranowski et al., 2018).

Delays involving entering and evaluating ballistic evidence can significantly hinder the development of leads generated by the NIBIN. According to Huff et al. (2024), delays in generating leads through NIBINs affect the ability to provide scientifically-based insights regarding origins, composition, and connections between suspects and violent crimes. Yost (2023) reported expansion of digital ballistic testing has notably increased closures in crime gun investigations in Ohio, especially when DNA analysis was used. Yost attributed these improvements to more law enforcement agencies' inputting ballistic data into the NIBIN, changes in the program’s administration to expedite processing, and timely dissemination of crime intelligence to law enforcement.

In 2023, improved administration of NIBIN resulted in a 19% increase in leads generated. The growing role of forensic intelligence in terms of providing investigative leads to law enforcement has been significantly supported by networks like the Automated Fingerprint Identification System (AFIS), Combined DNA Index System (CODIS), and now NIBIN. Consequently, there is an urgent need to evaluate the effectiveness of the NIBIN program in terms of the timely evaluation of firearms and ballistic evidence to generate leads that facilitate case closure of gun crime investigations.

Problem Statement

This study involved addressing the need for forensic labs that are responsible for processing firearms and ballistic evidence to evaluate the effectiveness of NIBIN technology in terms of generating actionable leads that assist in closing violent crime investigations involving firearms. The ATF and its law enforcement partners have collaboratively entered digital images of firearms and ballistic evidence from crime scenes, investigations, and gun-related incidents into the NIBIN database. This has resulted in the creation of the largest database for firearms and ballistic evidence in the United States. Since its inception, over 6.5 million pieces of evidence have been entered, and increased use of IBIS technology has produced matches yielding more than 912,000 investigative leads; in 2023 alone, the NIBIN generated 221,000 leads (ATF, 2024).

However, due to inadequate feedback, the client organization was unable to measure the program's effectiveness or impacts on resolving violent crime cases, such as aggravated assaults and homicides involving firearms. Despite leads generated by the program, the organization lacked data linking NIBIN leads to actual case closures of violent crimes.

Huff et al. (2024) stated, "Reliance on specialized investigators and long intervals between gun crimes, evidence collection, and evidence processing are barriers to timely intelligence" (p. 80). The NIBIN's automated comparison of fired cartridges and other ballistic evidence supports quick identification of matches, initiation of correlation reviews, and dissemination of leads. Gaining evidence-based knowledge on the relationship between NIBIN leads and crime gun closures is a significant social endeavor, as other crime prevention and reduction programs that are aimed at specific individuals and locations, such as Operation Ceasefire and Project Safe Neighborhoods, have effectively enhanced public safety and health (Huff et al., 2024).

Consequently, the client organization needed to develop a better understanding of the challenges and obstacles involved in administering the NIBIN program. This lack of critical feedback has hindered the organization's understanding of the effectiveness of the personnel and resources allocated to this initiative, as well as the need for program improvements and the justification for its continuation.

I provided a written report to the client organization that outlined findings. The report presented evidence-based data to inform policy changes that were aimed at expediting the processing of NIBIN-generated leads for law enforcement. The objective was to assist in closing gun crime cases by ensuring timely submission, triage, analysis, and generation of NIBIN leads.

Purpose

The purpose of this quantitative study was to evaluate the effectiveness of leads generated by the NIBIN in terms of solving crime gun investigations, specifically aggravated assaults and homicides involving firearms. This study was guided by Locard's exchange theory, which states that every contact between perpetrators and crimes leaves traces (Fish et al., 2011; Baranowski et al., 2018). The client organization, a partner in the NIBIN program managed by the ATF, lacked evidence-based data to assess the program's effectiveness.

The research question for this study was: What impact do NIBIN leads have on case closure rates for aggravated assaults and homicides involving firearms? This question served as the foundation for addressing the research problem and developing actionable solutions.

Study results were presented to the client organization in the form of an executive summary. The goal was to provide evidence-based data on the relationship between NIBIN-generated leads and their effectiveness in terms of closing criminal investigations involving firearms, specifically aggravated assaults and homicides. By analyzing variables such as incident date, closure status, crime type, close date, and generation of NIBIN leads, the client organization gained the ability to make informed decisions regarding allocation of resources and personnel to meet program needs. Furthermore, the organization gained insights regarding how NIBIN-generated leads affect investigative closures, which in turn influenced its policies involving forensic analysis, crime gun intelligence, and crime reduction strategies.

Summary of Data Sources and Analysis

In this study, I employed a quantitative approach with a comparative analysis framework to assess the relationship between timely NIBIN-generated leads and case closures of crime gun investigations. Quantitative research involves statistically describing datasets to enhance understanding of relationships (Burkholder et al., 2020). This process enabled me to collect, analyze, and interpret the dataset, thus providing a real-world understanding. A comparative framework was particularly suitable for analyzing how independent variables directly influenced program outcomes in various contexts.

For this study, I collaborated with the client organization to collect data on NIBIN entries, firearms and ballistic comparisons, and procedures for disseminating crime gun intelligence related to generating NIBIN leads. Additionally, I gathered information regarding the status of crime gun investigations (e.g., whether they were active investigations or had resulted in arrests) from the local department's record management system Premier-One. Based on data I collected and analyzed, I provided a detailed interpretation of findings related to the administration of the NIBIN program for generating crime gun intelligence. This is essential for resolving incidents involving gun violence promptly.

Findings from this study led to valuable and evidence-based insights to assist the client organization in terms of planning, organizing, implementing, and reassessing policies and procedures that are aimed at ensuring timely firearm and ballistic entry, processing, and dissemination of NIBIN-generated leads. Ultimately, this will help leverage crime gun data to resolve violent crime cases more effectively.

Definitions

The following terms were used in this study to ensure an appropriate context for readers:

Acquisition: According to the ATF (2018), acquisition is "the digital imaging of various firearms-related markings present on cartridge cases into NIBIN" (p. 8).

Assessment: According to the ATF (2022), assessment is "an inspection used to evaluate, confirm, or verify activity related to quality" (p. 1).

BrassTrax HD3D: According to the ATF (2018), BrassTrax HD3D is "the acquisition station developed by Forensic Technology that captures highly detailed images of cartridge cases, including firing pin impression on the primer, breech face, extractor, and ejector markings" (p. 8).

Correlation: According to the ATF (2018), correlation is "the automated comparison of an acquired digital image to other images in the databases using an algorithm that provides a list of ranked possible matches" (p. 8).

Correlation review: According to the ATF (2018), correlation review is "the on-screen comparison of digital images by a trained technician/specialist to determine the potential for two cartridge cases to have been fired from the same weapon" (p. 8).

Crime Gun Intelligence Center: According to the ATF (2018)," An ATF-led interagency collaboration focused on analyzing and investigating gun crime in a local community. CGIC unites cutting-edge technology and a dedicated multiagency investigative team to identify, disrupt, and prosecute serial shooters and their source of crime guns" (p. 8).

Firearms Examiner: According to the ATF, a firearms examiner is "a forensic scientist who is an expert in evidence regarding firearms and ballistics. They perform forensic comparisons and analyses, serve as expert witnesses, and prepare courtroom evidence" (p. 8-9).

Firearms and Ballistic Evidence: According to the National Institute of Standards and Technology (NIST, n.d.), firearms and ballistic evidence is "forensic evidence linking fired cartridge casings to specific firearm(s) based on microscopic markings transferred during discharge" (p. 1).

Integrated Ballistics Identification System (IBIS): According to the ATF (2018), IBIS is "an automated ballistics imaging and analysis system that populates a computerized database of digital ballistic images of bullets and cases from crime guns. Technology that enables the imaging and identification of large quantities of firearms evidence across a network of sites as well as the automated identification of likely matching bullets or cartridges cases" (p. 9).

Match Point Plus: According to the ATF (2018) Match Point Plus is "a system that stores ballistic images and contains the algorithm program for correlation reviews" (p. 18).

National Integrated Ballistic Information Network (NIBIN): According to the ATF (2018), the NIBIN is "a program managed by the AFT that automates the imaging of the unique identifiers of cartridge cases fired from firearms and stores the digital images into a database for comparison across a national network of participating sites" (p. 9).

NIBIN hit: According to the ATF (2018) a NIBIN hit is "The result of two or more firearms ballistic evidence acquisitions that have been confirmed as a match by a firearms examiner" (p. 9).

NIBIN lead: According to the ATF (2018), a NIBIN lead is "an unconfirmed, potential association between two or more pieces of firearm ballistic evidence based on a correlation review of the digital images in the NIBIN database by either a firearms examiner or a trained NIBIN technician" (p. 9).

Notification: According to the ATF (2018), a notification is "a written or electronic communication to the submitter of firearm ballistic evidence indicating the results of an acquisition or correlation review" (p. 10).

Secondary review: According to the ATF (2018), secondary review is "the process that ensures the work performed meets quality standards and requires two qualified individuals to concur on the finding. For the NIBIN, the ATF defines secondary review as a second correlation review or examination by a trained IBIS technician and/or firearms examiner using MATCHPOINT" (p. 10).

Test Fires: According to the ATF (2018), test fires are "cartridge cases known to be fired from a specific firearm in law enforcement custody" (p. 10).

Triage: According to the ATF (2018), triage is "the process of assessing cartridge cases having similar firearm-produced markings for NIBIN entry" (p. 10).

Significance

This project was significant in terms of providing the client organization with essential analytical results related to the relationship between NIBIN-generated leads and the timely case closure of violent crimes involving firearms. This has the potential to improve the administration of the program and enhance its effectiveness. While it is axiomatic that a better grasp of this relationship could lead to quicker apprehension of violent and repeat offenders using firearms, this study is the first of its kind to provide statistical evidence. Results include insights to review NIBIN operational policies, enhance crime gun analysis, generate more leads, and ideally decrease closure times.

Implications of this study extend beyond the client organization. Findings will potentially benefit other law enforcement agencies by offering new insights regarding how NIBIN-generated leads contribute to the closure of crime gun investigations. Additionally, I recommended streamlining NIBIN procedures to improve the effective allocation of personnel and resources. This will potentially lead to more effective evaluation of firearms and ballistic evidence from crime scenes or other gun crime investigations.

Gaining a deeper understanding of the positive social implications of NIBIN leads in terms of resolving firearm-related crime investigations can empower the client organization to drive meaningful social change. Knowledge and insights from this investigation will have a significant impact on the justice system and public administration as a whole. Ultimately, findings of this study will potentially promote positive social change by encouraging more evidence-based case closures, increasing trust in law enforcement investigations and enhancing support for forensic science.

Summary

In this section, I provided a brief overview of the NIBIN program and its partnership with the client organization in order to reduce incidence of gun-related crimes in local communities, specifically targeting aggravated assaults and homicides involving firearms.

I introduced the research problem, outlined the study’s purpose, and presented guiding research questions to explore this issue. I also defined key terms and described NIBIN procedures that were essential for the program’s success. Additionally, I specified sources of data collection and explained methods for data retrieval.

Section 2 includes information about the literature review, relevant findings, and the conceptual framework. By synthesizing pertinent literature, I aimed to enhance understanding of key concepts involving forensics and crime gun investigations, ultimately aiding in assessment of the program’s effectiveness.

Section 2: Conceptual Framework and Relevant Literature

In this study, I evaluated how effective leads generated by the NIBIN are in contributing to the closure of cases involving crime guns that are used in violent offenses, such as aggravated assaults and homicides that involve firearms. Crime guns are used in crimes, suspected of involvement in crimes, or illegally possessed (e.g., straw purchases). I specifically focused on guns involved in aggravated assaults and homicides by firearm.

Additionally, literature underscores the current albeit limited state of crime gun intelligence through NIBIN technology. A significant gap exists due to the lack of constructive feedback from law enforcement stakeholders regarding crime gun intelligence. This feedback is crucial as the client organization aims to manage its limited personnel and resources effectively. As the importance of forensic evidence grows in criminal investigations, understanding the impact of NIBIN technology on resolving gun-related cases becomes essential for law enforcement, prosecutors, and defendants. This understanding can significantly influence case outcomes by linking individuals to crimes or helping to establish their innocence.

