TIMING IS EVERYTHING: STATE-BY-STATE ANALYSIS OF THE COLLECTION OF LAWFULLY OWED DNA FROM OFFENDERS

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A Thesis

Presented to

The Faculty of the Department of Criminal Justice and Criminology

Sam Houston State University

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In Partial Fulfillment

of the Requirements for the Degree of

Master of Arts

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by

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May 2023

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ABSTRACT

Maples, Angelica C., *Timing is everything: state-by-state analysis of the collection of lawfully owed DNA from offenders.* Master of Arts (Criminal Justice and Criminology), May, 2023, Sam Houston State University, Huntsville, Texas.

The purpose of this thesis is to describe differences across states in the core elements of their statutes on the collection of DNA from suspects and convicted offenders and to analyze the influence of specific components of state statutes on the collection of lawfully owed DNA throughout the United States, the District of Columbia (D.C.), and the three united territories (Guam, Puerto Rico, and Virgin Islands). State legal data on the collection of DNA is coded for all 50 states, D.C. and three united territories, along with data on the total number of CODIS hits as of October of 2021. This thesis answers three research questions. What do state statutes require for the collection of lawfully owed DNA? The thesis answers this question with the systematic collection of data about state statutes and a descriptive analysis of the data. Second, do states enter fewer investigations aided into CODIS if their statute indicates DNA will be collected at both arrest and conviction? The hypothesis is that the collection of lawfully owed DNA by states at both arrest and conviction would have a negative relationship with the number of investigations aided as defined by the FBI in the National DNA Index System (NDIS). The study tests this relationship through an independent samples t-test analysis. Third, are aspects of state statutes related to the number of offender profiles within NDIS? The hypothesis is that the number of points at which lawfully owed DNA is collected during the conviction process would be correlated with the number of CODIS offender profiles. The thesis tests this relationship through an Analysis of Variance (ANOVA) test of five points in time. The results of these three analyses provide insights into the potential benefits of regulating components within state statutes. The study also presents policy recommendations that have the potential to reduce inconsistency with the collection of lawfully owed DNA.

KEY WORDS: Lawfully owed DNA; CODIS; CODIS hits; Investigations aided; Offender profiles; NDIS; State statutes; SAKI

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CHAPTER I

Introduction

The use of forensic evidence can be traced back to ancient times. In 44 BC, a Roman physician, Antistius, conducted the first recoded autopsy of a dead body; the body being Julius Cesar (IFF Labs, 2018). In 3000 BC, the Egyptians practiced the removal and examination of human organs from dead bodies, which was also an early example of forensic autopsy (IFF Labs, 2018). In the first Century AD, a basic understanding of forensics was used by a Roman jurist to acquit an individual who was innocent (IFF Labs, 2018). In the 13th Century, Song Chi wrote “The Washing Away of Wrongs”, which detailed different causes of death, such as accidents and murder (IFF Labs, 2018). In the 16th Century, two Italian surgeons, Fidelis and Zacchia, studied changes in the human body caused by diseases, which formed the foundation for modern pathology (IFF Labs, 2018). In 1773, a Swedish chemist, Scheele, created a chemical test that could detect arsenic in dead bodies (IFF Labs, 2018).

In 1814, the “Father of Forensic Toxicology”, Mathieu Orfilla, published the first article on the detection of poison in or on the human body (IFF Labs, 2018). In 1835, Henry Goddard was the first person to connect a bullet to a weapon used in a murder (IFF Labs, 2018). In 1880, Sir Francis Galton was the creator of the first technique to match fingerprints (IFF Labs, 2018). Sixteen years later, in 1896, Sir Edward Henry created the Henry Classification System which was used as a basis for criminal fingerprinting techniques worldwide (IFF Labs, 2018). And lastly, in 1910, “The Sherlock Holmes of France”, Edmond Locard, formulated the basic principles of forensic science with the saying, “everything leaves a trace” (IFF Labs, 2018, para. 61). These represent significant events in forensic science.

After the use of forensic evidence started to advance, there was a growing distinction between different types of forensic science. Today there are 16 different fields of forensic science: trace evidence forensics; forensic toxicology; forensic psychology; forensic podiatry; forensic pathology; forensic odontology; forensic linguistics; forensic geology; forensic entomology; forensic engineering; forensic DNA analysis; forensic botany; forensic archeology; forensic anthropology; digital forensics; and forensic ballistics (IFF Labs, 2019). Of these 16 different forensic fields, the following eight forensic fields represent those that are most commonly used by criminal justice agencies: trace evidence, forensic toxicology, forensic psychology, forensic podiatry, forensic pathology, digital forensics, forensic ballistics, and forensic DNA analysis.

Trace evidence analysis is the recovery of trace elements such as hair, fingerprints, soil, feathers, rope fibers, building materials, fabric fibers, etc. that are left at a crime scene or transferred during the commission of a crime (IFF Labs, 2019). Forensic toxicology is the study of toxic substances that are found inside a body (human or animal) and how it affected that individual (IFF Labs, 2019). Forensic psychology is the use of psychology to study and analyze law breakers and the offenses they commit to understand the criminal’s personality and behavioral traits to create a criminal profile (IFF Labs, 2019). Forensic podiatry is an understanding of evidence related to the lower body, such as abnormalities and/or diseases in the ankle and foot and is most commonly associated with footprints or shoe prints in criminal cases (IFF Labs, 2019). Forensic pathology is the analysis of dead bodies to determine the cause of death (IFF Labs, 2019).

Digital forensics is mostly used in cybercrime and analyzes digital evidence found in computers, hard drives, USB drives, etc. (IFF Labs, 2019). Forensic ballistics is the analysis of evidence related to guns such as the gun itself, bullets, shell casing, gunpowder residue, etc., and the inferences of the type of weapon used to commit a crime, the distance from which the firearm was shot, the velocity of the bullet, the angle the gun was fired, and possibly the shooter themselves (IFF Labs, 2019). And finally, forensic DNA analysis is the collection and analysis of biological evidence from, skin, hair, semen, blood, urine, saliva, and sometimes bone marrow or ashes in heavy burn cases (IFF Labs, 2019). Forensic DNA is the main topic of discussion in this thesis, as the laws pertaining to the collection of biological evidence from certain individuals will be analyzed.

Every cell in the human body contains a strand of DNA, or deoxyribonucleic acid, which is unique to an individual. DNA can be extracted from a multitude of different types of biological samples (e.g., hair, skin, blood, etc.) (Turman, 2001). When forensic laboratories analyze DNA, they use a Polymerase Chain Reaction (PCR). PCR amplifies a Short Tandem Repeat (STR) loci within the DNA strand, making it easier to analyze the sample (Budowle et al., 1998; Williams & Johnson, 2005). Because DNA profiles are unique to individual humans, forensic scientists are able to include or eliminate suspects from a case and provide value to criminal investigations (Budowle et al., 1998).

As previously detailed, forensic science had a major breakthrough in the 1800s and 1900s. In the 1800s, for example, scientist developed a chemical to detect the presence of blood at a crime scene, a ballistics was used for the first time to convict a murderer, a toxicology report was used in a jury trial for the first time, and fingerprints were used for the first time to solve a crime (IFF Labs, 2018). In the 1900s, there was a greater focus on major breakthroughs in DNA analysis: the development of absorption-inhibition techniques for ABO blood typing; developmental luminol to test for blood at a crime scene; and the increased ability to conduct DNA profiling (IFF Labs, 2018). DNA evidence was used in a criminal case for the first time in 1986 and has since paved the way for greater use because of ever-evolving technology. “DNA not only helps place suspects at crime scenes, but it also enables forensic genealogists to solve cases that went cold decades ago” (Science, 2019, para. 1).

Today, the collection of DNA evidence from individuals in an attempt to solve and prevent crimes is commonplace. This is called “lawfully owed DNA”, where a convicted offender is required by law to have their DNA collected and submitted into CODIS based on the offenses the individual has committed; however, DNA is frequently not collected and/or entered into CODIS (Sexual Assault Kit Initiative, n.d.; Jeanguenat, n.d.; Lovell, 2022; Sexual Assault Kit Initiative, 2021). From an email with Dr. Lovell (2023), the term “lawfully owed DNA” was coined within the Bureau of Justice Assistance as a distinct Sexual Assault Kit Initiative (SAKI) purpose area, by Angela Williamson and Denise o’ Donnell.

In 1989, Virginia was the first state to implement a policy on DNA testing in criminal investigations (Doleac, 2017; Hibbert, 1999; Virginia Department of Forensic Science, 2022). The policy was called “The Virginia Post-Conviction DNA Testing Program and Notification Project” and was originally implemented to test post-conviction DNA for offenders that did not undergo DNA analysis at the time of their conviction (Virginia Post-Conviction DNA Testing Program & Notification Project, n.d.). Later that same year, Virginia proceeded to modify the law to require certain types of offenders (i.e., sex offenders and violent offenders) to submit their DNA into a state DNA databank upon arrest and conviction (Hibbert, 1999): VA Code Ann. § 19.2-310.2 and VA Code Ann. § 19.2-310.2: 1. The Federal Bureau of Investigation's (FBI's) Combined DNA Index System (CODIS) was established the next year, in 1990, with Virginia being one of the pilot states (Virginia Department of Forensic Science, 2022). CODIS is a tool that is used by the criminal justice system to help identify offenders, generate investigative leads, link cases together, and identify serial criminal activity (Forensic Technology Center of Excellence, 2021; Lovell, 2022). The term CODIS represents the FBI program and software systems that support the databases used by the criminal justice system (Adams, 2002; FBI Fact Sheet; Forensic Technology Center of Excellence, 2021). Later, in 1994, the DNA Identification Act was formalized and allowed the FBI to establish a National DNA Index System (NDIS) (Budowle et al., 1998). The DNA Identification Act of 1994 focused on providing funding to states to either develop or further improve forensic laboratories to be able to conduct DNA analysis. The act also provided a framework for the federal supervision of DNA technology within forensic laboratories (Shapiro & Reifler, 1996). In 1998, the Division of Forensic Sciences for Virginia "estimated that the DNA databasing system will assist them in solving at least 600 cases in the next three years" (Hibbert, 1999, para. 3). This statement was affirmed when the Virginia DNA Database reached the 1,000th CODIS hit on November 13, 2002. And again, in April 2015, the Virginia DNA Database recorded the 10,000th CODIS hit, and on September 2021, Virginia DNA Database recorded the 15,000th CODIS hit (Virginia Department of Forensic Science, 2022).

It took approximately nine years after the formalization of CODIS for the other 49 states to pass laws requiring the collection of DNA from convicted offenders to create their own state DNA databank (Hibbert, 1999). After the nationwide formalization of the collection of DNA from convicted offenders, the collection of DNA itself was seen as playing both a reactive and proactive role. “The purpose of entering an individual’s DNA profile [in] the Database is to see if they are a potential suspect for a past crime” (De Moor et al., 2017, p.176). Collecting DNA from convicted offenders was seen as proactive, because it was able to provide information that may be needed to solve a crime with no leads and no suspects. The collection of known DNA is proactive in this manner because even if the individual had already committed an offense, the collection of their DNA could help solve future crimes (De Moor et al., 2017). The same is true for a reactive role: where the collection of an offender’s DNA could tie them to unsolved cases (cold cases) in the past, where there was no known suspect. The collection of DNA from a crime scene was viewed as reactive because the incident had already occurred and there were no leads to identify a suspect. There are four examples that illustrate the value of collecting DNA from convicted offenders: Anthony Sowell, Larry McGowan, Antonio Huffman, and Brandon Weathers (Augenstein, 2017; Dissell, 2011, 2013, 2018, 2019; Lovell & Klingenstein, 2019).

Anthony Edward Sowell was arrested for rape and incarcerated for 15 years in 1990 where, by state statute, his DNA was collected due to his conviction of a sex offense. Sowell’s DNA was sent to a forensic lab to be tested and entered into CODIS, but during the process of mailing the DNA, the sample was lost.[1] Sowell was then

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[1] The debate of the ethical issues of the DNA sample being lost in the mail is beyond the scope of this thesis.

released in 2005, reoffended in 2009 by raping another woman, had an arrest warrant issued for his arrest, and was eventually caught and arrested. The investigation revealed 11 dead and decaying bodies in and around his home. During the second arrest, his DNA was collected and tested. Officials found that Sowell's DNA was not entered in CODIS following his first conviction. When Sowell's DNA was entered into CODIS at his second arrest, his DNA profile had 74 forensic hits from rape kit collections. Sowell is now known as the Cleveland Strangler and was officially sentenced to death in 2011 (Dissell, 2011; Lovell, 2022).

