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The Evolution of the Criminal Justice System through DNA Sequencing

Abstract:

Deoxyribonucleic acid or DNA stores all of the genetic information that is unique to each individual. Scientists have long since discovered DNA, however without the proper technology it has been of little use in forensic analysis. In 1970 the first method of DNA sequencing had been developed which had great promise amongst many fields including biology, psychology, and even forensics. Specifically, with respect to the criminal justice system investigators now had the ability to accurately convict guilty criminals as well as to exonerate those who have been wrongfully convicted. Although DNA sequencing is very commonly used across many different disciplines, I will specifically take into consideration important cases including the Colin Pitchfork case, Kirk Bloodsworth's exoneration, as well as the Commonwealth versus Tassone. This paper will first discuss the different types of DNA sequencing technology that is available to forensic analysts and explain the science behind them. I will also discuss the importance of having DNA databanks and how they have proven to be useful, specifically taking into account the Combined DNA Index System (CODIS). Additionally, I will discuss the difference between admissible and inadmissible evidence with respect to DNA sequencing and how it can actually be used in the courtroom.

Introduction:

DNA sequencing has become a discovery that has revolutionized, not only law enforcement and the justice system, but individuals in society who have been wrongfully convicted of heinous crimes and later on been proven to be innocent. As DNA sequencing has evolved over the years, there have been many other advances in technology to keep up with our ever-changing society. Such advances are the CODIS database, which is used to store hundreds of thousands of DNA samples, that are used as comparisons for other crimes. There are several different ways to collect DNA samples. The first method is fingerprinting which has been used for many years. Then there is swabbing for DNA, and touch DNA. Each method is beneficial to some degree, yet with the technological advances today, DNA is becoming more and more useful.

DNA is a biological molecule that provides a blueprint of instructions for the survival of an organism. A DNA sequence consists of four different nucleotides: adenine (A), thymine (T), guanine (G) and cytosine (C) (Tipu, 2015). The particular order of these nucleotides dictates the physiological outcome in the organism. Recent scientific advances have paved the way for DNA to be understood on a much deeper scale, particularly technologies such as DNA fingerprinting and DNA sequencing which have revolutionized the criminal justice system. DNA fingerprinting relies on properties of DNA and use restriction endonucleases that can cleave a DNA molecule at a specific sequence. The DNA can then be collected and placed into a gel electrophoresis chamber, where it will then be separated via an electric current that is applied. This procedure works by creating DNA fragments in the first step, and being able to visualize them in the second step. Using the unique banding pattern of each individual person, it is possible to identify that individual.

Soon after, the Sanger method of DNA sequencing was developed which further enhanced our understanding of DNA molecules (Tipu, 2015). The Sanger method uses dideoxy (as opposed to deoxy) nucleotides to synthesize a new DNA molecule as a replication of the DNA sequence of

interest (Tipu, 2015). However, the new DNA molecule cannot be synthesized any further after the dideoxy nucleotide has been added to the sequence (Tipu, 2015). Thus, treating the DNA with all four dideoxy nucleotides will arrest DNA synthesis at each position in the sequence (Tipu, 2015). These sequences are then cleaved and separated via gel electrophoresis where the length of each fragment is used to put the sequence in its correct order. Again, this could be used to distinguish different individuals as everybody has a unique DNA sequence. The ability to use this type of technology has not only been used as evidence to convict many horrible criminals, but also to exonerate wrongfully convicted individuals. Thus, DNA sequencing is a discovery that has completely revolutionized the criminal justice system.

Types of DNA:

There are two different types of DNA that are used in the criminal justice system. The first being DNA fingerprinting, and the second being swabbing (Ferraro, 2012). The question of whether fingerprinting or swabbing holds more weight is a controversial topic. Another question that is posed is whether one method is actually better than the other (Ferraro, 2012). Both methods are used because both methods have their own benefits. The most important difference between the two is that to this day, no two persons have the same fingerprint. Whereas, swabbing for DNA has concluded that in cases where identical twins are involved, they have the exact same DNA, but do not have identical fingerprints. More or less DNA sequencing is used as a modern day “fingerprint,” (Ferraro, 2012).

