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Ethical Implications of CODIS

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Abstract

CODIS stores and maintains numerous DNA profiles, and is used as a tool by the criminal justice system in order to help solve crime. Deoxyribonucleic Acid, or DNA for short, is the genetic material that an individual inherits from one's parents (NIH, 2019). Certain portions of this genetic material are selected for use within the CODIS database due to their lack of medically relevant information. There is an immense amount of power associated with DNA and the CODIS database that it is held within, which allows for many ethical issues to arise. In order to create a usable and safe database, these issues must be well understood and handled properly. The purpose of this study is to conduct a systematic review detailing the ethical implications of the Combined DNA Index System (CODIS). This systematic review allows for a thorough discussion of the main ethical implications faced by CODIS, such as: what DNA is, DNA analysis methods (historic to present), expansion of CODIS markers, DNA collection protocols, procedural consistency, size of CODIS database, familial searching, inclusivity, time spent in CODIS, and frequency of running through the CODIS database, to be undertaken. Finally, this study offers potential solutions about how to respect and protect the privacy of individuals while still allowing for a complete and inclusive CODIS database to be created and maintained. These solutions include: stronger and consistent data protection protocols, destruction of physical DNA sample after profile is entered into CODIS, and retiring loci that yield too much medically relevant information.

Keywords: DNA analysis, ethical implications of CODIS, familial searching, forensic DNA analysis, DNA and the criminal justice system, CODIS and the criminal justice system, CODIS

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Chapter I-Introduction

Over the years, there have been many new technologies that have developed in order to better solve crimes. With the development of new technologies comes the development of ethical implications that must be addressed. One such technology is the Combined DNA Index System (CODIS). The commonly used acronym is CODIS, and is "used to describe the FBI's program of support for criminal justice DNA databases as well as the software used to run these databases" (FBI, 2018). Forensic scientists use this database to conduct DNA analysis on genetic samples collected from crime scenes. Overall, the criminal justice system uses CODIS to identify unknown individuals, whether they are victims or perpetrators of a crime. CODIS itself is broken down into three levels (discussed in the next chapter) containing local, state, and federal DNA databases, and used to catalog genetic profiles collected from individuals who commit crimes (mostly felons) and government workers. When genetic evidence is found at a crime scene, on a victim, or DNA evidence is collected from an unknown victim or offender themselves, this material is analyzed and used to create a DNA profile which is entered into CODIS and searched against existing profiles in an attempt to find a genetic match.

Deoxyribonucleic Acid (DNA)-What Is It?

Deoxyribonucleic Acid, or DNA for short, is the genetic material that an individual inherits from one's parents (NIH, 2019).

There are two areas within the human body where DNA is found (NIH, 2019). These are the nucleus of a cell, where nuclear DNA is found, and the mitochondria of the cell, where mitochondrial DNA (mtDNA) is found (NIH, 2019). Nuclear DNA, commonly referred to as just DNA, is the most common genetic material that is used in forensic testing. However, mtDNA is utilized in this analysis as well. The difference between these two types of DNA is

the information that they yield when analyzed using forensic methods. Nuclear DNA can yield information about the person it belongs to, their family (both maternal and paternal), as well as medical information. Mitochondrial DNA (mtDNA), yields information about the individual it belongs to, and information that is unique to the maternal side of one's family. This is due to the fact that mtDNA is only inherited from an individual's mother. For the purpose of this study, when DNA is mentioned, only nuclear DNA is being discussed, unless specifically stated otherwise.

The patterns that are formed when the DNA bases bond together have been used in past DNA analysis methods in order to narrow down the number of individuals who were potentially involved in a criminal event. This will be discussed in detail in the next chapter.

The Power of DNA

Despite its ability to aid in solving crime, CODIS and DNA have many ethical ramifications that must be addressed. Access to such information raises concerns of privacy violations. There is an immense amount of power associated with the obtainment of DNA. A small genetic sample can reveal a plethora of private information about an individual, such as medical information and familial ties. With as much power as DNA evidence carries, there are multiple ethical concerns that must be examined in regard to the amount of information that can be gathered about an individual through obtaining a sample of genetic material. Individuals who have not obtained informed consent when accessing this information, and are not a part of the medical field, are now able to learn an astounding amount about an individual and those they are related to, whether they have participated in criminal activity or not. This access to genetic information is worrisome to some individuals, due to a fear of "genetic surveillance" that could

potentially occur over a person's lifetime, involving both criminal offenders and non-offenders who share genetic information (Kaye, 2014).

This power brings up many ethical concerns, which include: expansion of CODIS markers, DNA collection protocols, size of CODIS database, familial searching, inclusivity, time DNA samples spend in CODIS, and frequency of running through the CODIS database. All of the aforementioned create significant ethical challenges for the use of CODIS in the criminal justice system that must be understood to fully inform its use.

The purpose of this study is to systematically examine the literature on ethical implications related to the Combined DNA Index System (CODIS). More specifically, this study will answer the following research question:

1. What are the ethical implications of CODIS?

This study contributes to the broader knowledge base on the topic of CODIS by discussing its ethical implications and will provide potential solutions to the issues raised. These solutions include: stronger and consistent data protection protocols, destruction of physical sample after being entered into CODIS, and retiring loci that yield too much information that is medically relevant.

To answer the research question this study will first conduct a literature review pertaining to CODIS, DNA analysis from its beginning to present time, and the role of CODIS in the criminal justice system; second, the methods used to examine the ethical issues will be outlined, including the inclusion and exclusion criteria used to determine what sources were applicable; third, the ethical implications pertaining to CODIS will be defined and explored, including: expansion of CODIS markers, DNA collection protocols, size of CODIS database, familial searching, inclusivity, time DNA samples spend in CODIS, and frequency of running through

the CODIS database; and finally, potential solutions to these ethical implications will be put forth, including: stronger and consistent data protection protocols, destruction of physical DNA sample after profile is entered into CODIS, and retiring loci that yield too much medically relevant information.

In order to gain a better understanding of the power associated with DNA and its use in CODIS, the next chapter will discuss the different levels of the CODIS system. This will explain where the DNA profiles are cultivated from in order to create this nationwide database that the criminal justice system can utilize. Furthermore, DNA analysis methods will be defined and cataloged. Moving from historical to present methods for analysis, this will illustrate just how sensitive forensic DNA analysis methods have become. Through technological advances, DNA evidence that was once deemed too small or degraded for successful use in CODIS can now be analyzed and used for comparison purposes in the criminal justice system.

Chapter II-Literature Review

DNA and Forensic Science

Overall, DNA contained within human cells contains about three billion bases, and over ninety-nine percent of these bases are identical in every person (NIH, 2019).

Structurally, DNA is a double helix, a structure that looks like a ladder that has been twisted (NIH, 2019). Within this double helix are four bases, or building blocks, that make up DNA: thymine (T), guanine (G), cytosine (C), and adenine (A) (NIH, 2019). To create the double helix structure, A bonds with T and C bonds with G, which create what are referred to as base pairs (NIH, 2019). Bonded to these base pairs is the backbone of the DNA structure, which is created by a sugar molecule bonding to the bases, and a phosphate molecule bonding to the sugar (NIH, 2019).

The Combined DNA Index System (CODIS)

There are three levels which make up the FBI's Combined DNA Index System (CODIS), the database used to house DNA profiles of those involved within the criminal justice system, and they are: local, state, and federal (Miller, Brown, & Budowle, 2003). Local databases contain every DNA profile that is collected and analyzed at the level of the local criminal justice system, thus referred to with the acronym of LDIS (Local DNA Index System) (Miller, Brown, & Budowle, 2003). State level databases contain the data that is collected and analyzed at the level of the local criminal justice system, which is then disseminated to the state level database; this database is referred to as SDIS (State DNA Index System) (Miller, Brown, & Budowle, 2003). Lastly, the federal level, referred to as NDIS (National DNA Index System), is at the top of the hierarchy that CODIS refers to, and is where DNA profiles are exchanged and compared nationally (Miller, Brown, & Budowle, 2003).

The DNA that is used to create the profiles that are housed within the CODIS databases are collected from many different sources (Miller, Brown, & Budowle, 2003). These sources include: convicted felons, individuals who are classified as missing and those they are related to (i.e. collecting hair or other biological material from the missing person's items or a DNA sample from a relative to compare to an unknown sample law enforcement collected in connection with the missing person), and evidence collected for forensic purposes (Miller, Brown, & Budowle, 2003). Government officials also have DNA profiles that are entered into the CODIS system, under different qualifications, mainly for the purpose of being able to identify contamination should it occur (Hong, Wang, Xing, Hwang, & Park, 2015).

When an unknown sample is collected from a crime scene, offender, or victim, a genetic profile is created from the sample's material (FBI, 2018). CODIS is then used to run this DNA profile and compare it to the known samples that are accessible (FBI, 2018). Once a match is found, if there is one within the database, then confirmation procedures will take place to verify that the unknown sample is a match to the profile contained in the DNA database (FBI, 2018). If confirmation is successful, the identity of the individual the DNA matched to will be obtained (FBI, 2018). This DNA sample is also run through other databases, such as "the state's database of crime scene DNA profiles called the Forensic Index" (FBI, 2018, p. 1å) to see if there are any other crimes that were committed by the same individual. In the case of a DNA sample being collected from a source other than the offender, this information is then used to advance the investigatory process by allowing a court order to be obtained that allows for the collection of a DNA sample from the suspect (FBI, 2018). This known sample is then analyzed by a forensic lab, in order to confirm that the genetic match that has been previously established is indeed correct and corresponds to this individual (FBI, 2018). This final confirmation allows for the

biological sample that was found at the crime scene to be used in an evidentiary manner once the case goes to court (FBI, 2018).