In 2011 the Bureau of Criminal Identification and Investigation created a list of inmates in Ohio who lawfully owed DNA. In other words, individuals who were required to submit DNA samples to the state because of their criminal status. That list consisted of 307 inmates and parolees; Larry McGowan was one of them (Dissell, 2013). McGowan's DNA was on the list stating that he owed DNA, but the state never collected it. McGowan was arrested for raping a woman in 2012. During the investigation police determined that his DNA matched a DNA profile connected to the rape and murder of a woman in 1997. Between 1997 and 2012 McGowan had served several sentences in prison and jail for crimes related to burglary and arson and never had his DNA collected (Dissell, 2019). In the end, McGowan was convicted for the rape of five women, one of them being a woman that he killed in 1997 (Lovell, 2022).

In August of 1997, a 17-year-old girl was kidnapped and sexually assaulted. The authorities collected a rape kit. Seven years later, in 2004, her rape kit was tested as part of the Cuyahoga County Sexual Assault Kit Initiative (Lovell & Klingenstein, 2019; Lovell, 2022). The DNA profile from the rape kit was entered into CODIS and did not match any known DNA profiles. The lab then labeled this unknown DNA profile as "John Doe 124" (Dissell, 2018; Lovell, 2022). In 2012, Antonio Huffman was charged with felonious assault and was sentenced to time in prison; his DNA was not collected during this sentence. In 2015, Huffman was charged for illegal possession of a firearm during his probation and was sentenced again to prison; his DNA was not collected. In 2017, while Huffman was on probation for his 2015 offense, his DNA was finally collected. His DNA profile matched the "John Doe 124" DNA profile from a sexual assault in 1997 (Lovell & Klingenstein, 2019; Lovell 2022). This forensic hit would have occurred much sooner if his lawfully owed DNA had been collected as prescribed under Ohio law.

In 2016, Brandon Weathers was convicted of sexually assaulting a 13-year-old foster home girl who lived with him in Nebraska (Augenstein, 2017). Weathers was sentenced to 100 to 160 years. Upon his entrance to prison, he refused to give a sample of his DNA to be entered into CODIS. After one year, the court issued an order for the collection of a DNA sample, by force if need be. When his DNA was collected and entered into CODIS, four different CODIS hits for violent rapes in Omaha, NE between 2002 and 2004 resulted (Augenstein, 2017). Weathers had previously served time in 1995 and in 2000, both before the violent rapes between 2002 and 2004, but his DNA was not collected at those times (Augenstein, 2017). As in the Ohio cases, if Weathers DNA had been collected as required under law, police may have been able to identify him as a suspect and prevent future offenses.

These four individuals and their cases illustrate the importance of collecting DNA from convicted individuals as prescribed by law. Yet scholars do not understand the factors that may explain why DNA is not collected when mandated. “When the lawfully owed DNA initiative [in Cuyahoga County] began, there was a very limited ‘blueprint’ to follow to determine who lawfully owed DNA, how to obtain a DNA sample from them, and what would be the results of these efforts” (Lovell, 2022, p. 2330). Keeping this in mind, we do not understand the scope of this problem.

To aid in the development of solutions, the current thesis will answer three research questions. First, what do state statutes require for the collection of DNA from offenders? The thesis will summarize state statutes on the collection of lawfully owed DNA. This analysis will describe when the statutes were created, when they were created and updated, the standards for DNA collection, the organizations that collect and analyze the DNA, and measurements recorded within NDIS. Second, do states enter less investigations aided into NDIS if their statutes indicate DNA will be collected at both arrest and conviction? The thesis will perform a quantitative analysis of the relationship between the measurement of investigations aided in NDIS and whether states collected DNA at both arrest and conviction or at conviction only. Third, are aspects of state statutes related to the number of offender profiles reported within NDIS? This thesis will measure the relationship between the entry of offender profiles in NDIS and states’ requirements about the point at which DNA is to be collected, according to state law. This will be down by choosing five specific aspects (first incarceration, release from incarceration, during parole, during probation, and sex offender registration) and comparing them to the number of offender profiles within NDIS. The goal of these three research questions is to describe state statutes that regulate the collection of DNA evidence from suspects and convicted offenders in order to identify potential weaknesses that need to be overcome. In addition, the thesis will identify variation across states in DNA collection requirements and will identify correlations between state statutes and CODIS performance, as measured by the FBI.

CHAPTER II

Literature Review

Brief History

The first three criminal cases in which forensic evidence was used set the foundation for the importance of forensic evidence in the criminal justice system today. The first case is the conviction of John Toms for the murder of Edward Culshaw on January 19th, 1784, in Lancaster, England (IFF Labs, 2018; Starmans, 2018). Ballistic evidence was used in the case. Ballistic evidence is a form of forensic evidence related to the use of firearms, such as bullets, bullet marks, gunpowder residue, and shell casings (IFF Labs, 2019). The turning point in this case was a match between paper residue on Culshaw’s gun wound and paper found on Toms person when he was arrested (IFF Labs, 2018; Starmans, 2018). The second case involved the conviction of a farm laborer in Warwick, England in 1816 for the murder of a maid (IFF Labs, 2018; Saha, 2011). The forensic evidence that made a break in the case was footprint and cloth impressions found near the pool where the maid had drowned (Saha, 2011). The forensic analysis of the impressions, along with grains of wheat and chaff left at the scene, led to the conviction of the farm laborer (IFF Labs, 2018; Saha, 2011). This type of evidence is considered forensic podiatry; the forensic study of foot-based evidence such as foot/shoe prints (IFF Labs, 2019). The third case was the use of fingerprinting evidence was in a criminal case in 1986 in the UK when police officers asked a professor at the University of Leicester to analyze fingerprints from a crime scene of an individual who confessed to two rape-murders (Panneerchelvam & Norazmi, 2003). The results showed that the individual who confessed to the crimes was not the person who committed them (Panneerchelvam &

Norazmi, 2003). This is the first recorded use of fingerprinting evidence in a criminal case, even though it wasn't used to convict an individual. Fingerprinting falls under trace evidence analysis, where forensic evidence is left at the scene of the crime (IFF Labs, 2019).

It was only a year after the 1986 case that forensic DNA evidence was used for the first time in a criminal case. DNA, or deoxyribonucleic acid, is present within every cell of the human body. "The DNA in people's blood is the same as the DNA in their saliva, skin tissue, hair, and bone" (Turman, 2001; p.2). An important aspect of using DNA as a form of evidence in criminal cases is that a person's DNA never changes throughout the person's life and no two people have the same DNA (with the exception of identical twins). Because of these features, DNA can be instrumental in linking or eliminating a suspect to a crime (Turman, 2001). When DNA is collected at the scene of a crime, it can be compared with other DNA samples within CODIS, the Combined DNA Index System. If there are no matches within CODIS, the DNA is then used to create its own profile, which can be compared to other samples of DNA in the future (Turman, 2001).

DNA evidence was first used to convict an individual of a rape investigation, committed by Tommy Lee Andrews in 1987 (Hibbert, 1999). The case involved a burglary and the rape of a Florida woman in her home in the middle of the night (Hibbert, 1999). A rape kit was collected from the victim and evidence in the kit matched a blood sample from Andrews, who was revealed to be a serial rapist (Hibbert, 1999). At the time, there was no state or federal database of DNA profiles, but after Andrews' case, it had become clear that a DNA database would be valuable. This spurred the creation of the Combined DNA Index System (CODIS).

CODIS

In 1990, the Combined DNA Index System (CODIS) was created. CODIS started as a pilot program that included 12 states and their forensic laboratories (Adams, 2002; Lovell, 2022). In 2009, the federal government passed a bill to mandate the collection of DNA from individuals convicted of certain crimes or, if mandated, at arrest (Forensic Technology Center of Excellence, 2021). Today, CODIS includes all 50 states, District of Columbia, and three united territories (Virgin Islands, Puerto Rico, and Guam) and their forensic laboratories (FBI, 2021; Forensic Technology Center of Excellence, 2021).

CODIS is an FBI criminal justice DNA database, and all the software and instruments related to the collection and analysis of DNA (Adams, 2002; *FBI Fact Sheet*).

> The two main objectives for CODIS operations are: 1) assist investigators in the identification of suspects of violent crimes, and 2) increase the efficacy of forensic laboratories by providing software to conduct DNA casework and perform statistical calculations. (Budowle et al., 1998, p.73)

CODIS is divided into seven subcategories: Convicted Offender Index, Forensic Index (Campbell et al., 2018; Forensic Technology Center of Excellence, 2021; Panneerchelvam & Norazmi, 2003), Victims Index, Unidentified Persons Index, Missing Person Index, Close Biological Relatives Index, and Population File (Budowle et al., 1998). When a crime occurs and DNA is left at the scene, the DNA of the suspect can be collected, developed, and sent to a forensic laboratory.

Scientists are able to develop DNA profiles from only a few human cells left at crime scenes. This is important because evidence can be collected even when it is not obvious. As Turman (2001) says, “Remember, even though a stain cannot be seen, there may be enough cells for DNA typing” (p. 6). Table 1 shows different types of places that DNA evidence can be found (specifically in a rape scenario) (Turman, 2001).

Table 1

Identifying DNA Evidence

Possible Locations of DNA	Source of DNA
Bite Marks	Saliva
Fingernail Scrapes	Blood or Skin Cells
Inside/Outside of Condom	Semen or Skin Cells
Clothing	Hair, Semen, Blood, or Sweat
Bedding	Semen, Sweat, Hair, or Saliva
Hat or Mask	Sweat, Skin Cells, Hair, or Saliva
Tissue or Towel	Saliva, Semen, Hair, Skin Cells, or Blood
Rim of Glass/Bottle/Can	Saliva
Tape or Rope	Skin Cells, Saliva, or Hair

Note. These possible locations of DNA are specifically relevant to sex offense cases; the crime most associated with DNA collection at the scene of the crime.

With the collection of biological samples, forensic scientists are able to extract DNA profiles. The forensic lab then enters these DNA profiles into the CODIS database. In order for a DNA profile to be entered into CODIS, it needs to meet specific criteria. These criteria concern the quality of the profile, the reasonable belief that a crime was committed, and that the sample belongs to the alleged offender (Budowle et al., 1998; Campbell et al., 2018). When a DNA profile passes these criteria and is entered into

CODIS, it is compared against other profiles, including those from convicted offenders and individuals who have been arrested, and profiles extracted from evidence collected at crime scenes.

DNA analysis in CODIS occurs by using Polymerase Chain Reactions (PCRs), which amplifies a DNA's Short Tandem Repeat (STR) location (loci) within the DNA strand (Budowle et al., 1998; Williams & Johnson, 2005). The PCR makes millions of copies of the DNA, which allows for labs to compare the DNA profile from the crime scene to other DNA profiles within CODIS (Budowle et al., 1998; Turman, 2001). When comparing an offender DNA profile to a forensic DNA profile (DNA found at a crime scene) within CODIS, what occurs is that the database is comparing the STR loci from the known DNA strand to the STR loci of the unknown DNA strand. In order for the DNA strands to be valid, they need to consist of at least 13 loci to be entered into NDIS (Budowle et al., 1998). "The 13 core loci are: CSF1PO, FGA, TH01, TPOX, VWA, D3S1358, D5S818, D7S820, D8S1179, D13S317, D16S359, D18S51, and D21S11" (Budowle et al., 1998, p.76). These 13 loci are what make-up a DNA profile.