In this section, I outline the literature search strategy for the study and explore existing literature, including prevailing findings regarding potential links between entry and processing of firearms and ballistics evidence and generation of leads, as well as how the NIBIN leads to the closure of crime gun investigations. Additionally, I define and explain the conceptual framework using relevant and peer-reviewed literature to provide context for administrative challenges, the study's purpose, and potential recommendations for improvement.

Literature Search Strategy

In exploring relevant literature on this topic, I examined peer-reviewed articles from professional journals. I accessed these resources through the Walden University Library and Google Scholar. Research involved disciplines within forensic science, crime investigations, and crime analysis, with a focus on NIBIN ballistic comparisons and forensic networks. I aimed to provide a comprehensive understanding that would enhance knowledge in the field.

To ensure a thorough exploration of relevant materials, I used the following key terms: *NIBIN*, *ballistic imaging*, *crime gun*, *investigative closures*, *crime analysis*, *crime investigations*, *forensic intelligence*, and *investigative leads*. I sought peer-reviewed articles that were published between 2021 and 2025. However, due to limited research on the topic, I also included seminal sources, such as information from the ATF's NIBIN website, organizational reports, and other general sources that were published before 2019. Inclusion of these seminal sources was crucial, as they provided foundational knowledge and historical context, which was essential for a comprehensive understanding of the NIBIN program and its practical implications in terms of crime investigations. Additionally, to enrich context involving this program, I accessed relevant data on investigative closures from the local law enforcement record management system. This comprehensive and multifaceted approach including a wide range of sources and data was used to provide a nuanced understanding of the topic.

Conceptual Framework

The comparative analysis framework for this study was based on the exchange principle established by Dr. Edmond Locard. This principle asserts that when two objects come into contact, they leave behind trace evidence (Fish et al., 2011). This study specifically focused on cases in which the unique markings found on fired cartridge casings were matched to a particular firearm, contributing to crime gun intelligence used to solve violent crimes. Burkholder et al. (2020) suggest that the purpose of a conceptual framework can vary significantly depending on the author's objectives, such as whether it is meant for argumentation, explanation, or generation (p. 41). In this study, I examined whether leads generated by the NIBIN concerning ballistic imaging matches contributed to the timely case closure of violent crimes involving firearms.

The survival analysis model comprises a set of statistical procedures used to analyze data when the outcome of interest is the time until a specific event occurs (Ruth et al., 2023). This study evaluated the timeframe between NIBIN leads and the case closure of violent crimes. However, due to issues with incomplete data (often referred to as "dirty data"), some intervals were not fully observed. If the event of interest is not observed after a specific follow-up period, a portion of the survival time may remain unknown; this phenomenon is known as censoring (Ruth et al., 2023).

The table below illustrates the independent variables investigated, which included cases where NIBIN generated a lead, cases with no lead generated, and the number of days until the case was closed. Huff et al. (2024) assert that “linking gun crimes can potentially disrupt and prevent serial and violent crime by identifying investigative leads and tracking firearms usage" (p. 83), a perspective also shared by Lopez et al. (2020). They further suggested that the timing of a NIBIN-generated lead significantly influences the effectiveness of solving cases.

Table 1

NIBIN Lead

Headings	Yes	No
NIBIN Lead Generated	Confirmed Hit	
NIBIN Lead Generated		No match in network
Time to Case Closure	Observed during study	Not observed during study

This survival analysis used the Cox proportional hazards model, a seminal method designed to analyze survival times and predict influencing factors across various situations. This regression model helped explain how the timing of events, as shown by the survival function, relates to various factors that may affect this timing (Monikapreethi et al., 2024). I conducted this analysis using the R programming language, renowned for its robust statistical capabilities. Specifically, I utilized the survival package, which was designed for analysis of survival data and offers valuable tools for modeling and interpreting results (Pawar et al., 2022; Schutte, 2019). My goal was to examine the survival patterns in the dataset to find important insights. I presented the results from the Cox proportional hazards model using charts and tables, making the data easier to understand and identifying key trends. In the following sections, I explain the methods used and demonstrate their connection to my research goals, providing a better understanding of survival phenomena.

Literature Review for the Study

The introduction of automated ballistic imaging and analysis in the 1990s transformed how law enforcement investigates firearm-related crimes (De Biasi, 2024). This technology efficiently compares firearms and ballistic evidence by matching the unique markings—referred to as signatures—left on fired cartridge casings to specific firearms. By accelerating the analysis process and utilizing advanced technology, law enforcement agencies can quickly connect crucial ballistic evidence found at crime scenes or discovered during investigations. This advancement significantly enhances their ability to solve cases and uphold the integrity of justice (De Biasi, 2024).

The primary system used by forensic labs in government organizations today was developed by Forensic Technology Incorporated and is known as the Integrated Ballistic Information System (IBIS). This system was designed to assist law enforcement in linking fired cartridge cases (FCCs) to firearms evidence collected at crime scenes or through investigations. Since its creation, IBIS has undergone numerous improvements in computer software, image comparison algorithms, and high-resolution imaging, thanks to the collaboration of firearms identification experts, scientists, and computer specialists worldwide.

In 1997, the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) adopted this technology to establish the National Integrated Ballistic Information Network (NIBIN) program, a comprehensive government initiative focused on collecting, comparing, analyzing, and providing leads to local, state, territorial, tribal, and federal law enforcement partners in the fight against violent crimes involving firearms (Pierce &

Lambert, 2023). The program uses ballistic evidence, primarily fired cartridge cases, collected from crime scenes or obtained through investigations to create high-resolution digital images using a NIBIN acquisition station (such as BrassTrax). Recovered firearms are test-fired to generate comparison samples for the fired cartridge cases in the NIBIN system. When a match is identified, a firearms identification expert trained in NIBIN conducts an on-screen comparison of the digital images, known as a correlation review, to verify the likelihood of a match (Pierce & Lambert, 2023; ATF National Firearms Commerce and Trafficking Assessment, 2023, vol. 2, Part 1, NIBIN, P.5). These investigative leads are generally forwarded to law enforcement through the ATF's Crime Gun Intelligence Center, which also cross-references the firearms using e-Trace to determine their manufacturing origin, original point of sale, and ownership history (Pierce & Lambert, 2023; ATF National Firearms Commerce and Trafficking Assessment, 2023, vol. 2, Part 1, NIBIN, P.5). However, whether this information has been successful in providing law enforcement with efficient and actionable insights to solve violent crimes involving firearms was a matter of debate.

Forensic Crime Laboratories and the NIBIN

In 2020, 326 publicly funded forensic crime laboratories in the United States received 3.3 million requests for service, according to the U.S. Department of Justice's Bureau of Justice Statistics (Brooks, 2023). These crime labs provide a variety of forensic analysis services for federal, state, and local agencies, focusing on physical evidence, trace materials, firearms and ballistics, and biological evidence collected from crime scenes or submitted for investigation. Their services include generating reports and providing expert testimony (Brooks, 2023).

Many of these publicly funded forensic labs have specialized divisions dedicated to firearms and ballistics examination (Shadwick et al., 2019). The examination process involves a detailed analysis of fired cartridge casings (FCCs) to match the markings imprinted on these casings by the firearm's firing pin and barrel when fired. Firearms identification examiners utilize NIBIN technology, which was overseen by the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF). This organization established and managed the National Integrated Ballistics Information Network (NIBIN), allowing examiners to compare high-resolution digital images from a comprehensive database (Shadwick et al., 2019; Barao & Mastroianni, 2024).

The initial investigation into the impact of NIBIN leads on case closures was inconclusive. King et al. (2017) identified that the lack of a significant correlation between NIBIN leads and case closures stemmed from deficiencies in evidence entry frequency, workflows, and processing times (King et al., 2013, 2017). Some research has suggested that improving crime lab procedures to speed up the processing of firearms and ballistic evidence could positively influence investigative closures (DeBiasi, 2024), offering hope for future improvements. While explicit empirical evidence remains elusive (Barao & Mastroianni, 2024), the potential impact of these changes is promising.

NIBIN serves as an essential national resource that compiles and organizes ballistic images from crime guns recovered at crime scenes or linked to violent incidents

(Huff et al., 2024). This network provides law enforcement agencies with crucial intelligence, enabling them to connect diverse pieces of evidence in their investigations.

Crime Gun Intelligence

The Pew Research Center (2023) reported that 149,766 assault offenses in the United States involved firearms, 79% of which were homicides (Gramlich, 2025). Law enforcement agencies have adopted crime gun intelligence strategies to expedite the analysis of forensic ballistic evidence. These strategies aim to develop actionable NIBIN leads that will assist investigators in closing violent crime cases.

Several law enforcement agencies nationwide have established crime gun intelligence centers to investigate leads generated by the NIBIN (Bottema & Barter, 2024). These centers are intended to conduct comprehensive investigations and improve understanding of how leads contribute to clearance rates. Findings from studies on crime gun investigations underscore the need for expedited entry of firearms and ballistic evidence into NIBIN, as well as quicker analyses, correlation reviews, and feedback from disseminated leads (Bottema & Barter, 2024).

Much of the research investigating crime guns has used NIBIN, which leads to a better understanding of the time between the sale of purchase and when the firearms are recovered. Research indicated that the majority of firearms used in violent crimes are recirculated by a small number of recidivists (Dierenfelt et al., 2024; Flippin et al., 2021). Dierenfelt et al. (2024) used NIBIN-generated lead logs from the Chattanooga Police Department to help determine the extent of time to crime using a negative binomial regression and provided details regarding the total number of days from initial use in a crime to its eventual recovery. This data is cross-referenced with e-trace data to identify the firearms manufacture, distribution, and ownership (Flippin et al., 2021).

Other studies that focused on reducing the time between collecting evidence at a crime scene and receiving actionable forensic intelligence are not a new concept in law enforcement. Crime gun intelligence centers have combined various forensic techniques with NIBIN-generated leads to enhance their effectiveness. For example, in 2024, Minnesota created the Violent Crime Support Unit (VCSU) to consolidate and expand forensic services offered by the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) NIBIN program, thereby speeding up the delivery of criminal leads for violent crime investigations (Wickenheiser & Knutson, 2024). The VCSU, in particular, combines rapid DNA protocols with traditional crime scene investigations and ballistic imaging comparisons to link individuals, incidents, and locations to collected evidence (Wickenheiser & Knutson, 2024). However, NIBIN and other techniques, even when combined, have limited or no impact on fatal and non-fatal shootings (Koper et al., 2019; Mei et al., 2019).

Wickenheiser and Knutson (2024) asserted that this modified approach, with NIBIN at its core, has not only significantly reduced the crime gun (or firearm) backlog and decreased turnaround times but also created a pathway for quicker processing of expedited requests for the district attorney's office. This success story, made possible by NIBIN, should instill confidence in our collective efforts to combat crime and gun violence, and the potential impact of NIBIN in the future.

Similarly, Huff et al. (2024) conducted a study involving the Indianapolis, Kansas City, and Phoenix police departments to assess the impact of timely NIBIN-generated leads on case closures. Using survey data from the three police departments, they found that detectives who received timely NIBIN-generated leads after a crime were more satisfied. This perspective supports Huff et al.'s findings, suggesting that the creation of the Minnesota Crime Investigation Support Unit was based on the concept of Forensic Intelligence Response Support and Testing (F.I.R.S.T), which emphasizes the value of timely examination of forensic firearms and ballistic evidence to produce credible investigative leads.

Summary

In this section, I restated the project's administrative problem and purpose. I provided context by conducting a comprehensive review of NIBIN's history, operations, and strategic purpose. This included key terms used during the search, the peer-reviewed sources consulted, and an evaluation of the appropriateness of the sources. Additionally, I outlined the conceptual framework for investigating the administrative problem and synthesized the research findings.

In the next section, I explained the data collection process and analysis. Furthermore, I elucidated how this study collected, compiled, analyzed, and interpreted relevant data to ensure that the administrative problem, purpose, and research questions aligned with the chosen research method. This approach aimed to assess the effectiveness of NIBIN leads in contributing to the timely resolution of investigations into violent crime, specifically aggravated assaults and homicides involving firearms. This description included identifying the research tradition and the rationale for choosing that method, the researcher's and organization's roles in the project, the strategy for evaluating effectiveness, the trustworthiness of the study, and the measures I implemented to ensure ethical practices throughout the research process.