DNA Analysis and the History of CODIS

It is important to take a step back from technological advancements that are used within the criminal justice system today, in order to gain an understanding of the progress that has been made. While rudimentary DNA analysis methods have been around for the past five or so decades, rapid changes have occurred within the last few. In the early years of the 1990s, it was determined through much research that particular pieces of human DNA, known as short tandem repeats, were particularly effective at identifying individuals via forensic analysis (Butler, 2006). The United Kingdom and other labs based in Europe were at the forefront of this research, and began to voraciously pursue new sections of human DNA for the purpose of identifying additional short tandem repeats in order to improve human identification practices (Butler, 2006). Upon identifying 13 locations within human DNA to use for identification purposes, European databases were developed in order to contain and utilize all of this new information (Butler, 2006).

The United States, following in the United Kingdom's footsteps, established a DNA database that was nationwide (McDonald & Lehman, 2012; Butler, 2006). Through the FBI, the Combined DNA Index System (CODIS) was officially launched (McDonald & Lehman, 2012). This would not have been possible without the progress that has occurred in the field of human genetics and forensic science. DNA analysis methods have greatly changed since their inception. Methods went from vague, with the ability to produce the genotype of an individual and narrow down potential suspects to five percent of the population, to providing a DNA profile that, when matched, is so specific that it would be nearly impossible for another individual to

have the same genetic profile. These changes over time have enabled DNA evidence to be an incredibly powerful tool in the criminal justice system. Due to the specific nature of current DNA analysis methods, it is imperative that ethical practices are observed and enforced. For these reasons, to fully understand how CODIS came to be, it is important to understand how DNA analysis has evolved over time, and become sensitive enough to allow for the creation of a national DNA database.

DNA Analysis Methods: Historical to Present

Prior to the existence of methods allowing for DNA analysis, "blood typing was an important forensic tool" (McDonald & Lehman, 2012, p. 113). However, unlike DNA analysis, blood typing was not a specific analysis process capable of providing results that were highly discriminating (McDonald & Lehman, 2012). For instance, blood could be found at a crime scene and be identified as blood type A-positive (McDonald & Lehman, 2012). This particular type of blood can be found in "30% of the population" (McDonald & Lehman, 2012, p. 113). For this reason, blood typing is not a practice that is employed by forensic scientists any longer (McDonald & Lehman, 2012). Instead, "if blood is found at a crime scene, DNA profiling is performed" (McDonald & Lehman, 2012, p. 113). DNA analysis methods have evolved over time and have provided a highly discriminate method for determining who really committed a crime.

DQ Alpha is an older method of DNA analysis that has been previously used within the criminal justice system. The process involved in this analysis was the amplification of a particular gene held within a DNA sample (Comey, Budowle, Adams, Baumstark, Lindsey, & Presley, 1993). Through further forensic analysis, this sample was further sequenced in order to create a useable DNA sample that could be applied in the criminal justice system for the purpose

of narrowing down the potential pool of suspects (Comey et al., 1993). This DNA analysis method is not an exact testing method, but has the ability to exonerate an individual who was incorrectly accused of committing a crime (Osborne, 2009). However, this method is limited in exactness because the majority of the time, it cannot identify a specific perpetrator (Osborne, 2009). Instead, DQ Alpha testing is capable of limiting the matches to the DNA profile to, at minimum, individuals who make up five percent of the general population (Osborne, 2009).

Restriction-fragment-length-polymorphism (RFLP) was a method of analysis that came into use in forensic science in 1984 (McDonald & Lehman, 2012) after DQ Alpha DNA testing. RFLP analysis involved analyzing areas in the DNA sequence that contained nucleotides (the pieces of genetic information that make up the double helix structure of DNA) that were repeated in a series of two or more (McDonald & Lehman, 2012). This analysis process was generally known as "DNA fingerprinting" (McDonald & Lehman, 2012, p. 110). RFLP DNA analysis methods are very time consuming, due to the test requiring a larger genetic sample size in order for analysis to be completed (McDonald & Lehman, 2012). However this lack of efficiency did not prevent this technique from being used in the forensic setting (McDonald & Lehman, 2012). RFLP testing was used in the United Kingdom in 1986 to not only convict the perpetrator of the crime but was also able to show which individual should be excluded as a person of interest due to a false confession (McDonald & Lehman, 2012). This was the first instance of using DNA analysis, and the resulting profile, to convict an individual for a criminal act (McDonald & Lehman, 2012).

Following RFLP data analysis, polymerase chain reaction (PCR), which was developed in 1983, greatly increased the abilities of DNA testing (McDonald & Lehman, 2012). PCR is a process that allows for DNA samples to be amplified, or the DNA to increase in number, by

replicating specific DNA sequences that were desired for testing (McDonald & Lehman, 2012). This process was an incredible step forward for DNA analysis because it requires only a small sample of genetic material in order for replication to occur (McDonald & Lehman, 2012). Amplification is a process that occurs with the help of a thermocycler and primers (McDonald & Lehman, 2012). Along with the genetic material, primers which are designed to bind to the particular DNA segments that are desired for analysis are put together in a dish that contains multiple wells (McDonald & Lehman, 2012). This dish is then placed in a thermocycler that cycles through varying set temperatures that allow for the DNA to separate into single strands and the primers to bind to the newly separated strands (McDonald & Lehman, 2012). These primers also contain fluorescent markers that, when run through the proper instrument, will provide a visual illustration of the DNA profile of the individual the genetic material came from (McDonald & Lehman, 2012). This profile is what is entered into CODIS, so it can be compared to existing profiles, as well as new ones that are entered after other crimes are committed (McDonald & Lehman, 2012).

During the 1990s, a switch was made from analyzing amplified fragment length polymorphisms (AFLPs), which were sections of DNA that contained a particular locus (or a specific location on a gene) that was of interest and used in the forensic setting (McDonald & Lehman, 2012). During the 1990s, AFLPs were replaced with short tandem repeats (STRs), which contained much smaller pieces of DNA for analysis when compared to AFLPs (McDonald & Lehman, 2012; Liu & Harbison, 2018). The shorter length of the STR fragments of DNA makes them easier to amplify (McDonald & Lehman, 2012). Furthermore, less genetic material needs to be present in order for STRs to be properly amplified by the process of PCR (McDonald & Lehman, 2012). Lesser amounts of DNA material being required is advantageous to the

criminal justice system because genetic evidence found at crime scenes is very often degraded or small in amount (McDonald & Lehman, 2012). The aforementioned information pertaining to the science behind PCR—the primers and thermocycler—are other technological advances that allow a smaller portion of genetic material to be useful in the forensic setting, where in the past it would not have been. Finally, analyzing STRs allows for many loci to "be analyzed at the same time", which not only allows for time to be conserved (through producing DNA profiles and analysis in a lesser amount of time) but also uses less materials for analysis and requires "a smaller sample size" (McDonald & Lehman, 2012, p. 110).

Mitochondrial DNA testing was also found to have great use in the field of forensic science (McDonald & Lehman, 2012). While STRs come from DNA which is housed in the nucleus of the cell, mitochondrial DNA (mtDNA) is housed in the mitochondria of the cells. Mitochondrial DNA is useful in the forensic setting because it can be used to trace the maternal ancestry of an individual; meaning that mtDNA is not inherited from both parents, but is only passed on from mother to child (McDonald & Lehman, 2012, p. 112; Liu & Harbison, 2018). This makes mtDNA very effective at tracking individuals from the same family, as well as individuals who are from analogous populations (McDonald & Lehman, 2012, p. 112). However, the power associated with mtDNA carries its own risks of harassing and embarrassing individuals who are only guilty of being related to an individual who committed a crime.

RFLP and PCR, at its inception, were the markers that scientists entered into CODIS for DNA profiles prior to 2000 (McDonald & Lehman, 2012). However, once STR analysis methods were developed, only profiles created by "STR data were added" (McDonald & Lehman, 2012, p. 112); this occurred after 2000 (McDonald & Lehman, 2012).

The power associated with DNA evidence means that databases, such as CODIS, must be as complete and inclusive as possible. Additionally, this all must be done without violating privacy rights, in order to provide an effective and accurate tool that can be used by forensic scientists to aid the criminal justice system. However, "the impact of DNA identifications achieved using CODIS is complicated by societal issues and systemic challenges in the administration of criminal justice" (Gabriel, Boland, & Holt, 2010, p. 396).

CODIS and the Criminal Justice System

CODIS's role in the criminal justice system has changed since its inception in 1990. Currently, United States forensic laboratories use 13 loci within the STR strands of DNA for the purposes of analysis (McDonald & Lehman, 2012). These 13 loci are the locations on DNA that are used to create the profile that is entered into CODIS for comparison purposes (McDonald & Lehman, 2012). This genetic profile can be used to "statistically predict the likelihood that an individual would have a particular allele at a certain locus" (McDonald & Lehman, 2012, p. 111). This means that through the use of statistics, the likelihood of two people having the same gene at the same location can be determined (McDonald & Lehman, 2012). Through statistical analysis of DNA profiles, it has been determined that "the likelihood of two unrelated individuals having the same DNA profile is…about 1 in 594 trillion individuals" (McDonald & Lehman, 2012, p. 111). For context, the population of the earth is roughly 7.4 billion. This statistic shows how powerful DNA analysis techniques are today, when compared to what past analysis methods were capable of.