The first type of DNA profile in CODIS is an 'unknown' DNA profile that is typically collected at the crime scene or from a rape kit and is within the Forensic Index in CODIS (Adams, 2002; Budowle et al., 1998; Campbell et al., 2018; De Moor et al., 2017; Panneerchelvam & Norazmi, 2003; Turman, 2001). The second type of DNA profile is a 'known' DNA profile. These are typically collected from a suspect or known offender and are within the Convicted Offender Index in CODIS (Adams, 2002; Budowle et al., 1998; Campbell et al., 2018; De Moor et al., 2017; Panneerchelvam & Norazmi, 2003; Turman, 2001). If there is a match, where the unknown profile matches a known profile, three types of responses may occur: inclusion, exclusion, and inconclusive (Turman, 2001). Inclusion occurs when a DNA profile obtained from a victim or suspect matches a DNA profile from evidence at the crime scene. Indicating that a suspect or victim is a possible source of said DNA evidence (Turman, 2001). For inclusion to occur however, it must meet the general requirement for DNA to be entered into CODIS, meaning the evidence has to have a certain number of loci present (Budowle et al., 1998; Turman, 2001).

Exclusion occurs when a DNA profile obtained from a victim or suspect is not the same as a DNA profile obtained from the evidence at the crime scene. This excludes the suspect or victim as a possible source of DNA evidence that was collected at the crime scene (Turman, 2001). Exclusion does not always mean, however, that the individual was not involved in the incident but that no DNA connects an individual to the crime scene (Turman, 2001). An inconclusive result occurs when DNA testing could neither include or exclude a victim or suspect as the source of DNA evidence at a crime scene. These types of results typically occur when the DNA evidence collected at the crime scene is not of sufficient quality or quantity to produce an accurate result during DNA analysis. For example, there may noy have been enough loci present in the sample (Budowle et al., 1998; Turman, 2001).

CODIS is not the only database that is used to track DNA profile information. There are three tiers of sub-indexes that exist within CODIS: local, state, and national (Budowle et al., 1998; Forensic Technology Center of Excellence, 2021; Panneerchelvam & Norazmi, 2003). The Local DNA Index System (LDIS) is used by local police departments and is accessed by examiners through CODIS (Forensic Technology Center of Excellence, 2021; Panneerchelvam & Norazmi, 2003). The State DNA Index System (SDIS) is used by the state agency responsible for the statute on the collection of DNA from convicted offenders. SDIS is also accessed through CODIS and is comprised of all the data from LDIS so that profiles can be compared against each other (Panneerchelvam & Norazmi, 2003). The National DNA Index Statistics (NDIS) operated by the FBI is a composition of all the CODIS profiles on a federal, state, and local level (FBI, 2021; Panneerchelvam & Norazmi, 2003).

While CODIS hits are used in the identification of offenders, that does not always mean that they help in an investigation. The success of CODIS is defined by the FBI as an investigation aided (FBI, 2021). "Investigations aided" means a CODIS hit adds some form of value to the investigation of the crime in question. Beyond this, there are no exact criteria used to define what "investigations aided" means, so the measurement is limited. "The FBI measures the success of the CODIS program by counting the crimes it helps to solve" (Panneerchelvam & Norazmi, 2003, p.25). Currently, FBI regulated NDIS shows as of October 2021 that CODIS has had over 587,773 hits, resulting in over 574,343 investigations aided (FBI, 2021). While this is a very large number and suggests CODIS hits aid in investigations, it is important to put the number in perspective. The FBI reports over 14,836,490 offender profiles, 4,513,955 arrestee profiles, and 1,144,255 forensic profiles in NDIS (FBI, 2021). There is a large disparity between the number of DNA profiles present in NDIS and the number of investigations aided. In comparison, the disparity between CODIS hits and investigations aided are relatively small. There are situations in which a CODIS hit may have aided an investigation, but charges were not filed. For instance, the victim may not have wanted to participate in the investigation, or the prosecutor may have declined to file charges. In these kinds of situations, the CODIS hit could have aided in investigation, but the investigation was dropped so it does not count toward the NDIS data. For this reason, the way the FBI measures "investigations aided" is limited. This measure may not represent the true success of CODIS and DNA collection.

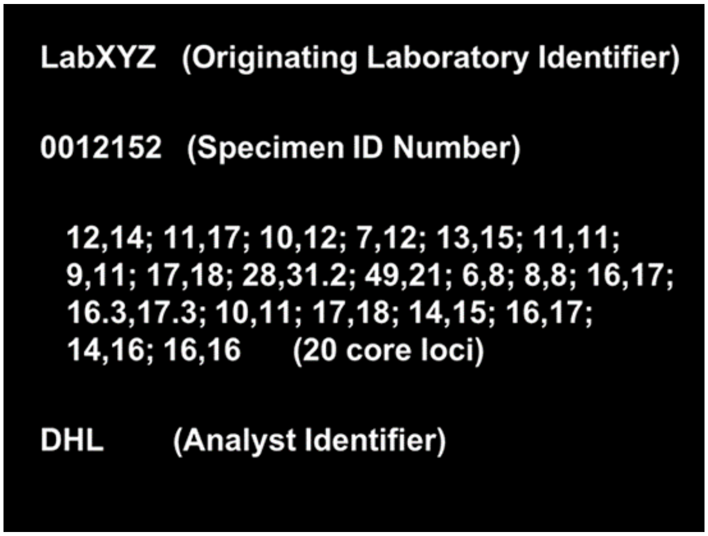
There are two types of CODIS hits: offender hits and forensic hits (FBI, 2021; FBI Fact Sheet, n.d.; Forensic Technology Center of Excellence, 2021). Offender hits entail a match between a DNA profile entered into CODIS and a DNA profile already associated with a known offender in CODIS (Forensic Technology Center of Excellence, 2021). Offender hits are commonly referred to as "lawfully owed DNA samples" because if the DNA was not acquired from the convicted offender through the laws on the collection of DNA from offenders, there would have been no hit (Forensic Technology Center of Excellence, 2021; Office of Justice Programs, 2022). These lawfully owed DNA samples will be the main focus of this thesis. Forensic hits occur when a DNA profile entered into CODIS matches with another DNA profile, but that profile is not attached to a known offender (FBI Fact Sheet). Forensic hits entail a match between forensic evidence found at different crime scenes that create investigative leads (Forensic Technology Center of Excellence, 2021).

What happens when there is an offender hit? Once a match is made in the CODIS database and is confirmed by the forensic lab, this information is provided to the agencies tied to the forensic profile. The offender hit information can then be used by detectives and in court as an investigative lead to be used in a prosecution (DNA database 101, 2016; FBI Fact Sheet, n.d.). Once an offender hit occurs and the hit is confirmed by a forensic examiner, a name is then attached to the DNA profile. Once the offender's name is associated with the DNA profile, the profile is kept in a separate computer file in CODIS that is only released to the corresponding law enforcement agency that matched the DNA profile (DNA database 101, 2016). Once enough evidence is collected by the corresponding law enforcement agency to charge the offender with the crime, a warrant can be issued to obtain a direct DNA sample from the offender in question to be used during court proceedings (DNA database 101, 2016).

What type of information is stored in CODIS? DNA profiles within CODIS are numerical files with no personal information, with the exception of the scenario discussed in the previous paragraph (DNA database 101, 2016). The only time this would be an exception is for a missing person's DNA profile, which may include the age and the birthdate of the individual in CODIS (FBI Fact Sheet, n.d.). The only information that is recorded in CODIS consists of the following: the DNA profile; the agency identification number related to the specimen; the specimen identification number; and the DNA laboratory that processed the specimen (Budowle et al., 1998; FBI Fact Sheet, n.d.; Panneerchelvam & Norazmi, 2003). CODIS does not keep information about criminal histories, case information, date of birth, and social security number for an individual whose DNA is entered into the system (Panneerchelvam & Norazmi, 2003). Figure 1 is an example of how a DNA profile appears in CODIS (DNA database 101, 2016).

Figure 1

CODIS DNA Profile



Note. Visual representation of a DNA profile within CODIS.

While the CODIS database does not mention personal information about an individual, there are still ethical concerns. Of these concerns, the debate revolving around the collection of DNA and the Fourth Amendment are most common. The Fourth Amendment protects individuals from unreasonable search and seizure. The collection of DNA from arrested or convicted individuals (e.g., for felony offenses) has been constitutionally challenged multiple times, but the collection of DNA from these individuals was found not to violate the Fourth Amendment (DNA Database 101, 2016).

> The US Supreme Court [Alonzo Jay King, Jr. v. State of Maryland, No. 68, September Term, 2011] has ruled that requiring a forensic DNA sample upon felony arrest does not violate rights guaranteed by the 4th Amendment of the US Constitution. Specifically, the court stated that requiring a DNA sample from an individual arrested for a felony is a reasonable and legitimate police booking

procedure, similar to fingerprinting or photographing. (DNA Database 101, 2016, p. 1; *King v. Maryland*, 2011)

DNA and Criminal Investigation

The use of DNA evidence in criminal investigations has been expanding since its first use in the 1980s (Wilson et al., 2011). Studies have examined how DNA evidence affects criminal investigations (Briody, 2004; Dunsmuir et al., 2008; Roman et al., 2008; Schroeder, 2007; Tully, 1998).

Roman et al. (2008) drew connections between the use of DNA evidence in property crime cases and suspect identifications, arrests, and prosecutions in five different police departments (Phoenix, Arizona; Los Angeles, California; Orange County, California; Denver, Colorado; and Topeka, Kansas). Among the five police departments, there was a total of 2,160 cases that had the potential for DNA evidence. The results indicated that 31% of cases were solved due to the use of DNA evidence and DNA analysis practices (Roman et al., 2008). In comparison, with cases where no DNA evidence was used, only 12% of the cases were solved (Roman et al., 2008). Of all the cases present in the study, 70.3% of the cases had DNA evidence at the crime scene, over 50% of those cases produced a DNA profile in CODIS, 23.3% generated a CODIS hit, and 20.6% resulted in suspect identification (Roman et al., 2008). The overall conclusion of the study was that the use of DNA analysis in criminal investigations led to a higher success rate than in investigations without DNA evidence (Roman et al., 2008).

Dunsmuir et al. (2008) drew connections between the expanding use of the DNA database in Australia to clearance rates, charging rates, and conviction rates for eight specific crimes (sexual assault; robbery with firearm; robbery without firearm; break and enter – dwelling; break and enter – non dwelling; motor theft; theft from vehicle; and assault). Australia started collecting DNA from convicted offenders in 2001, creating an increase in the number of DNA profiles in their database (Dunsmuir et al., 2008). Dunsmuir et al. (2008) compared the clearance rates, charging rates, and conviction rates of the eight crimes before and after 2001. After 2001, clearance rates increased for crimes, including a 4.1% increase for sexual assaults, 7% for robberies with a firearm, 1.2% for robberies without a firearm, 0.4% for breaking and entering into a dwelling, and 0.5% for breaking and entering a non-dwelling. After 2001, charging rates increased for crime, including 1.7% for assault, 4.8% for sexual assault, 8.1% for robbery with a firearm, 2% for robbery without a firearm, 0.4% for breaking and entering into a dwelling, 0.5% for breaking and entering into a non-dwelling, and 0.1% for theft from a vehicle. After 2001, conviction rates increased for crimes, including 3.3% for assault, 5% for sexual assault, 2.8% for robbery with a firearm, 3.2% for robbery without a firearm, 3.5% for breaking and entering into a dwelling, 1.4% for breaking and entering into a non-dwelling, and 1.6% for motor theft (Dunsmuir et al., 2008; Wilson et al., 2011). Overall, these results showed that there was an improvement (however slight) in clearance rates, charging rates, and conviction rates after the DNA database increased.

Briody (2004) compared the presence and absence of DNA evidence in homicides and their propensity to reach court, for the defendant to enter into a plea bargain, and conviction rates. The results showed that the probability of 100 cases with the presence of DNA evidence reaching court was 93%. In addition, DNA evidence had a strong influence over the decision of a jury. A jury was 23 times (odds = 23.09) more likely to convict the defendant than if there was no DNA evidence (Briody, 2004). Overall, the study showed that juries were more likely to convict offenders when DNA evidence was present compared to when it was not.

Schroeder (2007) studied cleared homicide cases in Manhattan, New York and assessed whether DNA evidence was the deciding factor in the closure of cases. From 1996 to 2003, there were a total of 957 homicide cases. Of those 957 cases, only 602 cases were available for the study. Of those 602 cases, there were 230 cases where DNA evidence was present but not used during the investigation process and 40 cases where DNA evidence was available and used in the investigation. Of the 230 cases where DNA was present and not used, 74% of the cases were cleared. Of the 40 cases where DNA evidence was present and used, only 28% of the cases were cleared (Schroeder, 2007; Wilson et al., 2011). This finding was much different to the previous studies where the use of DNA evidence showed a significant increase in the clearance rate of cases (Briody, 2004; Dunsmuir et al., 2008; Roman et al., 2008;).