Section 3: Data Collection Process and Analysis

The central question of this study was whether leads generated by the NIBIN contribute to solving violent crimes, specifically aggravated assaults and homicides involving firearms. This question was significant because the client organization responsible for allocating personnel and resources for this crime-fighting strategy lacked evidence of its effectiveness. The purpose of this study was to gain a better understanding of the relationship between NIBIN-generated leads, which provide ballistic evidence comparisons, and investigative closures for violent crimes. With this understanding, the client organization will be able to make more informed personnel and resource allocation decisions and make necessary changes to its policies and procedures to enhance the program's performance.

In this section, I provide a comprehensive overview of the methodologies used for data collection, detailing the various sources of evidence that were utilized. This section also outlines the ethical procedures governing the research to ensure the integrity and respect of all participants involved. I explained the analytical processes that were employed to synthesize the collected data, demonstrating the thoroughness of this research approach and instilling confidence in the methodology.

This section addresses the practice-focused research question, along with a description of the research design constructed to effectively address this question. I elaborated on the roles and responsibilities of the client organization and me within this context, highlighting the collaborative nature of the research process and the mutual benefits it brings.

Moreover, I described the specific methodology chosen for this study, including the strategic framework for analysis that was applied to accurately interpret the data. Finally, I discussed the measures taken to ensure the trustworthiness of the study, detailing how I complied with ethical standards to meet both university requirements and professional ethics, thereby reinforcing the credibility and reliability of the research findings.

Practice-Focused Research Questions and Research Design

In this administrative study, I examined the effectiveness of the NIBIN programs in generating actionable leads that contribute to closing investigations related to aggravated assaults and homicides. Law enforcement agencies have integrated this technology into their crime-fighting strategies to reduce violent crimes involving crime guns. By aligning the practice-focused research question with an appropriate research design, I intended to identify potential solutions or improvements that the organization can implement to enhance closure rates.

Through the lens of the research question, I examined the administrative problem faced by the organization: What impact does a NIBIN lead have on case closure for aggravated assaults and homicides involving firearms?

The deliverable was a professional administrative study, which included an executive summary outlining the organization's problem, purpose, methodology for examining the research question, and the study's outcomes. The goal of the executive summary was to assist readers in comprehending the core issue, identifying its underlying causes, examining potential improvements, and evaluating the implications of these matters on the crime strategy. The study provided the client organization with insights based on the analysis to help assess whether changes to the NIBIN policy are necessary to expedite ballistic examinations and the dissemination of leads to law enforcement partners. Additionally, this information can empower the organization to make informed decisions regarding budget requests, resource allocation, and operational adjustments to address emerging public needs.

The study used a Cox proportional hazards model. This statistical method is designed to analyze the relationship between various independent variables and the timing of events. The Cox proportional hazards model, a multivariate approach, was chosen for its effectiveness in identifying which independent variables have a statistically significant impact on the case closure rate (Monikapreethi et al., 2024). By utilizing this method, the study aligns the problem statement, research questions, and methodology, facilitating a comprehensive assessment of the NIBIN program's effectiveness.

Roles of the Researcher and Client Organization

I have worked for the local law enforcement agency involved in this study for 28 years. This includes eight years in the detective division and four years in the forensic laboratory that handles NIBIN entries. Currently, I serve as the commanding officer of the Crime Scene Unit, which is responsible for processing crime scenes, collecting firearms and ballistic evidence, preserving the forensic evidentiary value, and submitting the evidence to the Firearms Identification Unit (FIU). The FIU is tasked with examining, test-firing, and entering ballistic evidence into the NIBIN system. As such, I am not involved in comparing or confirming hits or disseminating any NIBIN leads.

In this study, I was the sole researcher responsible for mitigating potential biases throughout the design, data collection, analysis, and reporting processes to enhance the study's validity and reliability (Burkholder et al., 2020). My role involved collaborating with the client organization to create a limited dataset containing the essential fields for examining the research question. This process included gaining access to the government database and compiling, analyzing, and interpreting data retrieved from the local law enforcement's record management system. The objective was to explore the relationship between NIBIN leads and the timing of investigative closures. The findings of this study were interpreted based on the appropriateness of the statistical design and methods and will be presented in an unbiased and objective manner.

The client organization plays a crucial role in this study by providing access to archived data in the record management system. The RMS integrates relevant information related to violent incidents such as aggravated assaults and homicides by firearms, including incident reports, interviews, background checks, and firearms checks such as NIBIN and e-trace reports. Additionally, the organization has specialists on-site who can offer insights into the NIBIN operation, assist in retrieving essential data such as the number of firearms, ballistic entries, acquisitions, correlation data, and the total number of hits generated, and help ensure a comprehensive understanding of the data. Additionally, crime gun intelligence specialists who understand the nuances of the NIBIN problem were available to answer questions about locating and analyzing system data, ensuring that I utilize all available resources for a complete evaluation.

Methodology

The research method used in this study was a quantitative survival analysis designed to provide insights through a comparative framework. This framework employed a Cox proportional hazards model to statistically examine the differences in closure times for violent crime investigations based on whether NIBIN-generated leads were available. This regressive method focused on quantifying and testing survival variations between the two groups, aiming to understand better the time it takes to obtain NIBIN-generated leads and the subsequent time required to achieve investigative closure (Deo et al., 2021; Jackson et al., 2024). Specifically, the study addressed violent crimes involving firearms, particularly aggravated assaults and homicides. The primary objective was to clarify how NIBIN-generated leads influence the speed of resolving investigations, comparing the effectiveness of cases that utilize these leads with those that do not.

The study was important for understanding the extent to which NIBIN-generated leads aid in the swift resolution of violent crime cases—especially those involving shootings and firearms-related homicides. Additionally, it aimed to enhance the organization's understanding of the effectiveness of these leads, ultimately informing strategic decisions regarding personnel deployment, resource allocation, and funding initiatives crucial for the program's sustainability.

By evaluating an array of archival and operational data, the results assess the program's ability to produce actionable crime intelligence that significantly contributes to investigative closures. The data collected originates from diverse sources, including the

Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) NIBIN program, the e-Trace initiative, and local law enforcement record management systems. In this study, I rigorously assessed how effectively these leads contribute to the prompt case closure of violent crime cases through careful analysis and cross-referencing of this information.

This comprehensive analysis is further bolstered by existing research on the topic, allowing for informed generalizations about the program's effectiveness (Bureau of Alcohol, Tobacco, Firearms and Explosives, 2023; Bureau of Alcohol, Tobacco, Firearms and Explosives, 2024). Furthermore, the findings may promote discussions about the practical applications of this intelligence in law enforcement strategies specifically aimed at combating the rising tide of violent gun crimes.

Strategy for Data Analysis

The archival data for this study were obtained from the agency's record management system. This database serves as the organization's repository for essential law enforcement information related to investigative incidents in the local area, including arrest reports, NIBIN lead reports, and various other investigative documents. All of this information is consolidated into a single, user-friendly platform known as the NIBIN Enforcement Support System.

The database is designed to collect, store, and share investigative information with authorized law enforcement partners. It contains case reports that include a synopsis of incidents, arrest reports, interviews, property receipts, firearms identification reports, NIBIN reports, latent print reports, and other relevant discoverable information. Notably, the NIBIN report provides details about the linking of firearms and ballistic evidence from various crime scenes. The FIU report contains e-Trace information regarding the manufacturing characteristics of the firearms, including make, model, type, caliber, and serial numbers. This information provides a comprehensive overview of the firearms involved in the investigation.

To analyze this dataset, I employed a Cox proportional hazards regression model (Monikapreethi et al., 2024). This multivariate model utilizes descriptive statistics and survival curves to illustrate the relationship between time to an event and a set of covariates. The model assumes that covariates have a multiplicative and constant impact on survival (Monikapreethi et al., 2024). Specifically, it will examine how the generation of a NIBIN lead impacts investigative closures for aggravated assaults and homicides involving firearms.

Data Analysis for Time of Event

The archival data for this study were carefully sourced from the client organization's secure record management system (RMS). This secure database serves as the repository for the organization's criminal investigation documents, including investigative reports, search warrants, and arrest reports. Additionally, it contains forensic reports that support investigations, such as NIBIN reports, which provide automated digital ballistic leads, and e-Trace reports, which offer information about firearm origins and ownership. Other forensic reports include latent print and biological data, such as DNA information.

To conduct an analysis, I created a detailed dataset derived from the database, which I used for statistical analysis in the R programming language. This dataset was designed to facilitate comparisons of various critical variables. The primary independent variables under investigation are categorized into groups: cases with a NIBIN lead and those without one. Additionally, the dataset includes other significant variables, such as crime types (e.g., homicide or aggravated assault involving firearms), the incident date, and the close date. To ensure privacy and confidentiality, the unique case identifiers for each incident were encrypted and stored separately from the dataset.

The study's independent variables were divided into two binary categories. The first category consists of NIBIN-generated leads, which indicate that digital ballistic evidence (i.e., fired cartridge cases) was matched with other evidence or a specific firearm. These matches, known as "hits," are established through a computerized algorithm provided by the Integrated Ballistic Information System (IBIS) and are subsequently validated by trained forensic technicians (Bureau of Alcohol, Tobacco, Firearms, and Explosives, 2023). Once confirmed, these leads are disseminated for further investigative action.

The second category pertains to the absence of a NIBIN lead, suggesting that not enough digital ballistic evidence was collected and analyzed to link the evidence to other scenes. In the study, the presence of a NIBIN lead indicated a positive relationship between crime gun intelligence and investigative closures; conversely, the absence of a lead may contribute to investigators' difficulty in closing violent crime cases. Additionally, cases that remain active introduce the concept of right-censoring. Right-censoring captures unobserved events in survival analysis, which can still provide valuable insights that contribute to unbiased conclusions.

The dependent variable in this survival analysis study was the time until investigative closure of violent crimes, specifically homicide and shooting cases. This variable was measured in days, starting from the date of the initial incident until the case was closed by arrest. It also took into account whether the investigator had access to a confirmed NIBIN lead during the observation period. The significance of the NIBIN lead is expressed in terms of correlation, which refers to the automated comparison of digital ballistic images matched by the algorithm previously mentioned. This important crime gun intelligence is shared with local law enforcement agencies, enhancing their ability to link incidents and offenders in violent crime investigations. Previous research indicates that timely sharing of this intelligence can uncover trends, improve closure rates of violent crimes, and provide insights that may enhance future investigative methodologies.

The dataset for this analysis examines aggravated assaults and homicides over a five-year period, from 2019 to 2024, providing a comprehensive overview of these serious crimes. Some cases will remain unresolved during the analysis period and will be categorized as right-censored (Schober & Vetter, 2018). This classification signifies that, although the exact timing of when these cases will be concluded is unknown, it is anticipated that they will ultimately be resolved in the future. Additionally, it is important to note that I assume the presence of these censored cases will not impact the overall findings of the study (Schober & Vetter, 2018).

Data analysis was conducted using R, utilizing the survival package to evaluate the probability of events over time through survival and hazard functions (Therneau, 2015). The Cox proportional hazards model, a widely accepted and robust statistical tool, was used to investigate how independent variables (covariates) influence the timing of events. This model combines both survival times and covariate data to estimate coefficients. A coefficient that is significantly different from zero indicates that the corresponding covariate has a meaningful effect on the timing of the event (Gandhi et al., 2024).

RStudio was downloaded from the Comprehensive R Archive Network (CRAN) for Windows and set up for extensive data processing and analysis. According to Lord et al. (2018) and Gandhi et al. (2024), R is a highly regarded statistical platform, particularly effective for survival analysis and managing complex datasets. Statistical relationships were clearly visualized using charts and graphs produced from the Cox regression model.

Issues of Trustworthiness

To establish a strong foundation of trustworthiness in this quantitative study, I followed a rigorous process of collecting, compiling, analyzing, and accurately reporting the findings to ensure their reliability and validity (Burkholder et al., 2020). This study applied key criteria for trustworthiness in quantitative research, which include credibility, transferability, dependability, and confirmability (Burkholder et al., 2020). It was carefully designed to examine the relationship between NIBIN-generated leads and the timely closure of violent crime cases involving firearms, utilizing reliable government sources to ensure consistency in data collection, analysis, and reporting.