Overall, "Twenty-eight States and the Federal Government have enacted statutes… authorizing the collection and analysis of DNA samples from felony arrestees for use in a forensic identification database" (Brief for the State of California et al., *Maryland v. King*, 2013,

p. 1). These statutes allow for a minimally invasive collection method, consisting of a buccal swab (or cheek swab) being used to collect a saliva sample after an individual has been arrested (*Maryland v. King,* 2013). Using this method of DNA collection "is quick and painless,…requires no surgical intrusion[n] beneath the skin,… and poses no threa[t] to the arrestee's 'health or safety'" (*Maryland v. King*, 2013, p. 444 [quoting *Winston v. Lee*, 470 U.S. 753, p. 760 (1985); internal quotation marks omitted]). The process requires a swab being placed inside an individual's mouth, and being gently brushed against the inside of the cheek (*Haskell v. Brown,* 2009). In comparison to blood being drawn, which is much more invasive than a buccal swab, this method, while still classified as a search according to the Fourth Amendment, is far more reasonable than other search methods (*Maryland v. King*, 2013). Additionally, collecting an individual's DNA is done in conjunction with other information gathering procedures, including photographing the individual and collecting their fingerprints (*Maryland v. King*, 2013).

The Effect of CODIS on the Criminal Justice System

As is suggested by the many improvements that have occurred in the analysis of DNA, advances in technology have had an immense impact on the criminal justice system (Singer, Miller, & Adya, 2007). This has produced both positive and negative outcomes within the criminal justice system (Singer et al., 2007). When specifically looking at the advancement of DNA testing, its "impact…on the legal system cannot be overstated; it is one of the more transformative developments that have taken place in recent legal history" (Singer et al., 2007, p. 96). This impact can be seen in DNA's power to determine the legal outcome of criminal case by "providing certainty about identity in a way that has not been possible before", and

establishing the innocence or guilt of an individual suspected of a criminal act (Singer et al, 2007, p. 96).

Collection.

Collection of DNA samples for the purpose of creating profiles within the CODIS database has been found to greatly improve the ability of a state to solve crimes of a violent nature (*Maryland v. King*, 2013). This is due to the fact that "With the exception…of nuclear DNA analysis…no forensic method has been rigorously shown to have the capacity to consistently, and with a higher degree of certainty, demonstrate a connection between evidence and a specific individual or source" (Brief for the States of California et al., *Maryland v. King*, 2013, pp. 20-21). Furthermore, collection of genetic material gives the criminal justice system a greater ability to determine which individuals have committed lower level offenses, and which individuals pose more danger to society *(Maryland v. King*, 2013). This information can then be used to determine if bail should be offered to an individual or not (*Maryland v. King*, 2013).

Additionally, collecting DNA samples and placing them in CODIS has been found to serve as "a compelling government interest in using incarceration powers sparingly" (Brief for the States of California et al., *Maryland v. King*, 2013, p. 7). This is because utilizing DNA profiles allows for the criminal justice system to have greater accuracy and carry out its obligations in a more just manner (Brief for the States of California et al., *Maryland v. King*, 2013). Applying incarceration more sparingly, in addition to being able to more accurately identify the proper individual in a criminal case, allows for the criminal justice system to determine which individuals can be released safely back into society, and those individuals who should remain confined while awaiting trial (Brief for the States of California et al., *Maryland v. King*, 2013).

Collecting an individual's DNA upon arrest, as opposed to after an individual is convicted of a felony, is also very beneficial to the criminal justice system, "beyond closing old cases and preventing new ones" (Brief for the States California et al., *Maryland v. King*, 2013, p. 14). This is because CODIS has provided the criminal justice system with the ability to provide victims of crimes closure in a timelier manner (*Maryland v. King*, 2013). This is done through sparring the individuals who were victims of a crime the fear that the offender who victimized them might abscond from the custody of law enforcement and pose a potential threat to them once more (*Maryland v. King*, 2013).

DNA Evidence in the Courts.

Furthermore, advanced DNA technology can be applied to cases where DNA evidence was either not tested, due to being collected before analysis methods were put into place, or tested using rudimentary analysis methods (Singer et al., 2007). In some cases, analyzing this evidence with up to date methods of analysis can corroborate the original conviction (Singer et al., 2007). This has the power to "reaffirm the accuracy and validity of the legal system", because the individual who was truly guilty of a criminal offense was successfully apprehended and prevented from committing any further harm (Singer et al., 2007, p. 101). Additionally, the development of sensitive DNA technology within the criminal justice system has also been recognized due to its ability to exonerate an individual who was potentially found guilty of a crime they did not commit due to other types of evidence (Singer et al., 2007).

The process of setting bail is not the only area of the criminal justice system that is highly influenced by the presence of DNA profiles. DNA samples placed in CODIS also allow the government a greater ability to accurately identify individuals who have been arrested for felonies, supervise individuals who were placed on probation for committing misdemeanor

crimes, and distinguish "between low-level and dangerous arrestees for custody purposes" (Brief for the States of California et al., *Maryland v. King*, 2013, p. 14). DNA collection and placement in CODIS has also been found to reduce the rate of recidivism for individuals who committed felonies (Brief for the States of California et al., *Maryland v. King*, 2013).

Conviction.

The quicker identification of suspects, through matching DNA profiles, also allows the criminal justice system to produce convictions that are "more certain and reliable" (Brief for the States of California et al., *Maryland v. King*, 2013, p. 16). This is accomplished by determining if an individual who is arrested for criminal behavior has participated in any other crimes that have yet to be solved (*Maryland v. King*, 2013). Upon identification of these crimes through the application of DNA analysis, less time has passed between the crime and the trial, which allows individuals who witnessed the event, and any evidence associated with the crime to be found in a timelier manner (Brief for the States of California et al., *Maryland v. King*, 2013). Also, the memory of the witness, or witnesses, is much fresher when DNA is used to identify a suspect and link their crimes together (Brief for the States of California et al., *Maryland v. King*, 2013).

DNA profiles also aid in focusing criminal investigations (*Maryland v. King*, 2013). If an individual is arrested for a crime, and their DNA is collected, but does not match the DNA left at the crime scene, that individual is no longer under investigation (Brief for the States of California et al., *Maryland v. King*, 2013). These factors allow for the criminal justice system to cease investigation of an innocent person, and not waste resources pursuing an individual who did not commit the crime (Brief for the States of California et al., *Maryland v. King*, 2013).

Furthermore, through the exchange of information, in the form of CODIS profiles, local, state, and federal crime labs can compare DNA profiles in order to connect the crimes committed

with the correct offenders (*United States v. Kincade*, 2004; *Maryland v. King*, 2013). Exchanging information between labs also allows CODIS profiles to serve as a tool for resolving any conflicts that exist when consulting fingerprint records or history of criminal activity (See 28 C.F.R. § 28.12). While helping to ascertain an individual's identity, CODIS serves as a check and balance for other identification databases through "allowing states to recognize incorrect entries" when fingerprint, DNA, and criminal records do not correlate with one another (Brief for the States of California et al., *Maryland v. King*, 2013).

CODIS allows for prevention of serious crime.

For these reasons, DNA evidence carries an immense amount of power in the criminal justice system. "Unlike social science research that is able to demonstrate the *possibility* of false convictions, DNA technology and research is a tool that can be used to determine false convictions with a high probability of accuracy" (Singer et al., 2007, p. 102). This level of accuracy has allowed for a study conducted at the national level (Lovrich, Pratt, Gaffney, Johnson, Asplen, Hurst, & Schellberg, 2004) to conclude that more than one hundred offenses that were classified as serious, would have been able to be prevented if only these individuals' DNA had been collected as a result of previous crimes and/or analyzed earlier (Singer et al., 2007, p. 101).

The prevention of serious crime is brought about by analyzing DNA that is pertinent to crimes that are minor in nature (Singer et al., 2007). Testing the genetic evidence that is left behind during the commission of minor crimes allows a CODIS profile to be developed (Singer et al., 2007). If an individual is a repeat offender, their profile can be developed in order to establish a pattern that is robust enough for analysis (Singer et al., 2007; Gabriel et al., 2010). The analysis of this profile will help in identifying this individual before their criminal activity

escalates (Singer et al., 2007). Identifying individuals who participate in these types of crime has the potential to prevent "major crimes from coming to bear" (Singer et al., 2007, p. 102). By being able to connect cases together, evidence from a singular case can be applied to others it is related to, which increases the amount of information that criminal justice organizations, such as law enforcement, have at their disposal while working to solve crimes (Singer et al., 2007). For these reasons, DNA and the technology required to carry out its analysis, create an invaluable tool for the criminal justice system as a whole, and therefore warrant continued "consideration and investment" (Singer et al., 2007, p. 102).

However, in spite of these many benefits that have been provided by DNA evidence, and its retention in the CODIS database, there are limitations that must be considered when this tool is utilized by the criminal justice system.

Practical Limitations of CODIS in the Criminal Justice System

In spite of the power associated with DNA evidence, there are limitations to the applicability of CODIS in the criminal justice system (Singer et al., 2007). This is due to the fact that DNA evidence is not helpful in every case across the board (Singer et al., 2007). For example, obtaining a DNA match via entering the unknown sample into CODIS for the purpose of comparison, in some instances, really only indicates that an individual was at some point in time present at the crime scene (Singer et al., 2007). This does not, however, conclusively indicate that this individual perpetrated the specific crime or criminal offense being investigated, or participated in any manner that would be classified as criminal behavior (Singer et al., 2007). Part of this can be attributed to the fact that while DNA and other forensic technologies, such as the CODIS database, are accurate generally, the human component of these analyses can allow for error to occur (Singer et al., 2007). This potential for error is similar to that of eyewitness

testimony and confessions of a false nature (Singer et al., 2007). While the scientific community is used to, and capable of, contending with error that can occur from human involvement in forensic testing, the general population is not as well equipped (Singer et al., 2007). The general idea, held by lay individuals, of scientific evidence being conclusive every time "illustrates an erroneous belief that scientific evidence is more reliable than other types of evidence, when many times this is not the case" (Singer et al., 2007, p. 112). This belief could be detrimental for the criminal justice system (Singer et al., 2007).