Tully (1998) analyzed the role that the presence and use of DNA evidence had in criminal investigations in comparison to the presence of DNA evidence but not the use of it in a criminal investigation in Maryland (Anne Arundel County, Montgomery County, and St. Mary's County) for conviction rates, sentence lengths, and plea bargaining. Across the three counties, there were a total of 107 cases in which DNA evidence was used and 92 cases with DNA evidence was not used. When DNA evidence was used, the results showed that cases were 1.6 times more likely to end in a conviction, 2.8 times more likely to end in a longer sentence length, and 1.5 times more likely to entail a plea bargain (Tully, 1998; Wilson et al., 2011). This pattern is consistent with the results from

Roman et al. (2008), Dunsmuir et al. (2008), and Briody (2004) in showing that DNA influences criminal case outcomes.

Overall, these studies show the important role that DNA evidence can play in criminal investigations. Through the collection of DNA from offenders we are adding to the CODIS database and giving criminal justice agencies a better chance of using the DNA profiles to solve crimes. It is important to understand why some offenders who lawfully owe their DNA, are not having their DNA collected and entered into CODIS.

Sexual Assault Kit Initiative

The National Sexual Assault Kit Initiative is an initiative by the Bureau of Justice Assistance to support communities in tracking and testing previously unsubmitted sexual assault kits (SAKs) [Bureau of Justice Assistance, 2022]. From this initiative, the Ohio Bureau of Criminal Investigation (BCI) tested and returned a total of 1,822 previously untested sexual assault kits to the police department in Akron (Bureau of Justice Assistance, 2021). Of those 1,822 kits, 847 of them were matched with eligible CODIS profiles from cold cases - 1 year or older (Bureau of Justice Assistance, 2021). Of those 847 CODIS profile matches, 498 of them were connected to a known profile, leaving the 349 others to be connected to unknown profiles (Bureau of Justice Assistance, 2021). What this meant is that the Akron Police Department now had 498 new leads or possible suspects in cold cases related to sexual assault. Research findings from SAKI establish the need to enter lawfully owed DNA profiles into CODIS.

Another SAKI project involved an analysis that combined the results from the Cuyahoga County SAK Task Force and the Akron SAK initiative (Lovell et al., 2022). From an original set of 7,000 untested rape kits in Cuyahoga County and 1,800 untested rape kits in Akron, the study (Lovell et al., 2022) found that a single offender was linked by his DNA profile to 22 of the sexual assault kits analyzed. The theory is that, if these rape kits were analyzed sooner, when they were supposed to be, there may not have been as many as 22 sexual assaults by one offender. While this realization is stark, the 22 connected rape kits were used by researchers to focus on how this particular offender committed 22 additional rapes. While the offender for these sexual assaults is still unknown, the study showed that the collection of DNA can be used to better understand offenders and the methods they use to prevent future incidents. It is also important to better understand how often DNA evidence is being analyzed and why it is not being analyzed when it should be.

As of September 2020, SAKI has identified over 105,626 samples of lawfully owed DNA, collected 6,353 samples, submitted 5,988 samples for testing, uploaded 4,423 profiles into CODIS, generated 116 CODIS hits with 55 of the CODIS hits being for something other than a sexual assault (Forensic Technology Center of Excellence, 2021). Testing unsubmitted rape kits (the SAK Initiative) has highlighted the value of collecting of lawfully owed DNA. The multitude of untested rape kits that should have been tested falls along the same type of analysis of the multitude of individuals who lawfully owe their DNA, but it has not been collected.

Lawfully Owed DNA

Lawfully owed DNA refers to situations in which a convicted offender is required by law to have their DNA (e.g., blood, saliva, hair, etc.) collected and submitted into CODIS based on the offenses the individual has committed, but DNA was not collected and/or entered into CODIS (Sexual Assault Kit Initiative, n.d.; Jeanguenat, n.d.; Lovell, 2022; Sexual Assault Kit Initiative, 2021).

There are two factors that influence the collection of lawfully owed DNA: the offenses for which DNA is to be collected and the points in time that DNA should be collected. Each of these components are outlined in the states' statutes. The reasons DNA is collected, and profiles are entered into CODIS, are based on the types of crimes an individual has committed. For example, an offense in which DNA is to be collected would be a sexual offense, a felony, and some misdemeanors (depending on the state). The points in time that DNA should be collected varies across states, and can include the point of arrest, conviction, and release from prison or jail. States vary in terms of the offenses for which DNA is to be collected and the point in the justice system during which DNA is to be collected. The potential for problems to arise may increase when states allow DNA to be collected at several points in the criminal justice process, such as at conviction, upon entry into a correctional facility, or upon release from a correctional facility. When DNA can be collected at multiple stages in the process there is a greater chance for gaps to occur in the system. This occurs because DNA only needs to be collected once, and when there is more than one point in time that DNA can be collected, collection agencies get to choose that point in time. The issue with this is that the agencies handling the offender either think the offender has already had their DNA collected or that the offender will have his DNA collected later (hypothetically). "For example, if Step C in the process is not checking whether collection occurred in Step A or B, then DNA sample collection misses will occur and likely continue to occur" (Lovell, 2022, p. 2330). When multiple parties or organizations are responsible and when communication breakdowns occur, it is possible that the task of collecting DNA will be overlooked There may be too many opportunities for agencies to pass the responsibility of collecting DNA to another organization. The overall take-away is that by having so many points in which DNA is to be collected, there is a greater possibility that an individual's DNA may not be collected. The analysis section of this thesis will describe statutes that regulate the collection of lawfully owed DNA for each state, D.C. and the three united territories (Guam, Puerto Rico, and the Virgin Islands).

Current Studies

The body of research on lawfully owed DNA has primarily focused of the Sexual Assault Kit Initiative (SAKI) and individuals who commit sex offenses. This is significant because research has not examined the broader issue and has generally overlooked the collection of lawfully owed DNA in other crimes (i.e., murder). To date, there have only been five studies that have explored lawfully owed DNA that do not pertain to SAKI.

A study by Lovell and Klingenstein (2019) examined the collection and processing of lawfully owed DNA swabs in Cuyahoga County, Ohio. The Ohio Bureau of Criminal Investigation (BCI) provided a list of 15,370 individuals who lawfully owed their DNA but whom had not had their DNA collected and submitted to CODIS. Of those 15,370 individuals, researchers were able to collect DNA samples from 1,503 (9.8%) individuals. The DNA samples were then analyzed and entered into CODIS, and of the 1,503 samples, 63 (4.2%) resulted in a forensic hit. Of those 63 forensic hits, three-fourths (74.6%) were "cold" hits, meaning the individuals were not previously a suspect for the crime they matched (Lovell & Klingenstein, 2019). From the results, it was estimated that if researchers would have been able to collect DNA from the remaining 13,867 individuals, it would result in 582 forensic hits (success rate of 4.2%) in CODIS (Lovell & Klingenstein, 2019). The large number of individuals who lawfully owed their DNA is concerning given the number of forensic hits that would occur.

After this study (Lovell & Klingenstein, 2019), Lovell (2022) then conducted an in-depth analysis of the individuals who lawfully owed their DNA and had it collected as part of the Cuyahoga County SAKI Task Force's work. The collection of DNA samples occurred in four stages: jail sweeps; arraignment/bail sweeps; probation sweeps; and CODIS sweeps. Two jail sweep were conducted that compared the 15,370 individuals from the Ohio BCI census to the jail population, identifying 77 inmates that needed, and then had, their DNA collected. Seven arraignment/bail sweeps were conducted consisting of collecting information on the number of defendants who were ordered to submit their DNA sample in the court room, identifying 413 individuals. Two probation sweeps compared the 15,370 individuals from the Ohio BCI census to offenders under probational supervision, identifying 546 individuals who lawfully owed their DNA and it had not been collected yet. The CODIS sweeps consisted of a total of 15 sweeps after 2018 that kept track of the number of DNA profiles that were entered into CODIS from the Ohio BCI census, which came out to a total of 1,965 people with DNA profiles now in CODIS. As of June 30, 2022, Cuyahoga County had a total of 116 forensic hits from those 1,965 DNA profiles (Lovell, 2022). Within the 116 forensic hits, there was a total of 11 different types of crimes present: arson, auto theft, felony assault, breaking and entering, burglary, drug abuse, fleeing and eluding, homicide, robbery, rape or other sexual offense, and theft. Of the 116 cases, 55 (47%) were for rape or another sex offense, 21 (18%) for burglary, 12 (10%) for breaking and entering, and 7 (6%) for homicide (Lovell, 2022). While the majority of the cases were sexual assault related (47%), this study raised the specter that other crimes were linked to lawfully owed DNA.

A study conducted in the state of Washington by Attorney General Bob Ferguson (2021) identified individuals who lawfully owed their DNA and then collected DNA samples and input them into CODIS to create leads on unsolved cases. Participating agencies found 635 individuals convicted of a sex offense who lawfully owed their DNA to the state. Of those 635 sex offenders, participating agencies were able to collect DNA samples from 345 of them. Of the 290 sex offenders that didn't have their DNA collected, 225 of them were not able to give a DNA sample for various reasons: 107 had died or left the state; 98 had failed to register as a sex offender and had disappeared; 20 had not been collected for various reasons not explained in the study (Sexual Assault Kit Initiative, 2021). The remaining 65 sex offenders were registered in specific counties in Washington where the participating agencies had yet to collect their DNA (Sexual Assault Kit Initiative, 2021). The goal of this study was to bring attention to the notion that collecting lawfully owed DNA could be part of a "comprehensive approach to addressing sexual assault reform" (Sexual Assault Kit Initiative, 2021, para. 9). The authors also indicated "Washington state has not developed a consistent method for collecting DNA upon conviction. Instead, every county implements different procedures" (Sexual Assault Kit Initiative, 2021, para. 11). This finding establishes the importance of this thesis. A necessary first step to identify problems that need to be overcome is to document the different state requirements associated with collecting lawfully owed DNA.

In 2016, the Bureau of Justice Assistance (BJA) defined the need to fund the collection of lawfully owed DNA at local levels (Sexual Assault Kit Initiative, n.d.). That same year, the Cuyahoga County Prosecutor's Office was the first agency to receive funding for the collection of lawfully owed DNA (Sexual Assault Kit Initiative, n.d.; Lovell & Klingenstein, 2019). In 2017, the Nevada Office of the Attorney General received funding for the collection of lawfully owed DNA (Sexual Assault Kit Initiative, n.d.). In 2018, four different agencies in Oregon, Florida, North Carolina, and West Virginia all received federal funding to collect lawfully owed DNA (Sexual Assault Kit Initiative, n.d.). In 2019, the Washington State Attorney General's Office (Sexual Assault Kit Initiative, 2021) and the Texas Department of Public Safety also received funding to collect lawfully owed DNA (Sexual Assault Kit Initiative, n.d.). BJA measured the outcomes of the funding. From 2016 to 2022, BJA has documented the following information: 312,204 samples identified; 10,987 samples collected; 12,658 samples sent for testing; 10,886 samples tested to completion; 10,275 profiles uploaded to CODIS; 243 CODIS hits; 93 CODIS hits to sex offenders; 16 CODIS hits to serial sex offender; 12 CODIS hits to homicides; 111 CODIS hits to other crimes; 29 cases charged; and 11 convictions (Sexual Assault Kit Initiative, n.d.). The fact that the BJA has provided funding to these states illustrates the importance of studying issues surrounding lawfully owed DNA.