Furthermore, the study employed a quantitative survival analysis, specifically utilizing a Cox proportional hazards model. This model offers a clear and respected method for demonstrating the repeatability and reliability of the findings. Using R software with a specialized survival package, the study ensured accuracy in data collection, analysis, and reporting, emphasizing the robustness of the statistical methods and software applied to address the relevant research questions. The findings from the completed analyses were presented clearly and objectively, reinforcing both internal and external validity, as well as reliability (Burkholder et al., 2020).

By strategically utilizing reputable data sources, rigorously validating the accuracy of the results, and consistently adhering to the established methodology, I minimized administrative issues and facilitated the efficient dissemination of NIBIN leads, which impact the closure of violent crime cases (Burkholder et al., 2020).

Survival data analysis is an effective statistical method used to investigate the relationship between the generation of NIBIN leads and the timing of investigative closures. The credibility component of this study evaluated whether the findings and interpretations were trustworthy and clearly articulated based on the available data (Enworo, 2023). This study may also encourage other scholars and practitioners to corroborate and verify the findings (Enworo, 2022). By ensuring academic rigor and demonstrating a strong commitment to validity and reliability in the research design, I aimed to enhance its overall credibility.

Additionally, the research embraced the concept of triangulation by focusing on a specific topic, using a specially designed method to examine this phenomenon, and supporting evidence with existing peer-reviewed journals wherever possible (Burkholder et al., 2020). This multifaceted approach enhanced the analysis and facilitated meaningful conclusions regarding the relationship between NIBIN-generated leads and the expedited case closure of violent crimes.

The main goal of this study was to establish trust and reliability in examining this critical phenomenon. By effectively aligning the administrative problems of the client organization with the study's purpose, research question, and methodology, the findings highlight how leads generated by NIBIN can assist in the prompt closure of violent crimes involving firearms in the community.

Ethical Procedures

This study was founded on a strong commitment to ethical practices, which ensures that all research activities adhere to the rigorous standards established by Walden University’s Institutional Review Board (IRB). In exploring this topic, I utilized archived data and sensitive government information obtained from the client organization. To uphold the highest ethical standards, I sought and received IRB approval before collecting any data and meticulously followed all IRB guidelines designed to protect the privacy and confidentiality of these crucial sources (Walden University LLC, 2025).

I did not anticipate any ethical issues regarding data collection since it involved archival and operational data that did not include human participants. For instance, there were no interviews conducted, nor were any surveys distributed. Additionally, my interactions with personnel from the client organization and the NIBIN specialist were limited to discussions about accessing database information and brief conversations regarding the NIBIN operation. This approach helped preserve the integrity and confidentiality of the data sources. Furthermore, I am authorized to retrieve data from the

Records Management System (RMS) and other investigative systems. I also coded the unique identifiers for investigative cases and stored them in a separate location to ensure that the identities of these information sources remain completely anonymous.

The IRB granted approval to collect, analyze, and interpret relevant data for the completion of the capstone project; the following compliance number (05-06-25-1190925) was provided to confirm this authorization. Additionally, the study included an organizational agreement that underscored the client organization's commitment to collaborating with me on this significant administrative issue, which has important implications for public safety.

Given that the data analyzed in this study comprises sensitive government information, I ensured its security by storing it on an encrypted USB flash drive kept in a safe throughout the retention period mandated by both university and IRB protocols. Access to this information will be restricted solely to me, safeguarding it from unauthorized access. After completing the study, I stored the data on an encrypted flash drive and locked it in my personal safe to ensure privacy and confidentiality, in accordance with IRB provisions.

Summary

In this section, I described the role of research questions in guiding data collection and analysis for the study's evaluation. Clearly defined research questions act as a compass for the quantitative research design, outlining the roles of both the researcher and the client organization while highlighting their importance in facilitating the study.

The methodology description involved a comprehensive process that included identifying sources, collecting data, analyzing it, and organizing the research around the conceptual framework. The strategy for data analysis was thorough and encompassed traditional approaches, variables, the technology used, and statistical methods. Additionally, I included a discussion about the trustworthiness of the study and how ethical protocols were maintained throughout the research process.

The next section, which includes results and recommendations, was completed after receiving approval from the University's Institutional Review Board (IRB). This section detailed how the study was conducted, with a focus on aligning the analysis with its purpose and research question. It provided an overview of how the collected data was utilized in the research design to measure the intended phenomena, including details about the timeframe, timing of events, and analysis duration. Furthermore, it explained how the data was collected from the identified sources.

The study’s findings included an evaluation and recommendations based on the analysis and synthesis of evidence. Finally, the recommendations provided to the client organization were outlined and discussed, along with an executive summary.

Section 4: Evaluation and Recommendations

The client organization was a publicly funded forensic lab that collaborates with the federal agency responsible for administering the program. The NIBIN program was designed to assist law enforcement in investigating gun-related incidents by providing comparisons of firearms and ballistic digital imaging, linking these to various crime scenes (Bureau of Alcohol, Tobacco, Firearms & Explosives, 2024; Dierenfeldt et al., 2024). The purpose of this study was to evaluate how effective NIBIN-generated leads are in reducing the time taken to solve violent crimes, specifically homicides and aggravated assaults involving firearms. The client organization needed this information to make informed decisions regarding resource and staffing allocations, to determine whether changes were necessary to improve efficiency, and to justify further requests for additional funding.

Consequently, the guiding research question for this quantitative study was: What impact does a NIBIN leads have on case closure for aggravated assaults and homicides involving firearms? This research question was designed to align the study's problem and purpose with a rigorous regression model, which indicated how the data was collected, analyzed, and interpreted to ensure validity and reliability in the findings (Burkholder et al., 2020).

As a deliverable, the client organization received an executive summary. This summary included actionable recommendations for improvement and identified opportunities for further research. Additionally, a meeting with management staff was scheduled to present the study’s findings and discuss their potential implications through a PowerPoint presentation.

This section outlined the results and recommendations subsections: data collection, data preparation, data analysis, findings and implications, deliverables and recommendations, evidence of trustworthiness, strengths and limitations of the study, and a summary.

Data Collection

For this quantitative study, data was collected on-site from the client organization's record management system (RMS). As an employee of the organization, I had access to the data and received permission from the executive director of the laboratory to use it for this study. I was the only individual collecting the archival data. Over a period of seven days, I spent approximately four hours each day compiling the necessary dataset.

To create the dataset, I accessed the client organization's RMS and recorded all homicides from 2019 to 2024, totaling 2,377 cases. I verified the accuracy of this count by cross-referencing the crime scene database, which is managed by the unit responsible for forensic evidence collection and submission to the firearms identification unit (FIU) for all homicides involving firearms.

I then recorded instances of aggravated assault involving firearms for the same time period. However, due to a change in the RMS in 2021, crimes that occurred prior to that year were archived. This required me to manually check the system for aggravated assaults involving firearms, resulting in a lower count than expected. I verified these cases through the Preliminary Arraignment System (PAR), which yielded a total of 1,032 observations. While this data set is not comprehensive, it is sufficiently large to support a robust examination of the variables under study.

The observations were documented in an Excel spreadsheet that included five key variables: incident date, crime type, NIBIN lead status, closure type, and closure date. The time-to-event variables, representing the duration until case closure, consisted of incident dates and, when available, closure dates. This study specifically focused on two types of crime: homicides and aggravated assaults involving firearms, aiming to evaluate the impact of NIBIN leads on solving violent crimes.

The predictor variable, referred to as NIBIN (Yes), indicated whether the investigator had access to a lead generated by NIBIN. Additionally, the closure type specified whether a case was closed by arrest; if a case was not closed by arrest, it was considered right censored, as the case remained active beyond the observation period. Finally, the dataset was converted into a comma-separated values (CSV) file for analysis and saved on a flash drive to ensure privacy and confidentiality, which will be discussed further in the next section.

Data Preparation

For this study, I created a dataset called *NIBIN.Dataset* using Microsoft Excel. It included five variables: incident date, crime type, NIBIN (Yes), close type (closed), and close date. I then converted the dataset into a comma-separated value (CSV) file to facilitate easier manipulation in R, using RStudio, an integrated development environment (IDE) designed to streamline work in R.

Next, I installed several R packages, including survival, survminer, and tidyverse. The survival package offered a broad set of statistical methods for survival analysis. This included Cox proportional hazards regression models, survival curves, and hypothesis testing, as well as methods for handling censored data (UCLA Office of Advanced Research Computing, Statistical Methods and Data Analytics, n.d.). I used the survminer package to enhance my survival analysis by creating high-quality, publication-ready visualizations. These plots effectively illustrated the number of risks, the distribution of events, and survival probabilities while also displaying associated p-values. Additionally, survminer provided graphical diagnostics to assess the proportional hazards assumption and evaluate the model's goodness-of-fit (UCLA Office of Advanced Research Computing, Statistical Methods and Data Analytics, n.d.).

Lastly, the tidyverse collection played a pivotal role in this study, significantly improving the data cleaning process. It offered powerful tools for data manipulation, exploration, visualization, and modeling (UCLA Office of Advanced Research Computing, Statistical Methods and Data Analytics, n.d.). In this analysis, I used the survival and associated packages to manage the dataset more effectively and perform comprehensive survival comparisons, ultimately leading to more insightful and meaningful results.

Data Analysis

In this study, I employed a survival analysis as its conceptual framework to explore the impact of NIBIN leads on case closures of violent crimes involving firearms, using a Cox proportional hazard (i.e., Coxph) model. The Cox proportional hazards regression model is a widely used multivariate method that assesses the relationship between the time to an event occurring and various covariates.

The Coxph model was created using R code that assigned the results to a survival object. This object included details of the fitted model, such as the estimated coefficients, hazard ratios, and other relevant data. In this study, the survival object, which served as the response variable, was a fundamental component for conducting various survival analyses. It consisted of two main elements: the time to event (i.e., days until closure) and the censoring indicator, indicating whether a lead generated by NIBIN was developed or not.

I conducted a series of Cox Proportional Hazards regression analyses to evaluate the time to case closure across covariates. The survfit function was used to generate graphs, charts, and tables that facilitate a comprehensive understanding of this relationship. The initial regression model was executed using the following function: Coxph (Formula = Surv(days_to_close, closed) ~ NIBIN + CrimeType, data = df).

In this formula, the survival object denotes the number of days to case closure, representing the time to the event's occurrence. The event indicator, designated as "closed," identified the cases that have been closed by arrest within the data frame, whereas cases that remain active are categorized as right-censored. Within the framework of survival analysis, right-censoring assumes that these cases will ultimately be resolved at some point beyond the observation period.

The independent variable "NIBIN" is a binary variable that indicates the presence of a NIBIN lead, which refers to a confirmed hit provided to the investigative agency.

The variable "CrimeType" classifies the crime as either a homicide or an aggravated assault. Furthermore, the dataset specifies the source from which the data for this analysis was obtained.

In Table 2, the NIBIN exponential coefficient (β = 0.64801) represents the log hazard ratio examined by the Cox PH regression model. When exponentiated, this coefficient yields the hazard ratio: HR = exp(0.064801) ~ 1.912. This exponential coefficient indicates that for each one-unit increase in NIBIN, the hazard ratio (or risk) increases by 91.2 percent. This result is statistically significant, with a $P < .001$, which is well below the conventional threshold for significance (typically .05).

Table 2

Cox Proportion Hazard Model for NIBIN and Crime Type

Variable	**Coef**	**Exp (Coef)**	**SE (Coef)**	**Pr (>|Z|)**	**Significance**
NIBIN (Yes)	-0.43385	0.64801	0.05812	-7.464	P = 0.0839x10^-12
CrimeType Homicide	0.04305	1.04399	0.06545	0.658	0.511

Note. Created based on survival fit plot in R

The model produced an exponential coefficient (β = 1.04399) for Crimetype, indicating an increase in the log hazard ratio of approximately 4.4%, as calculated by exp(0.04305) − 1 ~ 0.044. However, this finding did not achieve statistical significance, as its p-value (i.e., $P > .511$) exceeds the conventional threshold of 0.05.