Another hurdle that the criminal justice system must navigate is the explanation of CODIS, DNA evidence, and its complex analysis process to the individuals who sit as jurors during trial (Singer et al., 2007). Since jurors are tasked with "distinguishing good science from bad science and…determining the reliability of the evidence collected", it is imperative that they have a complete understanding of the evidence and analysis methods that were used throughout the investigation (Singer et al., 2007, p. 107). However, it is difficult to determine how jurors will complete this task, and the quality of their decision making (Singer et al., 2007).

It has been found that, in multiple cases, individuals who were on the jury felt that the technical aspects of the evidence, and its analysis, was explained inadequately (Singer et al., 2007). Due to the lack of adequate explanation, it is highly likely that jurors will "commit serious mathematical errors when dealing with probabilistic evidence, such as DNA [CODIS] match statistics" (Singer et al., 2007, p. 108). This can cause a significant underestimation of "the weight of probabilistic evidence and" potentially cause the incorrect combination of mathematical variables given in relation to DNA results (Singer et al., 2007, p. 108). These potential errors can impact how DNA evidence and CODIS are evaluated, particularly when

presented with other evidentiary information, and can influence the final verdict (Singer et al., 2007).

Most often, this is attributed to what is referred to as the CSI Effect (Rhineberger-Dunn, Briggs, & Rader, 2016). There is not a widely used consistent definition of this phenomenon, however, those that exist seem to contain two specific components (Rhineberger-Dunn et al., 2016). First, individuals who watch crime shows expect trials to contain a high amount of forensic science based evidence (Rhineberger-Dunn et al., 2016). Second, due to the fact that crime shows depict forensic based evidence as being consistently reliable and foolproof, decisions made by juries are highly influenced by the presence or absence of forensic evidence (Rhineberger-Dunn et al., 2016). The presumption of the CSI Effect is that individuals who avidly watch crime-based shows are going to incorrectly hand down a guilty verdict for a defendant in the absence of forensic evidence (Rhineberger-Dunn et al., 2016). This is due to the fact that these individuals are thought to be more likely to give more weight to evidence that is forensically based that is presented during a trial (Rhineberger-Dunn et al., 2016).

In reference to DNA in the forensic setting, the CSI Effect posits that when this type of evidence is used in crime shows, the public perception of how effective law enforcement is when investigating and solving crimes in real life, is influenced (Rhineberger-Dunn et al., 2016). This, in turn, effects the decisions individuals make when they serve on a jury (Rhineberger-Dunn et al., 2016). For example, if a crime show consistently shows DNA evidence as being essential to solving a crime, members of the public may begin to expect law enforcement individuals to use DNA evidence in all cases (Rhineberger-Dunn et al., 2016). While this is not the reality for all criminal investigations, this expectation can have consequences. If there is not any DNA evidence presented in a trial, the public's perception of the police could be negatively impacted,

which could decrease the number of crimes reported and create tenuous relationships between law enforcement and the communities they serve (Rhineberger-Dunn et al., 2016).

However, there is not clear evidence that the CSI Effect exists, or if it does, how much impact it truly has (Rhineberger-Dunn et al., 2016). "The literature clearly shows that police, prosecution, defense attorneys, judges, potential jurors, and the general public believe that it exists, but the empirical evidence of its existence is mixed" (Rhineberger-Dunn et al., 2016, p. 534). Overall, the first component of the CSI Effect, that perceptions of how reliable and infallible forensic based evidence is, does differ between individuals who do watch crime shows compared to those who do not (Rhineberger-Dunn et al., 2016). Studies have yielded different results when investigating the merit of the second component, which refers to the decisions juries settle on being highly influenced by the presence or absence of forensic evidence (Rhineberger-Dunn et al., 2016). Out of eight studies conducted, three yielded results that indicated that the perceptions of individuals who watched crime shows were influenced in regards to the guilt or innocence of a defendant, while five studies showed no effect on perceptions of a defendant's guilt (Rhineberger-Dunn et al., 2016).

The three studies that found support for the CSI Effect were: Baskin and Sommers (2010); Hayes-Smith and Levet (2011); and Maeder and Corbett (2015) (as referenced in Rhineberger-Dunn et al., 2016). Baskin and Sommers' (2010) study showed that individuals "who watched three or more hours of crime shows per week were less predisposed toward conviction when scientific evidence was absent" (as referenced in Rhineberger-Dunn et al., 2016, p. 534). Hayes-Smith and Levett (2011) found similar results when they conducted their study (as referenced in Rhineberger-Dunn et al., 2016). Their results showed that individuals who avidly watched crime based shows were not confident when it came to deciding between

guilty or innocent when there was not forensic evidence presented (as referenced in Rhineberger-Dunn et al., 2016). Finally, Maeder and Corbett (2015) found that individuals who consumed higher amounts of crime based television shows had lower levels of certainty when it came to the guilt of the defendant (as referenced in Rhineberger-Dunn et al., 2016).

Conversely, the five studies that did not find support for the CSI Effect were: Podlas (2005); Shelton, Kim, and Barak (2006); Kim, Barak, and Shelton (2009); Schweitzer and Sakes (2007); and Brewer and Ley (2010) (as referenced in Rhineberger-Dunn et al., 2016). Podlas (2005) conducted a study that is "one of the most commonly cited studies in the CSI effect literature", and found that the decision-making process of individuals who frequently viewed the crime show CSI, were not influenced to a higher degree than individuals who did not frequently watch this specific show (as referenced in Rhineberger-Dunn et al., 2016, p. 534). Shelton, Kim, and Barak (2006) found that there was not a difference in "demand for scientific evidence as proof of guilt" between viewers and non-viewers of crime based television programs (as referenced in Rhineberger-Dunn et al., 2016, p. 536). Kim, Barak, and Shelton (2009), using data from their previous study which took place in 2006, incorporated a set number of crime based television programs into this study, as opposed to studying a wider range of crime based shows, and found results that were congruent with their previous study (as referenced in Rhineberger-Dunn et al., 2016). There was no effect on juror decisions in regard to the guilt or innocence of a defendant (as referenced in Rhineberger-Dunn et al., 2016). Schweitzer and Sakes (2007) found that when viewers of crime shows were compared to individuals who did not watch crime shows, there was no difference in the likelihood of a guilty verdict being voted for (as referenced in Rhineberger-Dunn et al., 2016). Finally, Brewer and Ley (2010) found that the type of television program individuals elected to watch had less bearing on their decision making

process than the amount of television that was watched (as referenced in Rhineberger-Dunn et al., 2016). In other words, individuals who spent more time watching television in general "perceived DNA evidence to be reliable, and were more likely to 'vote to acquit if the prosecution in a murder case did not present DNA evidence'" (as referenced in Rhineberger-Dunn et al., 2016, p. 536). Additionally, results indicated that individuals who consumed more crime based television believed that they understood DNA evidence and what it means more clearly than individuals who did not watch the same programs (as referenced in Rhineberger-Dunn et al., 2016).

To counteract the complexity of DNA analysis methods, and any influence the CSI Effect may have over individuals who make up a jury, evidence must be presented in a manner that is easier to comprehend (Singer et al., 2007). In regard to unknown DNA profiles being entered into CODIS for the purpose of comparison with known samples, if match statistics are presented as a "single target, framed as a probability", understanding is increased (Singer et al., 2007, p. 109). This method will decrease the amount of math that must be done by jurors, by simply stating a singular probability value that indicates the chance that a particular genetic sample does not belong to the suspected individual (Singer et al., 2007). An example of presenting DNA evidence, such as match that was found in CODIS, in this manner is presented by Singer et al. (2007) in the following statement: "the probability that the suspect would match the blood drops if he were not their source is 0.1%" (p. 109).

However, since CODIS and its associated databases are operated inside of the criminal justice system, there are restrictive guidelines that said system puts into effect that must be considered (Gabriel et al., 2010). For example, successfully gaining information via DNA analysis, through the use of CODIS, pertaining to unsolved crimes is influenced (i.e. may be

prevented or hindered by certain legislative or criminal justice policies) by many factors (Gabriel et al., 2010). As Gabriel et al. (2010) states, these factors include:

> (1) state and national DNA database legislation; (2) convicted offender and arrestee DNA sample collection; (3) crime scene and sexual assault evidence collection; (4) cold case review and DNA testing strategies; (5) charging decisions in criminal complaint and John Doe warrant filing; (6) case dismissals, plea bargain agreements, and prosecution of cold hits cases; (7) court hearings and rulings on forensic DNA evidence; (8) application of probation and parole as a criminal penalty; and (9) offender rehabilitation and supervision at re-entry in society. (p. 397)

For example, specifically looking at the first two components of factor (6), cases being dismissed or plea bargains being reached will circumvent the use of DNA evidence in the court room.

Additionally, even though CODIS profiles can help identify a repeat offender and aid in the establishment of a pattern of behavior, Gabriel et al. (2010) discuss the fact that this may not be as effective as is commonly believed. Gabriel et al.'s (2010) study found that "despite CODIS' potential to deter criminal behavior of the violent and/or prolific repeat offender, data…demonstrate that the criminal justice system was unsuccessful in interrupting behavioral patterns over time" for their specific sample (p. 403). This can be attributed to the fact that, despite the power of DNA analysis and the CODIS database as a whole, there are still numerous obstacles that exist further down the line of forensic testing, and are embedded within the "layers of the criminal justice system"; one such obstacle would be the variable referring to the propensity of individuals to reoffend and continue committing crime (Gabriel et al., 2010, p. 408). In other words, while CODIS, and other databases, provide individual identification in relation to crimes that have been committed, they do not have the power to permanently reduce

crime (Gabriel et al., 2010). This evidence shows that, overall, "the criminal justice system often faces an uphill struggle to improve public safety", even when technological advances improve the scientific methods employed by this system (Gabriel et al., 2010, p. 407). Further, the intelligent application of technology "and organizational strategy depends upon cooperation among criminal justice team members" (Gabriel et al., 2010, p. 408).