In September 2022, a report analyzed current state legislation to "identify possible gaps and root causes associated with the systemic failure to collect, track, and test lawfully owed DNA samples effectively" (Klauss et al., 2022, p. 1). The goal of the study was to provide legislative decision-makers, policy-makers, and criminal justice professionals with a guide to better understand the practices and legislation associated with the collecting, tracking, and testing of lawfully owed DNA samples (Klauss et al., 2022), Office of Justice Programs, (2022) identified 10 categories within the state statutes (including Washington D.C., Guam, Puerto Rico, and the Virgin Islands) that were viewed to greatly impact an agency's ability to collect, track, and test lawfully owed DNA profiles. The 10 categories are as follows: the presence of a statement of legislative intent; clear guidelines on the collection procedures for obtaining lawfully owed DNA samples (who collects DNA and when); the lack of procedures on the tracking of the collection of lawfully owed DNA samples from convicted offenders; clear legislative guidelines on the ability to collect lawfully owed DNA from previously uncollected samples outside of allotted time frame; the gap in legislation with respect to the collection of lawfully owed DNA samples from out-of-state individuals that transferred in; the issue of collecting lawfully owed DNA samples when a negotiated plea bargain changes a qualifying offense; lack of specification upon the offenders' refusal or resistance to provide a lawfully owed DNA sample; the legislative guidelines on the extent of disclosure of data from a DNA database; legislative guidelines on the good-faith exception on the use of DNA records inadvertently remaining in the database after it should be expunged; and legislative guidelines on the expungement of DNA samples from DNA records (Office of Justice Programs, 2022). Overall, Klauss et al. (2022) states that clarity on the guidelines of lawfully owed DNA samples is the key to effectively collecting, tracking, and testing said samples. The thesis specifically built off of this study by taking the state statutes [similar to Office of Justice Programs, (2022)] and focusing on the requirements on the collection of lawfully owed DNA samples (creating a smaller number of collection times), to create better success in the collection, tracking, and testing of DNA samples.

What the Literature Lacks

An examination of existing research and reports on lawfully owed DNA reveals important gaps in the literature. Nearly all discussions of the failure to collect lawfully owed DNA are linked to research on sexual assault investigations and sexual assault kit testing (Bureau of Justice Assistance, 2021; Sexual Assault Kit Initiative , n.d.; Lovell & Klingenstein, 2019; Lovell, Sabo & Dissell, 2022; Sexual Assault Kit Initiative, 2021). The goal of this thesis is to add to the literature by documenting state-level statutes that regulate the collection of lawfully owed DNA. This analysis will identify and describe variation across states, which may be an important factor in explaining different procedures organizations use to collect lawfully owed DNA. This, in turn, may provide contexts for understanding errors in collecting DNA. In order to address this, an analysis will be done to understand the points of time in which DNA is collected (i.e., first incarcerated, released from incarceration, during parole, during probation, etc.) and if the number of points holds any significance to collection rates. The thesis will then examine correlations between the points at which lawfully owed DNA is to be collected and measures of CODIS success (i.e., investigations aided and/or CODIS offender profiles).

CHAPTER III

Methods

The purpose of this thesis is to analyze the influence of specific components of state statutes on the collection of lawfully owed DNA throughout the United States, the District of Columbia (D.C.), and the three united territories (Guam, Puerto Rico, and the Virgin Islands). In order to achieve this, the author will conduct a descriptive, qualitative analysis of the statutes that mandate the collection of DNA for each state. This will answer the research question about what state statutes require for the collection of lawfully owed DNA. Next, the author will conduct a bivariate analysis (Independent Samples T-test) to answer research question two by comparing the states that collect DNA at arrest and conviction to the states that collect at conviction in terms of the number of investigations aided reported to NDIS. And lastly, the author will conduct a bivariate analysis (Analysis of Variances) to answer research question three by estimating the relationship between the five specific points in time (first incarceration, release from incarceration, parole, probation, and sex offender registration) that DNA is collected to the number of offender profiles reported to NDIS.

Data Sources and Variables

State Statutes

Several aspects of state statutes will be measured. State statutes that concern the collection of DNA from offenders and suspects were collected from Westlaw NEXT. Westlaw NEXT is a database of law-related resources such as state and federal court cases, state and federal statutes, and many other legal documents. The author located statutes for the 50 states, the District of Columbia, and three united territories (Guam, Puerto Rico, and Virgin Islands), using the following strategies: searching for the terms "DNA" and "convicted offender" for each state, browsing the titles of the sections of the statutes found under the search, reading through the relevant statutes, and finally creating groups in excel with the specific information I was wanting. Table 2 lists all the statutes that relate to the collection of DNA from individuals at conviction and/or arrest.

Table 2

State Statutes on Lawfully Owed DNA

State	Statutes
Alabama	Ala. Code 1975 § 36-18-25 Collection of DNA samples from convicted persons
Alaska	AS § 44.41.035 DNA identification system
Arizona	A.R.S. § 13-610 DNA testing
Arkansas	A.C.A. § 12-12-1006 Fingerprinting, DNA sample collection, and photographing
California	West's Ann. Cal. Penal Code § 296 Offenders subject to collection of specimens, samples, and print impressions
Colorado	C.R.S.A. § 16-23-103 Collection of biological samples from persons arrested for or charged with felonies
Connecticut	C.G.S.A. § 54-102g Blood or other biological sample required from certain arrested or convicted persons for DNA analysis
Delaware	29 Del. C. § 4713 DNA analysis and data bank
District of Columbia	DC ST § 22-4151 Qualifying offenses
Florida	F.S.A. § 943.325 DNA database
Georgia	Ga. Code Ann., § 35-3-160 Samples required; storage in DNA data bank
Guam	8 G.C.A. § 120.202 DNA Testing Requirements
Hawaii	HRS § 844D-31 Offenders subject to collection
Idaho	I.C. § 19-5506 Scope of law—Offenders subject to sample collection—Early collection of samples—Restitution
Illinois	730 ILCS 5/5-4-3 Specimens; genetic marker groups

State	Statutes
Indiana	IC 10-13-6-10 Convicted felons to provide DNA sample
Iowa	I.C.A. § 81.2 Persons required to submit a DNA sample
Kansas	K.S.A. 21-2511 Collection of biological samples, fingerprints, and other identifiers from certain persons; Kansas Bureau of Investigation, powers and duties; expungement of sample and profile record; failure to provide sample, penalties; other unlawful acts
Kentucky	KRS § 17.170 Maintenance of DNA samples collected before March 27, 2009; persons required to provide DNA sample; persons and procedures authorized for DNA sample collection; administrative regulation; penalties for refusing to provide DNA sample or tampering with samples or containers
Louisiana	LSA-R.S. 15:609 Drawing or taking of DNA samples
Maine	25 M.R.S.A. § 1574 Biological sample required for DNA analysis upon conviction or adjudication
Maryland	MD Code, Public Safety, § 2-504 Collection of DNA samples
Massachusetts	M.G.L.A. 22E § 3 Submission of DNA sample
Michigan	M.C.L.A. 28.176 DNA identification profile; retention; disclosure; collection and forwarding of samples; notice; assessment; disposal of sample and profile; circumstances, manner, record, and notice; good-faith errors
Minnesota	M.S.A. § 299C.105 DNA data required
Mississippi	Miss. Code Ann. § 45-47-1 DNA collection from persons arrested for crimes of violence; dissemination of DNA information without authority; penalties
Missouri	V.A.M.S. 650.055 Felony convictions for certain offenses to have biological samples collected, when—use of sample—highway patrol and department of corrections, duty—DNA records and biological materials to be closed record, disclosure, when—expungement of record, when
Montana	MCA 44-6-103 Collection of samples and maintenance of data
Nebraska	Neb. Rev. St. § 29-4106 Person subject to DNA sample; payment of costs
Nevada	N.R.S. 176.09123 Collection of biological specimen from persons arrested for felony; submission to forensic laboratory; identifying information submitted to Central Repository; genetic marker analysis; creation of DNA profile; information included in criminal history record
New Hampshire	N.H. Rev. Stat. § 651-C:2 DNA Analysis Required

State	Statutes
New Jersey	N.J.S.A. 53:1-20.20 Collection of blood sample or other biological sample for DNA testing
New Mexico	N. M. S. A. 1978, § 29-16-6 Collection of samples
New York	9 NYCRR 5.143 Executive Order No. 143: Directing the Commissioner of the Division of Criminal Justice Services to Expand the State DNA Identification Index to Include DNA Identification Profiles Obtained from Additional Convicted Offenders
North Carolina	N.C.G.S.A. § 15A-266.3A DNA sample required for DNA analysis upon arrest for certain offenses N.C.G.S.A. § 15A-266.4 DNA sample required for DNA analysis upon conviction or finding of not guilty by reason of insanity
North Dakota	NDCC, 31-13-03 Individuals to be tested—Costs
Ohio	R.C. § 2901.07 DNA testing of certain prisoners
Oklahoma	74 Okl. St. Ann. § 150.27a OSBI Combined DNA Index System (CODIS) Database
Oregon	O.R.S. § 137.076 Blood or buccal sample and thumbprint of certain convicted defendants; application
Pennsylvania	44 Pa. C.S.A. § 2316 DNA sample required upon conviction, delinquency adjudication, and certain ARD cases
Puerto Rico	34 L.P.R.A. § 4006 Persons subject to sampling
Rhode Island	Gen. Laws 1956, § 12-1.5-8 DNA sample required upon arrest or conviction for any crime of violence
South Carolina	Code 1976 § 23-3-620 When DNA samples required
South Dakota	SDCL § 23-5A-5 Persons convicted or adjudicated delinquent for qualifying offense required to provide DNA sample
Tennessee	T. C. A. § 40-35-321 DNA analysis; specimens
Texas	V.T.C.A., Government Code § 411.1471 DNA Records of Persons Arrested for or Convicted of Certain Offenses V.T.C.A., Government Code § 411.148 Mandatory DNA Record
Utah	U.C.A. 1953 § 53-10-403 DNA specimen analysis—Application to offenders, including minors
Vermont	20 V.S.A. § 1933 DNA sample required
Virgin Islands	5 V.I.C. § 4203 DNA sample required
Virginia	VA Code Ann. § 19.2-310.2 Blood, saliva, or tissue sample required for DNA analysis upon conviction of certain crimes; fee.

State	Statutes
	VA Code Ann. § 19.2-310.2:1 Saliva or tissue sample required for DNA analysis after arrest for a violent felon
Washington	West's RCWA 43.43.754 DNA identification system—Biological samples—Collection, use, testing—Scope and application of section
West Virginia	W. Va. Code, § 15-2B-6 DNA sample required for DNA analysis upon conviction; DNA sample required for certain prisoners
Wisconsin	W.S.A. 165.76 Submission of human biological specimen
Wyoming	W.S.1977 § 7-19-403 DNA samples required; collection; testing; reimbursement of costs

Variables

Once each state's statute was obtained, the author coded information contained in the statutes to measure five key variables. The first variable measures the point in the criminal justice process at which DNA is to be collected: the arresting process[2] and the conviction process.[3] The second variable measures the qualifying offenses for which DNA is to be collected within the conviction process. For example, if an individual committed a felony, a sex offense, or an enumerated misdemeanor. The third variable is similar to the second but measures the qualifying offenses for which DNA is to be collected within the arresting process. The fourth variable measures the point at which DNA is collected during the conviction process. For example, when an individual is first incarcerated, is released on parole, or is registered as a sex offender. The fifth variable is

[2] The "arresting process" is a term used to encompass any actions taken by the criminal justice system between the offender's arrest for a crime and the offender's conviction of said crime (i.e., arrest booking, charges filed, or pre-trial detention).
[3] The "conviction process" is a term used to encompass any actions taken between the offender's confirmed conviction of a crime to the offender's release from the criminal justice system (i.e., after release from prison, parole, or probation).

similar to the fourth but measures the point at which DNA is to be collected during the arresting process.

In addition to the five key variables of interest, additional information contained in the statutes were coded, including the following: the agencies responsible for collecting and analyzing the DNA samples, the presence of case laws within the statute, the year the statute was established, and the year the statute was last reviewed. The complete list of variables is in Table 3.

Table 3

Variable Breakdown

Variables	Descriptives
Point of DNA Collection	
Conviction Only	DNA is collected by the state during the conviction process.
Arrest and Conviction	DNA is collected by a state at both the arresting process and the conviction process.
Conviction Offenses that Require DNA Collection	
Felony	As defined by state statute.
Attempt/Conspiracy	Attempt or Conspiracy to commit a felony.
Crime Against a Person	As defined by state statute.
Crime Against a Minor	As defined by state statute.
Sex Offense	As defined by state statute.
Sex Crime Misdemeanor	As defined by state statute.
Enumerated Misdemeanor	As defined by state statute.
Plead of Insanity	As defined by state statute.
Arrest Offenses that Require DNA Collection	
Felony	As defined by state statute.
Enumerated Felony	As defined by state statute.