The Concordance test was used to assess the goodness of fit for the model. The concordance index ($C = 0.563$) indicates that the model accurately ranks survival times approximately 56.3% of the time, reflecting a moderate level of predictive performance. Moreover, the significant test statistic from the likelihood ratio test ($N = 64.35$) with 2 degrees of freedom suggests that the multivariate model is a more effective predictor of the relationship compared to a simpler model.

Next, the model was modified to exclude the CrimeType variable, thereby focusing exclusively on homicide data. This adjustment entailed retaining NIBIN as the sole variable and switched the data frame to reflect only homicides. The function utilized for this analysis is as follows:

Coxph(formula = Surv(days_to_close, Closed) ~ NIBIN, data = homicides)

In Table 3, the exponential coefficient for NIBIN ($\beta = 0.7789$) indicates that for every one-unit increase in the number of NIBIN leads, the likelihood of case closure increases by approximately 117.9%. This increase is calculated using the hazard ratio (HR) of 2.179, determined by the formula $(HR - 1) \times 100 = 117.9$. In other words, cases with more NIBIN leads are more than twice as likely to be closed at any given time compared to those with fewer or no leads.

Table 3

Cox Proportion Hazard Model for Homicides

Variable	Coef	Exp(Coef)	SE(Coef)	Pr(>|Z|)	Signifiance
NIBINYes	-0.2498	0.7789	0.6573	-3.8	P< 0.00144
Exp (coef)	exp (-coef)	lower .95	upper .95		
	0.779	1.284	0.6848	0.8861	

Note. Created based on Survival fit plot in RStudio

The 95% confidence interval (CI) for β is [0.6848, 0.8861], translating to a hazard ratio range of approximately [1.983, 2.425]. Since this interval does not include 1.0, it reinforces the conclusion that the effect of NIBIN leads on case closure rates is both positive and statistically significant.

The p-value is less than 0.05, indicating that the observed relationship is unlikely to be due to random chance. Additionally, the likelihood ratio test statistic is 14.6, with a $P < .001$ value, which further supports the statistical significance of the model. These strong findings suggest that leads from the NIBIN are associated with improvements in case closures for violent crimes, particularly homicides, within this analysis.

The model's fit was assessed using the concordance index, which resulted in a value of $C = 0.542$. This indicates that the model correctly ranks survival times only 54.2% of the time, slightly above random chance ($C = 0.5$). This finding suggests that the model has a limited ability to distinguish between outcomes, raising concerns about its practical utility, despite the coefficients being statistically significant.

In the final analysis, the covariate was modified to evaluate the impact of a NIBIN lead on the duration required to close cases of aggravated assault. In this vignette, aggravated assault replaced homicide in the Cox proportional hazards model and survival fit plot. Hence, the model employed is as follows:

Coxph (formula = Surv(days_to_close, Closed) ~ NIBIN, data = aggAssault)

In Table 4, the NIBIN exponential coefficient (β = 0.4034) indicates that a one-unit increase in the NIBIN score is associated with an increase in the log hazard ratio of the event. Again, the exponential coefficient represents the hazard ratio, which can be calculated as exp(0.4034). This indicates an approximate 49.7% increase in hazard (computed as exp(0.4034) - 1 = 0.497). The effect is statistically significant, as evidenced by a P < .001, well below the conventional threshold of 0.05.

Table 4

Cox Proportion Hazard Model for Aggravated Assaults

Variable	**Coef**	**Exp (Coef)**	**SE (Coef)**	**Pr**	
(>|Z|)	**Signifiance**				
NIBINYes	-0.9079	0.4034	0.1088	-8.343	P=0.002x10 ^-15
	Exp (coef)	exp (-coef)	lower .95	upper .95	
	0.4034	2.479	0.3259	0.4993	

Note. Created based on Survival fit plot in RStudio

The moderate-high concordance value (C = .604), consistent with what is seen in Tables 2 and 3, indicates that the model fits the data reasonably well. This suggests that having a NIBIN lead is associated with an increased hazard rate, or a faster time to case closure. Therefore, NIBIN leads appear to have a positive statistical impact on the resolution of aggravated assault and homicide cases, compared to cases without such leads.

In the subsequent section, the findings derived from the data analysis were interpreted to elucidate the similarities and differences among the covariates, thereby enhancing the understanding of their implications.

Findings and Implications

The primary objective of this study was to evaluate how leads generated by NIBIN contributed to solving violent crimes involving firearms, specifically homicides and aggravated assaults. The reports provide law enforcement with vital crime gun intelligence that links firearms and ballistic evidence to individuals, locations, and incidents through forensic technology. This aims to enhance their ability to resolve violent crimes more effectively. The analysis of the data from this study produced positive findings that could have significant social implications.

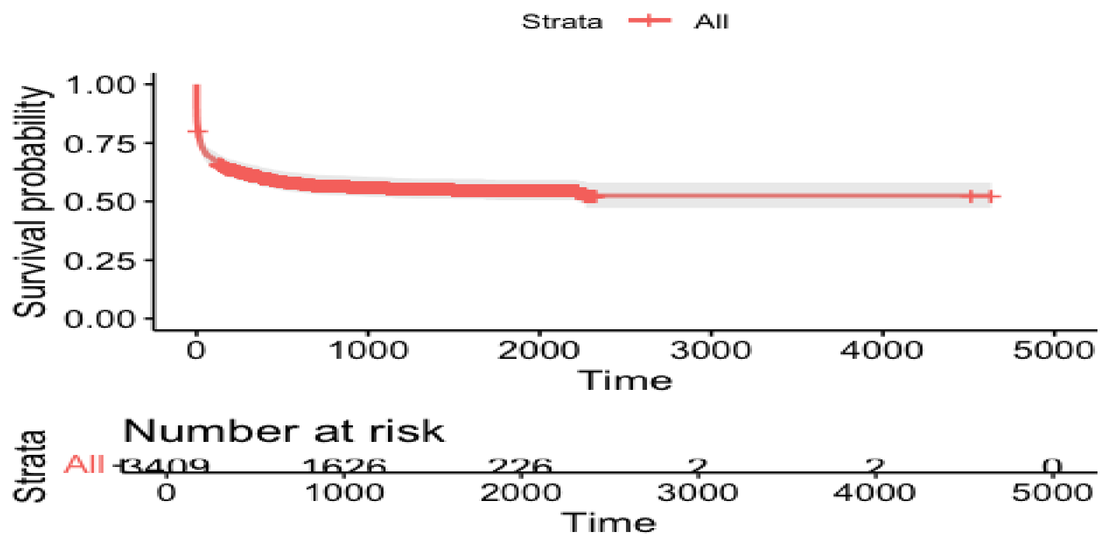
In this study, the Cox proportional hazards regression model was utilized to analyze the time to event (i.e., days to case closure) and the set covariates within a survival framework. The first model focused on the impact of NIBIN leads on the outcomes of crime types in general. The dataset included 3,409 observations and 1,298 events (i.e., closed cases), with two observations excluded due to missing values.

The analysis of the log hazard ratio indicated that having a NIBIN lead is associated with approximately a 91.2 percent faster time to case closure compared to cases without a lead. This high positive hazard rate suggests that NIBIN leads significantly increases the likelihood of solving violent crimes, particularly homicides and aggravated assaults involving firearms. These incidents, including shootings, are among the most serious crimes investigated by law enforcement and prosecuted by district attorney offices. Moreover, the low p-value associated with this finding indicates that the results are statistically significant, further reinforcing the validity of this conclusion.

Figure 1 provides a clear visualization of the survival curve created by the Cox proportional hazards model. The x-axis represents the number of days until a case is closed, while the y-axis indicates the survival probability. The curve shows that cases with a NIBIN lead have a high probability of closure within the first hundred days. However, this likelihood decreases and stabilizes around 500 days, indicating that case closures are less likely as time goes on.

Figure 1

Survival Curve for Crime Types



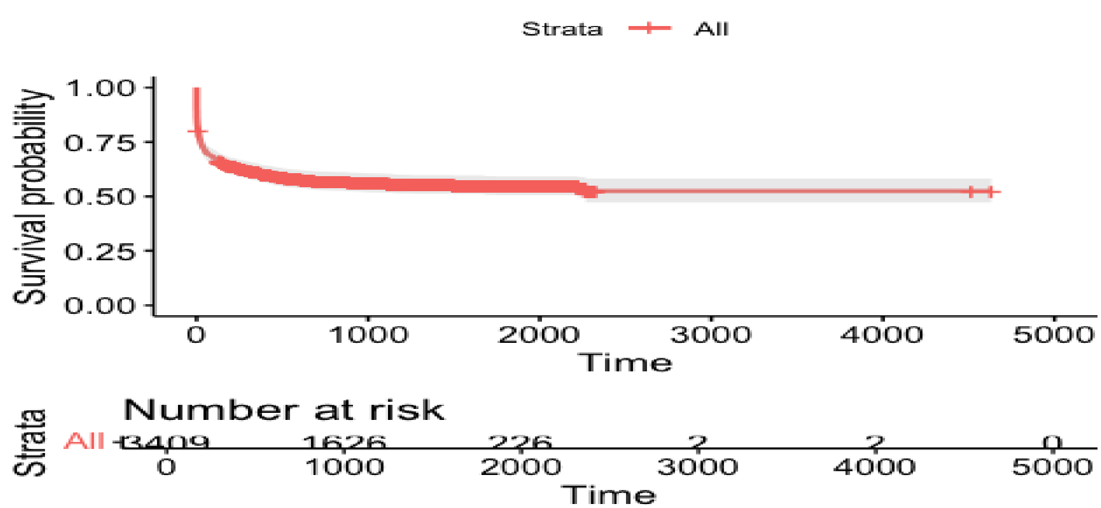
Note. Created with R.

The analysis employed a likelihood ratio test ($\chi^2 = 14.6$, df = 1, $p < 0.001$) and found strong evidence that the Cox proportional hazards model, which includes multiple covariates, fits the data significantly better than a simpler nested model that excludes those covariates. The extremely low p-value indicates that the inclusion of multiple variables significantly enhances the model's predictive performance compared to a simpler model.

The second Cox proportional hazards regression model evaluated the impact of NIBIN leads on the closure of homicide cases. The dataset consisted of 2,377 observations, which included 951 events representing case closures, with one observation omitted from the analysis. The findings revealed a log hazard ratio of 117.9, indicating that having a NIBIN lead for a homicide case doubled the chances of solving it. When graphed, the probability of closure was higher in the early days of the investigation, leveling out around one hundred days. While these results do not suggest that NIBIN leads are a panacea for solving violent crimes, the hazard ratio of over one hundred percent indicates that NIBIN leads contribute to faster case closures than the general average. Furthermore, the results were statistically significant, with a p-value well below the threshold of p < .001, suggesting that the analysis is reliable.

Figure 2

Survival Curve for Homicides



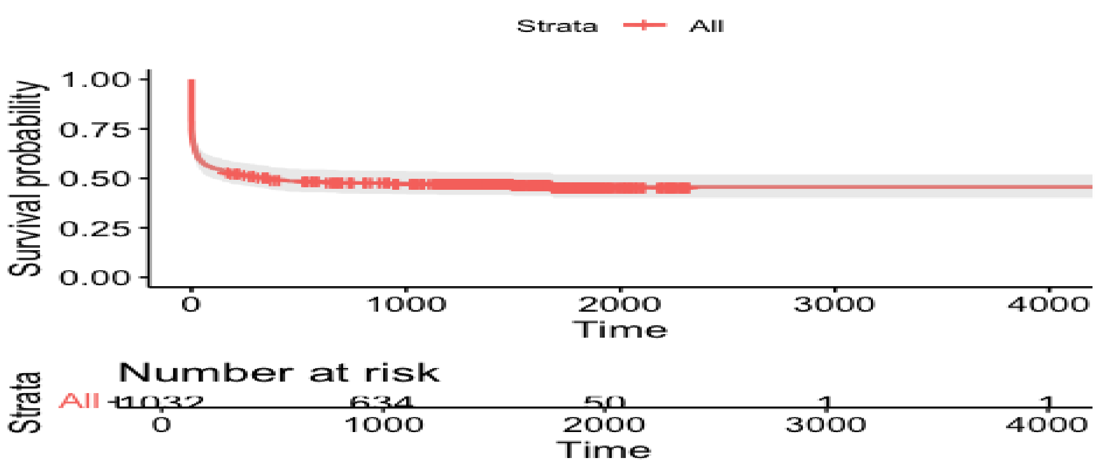
Note. Created within R.