However, all of this is contingent upon biological evidence being present at the crime scene (Singer et al., 2007). There are some crimes where DNA evidence is not left behind. This means that there is no material to be used to create a profile that can be entered into CODIS for comparison. In these instances, other evidence and law enforcement practices must be employed and relied upon in order to properly investigate and close the case. In other scenarios, there may be genetic material left behind at a crime scene, either from the perpetrator(s) or the victim(s), but it is too degraded or too small of a sample to be successfully used for analysis. With all of the technological advances during recent years, this has become less of an issue, but it is not completely eradicated. For this reason, it is important that the criminal justice system use all of the resources at its disposal in order to properly investigate crimes.

Limitations lead to ethical implications for CODIS.

These aforementioned limitations can also create ethical implications that must be addressed in regard to the use of CODIS and DNA evidence in the criminal justice system. Gaining an awareness of these implications will help to mitigate issues of potentially harassing individuals, and their families, who were not involved in the criminal offense being investigated, and use law enforcement resources more productively. Furthermore, understanding the potential for the limitations of DNA evidence and the use of CODIS will allow the criminal justice system to use its vast array of tools and resources to solve criminal cases, instead of relying solely on the

presence and analysis of DNA evidence, and comparing samples in CODIS. For these reasons, it is imperative that the highest standards are put into place and consistently enforced, not only for the innocent individuals who could be falsely accused of a crime, but also for the criminal offenders and victims.

This study seeks to identify and analyze the ethical implications that arise when discussing CODIS. These include: expansion of CODIS markers, DNA collection protocols, inclusivity, familial searching, time spent in CODIS, and frequency of running through the CODIS database. To do this, a systematic review was conducted, with the intent to create a detailed description of the pertinent implications, and the solutions that have been suggested for implementation.

Chapter III-Methods

A systematic review, or meta-analysis, was used to answer the research question: what are the ethical implications of CODIS?. "A systematic review has explicit inclusion/exclusion criteria and explicit information about searches that were carried out" (Farrington, Gaffney, Lösel, & Ttofi, 2017, p. 92). This study summarizes the ethical implications that are inherent to CODIS due to the sensitive nature of the genetic material contained within. Furthermore, this study synthesizes the mentioned issues in a manner that allows for suggestions to be made as to potential solutions and policies that can be put into place to create a more effective CODIS database, while maintaining the most stringent protections.

The following key words were used in the search: DNA analysis, ethical implications of CODIS, familial searching, forensic DNA analysis, DNA and the criminal justice system, CODIS and the criminal justice system, CODIS.

Utilizing the online library at Grand Valley State University, social science, criminal justice, law, and forensic science based databases were searched in order to gather peer reviewed journal articles and official government definitions for this study. The databases that were searched were: FBI Official Website, NIH Official Website, CJ Abstracts, Michigan eLibrary, Science Direct (PubMed, Web of Science, MEDLINE), Medical Database, HeinOnline (Business Insights: Global, PubMed, Web of Science, Social Sciences Citation Index), Proquest (LegalTrac, Web of Science, Social Science Citation Index, Worldwide Political Science Abstracts), Sociological Abstracts (pre-2017), Social Science Premium Collection, Science Direct, Westlaw, and Wiley Online Library (Academic OneFile, PubMed, Web of Science, Social Sciences Citation Index, PAIS Index).

The years included in the search were: 1993, 2000, 2003, 2004, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2018, and 2019. The particular years listed were chosen in order to gain a complete understanding of the development of the CODIS database, and all of the technological and scientific advances related to DNA that it took in order to make such a powerful database possible. These databases yielded a multitude of reports, whose abstracts were carefully analyzed in order to develop a list of journal articles and case briefs. Two government websites, belonging to the FBI and NIH, were also used as references for this study.

In order to determine which sources were applicable to this study, a content analysis was conducted on the articles that were found within the aforementioned databases that pertained to the research question. A content analysis is used by researchers to allow for a large amount of data to be sifted through with a greater amount of ease due to its systematic methods (Stemler, 2001). This methodology is useful when researchers seek to identify patterns in the literature they desire to use in a study (Stemler, 2001). Through this analysis, a pattern of important ethical issues pertaining to CODIS was discerned. Additionally, patterns pertaining to how CODIS is used in and impacts the criminal justice system as a whole were also discovered, and included in this study. Finally, a content analysis was done on the articles in order to ascertain which proposed solutions were repeatedly put forward as remedies to the ethical implications pertaining to CODIS. Articles that did not yield any new information, and/or repeated already present ethical implications or proposed solutions, were excluded from the sample.

Chapter IV-Ethical Issues

Ethical Implications of CODIS

Expanding DNA markers within CODIS.

As of 2012, the FBI was looking into the merits of expanding the number of loci used to create a DNA profile that is kept in CODIS (Hares, 2012). Including additional loci allows for greater accuracy and a greater ability to differentiate when comparing DNA profiles, while also improving how CODIS can be used as a tool by criminal justice personnel and promote the sharing of data at an international level in a compatible manner (Hares, 2012, p. e52). In order to increase the number of loci used with CODIS, certain acceptance criteria were recommended and proposed, including: "no known association with medical conditions or defects", a minimal rate of mutation, "high level of independence", and widely used across the "international forensic DNA community", to name a few (Hares, 2012, p. e52).

While only 13 loci are used today for the DNA profile that is created for CODIS databases, the entire sample of genetic material is stored, which is viewed as a threat to privacy due to the presence of medically relevant information present in the sample (Smith, 2006). Contained within the complete genetic sample is "both protein coding and noncoding DNA" which is made up of DNA regions known as short tandem repeats (Hong et al., 2015, p. 900). It is argued that "only in exceptional circumstances should entities such as law enforcement or defense and security have access to biospecimens or whole genome sequence data for non-health-related purposes without consent" (Hong et al., 2015, p. 900). This is because the entire sample of genetic material contains information about "current and future diseases" that non-medical personal should not have access to (Hong et al., 2015, p. 900).

Concerns in regard to expansion.

There are many issues that have been brought up in regard to CODIS and accessibility of DNA profiles. These include: potential conflict with Fourth Amendment protections, medically relevant DNA, protocols for DNA collection, consistent procedures, and inclusivity (i.e. the number of individual profiles contained within the CODIS database). Amendment concerns arise in regard to having an inclusive CODIS database, pertaining to whether individuals who are not criminals should or should not be included within this database (Smith, 2006; Simoncelli, 2006; *Maryland v. King*, 2013). This inclusivity has been viewed as a violation of Fourth Amendment rights; individuals who have not committed a crime should not have to give up their DNA in order to have it entered into a database that is searched on a regular basis (Smith, 2006; Simoncelli, 2006; *Maryland v. King*, 2013). Abandoned DNA, such as what is left behind after licking a stamp or touching a surface, is in some instances targeted by law enforcement in order to obtain a DNA sample from a person suspected of crime without their knowledge or involvement and is another issue of concern (Joh, 2006).

However, courts have ruled that upon an individual's arrest for felony charges, under the Fourth Amendment, it is reasonable to collect a DNA sample for the purpose of analysis and placement in the CODIS database (*Maryland v. King*, 2013). This is due to the courts' understanding that individuals who are arrested for felonies have a decreased level of expected privacy (*Maryland v. King*, 2013). In contrast, individuals who are free citizens, or persons not under the supervision of the criminal justice system, are entitled to, and expect, a higher level of privacy being provided to them via the U.S. Constitution (*Maryland v. King*, 2013). Additionally, individuals arrested for felonies do not have a constitutionally protected privacy expectation in regard to concealment of their identity when it comes to other criminal offenses he/she may have perpetrated (*Maryland v. King*, 2013). A felony arrestee expecting that

knowledge pertaining to his or her criminal acts will not come to light is different from a societal view point of what level of privacy is reasonable to expect for a free individual *(Maryland v. King*, 2013). For these reasons, "DNA identification like that at issue here thus does not require consideration of any unique needs that would be required to justify searching the average citizen" (*Maryland v. King*, 2013, p. 463).

CODIS and its DNA profiles provide the criminal justice system with a tool that increases the amount of information that can be learned about an arrested individual that is pertinent to the case, and can help reveal what a criminal offender may wish, but has no legal right, to keep private (*Maryland v. King*, 2013). These include who the individual is and what acts he/she has taken part in (*Maryland v. King*, 2013). DNA, when combined with other identification methods such as palm prints, can ensure that when an individual's identity is checked, complete and accurate results are returned (*Maryland v. King*, 2013).

There are, however, protections that are extended to individuals who are arrested for felonies. "As a constitutional matter, the limit on identification checks is that they may not be done in a manner that is arbitrary, capricious, or harassing" (Brief for the States of California et al., *Maryland v. King*, 2013, p. 18). However, there is not a constitutional requirement that limits the type or intrusive nature of a search that can be conducted to ascertain an individual's identity (*Maryland v. King*, 2013). Law enforcement, even if they know the individual they are arresting on sight, are still allowed to collect photographs, fingerprints, DNA, or other information pertaining an individual's identity in felony circumstances (*Maryland v. King*, 2013).

DNA collection protocols.