Variables	Descriptives
Felony Attempt	As defined by state statute.
Murder	As defined by state statute.
Sex Offense	As defined by state statute.
Enumerated Sex Offense	As defined by state statute.
Aggravated Offense	As defined by state statute.
Enumerated Misdemeanor	As defined by state statute.
Crimes of Violence	As defined by state statute.
Crimes Against a Person	As defined by state statute.
Crimes Against a Minor	As defined by state statute.
Point of Collection if Required at Conviction	
Court Order	DNA is to be collected by a court order.
Any Time Incarcerated[4]	DNA is to be collected from an offender any time during their incarceration.
ASAAP[5]	DNA is to be collected as soon as acceptably and/or administratively possible.
At/After Sentencing	DNA is to be collected from an offender at or after the sentencing process.
At/After Conviction	DNA is to be collected from an offender at or after conviction in the court room.
Upon Request	DNA is to be collected by request of the court or other official.
Parole	DNA is to be collected during the parole process.
Probation	DNA is to be collected during the probation process.
Parole and Probation	DNA is to be collected at both the parole process and the probation process.
Sex Offender Registration	DNA is to be collected when an individual needs to register as a sexual offender.
At First Incarceration	DNA is to be collected when an individual is first incarcerated.

[4] In the analysis, this group is measured as a state being able to collect DNA at any point of an offender's incarceration, so it is measured under the groups that involve incarceration instead as its own group.
[5] In the analysis, this variable is measured as a state being able to collect DNA at any point during the conviction process, so it is measured under all the groups instead as its own variable.

Variables	Descriptives
Before Release	DNA is to be collected before an offender is released from incarceration.
Transfer	DNA is collected when an offender is transferred to another correctional facility.
Term of Sentence	DNA is to be collected as a term of the offender's Sentence.
Point of Collection if Required at Arrest	
At Arrest	DNA is to be collected when an individual is first arrested.
At Charging	DNA is to be collected when an individual is officially charged with an offense.
At Booking	DNA is to be collected during the booking process.
At Fingerprinting	DNA is to be collected when offender is being fingerprinted.
ASAAP	DNA is to be collected as soon as acceptably or administratively possible.
Any Time	DNA is to be collected any time during the arresting process.
Intake Process	DNA is to be collected during the intake process at the jail.
Court Appearance	DNA is to be collected when an offender is first brought to court.
Court Order	DNA is to be collected by a court order.
At/After Indictment	DNA is to be collected at or after the indictment.
At/After PC Hearing	DNA is to be collected at or after the probable cause hearing.
Plea Bargain	DNA is to be collected if the offender is taking a plea bargain.
Preliminary Hearing	DNA is to be collected during the preliminary hearing.
New Charges	DNA is to be collected when new charges are added to an offender's sentence.
Sex Offender Registry	DNA is to be collected when an individual needs to register as a sexual offender.
Before Release	DNA is to be collected before release of individual from arrest.
Collection Agency	
Department of Corrections	
Department of Public Safety	
Arresting Law Enforcement Agency	

Variables	Descriptives
Department of Corrections and Rehabilitation	
Court Services (Juvenile and Adult)	
Offender Supervision Agency	
Department of Juvenile Justice	
State Police Director of Crime Lab	
Sheriff's Department	
Receiving Correctional Facility	
Parole or Probation Officer	
Department of Social and Health Services	
Analysis Agency	
Department of Forensic Science	
Department of Public Safety	
State Funded Crime Lab	
Department of Justice DNA Lab	
State Bureau of Investigations	
Superintendent of State Police Department	
State Police Forensic Lab	
State Police Department	
Department of Criminal Apprehension	
Division of Criminal Justice Services	
Sheriff's Department	
State Department of Justice	
Forensic Lab Services Bureau	
Department of the Attorney General	
Case Law Present in the Statute	
Yes	
No	

Variables	Descriptives
Year Statute was Established	
1989	
1990	
1991	
1993	
1994	
1995	
1997	
1998	
2000	
2002	
2003	
2004	
2005	
2009	
2010	
2011	
Year Statute was Established	
Within the past 2 years (2020-2022)	
Any time before 2020 (2019 and earlier)	

Note. For more information, review the statutes that are listed in Table 2.

Federal Bureau of Investigations

The data derived from the FBI database is used to measure elements of CODIS effectiveness. Data were collected to measure each state's annual number of Offender Profiles, Arrestee Profiles, Forensic Profiles, Forensic Labs, and Investigations Aided since the founding of CODIS. An offender profile is a DNA profile that was generated by collecting DNA from a convicted offender, and an arrestee profile is DNA collected from an individual who has been arrested, a forensic profile is DNA collected from a crime scene or victim, and forensic labs are the number of forensic laboratories in each state that collect and analyze DNA profiles [The forensic labs variable will not be used in this thesis due to the issues of obtaining relevant measurements during COVID (FBI, 2021)]. "Investigations aided" is a term used by NDIS to indicate that a DNA profile has added some value to an investigation (FBI, 2021). The standard in measuring the value a DNA profile having added to a case is not clarified within NDIS, leaving the exact meaning of this measure up to interpretation. Table 4 lists the measures found within the NDIS database.

Table 4

Variables Measured within NDIS as of October 2021

Variables	Measures
Offender Profiles	14,836,490
Arrestee Profiles	4,513,955
Forensic Profiles	1,144,255
CODIS Hits	587,773
Investigations Aided	574,343

Note. A more in-depth breakdown of these variables can be found within the FBI database.

Analysis Plan

All data from the state statues and from NDIS were entered into a single dataset to be used for the analyses. The first stage of the analysis is descriptive. This information will generate findings about research question one: what do state statutes require for the collection of lawfully owed DNA? The goal of the analysis is to provide a descriptive overview of states' requirements for the collection of lawfully owed DNA.

The second stage of the analysis consists of a bivariate analysis comparing states that collect DNA at arrest and conviction to states that collect DNA at conviction only in terms of investigations aided within NDIS. An independent samples t-test will be used to assess statistical significance. This information will generate data to answer research question two: do states enter fewer investigations aided into CODIS if their statute indicates DNA will be collected at both arrest and conviction? The hypothesis is that the state statutes that mandate the collection of DNA at arrest and conviction have a negative correlation with the number of investigations aided in NDIS. If a state collects DNA at both arrest and conviction, they are more likely to have a lower number of investigations aided present. This sounds counter-intuitive now but will be better explained further in the thesis.

The last stage of the analysis will consist of a bivariate analysis that measures the relationship between the number of times at which DNA is collected during the conviction process and the number of offender profiles as defined by FBI in NDIS. An Analysis of Variance (ANOVA) test will be used to assess the statistical significance. This information will generate data to answer research question three: are aspects of state statutes related to the number of offender profiles, as defined by the Federal Bureau of Investigations in NDIS? The hypothesis is that the state statutes that have a fewer number of points of collection of DNA will have a greater number of offender profiles. States that collect DNA at one out of five points in time (first incarceration, release form incarceration, during parole, during probation, and sex offender registration) will have a higher number of offender profiles than states that collect DNA at more than one point. These five points in time were selected due to the significance they hold within the conviction process. This also sounds counter-intuitive but will be better explained further in the thesis.

CHAPTER IV

Analysis

Research Question 1

What do state statutes require for the collection of lawfully owed DNA? To answer this question, a descriptive analysis will be conducted on three variables: the point of DNA collection at arrest and/or conviction; conviction offenses that require DNA collection; and the point of DNA collection if required at conviction. Table 5 presents the descriptive results that summarize state statutes in terms of the key variables of interest.

Table 5

Descriptive Analysis

Variables	N	%	States
Point of DNA Collection			
Conviction Only	20	37.0	DE, DC, GA, GU, HI, ID, IA, KY, ME, MA, MT, NE, NH, NY, OR, PA, VT, WA, WV, WY
Arrest and Conviction	34	63.0	Al, AK, AZ, AR, CA, CO, CT, FL, IL, IN, KS, LA, MD, MI, MN, MS, MO, NV, NJ, NM, NC, ND, OH, OK, PR, RI, SC, SD, TN, TX, UT, VA, VI, WI
Conviction Offenses that Require DNA Collection			
Felony	51	94.4	AL, AK, AZ, AR, CA, CO, CT, DE, DC, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NY, NC, ND, OH, OK, OR, PA, PR, RI, SC, SD, TN, TX, UT, VT, VA, VI, WA, WV, WI, WY
Attempt/Conspiracy	16	29.6	ID, KY, OR, PA, WV, DC, VT, IL, TN, FL, IN, KS, LA, NV, PR, SD
Crime Against a Person	6	11.1	AK, MO, NC, TX, NV, SD

Variables	N	%	States
Crime Against a Minor	8	14.8	TX, NV, GU, HI, NH, CT, WV, PR
Sex Offense	29	53.7	TX, NV, GU, HI, CT, WV, PR, AK, MO, SD, WA, IA, MT, NE, AL, AZ, UT, AR, MS, NJ, OK, VA, KY, OR, PA, VT, IL, TN, KS
Sex Crime Misdemeanor	22	40.7	NH, VI, CA, DC, TX, PR, MO, SD, WA, MT, AL, AZ, AR, MS, OK, PA, VT, IL, TN, NC, NM, NY
Enumerated Misdemeanor	18	33.3	WV, IA, NE, UT, VA, TX, WA, AZ, OK, PA, VT, TN, NY, KS, WI, SC, MI, FL
Plead of Insanity	14	25.9	WV, IA, AZ, WI, AK, NH, VI, CA, IL, NC, HI, CT, NJ, OR
Point of Collection if Required at Conviction			
Court Order	8	14.8	AR, CA, IL, CT, VT, ID, MT, AL
At/After Sentencing	19	35.2	MT, SD, CA, ID, IA, OR, UT, KY, IL, AZ, HI, WY, MN, MI, MD, LA, NY, DE, IN
At/After Conviction	13	24.1	CA, IL, ID, MT, IA, AZ, HI, OR, UT, NY, MI, KY, SD, DE, WY, MD, MN, IN, LA
Upon Request	8	14.8	CA, ID, IA, OR, UT, KY, VT
Parole	17	31.5	CA, ID, IA, OR, UT, KY, AL, IL, AZ, HI, NY, WV, AK, PA, TN, SC, GU
Probation	21	38.9	CA, ID, IA, OR, UT, KY, AL, AZ, HI, NY, WV, AK, PA, TN, SC, GU, MI, ME, MA, NE, GA
Sex Offender Registration	19	35.2	WA, CA, ID, IA, OR, UT, KY, PA, TN, GU, NE, IL, MT, SD, TX, OK, MO, MS, NV
At First Incarceration	27	50.0	CA, ID, IA, OR, UT, KY, PA, NE, IL, SD, MO, NV, WV, MI, ME, MA, GA, VT, MD, LA, CO, NH, NC, NJ, PR, ND, OH
Before Release	31	57.4	CA, ID, IA, OR, UT, KY, PA, NE, IL, SD, MO, NV, WV, ME, MA,

Variables	N	%	States
			VT, CO, NH, NJ, OK, MS, AK, SC, WY, MN, CT, VA, KS, FL, NM, RI
Transfer	15	27.8	CA, ID, IA, OR, UT, KY, IL, WV, ME, VT, CO, MS, MT, AZ, HI
Term of Sentence	9	16.7	VT, MT. PA, NE, SD, OK, VA, RI, AL

Note: Column four consists of the state abbreviations for each category.

The following are figures (2-21) representing the state breakdown of the group measurements mentioned above.

Figure 2

Collection of DNA during the Arresting and Conviction Process

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 3

The Collection of DNA upon Conviction of a Felony

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 4

The Collection of DNA upon Conviction of a Felony Attempt/Conspiracy

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 5

The Collection of DNA upon Conviction of a Crime Against a Person

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 6

The Collection of DNA upon Conviction of a Crime Against a Minor

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 7

The Collection of DNA upon Conviction of a Sex Offense

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 8

The Collection of DNA upon Conviction of a Sex Crime Misdemeanor

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 9

The Collection of DNA upon Conviction of an Enumerated Misdemeanor

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 10

If the Defendant Pleads Insanity

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 11

The Collection of DNA by Court Order

Note: Filled in states collect DNA at the specific instance, while blank states do not.