The final Cox proportional hazards model examined the effect of NIBIN leads on the closure of aggravated assault cases involving firearms. This analysis included 1,032 observations and 347 events, with one observation excluded due to missing values. The findings reveal that having a NIBIN lead increases the likelihood of case closure by 49.7% compared to those without a lead. Although this rate of closure is approximately half that of homicide cases, the positive hazard ratio remains statistically significant, as indicated by a p-value (P<.001), which is well below the conventional threshold.

In Figure 3, the Cox Proportional Hazards Plot indicates that aggravated assaults have a 50 percent probability of case closure from the time of the incident. This suggests that when law enforcement receives a NIBIN lead, they have approximately a 50 percent chance of solving violent crimes more quickly than those without such leads. Although this percentage is below the average and not nearly as strong as the case closure rates for homicides, the presence of a NIBIN lead significantly enhances the likelihood of case closure for both types of violent crimes examined.

Figure 3

Survival Curve for Aggravated Assault



Note. Created within R.

The implications of the study's findings for the client organization are profound. First, the findings that NIBIN leads are associated with faster case closures of violent crimes involving firearms suggest that streamlining the firearms and ballistic comparison process, which includes notifying law enforcement, should substantially increase the probability of case closures of homicides and aggravated assaults involving firearms. For instance, forensic evidence matching a firearm to fired cartridge cases found at a crime scene in the first forty-eight hours of a homicide investigation could significantly support and bolster search warrant affidavits, arrest warrants or reports, and the district attorney's office's ability to charge.

Second, NIBIN leads significantly increased the likelihood of solving violent crimes, which should prompt law enforcement investigators to utilize this crime gun intelligence. While previous studies have explored whether law enforcement would use NIBIN leads if received in a timelier manner, this study provides evidence of their effectiveness when available. Through the study, I did not capture when the NIBIN lead was confirmed and communicated to law enforcement, highlighting a need for further analysis in this area. Additionally, the high probability of achieving faster case closures should be appealing to investigators, resulting in increased usage. Moreover, the timely receipt of NIBIN leads, combined with other forensic evidence and investigative efforts, should enhance the credibility of the investigation and strengthen community-police relations.

Third, based on the study's findings, I recommend increasing the staffing and resources allocated to the NIBIN program, as this could lead to a higher rate of case closures. Enhancing the use of NIBIN and the potential for increased case closures may justify additional staffing and investment in forensic technology. This could have significant financial implications for the client organization. Furthermore, this positive impact may encourage further research into the effects of forensic technology on case closures, ultimately advancing the field.

Lastly, the findings provide a strong incentive for further investigation of NIBIN leads on violent crimes in communities across the nation. With the public increasingly expecting forensic evidence to support law enforcement investigations of crime incidents and the successful prosecution of offenders—often influenced by the "CSI effect"—it is essential to better understand how forensics can support these efforts and, by doing so, increase public confidence in the science and law enforcement actions to address violent crimes.

Deliverables and Recommendations

An executive summary and PowerPoint presentation that outlines the findings and recommendations of the study (see Appendix C) were sent to the management team of the client organization as an email attachment. Following this, a meeting was held with the management staff to present the PowerPoint slides, which detailed the study's findings and recommendations.

The recommendations for the client organization, as outlined in the study, are twofold. First, I suggest that the organization continue to streamline its process for comparing firearms and ballistic evidence. This process should encompass all necessary steps to generate timely NIBIN leads, including triage, acquisition, assessment, correlation, and correlation review.

Additionally, considering the program's apparent success, it would be reasonable to increase the staff and resources dedicated to speeding up the generation of NIBIN leads. Furthermore, since the program appears to improve the resolution time for homicides and aggravated assaults involving firearms, the organization can make a strong case for securing additional funding from the agency.

Second, I recommend conducting further research on the impact of NIBIN leads on case closures. The current findings indicate that these leads significantly contribute to faster case closures of homicide and aggravated assault cases involving firearms. Additionally, it would be beneficial to investigate how other forensic techniques, such as latent print analysis and DNA testing, can further enhance law enforcement strategies to reduce or prevent crime. Since this is the first known study on this topic, exploring additional factors could provide valuable insights.

Evidence of Trustworthiness

The concept of trustworthiness in academic research relates to the principles of validity and reliability. These principles are essential for demonstrating that measurements and findings meet rigorous standards of accuracy and consistency (Burkholder et al., 2020). In this study, I adhered to these standards by carefully collecting, verifying, and analyzing the dataset created from the client organization's record management system. This database is restricted to law enforcement personnel and requires multiple levels of information security and organizational clearance to ensure the privacy and confidentiality of its contents.

To comply with these rigorous criteria and ensure that the research accurately captures intended measurements, produces consistent findings, and is replicable, I maintained high academic standards throughout the research process. This commitment ensured that the conclusions drawn from this study would withstand scrutiny and make a meaningful contribution to the field (Burkholder et al., 2020).

Additionally, the study employed a Cox Proportional Hazards regression model, a type of survival analysis commonly used in public health studies to assess the time until an event occurs in multivariate analyses. The use of R, a statistical program, significantly enhanced the ability to reproduce the study's findings and produce graphical visualizations. To further support the study's credibility, the code has been included as an appendix.

The process for analyzing the dataset followed a systematic procedure to assess the influence of predictor variables on the dependent variable's outcomes. The research is supported by prior peer-reviewed studies and visual aids designed to reinforce the concepts of validity and reliability, ultimately leading to meaningful conclusions.

In conclusion, I sought to uphold academic rigor and demonstrate a strong commitment to validity and reliability throughout the research design, analysis, and interpretation. My objective was to encourage other scholars and practitioners to verify these conclusions, investigate additional variables that may affect the findings, and persist in seeking improvements.

Strengths and Limitations of the Study

The strength of this survival analysis lies in its ability to provide new insights into the effectiveness of NIBIN leads in contributing to case closures for violent crimes, such as homicides and aggravated assaults involving firearms. While the findings indicated a statistically significant and faster association between NIBIN leads and case closure for these two categories, further research is needed to better understand the program's potential over longer periods.

The study had several limitations. First, although the client organization was helpful in extracting the necessary data from their records management system (RMS), the implementation of a new system in 2021 resulted in the archiving of thousands of cases. Consequently, I was only able to retrieve a sample of aggravated assaults from the years 2019 to 2024, whereas all homicides were included in the analysis. As a result, some cases may have been overlooked during the search. Furthermore, since most aggravated assaults involving firearms are likely related to shooting incidents, it is possible that a significant number of aggravated assaults were reclassified as homicides during the study's observation period.

Summary

In Section 4, I discussed the components of the results and recommendations for the professional administrative study. This section covered topics such as data collection methods, data analysis procedures, findings, deliverables, and recommendations, along with the implications, evidence of trustworthiness, strengths, and limitations associated with the study.

To start, I provided a concise reintroduction to the study’s purpose and the organizational problem, along with an explanation of the deliverables presented to the client organization. I then outlined the data collection procedures used to gather, compile, and prepare the dataset for statistical analysis. Following that, I presented a detailed explanation of the dataset analysis and the findings obtained from the Cox proportional hazards model.

Furthermore, I discussed the potential implications of the study to encourage further research in this field. I also described how the findings were communicated to the client organization and articulated the recommendations derived from these findings. This section included a discussion on trustworthiness, linking the rigorous processes of collection, analysis, and interpretation to the principles of validity and reliability that are essential to quantitative analysis.

Finally, I highlighted the strengths of the study, particularly its first direct analysis of NIBIN-generated leads in relation to violent crime categories. Additionally, I acknowledged the limitations of the study, emphasizing the need for further investigation in this area.

Section 5: Dissemination Plan and Conclusion

Dissemination Plan

The findings of the study were communicated to the management team of the client organization through an email that included both the executive summary and a PowerPoint presentation. This communication was conducted in a two-step process. Initially, an email was dispatched to inform the client organization of the study's conclusions. This correspondence also expressed appreciation for the opportunity to evaluate the organizational program and to develop actionable recommendations.

Subsequently, the executive summary was provided to the members of the client organization's management team. This summary encompassed an introduction, a problem statement, an explanation of the analysis, recommendations, and conclusions. By presenting a concise and synthesized report, the management team was afforded adequate time to thoroughly review the findings and recommendations and to provide feedback that could inform further research, whether conducted independently or in collaboration with other scholars.

Additionally, the professional administrative study was published in ProQuest to ensure it is accessible to researchers and practitioners in a format that guarantees it is archived, preserved, and cited adequately for future investigation (Remler & Van Ryzin, 2011). Furthermore, making the study available to researchers allows them to consider the methodology, verify the data, and replicate the findings, which significantly enhances the validity and reliability of the study’s results and interpretations.

Lastly, I extended an invitation to the management team for an in-person meeting, during which I presented the PowerPoint and was available to address any questions they had. Given the study's conclusion that NIBIN leads contributed to faster closing times compared to those without, the study was well-received. However, since this is the first study on the topic, further research could identify potential enhancements in the program and areas that may lead to positive social implications.

Conclusions

In this study, I investigated the impact of NIBIN-generated leads on the probability of case closure for violent crimes involving firearms, specifically homicides and aggravated assaults. The significance of this study lies in the fact that the forensic laboratory collaborating with the federal agency responsible for administering the program lacked evidence-based data to justify resource allocation or demonstrate the program’s efficacy in supporting law enforcement efforts.

The study employed a survival analysis approach to assess the effectiveness of NIBIN leads based on the time to event (i.e., case closure) within two categories, a technique commonly used in the public health community (Shreffler & Hueckler, 2023). Although the analysis showed that NIBIN leads may contribute to faster case closure times, I identified a few limitations. Therefore, the study recommends further research to explore how other factors could provide the client organization, law enforcement stakeholders, and the public with a more comprehensive understanding of the program's capabilities.

Summary

The examination of NIBIN-generated leads associated with violent crimes, such as homicides and aggravated assaults, constitutes a significant area of scholarly inquiry. The implementation of various forensic techniques is essential in supporting strategies for crime reduction and prevention, playing a critical role in mitigating both crime and the associated fear within communities. NIBIN's analysis of firearms and ballistic images represents a significant advancement in this public safety initiative and may carry considerable implications.

Consequently, further research into the impact of NIBIN leads, which integrates data from law enforcement record management systems regarding case closures, as well as e-trace data detailing information about firearms manufacturers, makes, models, and ownership could produce meaningful positive social outcomes.

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Appendix A: Client Agreement

1. Client Information	
Name of Client Organization Name Withheld	***Name of Student/Researcher*** Massi A. Martin
Name of Client Contact Person Name Withheld	***Email of Client Contact Person*** Email Withheld
Client Contact's Mailing Address	Address Withheld

2. Project Description
In this quantitative study, I will collaborate with the client organization to evaluate the National Integrated Ballistic Information Network (NIBIN) and its impact on closing crime gun investigations. Data for this study will be gathered from the client, ATF, and secondary sources to compare NIBIN generated lead variables to crime gun outcomes related to public safety.

3. Tasks to be completed by Researcher
In this study, I will gather NIBIN generated data related to crime guns intelligences. In particular, date regarding time to NIBIN entry, the number of ballistic images entered, crime classification, and whether the NIBIN lead was generated. Next, this information will be used to compare the timeline of investigative closures for violent crimes such as aggravated assault and homicides.

4. Assistance (including data) to be provided by Client Organization
For this project, the researcher requires access to NIBIN generated data, local law enforcement investigation data, and discussions with forensic science subject matter experts.

5. Deliverables for the Client Organization
The deliverable for this project will be the capstone report, published in the ProQuest system. A copy of the report can be made available to the client organization if requested.