Protocols for collection of DNA samples have also been drawn into question, so much so that a case was heard by the Supreme Court. In *Maryland v. King* (2013) the act of collecting

DNA samples from individuals who were arrested due to being charged with a violent offense was upheld, in order to combat and solve cases of sexual assault. Collection of DNA was allowed to occur no matter how severe the crime was (Jordi, 2014). As the Code of Federal Regulations § 28.12 Collection of DNA samples states:

> Any agency of the United States that arrests or detains individuals facing charges shall collect DNA samples from individuals who are arrested, facing chargers, or convicted, and from non-United States persons who are detained under the authority of the United States. (28 C.F.R. § 28.12(b)).

In addition to this, the statute also states that the agencies that conduct DNA collection are authorized to employ reasonable means of detaining, restraining, and collecting DNA samples from individuals who fit the description given above (28 C.F.R. § 28.12(d)). An agency may also repeatedly collect DNA samples from individuals if they continue to be under the supervision of the agency, or return to said supervision (28 C.F.R. § 28.12(f)(3)). Finally, if a sample fails to fulfill the requirements necessary for successful analysis and entry into CODIS, a sample may be collected again (28 C.F.R. § 28.12(f)(2)).

Even though this federal regulation is in place, and the decision was upheld in *Maryland v. King* (2013) to continue routinely collecting DNA samples from those charged with violent offenses, including rape, these DNA samples often end up backlogged and are not tested in a reasonable amount of time, if ever (Sallomi, 2014, p. 98; Campbell, Pierce, Sharma, Feeney, & Fehler-Cabral, 2019). This allows for alleged offenders to get away with more acts of violence that could have been prevented if DNA analysis had taken place (Sallomi, 2014). As of 2007, there were “more than 350,000 cases where DNA” had “been collected but” had not been entered in the database for the purpose of comparison (Spagnoli, 2007, p. 43). In addition to this

immense amount of genetic information that has not yet been entered, there are an additional 200,000 sexual assault kits that are still waiting to be processed and analyzed (Spagnoli, 2007). Entering and testing these backlogged samples would yield an immense amount of information that law enforcement and the courts could use to apprehend and charge individuals who have committed criminal behavior (Campbell et al., 2019).

Procedural consistency.

Procedural consistency is also referenced as an issue in regard to CODIS. Lack of consistent operating procedures allows for different law enforcement agencies and forensic labs to carry out familial searching in a manner that is not uniform or consistent across the board (Gershaw et al., 2011). However, personnel within the criminal justice system have argued that the procedural differences that exist are not significant enough to warrant privacy concerns (Brief for the States of California et al., *Maryland v. King*, 2013). "In light of the substantial and uniform national protections required by NDIS-CODIS, variations in the State's arrestee collection procedures are constitutionally insignificant" (Brief for the States of California et al., *Maryland v. King*, 2013, p. 22).

Lack of consistent protocol, even when deemed insignificant by the criminal justice system, can lead to many issues. For example, there are an immense amount of DNA hits that result from a familial search of the CODIS database which indicate potential DNA matches, when a true match does not actually exist (Gershaw et al., 2011). This large amount of results can, in some instances, produce "red herrings", which are DNA hits that upon more specific DNA analysis, are not actually family members of the individual whose DNA profile is being analyzed for the purpose of identification (Gershaw et al., 2011, p. 19). Creating consistent procedures to follow when familial searching is deemed a necessary DNA analysis technique,

will limit the number of "red herrings" that arise and save the criminal justice system important time (Gershaw et al., 2011, p. 19). These consistent procedures will allow for CODIS to continue being as inclusive as possible, while greatly decreasing the number of false leads that could arise.

Size of CODIS database.

The issue of the size of the CODIS database is highly debated, for differing reasons. The sheer number of DNA samples that have been collected (4,138,015 profiles as of December 2006) is a cause of immense ethical concern (Singer et al., 2007). As of 2015, CODIS contained more than eleven million profiles (Hong et al., 2015, p. 900). The CODIS database is maintained in this robust manner in order to allow "local, state, and federal law enforcement agencies to be able to 'exchange and compare DNA profiles electronically, thereby linking crimes to each other and to convicted offenders'" (Singer et al., 2007, quoting Federal Bureau of Investigation, CODIS: Mission Statement & Background, http://www.fbi.gov/hq/lab/codis.program.htm, p. 122).

Samples from government agency employees, at both the state and federal level, are also held within the CODIS system (Hong et al., 2015). Creating an inclusive database, meaning that DNA samples from individuals who are not criminal offenders are included within CODIS, speeds up the process of investigating individuals who are considered persons of interest in crimes; when an individual can be eliminated through DNA analysis, investigation into that individual ceases and resources can be devoted to actions that make progress in closing the case (Smith, 2006).

However, different states have different levels of inclusivity. Originally, "all fifty states required those convicted of felony sex crimes to submit their DNA to the database" (Singer et al.,

2007, p. 122). Six of these states required all individuals who were convicted of any felony offense to have their DNA collected and submitted to the CODIS database (Singer et al., 2007). However, these regulations outlining who is included in the CODIS database have changed in more recent times (Singer et al., 2007). Today, some laws have changed, and now dictate that only individuals who have been charged with felonies, not convicted, are required to submit their DNA profiles to CODIS (Singer et al., 2007). This greatly increases the number of DNA profiles that are in CODIS. Such law changes also generate concern (Singer et al., 2007). Specifically, there is a general fear "that the government will not impose limits on whose DNA they take and that soon those who are arrested for any crime, no matter how minor, may be required to submit to DNA testing" (Singer et al., 2007, p. 122).

Upon acquittal of charges, or if the charges are dropped, an individual's DNA profile is removed from CODIS and the physical genetic sample is destroyed (*Maryland v. King*, 2013; Singer et al., 2007). This does not, however, stop this profile from being run through the system in an attempt to find a genetic match while it is in CODIS before being expunged (Singer et al., 2007). Additionally, the expungement of "arrestee DNA…is largely a myth" (Joh, 2015). In the majority of states where DNA samples are collected from individuals when they are arrested, "the process of expungement is burdensome, costly, and must be initiated by the arrestee" (Joh, 2015, p. 51). For that reason, very few of the individuals who are eligible to have their DNA expunged are successful in this endeavor (Joh, 2015).

Familial searching: Pros and cons.

While a sample is in the DNA database, familial searching is another ethical implication that must be taken into consideration when discussing CODIS and its application (Gershaw, Schweighardt, Rourke, & Wallace, 2011, p. 17). Familial searches involve "purposefully

searching a DNA database for a match at only a limited subset of the available typed loci…in an attempt to locate previously unknown relatives in order to open up new investigative leads" (Gershaw et al., 2011, p. 17). The "limited subset of the available typed loci" refers to the lesser percentage of matching genetic material; there will not be an identical match between samples, but certain portions of the DNA will match which indicates that these individuals are related in some manner (Gershaw et al., 2011; Pham-Hoai, Crispino, Phil, & Hampikian, 2014). This relationship between individuals can be determined based on how much of the genetic material matches (Gershaw et al., 2011). When this technology was first developed, the main purpose behind familial searching through DNA database was to find missing persons (Pham-Hoai et al., 2014). However, it was successfully used in France to solve a rape and murder case that remained open for ten years (Pham-Hoai et al., 2014). Through using the DNA left on the victim in 2002 familial searching found the offender's father, which allowed a positive identification to be made (Pham-Hoai et al., 2014).

However, despite the good intention, harassment and embarrassment can be the results of familial searching (Gershaw et al., 2011). Familial searching has the ability to increase instances of "discrimination and racial disparities" (Gershaw et al., 2011, p. 19). Certain groups, such as ethnic minorities and people considered to be of a lower social class, are overrepresented in groups of arrestees and individuals who are incarcerated (Gershaw et al., 2011; Hicks, Taroni, Curran, Buckleton, Castella, & Ribaux, 2010). For this reason, these individuals "are more likely to have submitted a DNA sample for storage in a database" (Gershaw et al., 2011, p. 19). Therefore, if familial searching were to occur, the families of these individuals would be "unfairly scrutinized", which could lead to unnecessary harassment and embarrassment of

individuals who are not guilty of any crime except potentially being related to someone incarcerated who has their DNA profile in one of the databases (Gershaw et al., 2011, p. 19).

Furthermore, using less loci than is required in a non-familial DNA match can also lead to obtaining a partial match to the individual that is under scrutiny, but later finding out that partial match was not in fact a relative (Gershaw et al., 2011). This has the potential to allow for harassment and embarrassment of an individual who has no connection to the perpetrator, while also wasting valuable time and money on a false lead (Gershaw et al., 2011). This draws into question the issue of proper use of such a powerful searching tool, including concerns for potential "genetic surveillance" over the lifetime of individuals (Kaye, 2014, p. 109). The fear associated with "genetic surveillance" is that persons will be viewed as guilty by association, through simply being related to an individual who committed a crime, and this view will allow for a family's privacy to be violated continually through "lifelong genetic surveillance" (Kaye, 2014, p. 111).

However, as Butler (2010) argues, with statutes and regulations dictating the use and confidentiality of DNA databases, it would be incorrect to assume or suggest that an entire genome is sequenced or analyzed during the processing of genetic material. The entire genome is not visualized at any point in the analysis process (Butler, 2010). The analysis that does occur, which involves 13 loci, involves a minute percentage (0.0006%) of an individual's DNA (Butler, 2010). Overall, state level laboratories do not have the ability to screen the entire human genome, in addition to being legally prohibited from doing this (Butler, 2010).

Despite these safeguards, there is still an immense amount of fear and numerous concerns that are associated with DNA profiles being held within a database. One idea that has been put

forth in regard to limiting the fear of surveillance of any kind through the use of genetic information is making CODIS an inclusive database (Kaye, 2014).