Figure 12

The Collection of DNA At or After the Point of Sentencing

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 13

The Collection of DNA At or After the Point of Conviction

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 14

The Collection of DNA upon Request by a Court

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 15

The Collection of DNA at any Time During Parole

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 16

The Collection of DNA at any Time During Probation

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 17

The Collection of DNA upon Sex Offender Registration

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 18

The Collection of DNA when an Offender is First Incarcerated

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 19

The Collection of DNA Before an Offender is Released from Incarceration

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 20

The Collection of DNA upon the Transfer of an Inmate

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Figure 21

The Collection of DNA as a Term of an Offender's Sentence

Note. Filled in states collect DNA at the specific instance, while blank states do not.

Twenty states (37%) required DNA collection at Conviction while 34 states and territories (63%) require collection at arrest and conviction. Among the 34 states and territories that require the collection of lawfully owed DNA at arrest and convictions three states (North Carolina, Texas, and Virginia) have separate statutes that require the collection of DNA from convicted offenders and arrested offenders. The other 31 states and territories have a single statute that addresses the requirement of the collection of DNA from convicted offenders and arrested offenders. Fifty-one states (94.4%) require collection at felony conviction, 16 states and territories (29.6%) require collection at felony attempt or conspiracy, 6 states and territories (11.1%) require collection at conviction of a crime against a person, 8 states and territories (14.8%) require collection at conviction of a crime against a minor, 29 states and territories (53.7%) require collection at conviction of a sex offense, 22 states and territories (40.7%) require collection at conviction of a sex crime misdemeanor, 18 states and territories (33.3%) require collection at conviction of an enumerated misdemeanor, and 14 states and territories (25.9%) require collection with the plea of insanity. When convicted, 8 states and territories (14.8%) require collection by court order, 19 states and territories (35.2%) require collection at or after sentencing, 13 states and territories (24.1%) require collection at or after official conviction, 8 states and territories (14.8%) require collection upon request by corresponding agency, 17 states and territories (31.5%) require collection during parole, 21 states and territories (38.9%) require collection during probation, 19 states and territories (35.2%) require collection upon registering as a sex offender, 27 states and territories (50%) require collection when first incarcerated, 31 states and territories (57.4%) require collection before release from incarceration, 15 states and territories (27.8%) require collection upon transferring facilities, and 9 states and territories (16.7%) require collection as a term of the sentence.

Overall, the results of the descriptive analysis indicated that states specify multiple conviction offenses that require the collection of DNA and multiple points of DNA collection in the conviction process. For example, Alabama collects DNA when individuals are convicted of felonies, sex offenses and sex offense misdemeanors and collects DNA in the conviction process by court orders, upon requests by officials, during parole, during probation, and as a term of sentences. In comparison, Wyoming collects DNA when individuals are convicted of only felonies, and then collects DNA in the conviction process, at or after sentencing and before release from incarceration. The point of this analysis is to describe disparities (e.g., the difference between Alabama and Wyoming) between what the statutes for each state mandate on the collection of lawfully owed DNA.

Research Question 2

Do states enter fewer investigations aided into CODIS if their statute indicates DNA will be collected at both arrest and conviction? The hypothesis is that when there is an abundance of options for collecting DNA, responsibility gets passed to the latest point in time while the agencies that collect at later points of time believe responsibility was taken by the agency that could collect at an earlier point in time. This creates the situation where no DNA is collected at all because agencies assume others took responsibility. This lack of collection can lead to fewer investigations aided because it reduces the probability of a CODIS hit that can provide a suspect or the offender to a case where one was not already present. To answer the research question, an Independent Samples T-test will be used to assess the relationship between the point of DNA collection and the number of investigations aided as reported by NDIS. The Independent Samples T-Test is used to examine the difference between two sample means of a nominal variable in relation to an interval or ratio variable. The point of DNA collection is the nominal value with two mutually exclusive groups and investigations aided is the ratio variable. The independent variable is used to create two groups: DNA is collected during the conviction process only and DNA can be collected at both the arresting and conviction process. The “conviction only” group is coded 0, and the “arrest and conviction” group is coded 1. The dependent variable (investigations aided) was a cumulative sum from the founding of CODIS in 1990 to 2021 and was not broken up by years, even though states had varying years of when the statutes were implemented. To remedy this, the dependent variable was averaged from the years the statute was present within each state. The dependent variable is the average number of investigations aided per year for each state.

The dependent variable was not normally distributed. A decision was made to use the natural log of the dependent variable in order to meet the assumptions of the statistical test. The natural log of the average of investigations aided per year will be used for this analysis.

Table 6 presents the descriptive results that summarize the average number of investigations aided per year in terms of the key variables of interest. There were two states and territories that had no report on the collection of lawfully owed DNA was established, so the overall number of participants for this study was 52 (N=52). The average number of investigations aided per year per state averaged (mean) to be about 446 cases (5.13 ln); the minimum being about 2 cases (0.83 ln) per year and the maximum being about 4,264 cases (8.36 ln).

Table 6

The Natural Log (LN) of Average Investigations Aided Yearly

Variables	N	M	SD	Skew.	Min	Max.
Average Investigations Aided	52	446.28	702.60	3.64	2.29	4264.21
Ln Average Investigations Aided	52	5.13	1.58	-0.45	0.83	8.36

Note. This table represents the variables of the average investigations aided per year and then the same measurements after the average investigations aided were natural logged.

With an Independent Samples T-test, there are certain assumptions that need to be met: the assumption of equal variance between the two independent variable groups. Equal variance is determined through the Levene's Test for Equality of Variances. If the p-value of F is < 0.05, we use information from the "unequal variance" statistics, and if the p-value of F is > 0.05, we use the information from the "equal variance" statistics. The p-value of F for the Levene's Test for Equality was 0.53, which is > 0.05, meaning we will be using the statistics from the “equal variance” results. Table 7 shows the results of the independent samples t-test.

Table 7

Difference in Average Investigations Aided Yearly by Point of DNA Collection

Point of DNA Collection	N	M	SD	*t*-test	*p*-value
Conviction Only	19	4.51	1.52	-2.23	0.03
Arrest and Conviction	33	5.49	1.53		

Note. This table represents the results of the independent samples t-test.

Nineteen states and territories (35.2%) collect at conviction only and 33 states (64.8%) collect lawfully owed DNA at arrest and conviction. The t-value is -2.23 and the p-value is < 0.05 (p-value = 0.03) meaning that there is a statistically significant relationship between the point of DNA collection and the average number of investigations aided per year as reported by NDIS. The states that collected DNA at only conviction had an average (mean) of 4.51 (ln) investigations aided per year in NDIS. The states that collected DNA at both arrest and conviction had an average (mean) of 5.49 (ln)investigations aided per year as reported by NDIS. The difference between these two averages (mean difference) is -0.98 (absolute value = 0.98), showing that there is a large difference (by natural log standards) between the two means. Converting the natural logs back to their original metric, this means that the conviction only group had an average of 91.01 investigations aided, while the arrest and conviction group had an average of 242.57. This is a difference of approximately 151 cases per year.

While the relation was statistically significant, the meaningfulness of the relationship can be measured through the Cohen’s D test (n > 50). The effect size measured by Cohen’s D test was -0.64, with an absolute value of 0.64. This value falls within the “medium effect size” category (0.5 – 0.79), meaning the strength of the effect size was above average. The results of the Independent Samples T-Test indicated that the relationship between the point of DNA collection (arrest/conviction) and average investigations aided per year was significant, and that the states that collected DNA at both arrest and conviction have on average 151 more investigations aided per year compared to states that collect DNA at conviction only. This is a medium effect size, and the pattern contradicted the original hypothesis.

Research Question 3

Are aspects of state statutes related to the number of offender profiles in NDIS? To answer this question, an Analysis of Variances (ANOVA) test will be used to measure the relationship between the number of times at which DNA is collected during the conviction process and the number offender profiles in NDIS. ANOVA is used to examine the difference of three of more sample means of a nominal variable in relation to an interval or ratio variable. The points of DNA collection as required at conviction is the nominal value and will consists of six categories and the number of profiles is the ratio variable. The independent variable groups are the collection of DNA when an individual is 1) first incarcerated, 2) before an individual is released from incarceration, 3) collected during parole, 4) collected during probation, 5) collected when an individual is to be registered as a sex offender, and 6) when DNA is collected at none of these points in time, it is collected at some other time (e.g., term of sentence, court order, etc.). As a reminder, these five points in time were selected due to the significance they hold within the conviction process. These six categories were used to calculate the number of different time points at which states collect lawfully owed DNA. A score of 0 means the state statute did not indicate DNA was collected at any of those points. Table 8 shows the number of states and territories that collect within those 6 groups. Six states and territories (11.1%) collect at none of the five points in time, 17 states and territories (31.5%) collect at one out of five points in time, 12 states and territories (22.2%) collect at two out of five points in time, 9 states and territories (16.7%) collect at three out of five points in time, 3 states and territories (5.6%) collect at four out of five points in time, and 7 states and territories (13%) collect at all five points in time. Table 8 presents the descriptive results on the number of states that collect DNA within these groups.

Table 8

Independent Variable Descriptive Information

Group	N	%
0 out of 5	6	11.1
1 out of 5	17	31.5
2 out of 5	12	22.2
3 out of 5	9	16.7
4 out of 5	3	5.6
5 out of 5	7	13.0
Total	54	100.0

Note. This table represents the descriptive results of the independent variable.

ANOVA tests require that certain assumptions be met: the assumption of equal variance between the independent variable groups and the dependent variable is normally distributed. The dependent variable (offender profiles) was a cumulative count from the founding of CODIS in 1990 to 2021 and was not broken up by years, even though states had varying years of when the statutes were implemented. To remedy this, the dependent variable was averaged from the years the statute was present within each state, so the variable is measured as the average number of offender profiles per year. The dependent variable was not normally distributed. A decision was made to use the natural log the dependent variable in order to meet the assumptions of the statistical test. The natural log of offender profiles will be used for this analysis.

Table 9 shows the descriptive statistics for the dependent variable. There were two states and territories that had no report on the collection of lawfully owed DNA was established, so the overall number of participants for this study was 52 (N=52). The average number of offender profiles per year per state averaged (mean) to be about 11,859 profiles (8.67 ln); the minimum being about 519 profiles (6.25 ln) per year and the maximum being about 89,694 profiles (11.40 ln). Table 10 presents the descriptive statistics from the ANOVA test. The highest average was the collection of DNA at all five points in time (M=9.14; SD=1.44). After that however, the next three highest values where on the lower end of the number of points of collection: two of five points of collection (M=9.0466; SD=1.0810); zero of five points of collection (M=8.68; SD=1.72); and one of five points of collection (M=8.51; SD=1.28).

Table 9

The Natural Log (Ln) of Average Offender profiles Yearly

Variables	N	M	SD	Skew.	Min	Max.
Average Offender Profiles	52	11,859.28	16,127.70	2.94	519.23	89,694.96
Ln Average Offender Profiles	52	8.67	1.25	-0.00*	6.25	11.40

Note. The * is to represent that the value goes beyond the tenth value (-0.002).

Equal variance in ANOVA is determined through a Homogeneity of Variances test. If the p-value of F is > 0.05, the variances are equal, and the results are interpreted from the ANOVA test. If the p-value of F is < 0.05, the variances are not equal, and the results are interpreted from the Welch statistic: Robust Tests of Equality of Means. The p-value for F was > 0.05 (p = 0.59) meaning we will be using the statistics from the original ANOVA results; $F_{(5,46)} = 0.74$, p = 0.60.

The p-value of the ANOVA test is > 0.05 (p-value = 0.60) meaning that there is not a statistically significant relationship between the number of points DNA is collected and the average number of annual offender profiles per year (ln) as reported by NDIS. Table 10 presents the results from the ANOVA test; $F_{(5,46)} = 0.74$, p = 0.60. While the result of the ANOVA test indicated that while the findings where not statistically significant (p-value > 0.05), it did show that states that collected DNA from zero to two points of collection had some of the top averages (means) offender profiles yearly (ln) in NDIS. The Eta Squared (η^2) value is 0.04 (4%), meaning there is almost no effect size existing within the analysis. No Post-Hoc analysis was conducted because no statistically significant relationship existed within the analysis.