Terms of confidentiality and compliance:

In all reports (including drafts shared with peers and faculty members), the student is required to maintain confidentiality by removing names and key pieces of information that might disclose an Institution's/individual's identity or inappropriately divulge proprietary details. If the client organization wishes to publicize the findings of this project, that is the organization's judgment call.

The student will publish the study in ProQuest as a doctoral capstone (with site and participant identifiers withheld). The study is based upon the academic research completed by the student as well as the data provided by the client organization and/or collected by the student as outlined in the above agreement. If the data collected include interviews, interview recordings and full transcripts will be shared with any interviewee (upon request), and the student will provide opportunities for clarifying previous statements. Transcripts with identifiers redacted may be shared with the doctoral student's university faculty, peer advisors, and site leadership (upon request).

The student will not use these data for any purpose other than the project outlined in this agreement. The doctoral student is responsible for understanding and complying with all of the client organization's policies and regulatory requirements.

The Code of Conduct in the current Walden University Student Handbook and the ethical requirements for IRB compliance will also govern the research completed by the student. Students are required to uphold professional principals in fulfilling their roles as consultants to client organizations. In addition to confidentiality requirements and protections as outlined above, students also will protect the integrity of the Walden University and the client organization and exhibit professional conduct at all times.

6. Project Approval & Signature	
Signature of Client Contact Person	***Date***
Name of Client Contact Person Name Withheld	Name Withheld
Title of Client Contact Person	Title Withheld

Appendix B: Executive Summary Deliverable

Executive Summary

To: Executive Team, Client Organization
From: Massi A. Martin, DPA
Date:
Subject: Study Summary and Recommendations

Organization Background and Problem Statement

The client organization has partnered with the federal agency responsible for managing the NIBIN program. NIBIN is a firearms and ballistics analysis program that uses algorithms to analyze digital images. It links evidence collected at crime scenes or from test-firing to assist law enforcement in identifying individuals and connecting related incidents. The program has received positive endorsements from law enforcement agencies focused on addressing gun-related crime. However, despite these endorsements, the client organization lacked empirical evidence to evaluate the program's effectiveness, which has limited their decision-making regarding staffing and resource allocation. This study aimed to fill that research gap and provide actionable recommendations to the client organization for potential improvements.

Key Findings

In this study, I used the Cox Proportional Hazards regression model to analyze the impact of various factors on the time taken to close cases. The analysis found that when law enforcement had a NIBIN lead, both homicide and aggravated assault cases involving firearms had a greater chance of being closed compared to those without such a lead. Specifically, the analysis revealed that homicide cases were twice as likely to close at any given time, while aggravated assault cases were closed 91.2 percent faster when a

NIBIN lead was present. Several diagnostic models were used to assess the fit of the model, and they were statistically significant. These findings could have significant implications for the client organization and its law enforcement partners.

Recommendations

This study provides two main recommendations. First, enhance the NIBIN processing method to accelerate lead sharing and expedite case closures. Second, investigate how other forensic techniques can improve NIBIN's capacity to deliver actionable crime gun intelligence. Additionally, it is important to address the timing of NIBIN leads and improve communication among law enforcement agencies to reduce bias. Strengthening community-police relations through research can increase public trust in the justice system and support efforts to prevent violent crime.

Conclusion

In this study, I presented initial evidence regarding the impact of NIBIN leads on the timely resolution of violent crime cases, particularly homicides and aggravated assaults involving firearms. This information is especially important given the growing demand for forensic evidence to support law enforcement investigations and criminal prosecutions. The client organization, as the primary provider of this forensic analysis, has now received statistical evidence to bolster its request for increased staffing and resources to assist law enforcement initiatives. Furthermore, the findings of this study have significant implications for public safety and encourage further research into forensic techniques aimed at enhancing public safety.

Appendix C: Analysis of NIBIN

Analysis of NIBIN on Violent Crime Case Closure

Massi Martin

2025-06-02

```
library(readr)
library(survival)
library(tidyverse)
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyve
rse 2.0.0 ──
## ✔ dplyr     1.1.4     ✔ purrr     1.0.2
## ✔ forcats   1.0.0     ✔ stringr   1.5.1
## ✔ ggplot2   3.5.1     ✔ tibble    3.2.1
## ✔ lubridate 1.9.4     ✔ tidyr     1.3.1
## ── Conflicts ────────────────────────────────────────── tidyverse_co
nflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to f
orce all conflicts to become errors
```

```
library(readxl)
library(survminer)
```

```
## Loading required package: ggpubr
##
## Attaching package: 'survminer'
##
## The following object is masked from 'package:survival':
##
##     myeloma
```

```
options(scipen=999)
```

```
df <- read_csv("Desktop/All Data Projects/R Projects/Massi Martin/New M
artin Dataset.csv")
```

```
## New names:
## Rows: 3424 Columns: 7
## ── Column specification
```

```
## ──────────────────────────────────────────────────────── Delimiter:
"," chr
## (2): IncidentDate, CloseDate dbl (3): CrimeType, NIBIN, Closed lgl (
2): ...6,
## ...7
## ℹ Use `spec()` to retrieve the full column specification for this
data. ℹ
## Specify the column types or set `show_col_types = FALSE` to quiet th
is message.
## • `` -> `...6`
## • `` -> `...7`
```

```
head(df)
```

```
## # A tibble: 6 × 7
##   IncidentDate CrimeType NIBIN Closed CloseDate ...6  ...7
##   <chr>            <dbl> <dbl>  <dbl> <chr>     <lgl> <lgl>
## 1 12/31/23             1     2      1 1/1/24    NA    NA
## 2 1/2/24               1     2      1 1/26/24   NA    NA
## 3 1/4/24               1     2      2 <NA>      NA    NA
## 4 1/4/24               1     2      1 1/19/24   NA    NA
## 5 1/4/24               1     2      2 <NA>      NA    NA
## 6 1/4/24               1     2      1 1/4/24    NA    NA
```

```
str(df)
```

```
## spc_tbl_ [3,424 × 7] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ IncidentDate: chr [1:3424] "12/31/23" "1/2/24" "1/4/24" "1/4/24"
...
##  $ CrimeType   : num [1:3424] 1 1 1 1 1 1 1 1 1 1 ...
##  $ NIBIN       : num [1:3424] 2 2 2 2 2 2 2 1 1 2 ...
##  $ Closed      : num [1:3424] 1 1 2 1 2 1 1 1 3 1 ...
##  $ CloseDate   : chr [1:3424] "1/1/24" "1/26/24" NA "1/19/24" ...
##  $ ...6        : logi [1:3424] NA NA NA NA NA NA ...
##  $ ...7        : logi [1:3424] NA NA NA NA NA NA ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   IncidentDate = col_character(),
##   ..   CrimeType = col_double(),
##   ..   NIBIN = col_double(),
##   ..   Closed = col_double(),
##   ..   CloseDate = col_character(),
##   ..   ...6 = col_logical(),
##   ..   ...7 = col_logical()
##   .. )
##  - attr(*, "problems")=<externalptr>
```

```
df$CloseDate[is.na(df$CloseDate)] <- "05/15/25"
df <- df %>%
  filter(CloseDate != '20223')
str(df)

## spc_tbl_ [3,424 × 7] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ IncidentDate: chr [1:3424] "12/31/23" "1/2/24" "1/4/24" "1/4/24"
...
##  $ CrimeType   : num [1:3424] 1 1 1 1 1 1 1 1 1 1 ...
##  $ NIBIN       : num [1:3424] 2 2 2 2 2 2 2 1 1 2 ...
##  $ Closed      : num [1:3424] 1 1 2 1 2 1 1 1 3 1 ...
##  $ CloseDate   : chr [1:3424] "1/1/24" "1/26/24" "05/15/25" "1/19/24
" ...
##  $ ...6        : logi [1:3424] NA NA NA NA NA NA ...
##  $ ...7        : logi [1:3424] NA NA NA NA NA NA ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   IncidentDate = col_character(),
##   ..   CrimeType = col_double(),
##   ..   NIBIN = col_double(),
##   ..   Closed = col_double(),
##   ..   CloseDate = col_character(),
##   ..   ...6 = col_logical(),
##   ..   ...7 = col_logical()
##   .. )
##  - attr(*, "problems")=<externalptr>

df$IncidentDate <- as.Date(df$IncidentDate, format = "%m/%d/%y")
df$CloseDate <- as.Date(df$CloseDate, format = "%m/%d/%y")
df$CloseDate[is.na(df$CloseDate)] <- as.Date("2025-05-15")
str(df)

## spc_tbl_ [3,424 × 7] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ IncidentDate: Date[1:3424], format: "2023-12-31" "2024-01-02" ...
##  $ CrimeType   : num [1:3424] 1 1 1 1 1 1 1 1 1 1 ...
##  $ NIBIN       : num [1:3424] 2 2 2 2 2 2 2 1 1 2 ...
##  $ Closed      : num [1:3424] 1 1 2 1 2 1 1 1 3 1 ...
##  $ CloseDate   : Date[1:3424], format: "2024-01-01" "2024-01-26" ...
##  $ ...6        : logi [1:3424] NA NA NA NA NA NA ...
##  $ ...7        : logi [1:3424] NA NA NA NA NA NA ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   IncidentDate = col_character(),
##   ..   CrimeType = col_double(),
##   ..   NIBIN = col_double(),
##   ..   Closed = col_double(),
##   ..   CloseDate = col_character(),
##   ..   ...6 = col_logical(),
```

```
##   ..   ...7 = col_logical()
##   .. )
##  - attr(*, "problems")=<externalptr>

df$CrimeType <- ifelse(df$CrimeType == 1, 'Homicide', 'Aggravated Assau
lt')

df$NIBIN <- ifelse(df$NIBIN == 1, 'Yes', 'No')
df$Closed <- ifelse(df$Closed == 1, 1, 0)
head(df)

## # A tibble: 6 × 7
##   IncidentDate CrimeType NIBIN Closed CloseDate  ...6  ...7
##   <date>       <chr>     <chr>  <dbl> <date>     <lgl> <lgl>
## 1 2023-12-31   Homicide  No         1 2024-01-01 NA    NA
## 2 2024-01-02   Homicide  No         1 2024-01-26 NA    NA
## 3 2024-01-04   Homicide  No         0 2025-05-15 NA    NA
## 4 2024-01-04   Homicide  No         1 2024-01-19 NA    NA
## 5 2024-01-04   Homicide  No         0 2025-05-15 NA    NA
## 6 2024-01-04   Homicide  No         1 2024-01-04 NA    NA

df$days_to_close <- as.numeric(df$CloseDate - df$IncidentDate)

head(df)

## # A tibble: 6 × 8
##   IncidentDate CrimeType NIBIN Closed CloseDate  ...6  ...7  days_to
_close
##   <date>       <chr>     <chr>  <dbl> <date>     <lgl> <lgl>
<dbl>
## 1 2023-12-31   Homicide  No         1 2024-01-01 NA    NA
1
## 2 2024-01-02   Homicide  No         1 2024-01-26 NA    NA
24
## 3 2024-01-04   Homicide  No         0 2025-05-15 NA    NA
497
## 4 2024-01-04   Homicide  No         1 2024-01-19 NA    NA
15
## 5 2024-01-04   Homicide  No         0 2025-05-15 NA    NA
497
## 6 2024-01-04   Homicide  No         1 2024-01-04 NA    NA
0

negative <- df %>%
  filter(days_to_close<0)
str(negative)

## spc_tbl_ [13 × 8] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ IncidentDate : Date[1:13], format: "2024-07-21" "2024-11-26" ...
```