Inclusivity: Violation of privacy or safety feature?.

In addition to debating the number of DNA profiles contained in CODIS, the issue of inclusivity deals with creating a more robust DNA database (Smith, 2006). While there are potential advantages, such as ruling out more individuals or having greater information for potential exonerations, this also means that people "must give up their DNA or have it taken from them for it to be profiled" (Smith, 2006, p. 385). While only 13 loci are analyzed for the DNA databases that make up CODIS, the entire genetic sample is kept intact and placed in storage (Smith, 2006). This practice is highly debated due to the immense amount of information that can be accessed about every individual who has had their DNA taken and placed in CODIS (Smith, 2006).

As was stated in by the U.S. Court of Appeals for the Ninth Circuit case in *United States v. Kincade* (2004), there is a fear that DNA samples, when retained by criminal justice personnel, could potentially be employed for purposes that were not above board by mining the samples for information of a more private nature, such as medically relevant information, or disclosing DNA profiles and their associated information to parties outside of the criminal justice system. The defense in this case argued that these potential privacy violations outweighed the interests held by the government when collecting genetic evidence for the purpose of solving crime (*United States v. Kincade,* 2004). Ultimately, rejecting this contention, *United States v. Kincade* (2004) argued:

> [B]eyond the fact that the DNA Act itself provides protections against such misuse, our job is limited to resolving the constitutionality of the program before us, as it is designed

> and as it has been implemented. In our system of government, courts base decisions not on dramatic Hollywood fantasies,… but on concretely particularized facts developed in the cauldron of the adversary process and reduced to an assessable record. If…some future program permits the parade of horribles the DNA Act's opponents fear…we have every confidence that courts will respond appropriately. (p. 838).

However, there are many positives associated with creating a more inclusive database. Making CODIS inclusive can provide protections for individuals (Smith, 2006). Inclusivity will minimize, and potentially eliminate, the overrepresentation of minority populations within the CODIS database, creating a more accurate sample to analyze and compare unknown biological samples against (Smith, 2006). However, while inclusivity has many pros in regard to the functioning of CODIS, the issue of how much time each sample spends within the database is often questioned.

Time spent in CODIS.

The length of time a DNA profile stays in the CODIS database is another highly debated ethical issue. It is commonly held that the seriousness of the offense committed should determine if a DNA sample is entered into CODIS at all (Jordi, 2014). One such court case that dealt with the issue of the amount of time a person's genetic profile spends in CODIS, specifically after their release from incarceration, is *Boroian v. Mueller* (2010) in U.S. Court of Appeals, First Circuit. Per this case, retaining an individual's DNA who was formerly on probation is constitutional (*Boroian v. Mueller*, 2010). Under the federal DNA Analysis Backlog Elimination Act of 2000 (referred to as the DNA Act) (Pub. L. No. 106-546, 42 U.S.C. 14135 et seq.), using this previously obtained DNA profile in the CODIS system to compare against other genetic samples does not meet the standards of a constitutional search, and therefore do not

violate the Fourth Amendment rights of the individual that was previously on probation (*Boroian v. Mueller*, 2010). This was because the process used to find a match is limited in its scope (*Boroian v. Mueller*, 2010). Only the profiles already legally obtained by the government, containing no new information about the individual who was formally on probation that could further intrude on the "reasonable expectations of privacy", can be used in this matching process (*Boroian v. Mueller*, 2010). The only manner in which comparison of previously obtained DNA would constitute a search against an individual who was formally on probation would be if new testing was going to be, or had already been, done on the genetic sample (*Boroian v. Mueller*, 2010).

In response to the issue of how long a DNA profile should be maintained within the CODIS databases, some states have procedures and policies in place allowing for the expunction of DNA samples from databases, but these are constantly being edited and changed (Tracy & Morgan, 2000). This makes it difficult to gain a complete understanding of what circumstances allow for the expunction of a DNA profile to occur (Tracy & Morgan, 2000). "For most states, the process for removal—or expungement—of DNA profiles from CODIS upon acquittal or case dismissal requires the arrestee to initiate the process; a minority of states must automatically carry out expungements for eligible individuals" (Samuels, Davies, & Pope, 2013, p. iii). For this reason, there are few examples of DNA profiles being expunged from CODIS in states where an individual is required to initiate the removal process (Samuels et al., 2013).

Frequency of running through CODIS.

Lastly, the frequency with which the entire CODIS database is run through is a highly debated ethical issue. Every day, the DNA profiles contained within CODIS are searched, "without judicial authorization…one-hundred thousand times" (Kimel, 2013, p. 933). This

includes DNA samples from individuals who are not connected to the crime that occurred in any manner (Kimel, 2013). Biological samples collected from crime scenes can be run against all of the samples contained within the CODIS database (Ehrenpreis, 2008). Some view this as the need to solve a crime is weighted as being more important than the privacy rights expected by, and given constitutionally to, individuals (Ehrenpreis, 2008).

However, the confidentiality requirements used at the state and federal levels outline and restrict how DNA databases operate (*Maryland v. King*, 2013). This means that every state is required to conform to the requirements established at the federal level in regard to the use of DNA samples (*Maryland v. King*, 2013). For these reasons, the U.S. Supreme Court has found that when DNA collection takes place, either prior to or following the development of probable cause or before or after the DNA profile has been expunged from the database, is not significant in regard to the constitution (*Maryland v. King*, 2013).

Additionally, agencies of the government habitually handle and disseminate various types of information of a sensitive nature that pertains to individuals within their purview (Ruby, 2010). Information that has been publicly released includes: medical research, documents from court trials, and public records (Ruby, 2010). Medical information often includes collecting DNA from infants, and sharing that genetic material with researchers in the medical field (Ruby, 2010). If such information can be disseminated to non-law enforcement entities, then the arguments provided in regard to keeping DNA databases secret are, as argued by Ruby (2010), not sound. Therefore, the argument presented by Ruby (2010) puts forth the idea that if the current routine sharing of newborn DNA with medical researchers is adequate in regard to protecting genetic information gathered about children, then the same guidelines and

dissemination practices are adequate to protect the DNA profiles of individual who have taken part in criminal activity.

Every state that has taken the initiative to enact laws pertaining to the collection of DNA samples from individuals who have been arrested have included provisions which limit how DNA records are disclosed (*Maryland v. King*, 2013). In addition to state level restrictions, the federal government also has standards in place that regulate every participating laboratory (*Maryland v. King*, 2013). This provides an additional layer of protection for DNA contained in databases, making sure that the constitutional principles are upheld (*Maryland v. King*, 2013).

Additionally, when the FBI designed CODIS, there were no personal identifiers used in the software (*Maryland v. King*, 2013). Instead, DNA profiles held within CODIS are tracked using a unique number (*Maryland v. King*, 2013). Only when a match is confirmed, is the name of the individual associated with their genetic profile (*Maryland v. King*, 2013). This identification process of matching a name to the genetic sample can only be done by the lab that the profile originated from (*Maryland v. King*, 2013).

Also, DNA profiles contained within CODIS can only be released under specific circumstances:

> (A)to criminal justice agencies for law enforcement identification purposes;
>
> (B) in judicial proceedings, if otherwise admissible pursuant to applicable statutes or rules; and
>
> (C) for criminal defense purposes to a defendant, who shall have access to samples and analyses performed in connection with the case in which such defendant is charged.

(2) Exemption

If personally identifiable information is removed, for population statistics database, for identification research and protocol development purposes, or for quality control purposes." (34 U.S.C. §§ 12593(b)(1)-(2)).

The only individual outside of law enforcement who is allowed to have access to their own profile, when such access to information is warranted based on the court case, is the person the genetic information belongs to (34 U.S.C. § 12592(b)(3)(C)). They are not, however, granted access to the other profiles and genetic information held within the database (34 U.S.C. § 12592(b)(3)(C)). Should these rules and regulations be violated, there are substantial penalties applied (34 U.S.C. § 12592(C)). One such penalty is cancelling a law enforcement agency's access to the federal DNA database (34 U.S.C. § 12592(C)).

Further protections are provided by the safeguards that the FBI has incorporated in regard to genetic information and NDIS (*Maryland v. King*, 2013). The operational safeguards include:

The computer terminals/servers containing the CODIS software are located in physically secure space. Access to these computers is limited to only those individuals authorized to use CODIS and approved by the FBI. Communications between participating federal, state, and local laboratories occur over a wide area network accessible to only criminal justice agencies approved by the FBI.

Pursuant to federal law (the DNA Identification Act of 1994), DNA data is confidential. Access is restricted to criminal justice agencies for law enforcement identification purposes. Defendants are also permitted access to the samples and analyses performed in connection with their cases. If all personally identifiable information is removed, DNA profile information may be accessed by criminal justice agencies for a population

> statistics database, for identification research and protocol development purposes, or for quality control purposes. The unauthorized disclosure of DNA data in the National DNA database is subject to a criminal penalty not to exceed $250,000. (FBI, 2018., pp. 2-3)

For these reasons, CODIS should be complete and inclusive in collection and retention of DNA samples, while respecting the legal protections that each individual is entitled to. Due to the importance of CODIS, as well as the present concerns, which are legitimate, there are many avenues that can be explored in terms of potential solutions, which include: stronger and consistent data protection protocols, destruction of physical DNA sample after profiles is entered into CODIS, and retiring loci that yield too much medically relevant information.

Chapter V-Discussion

This study sought to identify and analyze the main ethical implications that are associated with the FBI's Combined DNA Index System (CODIS). Through conducting a systematic review that involved outlining the definition of DNA, historical to present day analysis methods, the development and implementation of CODIS, and the role of CODIS in the criminal justice system, eight main ethical implications were identified. These include: expansion of CODIS markers, DNA collection protocols, procedural consistency, size of CODIS database, familial searching, inclusivity, time spent in CODIS, and frequency of running through the CODIS database.