Table 10

ANOVA Test of Ln Offender Profiles

ANOVA	Sum of Squares	df	Mean of Square	F	Sig.
Between Groups	5.96	5	1.19	0.74	0.60
Within Groups	73.71	46	1.60		
Total	79.66	51			

Note. This table represents the results of the ANOVA test.

Table 11 shows the descriptive results (ln) for each group. The states that collected DNA at one of five points in time had an average (mean) of 8.51 (ln) offender profiles yearly in NDIS. The states that collected DNA at two of five points in time had an average (mean) of 9.05 (ln) offender profiles yearly in NDIS. The states that collected

DNA at three of five points in time had an average (mean) of 8.18 (ln) offender profiles yearly in NDIS. The states that collected DNA at four of five point in time had an average (mean) of 8.32 (ln) offender profiles yearly in NDIS. The states that collected DNA at all five points in time had an average (mean) of 9.14 (ln) offender profiles yearly in NDIS. And lastly, the states that collected DNA at none of the five points in time had an average (mean) of 8.68 (ln) offender profiles yearly in NDIS. The overall average (mean) of the natural log of offender profiles of all six groups was 8.67 (SD=1.25 ln).

Table 11

Descriptive Results from ANOVA test

Group	N	M	SD	Min.	Max.
0 out of 5	5	8.68	1.72	6.60	10.94
1 out of 5	17	8.51	1.28	6.25	10.53
2 out of 5	12	9.05	1.08	6.75	10.61
3 out of 5	8	8.18	0.96	6.84	9.30
4 out of 5	3	8.32	1.41	7.37	9.94
5 out of 5	7	9.14	1.44	7.09	11.40
Total	52	8.67	1.25	6.25	11.40

Note. This table represents the descriptive results of each group of collection points.

Overall, the analysis used the number of offender profiles per year (ln) as defined by NDIS and compared the number of those profiles to specific points of DNA collection. The results of the ANOVA test indicated that the relationship was not statistically significant, but states that collected DNA at 5 out of 5 points in time had the highest average offender profiles (M=9.14), followed by: 2 out of 5 (M=9.05), 0 out of 5 (M=8.68), and 1 out of 5 (M=8.51). With this information, the thesis will go on to describe the importance of this pattern.

CHAPTER V

Discussion

Since 1990, criminal justice agencies have been collecting DNA to aid criminal investigations and hold offenders accountable. Few empirical studies have examined research questions about lawfully owed DNA. Lawfully owed DNA refers to situations in which offenders have committed specific crimes and are mandated by law to have their DNA collected and entered into CODIS. Recently, jurisdictions have determined that lawfully owed DNA often goes uncollected. This thesis adds to the body of literature by analyzing state statutes that govern the collection of lawfully owed DNA. This thesis presented a unique analysis about the growing importance of the issue of collecting lawfully owed DNA. The results from the analyses showed mixed support for the hypotheses that were tested. The states that collect lawfully owed DNA during both the arresting process *and* the conviction process had greater numbers of investigations aided, as reported in NDIS In addition, there were larger numbers of offender profiles in NDIS for states that mandated the collection of DNA at fewer points in time in the criminal justice process.

The results of the descriptive analysis summarized the statutes' requirements. The analysis identified the states that collect DNA at conviction only (37%) and the states that collect DNA at arrest *and* conviction (63%). The most common conviction offenses that required DNA to be collected consisted of the following: 51 entities (states, District of Columbia, and united territories) for felony (94.4%); 29 entities for sex offense (53.7%); 22 entities for sex crime misdemeanors (40.7%); and 18 entities for enumerated misdemeanor offenses (33.3%). The most common points of collection required upon conviction consisted of the following: 31 entities collect before release (57.4); 27 entities collect at first incarceration (50%); 21 entities collect during probation (38.9%); and 19 entities collect at sex offender registration (35.2%). Multiple entities participate in multiple points of collection required by conviction.

The second research question compared states that collect DNA at conviction and arrest to states that collect at only conviction, in terms of the number of investigations aided that are reported in NDIS. An independent samples t-test was used to assess the number of investigations aided per year between the states that collect DNA at conviction and arrest and the states that collect DNA at conviction. It was hypothesized that the states that collected DNA at both arrest and conviction would have a lower average number of investigations aided per year (ln) in CODIS than states that collected at just conviction. Results showed there was a relationship, and the effect size was marginally strong (0.763). The pattern did not support the hypothesis. States that collected DNA at both arrest and conviction have on average 151 more investigations aided per year compared to states that collect DNA at conviction only. This lends support for policies that mandate DNA collection at arrest *and* conviction.

The third research question addressed the relationship between specific points of time mentioned within the statutes and numbers of offender profiles within NDIS. It was hypothesized that the lower the number of points in time DNA is collected would be associated with a higher number of offender profiles per year within NDIS. The results for the ANOVA test were not statistically significant (p-value > 0.05) or meaningful ($\eta^2 = 0.04$). The pattern did not support the hypothesis. Given this, the author still wants to draw attention to the descriptive results of the analysis. The descriptive results showed that entities that collected DNA at 0 out of 5 points in time (M=8.68), 1 out of 5 points in time (M=8.51), and 2 out of 5 points in time (M=9.05) had higher averages of profiles in NDIS than entities that collected at 3 and 4 out of 5 points in time (M=8.18; M=8.32) – not including the 5 out of 5 points in time (M=9.14). Overall, the smaller number of points of collection (0, 1, 2 out of 5 points in time) had an 8.75 average, while the higher number of points of collection (3, 4, 5 out of 5 points in time) had an 8.54 average. The pattern of results can be viewed as partially supporting the hypothesis that the fewer number of collection points results in a higher number of offender profiles. When there are multiple stages and organizations that can collect lawfully owed DNA, it is possible the responsibility of collecting DNA can get delayed and pushed off to other points in time, instead of collecting at the first possible option. In addition, individuals involved in the later stages of DNA collection, such as at probation, may assume that DNA had already been collected at a previous point in time, such as first incarceration.

The results of the current thesis contribute new insights to existing knowledge. All of the analyses produced findings that build on existing studies (Ferguson, 2021; Office of Justice Programs, 2022; Lovell and Klingenstein, 2019; Lovell, 2022). Specifically, Lovell and Klingenstein (2019) tracked 15,370 individuals who lawfully owed their DNA and determined that DNA was collected from 1,503 of those individuals. After going through the process of getting the DNA samples and entering them into CODIS, the final result was 63 forensic hits. Lovell and Klingenstein (2019) estimated that if researchers would have been able to collect DNA from the remaining 13,867 individuals, it would result in 582 forensic hits (success rate of 4.2%) in CODIS. Lovell and Klingenstein (2019) showed that collecting more DNA samples at the state-mandated times would result in more forensic hits than trying to collect DNA afterwards (i.e., once the individual has left the criminal justice system). Building off this, Attorney General Bob Ferguson's (2021) study started with 635 individuals who lawfully owed their DNA and found that DNA was collected from 345 individuals. Of the remaining 290 individuals, the study broke down all the reason why the samples were unable to be collected: individual died, individual failed to register as a sex offender, and DNA had not been collected yet by the counties and various other reasons. Ferguson's (2021) study is important because it shows the difficulties in collecting DNA samples after an individual has left the criminal justice system. Lovell and Klingenstein's (2019) study and Ferguson's (2021) study highlight the importance of collecting DNA at the mandated times outlined by state statues. When agencies do not collect DNA from individuals when they are supposed to, this allows individuals to slip through the cracks and avoid submitting their DNA. This limits the effectiveness of CODIS. This thesis attempted to provide information about the most efficient times to collect DNA, to reduce the number of offenders who do not have their DNA collected before they leave the criminal justice system. The author believes that standardizing the points of DNA collection within the statutes will reduce the chances of DNA not being collected when individuals are within the criminal justice system.

The purpose of these analyses was to document the variation across statutes regarding the collection of lawfully owed DNA. The main variable of focus for this thesis was the point of DNA collection required at conviction. This variable was the focus in order to determine if fewer points in time where DNA can be collected were linked to a larger average number of offender profiles in NDIS. When DNA can be collected at multiple stages in the collection process, there is a greater chance for gaps to occur in the system. This occurs because DNA only needs to be collected once, and when there is more than one point in time when DNA can be collected, collection agencies get to choose that point in time. The concern is that the agencies handling the offender either think the offender has already had their DNA collected or that the offender will have DNA collected later (hypothetically) [Lovell, 2022; Sexual Assault Kit Initiative, 2021].

There are two primary limitations present within the data studied here. The first limitation is the measurement of success; "investigations aided" specifically. "Investigations aided" means a CODIS hit adds some form of value to the investigation of the crime in question. The limitation is that there are no exact criteria used to define what "investigations aided" means, so the measurement is limited (Panneerchelvam & Norazmi, 2003). The second limitation stems from an issue of generalizability. This thesis addressed all of the aspects within each state statute and drew conclusions. However, the issue of generalizability arises when discussing the local aspect of CODIS: Local DNA Index System (LDIS). Each local jurisdiction within states may participate in only a few of the many possible points of DNA collection that are listed in the statutes. Just because a state's statute lists all the points in time DNA should be collected does not mean that local agencies within that state have the ability to collect or follow through with all that is mandated. Potential gaps in collection can stem from a local level and not a state level, which this thesis was unable to address. Future research should examine how local context affects state-mandated DNA collection.

The policy implication of this paper is for standardization among statutes. Bringing to attention the disparity between the collection of lawfully owed DNA between the 50 states, the District of Columbia, and the three united territories, provides an opportunity to identify the most common point of collection and use it as a basis for standardization. This can be an analysis between states or within states. As mentioned in the study of Washington, "Washington state has not developed a consistent method for collecting DNA upon conviction. Instead, every county implements different procedures" (Sexual Assault Kit Initiative, 2021, para. 11). This is how cases such as Anthony Edward Sowell, Larry McGowan, Antonio Huffman, and Brandon Weathers occur, and that is what CODIS is intended to prevent.

Bivariate analyses were conducted to help identify the most successful aspects of the state statutes that could be used to guide standardization among states. The Independent Samples T-Test showed that states that collect at arrest *and* conviction have higher average numbers of investigations aided, which is counter to the hypothesis. However, based on the analysis results, a standardized policy should include the collection of DNA at both arrest and conviction if we want to increase the number of investigations aided. The ANOVA test results were found to be non-significant. This in mind, the descriptive results showed that states that mandated DNA collection at fewer numbers of points in time have higher average numbers of offender profiles, meaning that a standardized policy with fewer collection points could have an influence on the number of offender profiles in NDIS. The descriptive results identified the two most commonly used points of time by the states: at first incarceration and before release from incarceration. Even though these two points in time are the most commonly used, a potential gap emerges for states that do not collect DNA at these points in time. This could be addressed with the simplification or standardization of the points of collection of DNA mandated by each states' statutes.

Future research on the topic could measure the points of time at which DNA can be collected when statutes require collection at arrest versus conviction. This line of research would examine the exact points at which DNA is collected, such as booking, fingerprinting, and initial appearance in court versus first incarceration, parole, and probation. The research would consist of an analysis of statistics within NDIS (i.e., investigations aided, offender profiles, arrestee profiles, forensic profiles, etc.) to the points in time of collection of DNA during the arresting process (i.e., booking, fingerprinting, first court appearance, etc.). The results from research question two found that more investigations aided resulted when states collect DNA during both the arrest process and conviction process. In this thesis, the third research question only examined the conviction process, so future research ana analysis on this topic should consider points of collection within the arresting process.

In conclusion, the study adds new knowledge about lawfully owed DNA. The existing body of research about lawfully owed DNA has primarily focused of the Sexual Assault Kit Initiative (SAKI) and individuals who commit sex offenses. This study expanded this scope and studied state statutes that mandate the collection of lawfully owed DNA for all offenses. The overall goal of this study was to understand the factors associated with the collection of DNA in hopes of understanding why DNA is not being collected from some individuals when law requires DNA collection. As of now there are no repercussions within the policy for failures to collect lawfully owed DNA, but the federal government (i.e., BJA) is providing funding to study and correct problems of uncollected, lawfully owed DNA. Obviously, this is a problem, and in such, the author hopes this thesis helps move along the process of fixing this problem.

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