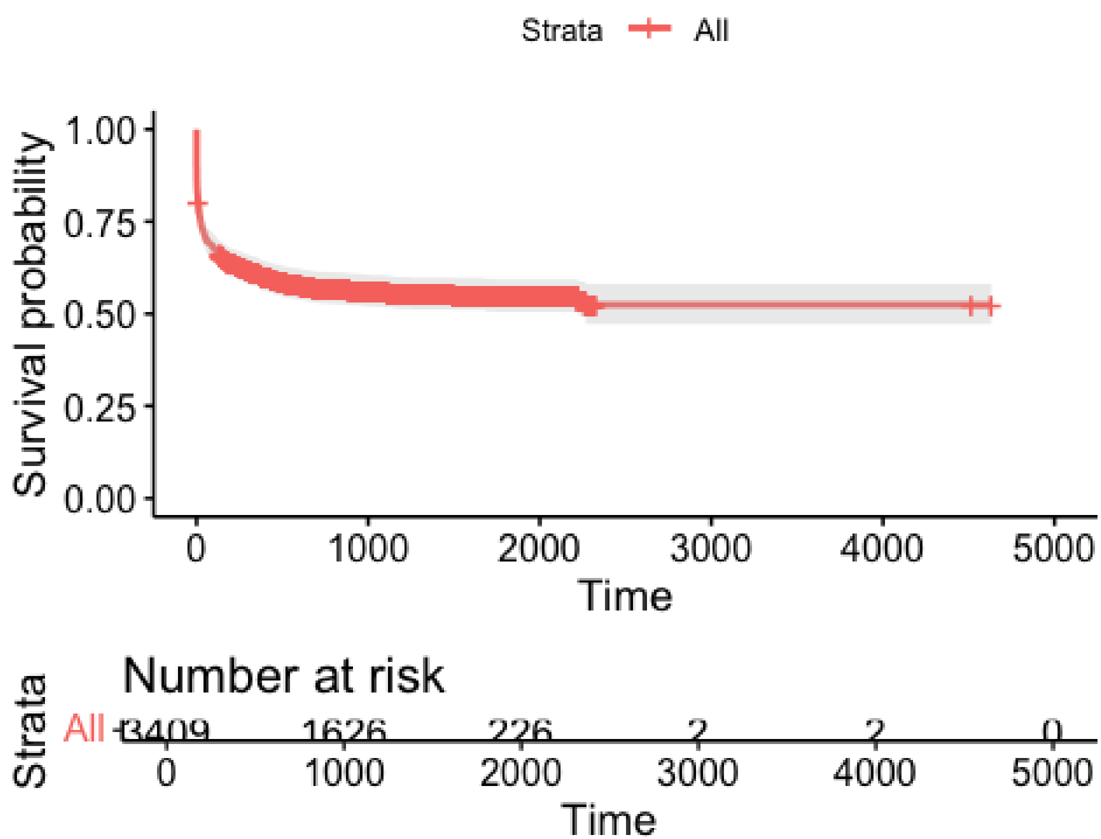
```
##  $ CrimeType    : chr [1:13] "Homicide" "Homicide" "Homicide" "Homic
ide" ...
##  $ NIBIN        : chr [1:13] "Yes" "No" "Yes" "No" ...
##  $ Closed       : num [1:13] 1 1 1 1 1 1 1 1 0 0 ...
##  $ CloseDate    : Date[1:13], format: "2022-07-24" "2024-01-26" ...
##  $ ...6         : logi [1:13] NA NA NA NA NA NA ...
##  $ ...7         : logi [1:13] NA NA NA NA NA NA ...
##  $ days_to_close: num [1:13] -728 -305 -273 -61 -299 ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   IncidentDate = col_character(),
##   ..   CrimeType = col_double(),
##   ..   NIBIN = col_double(),
##   ..   Closed = col_double(),
##   ..   CloseDate = col_character(),
##   ..   ...6 = col_logical(),
##   ..   ...7 = col_logical()
##   .. )
##  - attr(*, "problems")=<externalptr>
```

```
print(negative)
```

```
## # A tibble: 13 × 8
##    IncidentDate CrimeType      NIBIN Closed CloseDate  ...6  ...7  d
ays_to_close
##    <date>       <chr>          <chr>  <dbl> <date>     <lgl> <lgl>
<dbl>
##  1 2024-07-21   Homicide       Yes        1 2022-07-24 NA    NA
-728
##  2 2024-11-26   Homicide       No         1 2024-01-26 NA    NA
-305
##  3 2024-12-11   Homicide       Yes        1 2024-03-13 NA    NA
-273
##  4 2023-02-25   Homicide       No         1 2022-12-26 NA    NA
-61
##  5 2021-12-15   Aggravated As… No         1 2021-02-19 NA    NA
-299
##  6 2022-02-11   Homicide       No         1 2021-02-12 NA    NA
-364
##  7 2021-10-06   Aggravated As… No         1 2021-09-29 NA    NA
-7
##  8 2021-11-04   Aggravated As… No         1 2021-07-05 NA    NA
-122
##  9 2030-03-04   Homicide       Yes        0 2025-05-15 NA    NA
-1754
## 10 2030-03-05   Homicide       Yes        0 2025-05-15 NA    NA
-1755
## 11 2030-03-30   Homicide       No         1 2020-04-11 NA    NA
```

```
-3640
## 12 2030-03-20   Homicide       Yes         1 2020-09-06 NA    NA
-3482
## 13 2025-06-30   Homicide       Yes         0 2025-05-15 NA    NA
-46

df <- df %>%
  filter(days_to_close >= 0 )

homicides <- df %>%
  filter(CrimeType == "Homicide")

aggAssault <- df %>%
  filter(CrimeType == "Aggravated Assault")

coxmodel <- coxph(Surv(days_to_close, Closed) ~ NIBIN + CrimeType, data
= df)
survfit <- survfit(coxmodel)
summary_cox <- summary(coxmodel)
print(summary_cox)

## Call:
## coxph(formula = Surv(days_to_close, Closed) ~ NIBIN + CrimeType,
##     data = df)
##
##   n= 3409, number of events= 1298
##    (2 observations deleted due to missingness)
##
##                       coef exp(coef) se(coef)      z           Pr(>|
z|)
## NIBINYes          -0.43385   0.64801  0.05812 -7.464 0.0000000000000
839 ***
## CrimeTypeHomicide  0.04305   1.04399  0.06545  0.658              0.
511
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##                   exp(coef) exp(-coef) lower .95 upper .95
## NIBINYes              0.648     1.5432    0.5782    0.7262
## CrimeTypeHomicide     1.044     0.9579    0.9183    1.1869
##
## Concordance= 0.563  (se = 0.008 )
## Likelihood ratio test= 64.35  on 2 df,   p=0.00000000000001
## Wald test            = 64.09  on 2 df,   p=0.00000000000001
## Score (logrank) test = 65.14  on 2 df,   p=0.000000000000007

print(ggsurvplot(
  survfit,
```

```
  data = df,
  risk.table = TRUE,
  conf.int = TRUE,
  pval = TRUE
))

## Warning in .pvalue(fit, data = data, method = method, pval = pval, p
val.coord = pval.coord, : There are no survival curves to be compared.
##  This is a null model.
```

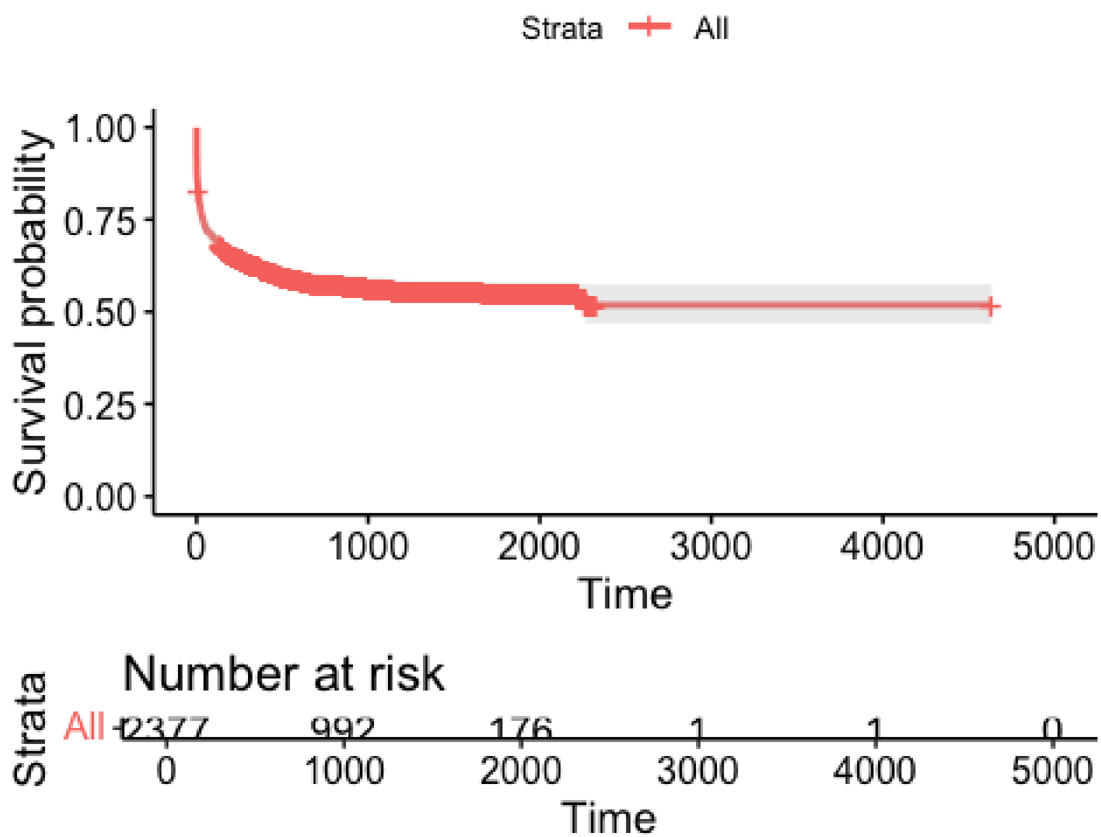



```
coxmodel <- coxph(Surv(days_to_close, Closed) ~ NIBIN, data = homicides
)
survfit <- survfit(coxmodel)
summary_cox <- summary(coxmodel)
print(summary_cox)

## Call:
## coxph(formula = Surv(days_to_close, Closed) ~ NIBIN, data = homicide
s)
##
##   n= 2377, number of events= 951
```

```
##    (1 observation deleted due to missingness)
##
##              coef exp(coef) se(coef)    z Pr(>|z|)
## NIBINYes -0.24980   0.77895  0.06573 -3.8 0.000144 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##          exp(coef) exp(-coef) lower .95 upper .95
## NIBINYes     0.779      1.284    0.6848    0.8861
##
## Concordance= 0.542  (se = 0.008 )
## Likelihood ratio test= 14.6  on 1 df,   p=0.0001
## Wald test            = 14.44  on 1 df,   p=0.0001
## Score (logrank) test = 14.52  on 1 df,   p=0.0001
```

```
print(ggsurvplot(
  survfit,
  data = homicides,
  risk.table = TRUE,
  conf.int = TRUE,
  pval = TRUE
))
```

```
## Warning in .pvalue(fit, data = data, method = method, pval = pval, p
val.coord = pval.coord, : There are no survival curves to be compared.
##  This is a null model.
```




```
coxmodel <- coxph(Surv(days_to_close, Closed) ~ NIBIN, data = aggAssaul
t)
survfit <- survfit(coxmodel)
summary_cox <- summary(coxmodel)
print(summary_cox)

## Call:
## coxph(formula = Surv(days_to_close, Closed) ~ NIBIN, data = aggAssau
lt)
##
##   n= 1032, number of events= 347
##    (1 observation deleted due to missingness)
##
##              coef exp(coef) se(coef)      z            Pr(>|z|)
## NIBINYes -0.9079    0.4034   0.1088 -8.343 <0.0000000000000002 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##          exp(coef) exp(-coef) lower .95 upper .95
## NIBINYes    0.4034      2.479    0.3259    0.4993
##
```

```
## Concordance= 0.604  (se = 0.013 )
## Likelihood ratio test= 64.78  on 1 df,   p=0.0000000000000008
## Wald test            = 69.6  on 1 df,   p=<0.0000000000000002
## Score (logrank) test = 74.44  on 1 df,   p=<0.0000000000000002
```

```
print(ggsurvplot(
  survfit,
  data = aggAssault,
  risk.table = TRUE,
  conf.int = TRUE,
  pval = TRUE
))
```

```
## Warning in .pvalue(fit, data = data, method = method, pval = pval, p
val.coord = pval.coord, : There are no survival curves to be compared.
##  This is a null model.
```