What Was Found

It was determined that there were multiple sides to each ethical implication that arose in regard to CODIS. Overall, the overarching concern that was seen throughout the individual ethical implications investigated in this study was that of privacy. From the criminal justice perspective, expanding the number of CODIS markers, increasing the size of the CODIS database, creating a more inclusive database, keeping genetic profiles in the CODIS database for a longer period of time, frequently running through all of the profiles held within CODIS, and employing familial searching have been shown to have many positive effects. For example, police resources can be used in a more focused and accurate manner, and identifying criminal offenders, or exonerating individuals who are innocent of involvement in a crime, becomes much quicker and more exact. Additionally, while the Supreme Court has ruled (*Maryland v. King*, 2013) that unobtrusively collecting DNA with a buccal swab, in conjunction with other identifying information gathered from individuals arrested for violent crime (i.e. photographs, fingerprints, etc.…), does constitute a search, it does not violate the protections provided by the

Fourth Amendment when an individual has been arrested for a violent crime, probable cause has been determined, or a warrant has been issued.

However, on the civilian end, there are many concerns about how privacy could be compromised in the face of these issues. Families fear genetic surveillance should their DNA be used to identify a relative that has been involved in criminal activity. Individuals who were previously under supervision of the criminal justice system are leery of how long their DNA profile stays within CODIS, and how many times it is compared against new and existing profiles within the database. Increasing the number of genetic markers that CODIS employs in order to identify individuals brings up the issue of medically relevant information being exposed to non-medical personnel.

Implications for Future Research and Policy

The concerns that arise in regard to the ethical implications surrounding CODIS and the use of this technology as a tool in the criminal justice system must be addressed. This can be done through continued research that involves gaining more knowledge about the use and application of familial searching, it's accuracy, and any protocols that could be put into place in order to protect innocent individuals. Research also needs to be done in order to continue increasing our understanding of human DNA, and what information it can reveal, so that privacy is protected in the best manner possible. Finally, policy needs to reflect what the research has shown, and be able to change when new knowledge is gathered. With how quickly DNA has come up within the field of forensic science, and more broadly within the criminal justice system as a whole, there needs to be up to date policies that protect individual privacy, while also allowing the criminal justice system to create and cultivate a tool that can be applied successfully in criminal cases. "While advanced uses of CODIS to identify putative perpetrators through

partial matches and familial searching may be beneficial in limited circumstances, true improvements to the national DNA Data Bank effort must be realized at the public policy level" (Gabriel et al., 2010, p. 408).

Future research must also look into the possibility of fabricating a DNA sample, and how to discern the difference between authentic DNA and a sample that has been manufactured (Bolden, 2011). As of 2009, forensic scientists in Israel scientifically proved that it was possible to create an artificial sample of DNA that could be tested by current DNA analysis procedures, and not create any different result than a non-manufactured sample of DNA (Bolden, 2011). This revelation can create many questions about the perceived infallible nature of DNA testing, and the power of such evidence in the criminal justice system (Bolden, 2011). For these reasons, future research must determine how to discern between a naturally occurring genetic sample, and one that was created in a laboratory setting, in order to maintain the integrity of forensic science, and the criminal justice system as a whole.

In addition to continued research and policy development, there are solutions that have been put forth that can provide some clarity and transparency when it comes to how DNA evidence is stored, processed, and applied within the field of criminal justice, while also increasing individuals' confidence that their privacy is not being violated. Some solutions to the ethical implications discussed within this study have been presented in order to help combat the privacy concerns that have arisen as DNA technology has advanced. These include: stronger and consistent data protection protocols, destruction of physical DNA sample after profile is entered into CODIS, and retiring loci that yield too much medically relevant information.

Proposed Solutions

Stronger and Consistent Data Protection Protocols.

In order to combat these ethical implications associated with CODIS, more protections should be offered and implemented. "Strong data protection" and acquiring informed consent from individuals (with the exception of collection from criminal offenders and suspects by law enforcement employees) are both examples of further protections that can be used to minimize any ethical issues that may arise (Hong et al., 2015, p. 900).

> For DNA database programs, the operative factors for the constitutional balancing analysis include the compelling government interests served by collecting DNA samples from felony arrestees, the minimal intrusion of sample collection, the arrestee's diminished expectation of privacy, and the limits on the scope of the search imposed by statutory and regulatory use and disclosure restrictions. (Brief for the State California et al., *Maryland v.* King, p. 13)

There should also be verified and widely implemented protocols. Creating and putting into effect a nationwide "privacy protection" plan that is consistent from state to state is imperative to creating consistent and respectful DNA databases, while still allowing for CODIS to be a complete and effective tool that can be employed by the criminal justice system (Hong et al., 2015, p. 900). In order to prevent instances of backlog, consistent protocols must be put into place that outline what operational procedures need to be used in particular circumstances.

California's protections when it comes to familial searching across the country, and the release of identifying information to law enforcement personnel, should be a model that is implemented across the country (Gershaw et al., 2011). These protections include assessment of "various factors" such as: the structure of the family, presence or absence of "criminal history", custodial state when the crime was committed, "and the number of owed samples" that have not yet been collected from the individual convicted of a crime, before any genetic information is

released (Gershaw et al., 2011, p. 19). For this reason, protocols need to be created and put into place in order to protect individuals against "too much" of their genetic information being placed in the CODIS database.

Destruction of Physical DNA Sample After Profile is Entered into CODIS.

After entering the genetic samples in the CODIS database, using the verified and approved 13 loci, the genetic sample needs to be destroyed in order to protect the privacy of the individual that the sample was collected from originally (Smith, 2006). Destruction is imperative for improving confidence in protections that are enforced when it comes to CODIS and its operations. Due to the fact that "the thirteen-STR technology is good enough" to identify an individual genetically, destruction of DNA samples after a profile is entered into CODIS is imperative to assuage the "legitimate concerns about further analyses of the individually-identified DNA found in stored tissue samples" (Smith, 2006, p. 389). This destruction should also occur in a manner that is as transparent as possible, in order to demonstrate to individuals that their concerns are being taken seriously, while also maintaining the integrity of the CODIS database (Smith, 2006). Furthermore, there is no better time than the present to begin this process of destruction of full genetic samples that are no longer necessary to maintain custody of due to already being entered into CODIS (Smith, 2006).

Retiring Loci That Yield Too Much Medically Relevant Information.

Additionally, it is an important practice to "retire" loci that divulge medically relevant information (Kaye, 2014). This retirement of loci would involve no longer using that particular DNA marker as an identifier in the CODIS database and replacing it with another locus present in the DNA that is less medically revealing (Kaye, 2014). This practice of "retiring" sensitive loci would allow for protections to be successfully carried out, while not allowing non-medical

personnel access to genetic material that could provide sensitive information that they should not be privy to. In conjunction with retirement, "statutory protections" should be enforced, such as not allowing genetic information to be released to entities outside of law enforcement without authorization (Kaye, 2014, p. 104). This, however, raises issues of trusting the government to enforce these "statutory protections" in an efficient and consistent manner (Kaye, 2014, p. 104).

Limitations

For the sake of this study's validity, limitations must be discussed. First, there are many ethical implications that arise when discussing CODIS, however this thesis sought to identify the ones most commonly mentioned in the literature. The list provided in this thesis is not exhaustive, but it is comprehensive and seeks to fill a gap in the literature pertaining to CODIS, its role in the criminal justice system, and the concerns that must be addressed. Second, this thesis only used secondary sources. The references used throughout this research were studies that were conducted by others, and subject to personal interpretations throughout the writing process.

Chapter VI-Conclusion

The purpose of this thesis was to identify and analyze the ethical implications associated with CODIS, and fill a gap in the literature pertaining to this issue. This was achieved through conducting a systematic review of the existing body of knowledge contained within scholarly sources, legal/case briefs, and federal government websites.

Taking the Research Further

In order to gain a more complete understanding of the ethical implications that arise in regard to CODIS, surveying and/or interviewing individuals within criminal justice professions would yield important information. These personnel could include: forensic DNA analysts; law enforcement personnel; judges, prosecutors, defense attorneys, lawyers, and jurors, in order gain first-hand knowledge of the perceptions about DNA evidence and its role in the criminal justice system. First, interviewing the experts in the field could provide much needed context as to what laboratory procedures are put into place at each level of government, and how differences that exist between these policies either help or hinder the application and reputation of CODIS. These individuals would include the forensic scientists who conduct the analysis on DNA evidence, enter and compare profiles in CODIS, and testify as expert witnesses on this subject. Moreover, interviewing forensic DNA analysts could help combat the "CSI Effect" by demystifying the process of DNA analysis and comparison within CODIS. Second, interviewing individuals within the court system could provide insight into how DNA evidence, and by association CODIS, are perceived by non-forensic science personnel. Being able to cultivate a better understanding of how DNA evidence and CODIS are viewed within the courtroom could help prevent and combat errors made by juries when either CODIS evidence is presented in a manner that is hard to understand/interpret, or to help juries and other court personnel navigate

instances when a CODIS profile is not present in a case. Additionally, these interviews could help identify the relevancy of the "CSI Effect", and how much impact this phenomena still has in present day criminal justice proceedings.

Through the identification of ethical issues that arise in regard to CODIS, and the potential solutions that haven been put forth to combat them, the criminal justice system can create and cultivate a powerful tool, while also implementing rules and regulations that aim to keep all of the sensitive information it holds safe. For these reasons, CODIS should be complete and inclusive in collection and retention of DNA samples, while respecting the legal protections that each individual is entitled to.

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