To begin to answer the question of which method is better, most often investigators are leaning towards swabbing for DNA rather than fingerprinting (Ferraro, 2012). Before the rise of DNA testing, in the 1980’s and 1990’s, fingerprints were the only method that was used (Ferraro,

2012). When you touch an object, your specific skin cells are transferred onto that object, which in turn, leaves behind DNA (Ferraro, 2012). This DNA can then be lifted off of that object, simply using tape, and sent to the lab for processing. Sometimes, a latent fingerprint can be left behind, other times if the print is not salvageable, the remains of the print can be swabbed for DNA evidence, known as touch DNA (Ferraro, 2012). There are specific objects in which DNA is easier to collect from (Ferraro, 2012). DNA is easiest to collect off of objects with texture (Ferraro, 2012). Specifically, door handles, steering wheels, and gear shifts (Ferraro, 2012). Whereas fingerprints are easiest to collect off of glass objects or smooth objects such as windows and plastic surfaces (Ferraro, 2012). It is also important to think about the size of the object that may have been touched (Ferraro, 2012). Small objects such as shell casings may have a fingerprint present, but since the object is so small, there may be an overlap in ridge detail which means that it cannot be used for comparison (Ferraro, 2012). Such a question is hard to give a solid answer because one method is not necessarily better or worse than the other. Many factors play a part in assessing which is the best course of action. Some of these factors include time, surface, and place (Ferraro, 2012).

A major difference between DNA sequencing and fingerprints is that fingerprints are usually taken at the time of an arrest, whereas DNA is not (Ferraro, 2012). In order for DNA to be taken at the time of an arrest, the person must meet the criteria of CODIS or a court order is necessary (Ferraro, 2012). DNA as well as fingerprints can also be taken through consent of the person (Ferraro, 2012). Another important thing to think about is the time frame for each process. Fingerprinting usually has a faster return time for results than DNA testing which could take weeks or even months (Ferraro, 2012). Generally, law enforcement agencies are staffed with latent fingerprint examiners, which makes the process much faster (Ferraro, 2012). DNA sequencing and fingerprint evidence has been widely used in the justice system during the trial process (Ferraro,

2012). The main reason for using DNA evidence is that there is a “1 in 2 billion” accuracy statistic (Ferraro, 2012). Whereas fingerprints typically have a less accurate statistic (Ferraro, 2012). Each method is used throughout the justice system, and each have their own advantages and disadvantages (Ferraro, 2012). This goes to show that one method is not necessarily better than the other, but both are beneficial in different respects.

DNA Databanks:

DNA databanks are an important tool that is utilized in the criminal justice field (Jakovski, 2017). CODIS is the National DNA Index System, which stands for Combined DNA Index System (CODIS, 2016). The DNA databank is a computerized storage system that holds millions of DNA profiles (Jakovski, 2017). There are two ways to obtain DNA that is found in the database. The first is crime scene DNA samples, and the second is individuals’ DNA samples (Jakovski, 2017). Individual DNA samples are obtained simply by court order, or willingly given by an individual. There are also state DNA index systems, although those operate based on each state’s laws and regulations (CODIS, 2016). CODIS is the term that is used to describe the the program in which the FBI uses to support criminal justice DNA databases, as well as the programs that are used to keep these databases running (CODIS, 2016). NDIS or the National DNA Index System is one part of CODIS, on the national level, which contains the DNA profiles that the federal, state and local forensic laboratories contribute (CODIS, 2016). This technological advanced system stores DNA profiles and facilitates the comparison and automated pairing of samples from crime scenes and individual profiles (Jakovski, 2017). In order for a match to be made when testing DNA from a crime scene, there needs to a match between the DNA in the database and the DNA found on the crime scene (Jakovski, 2017). “For example, in the case of a sexual assault where an evidence kit

is collected from the victim, a DNA profile of the suspected perpetrator is developed from the swabs in the kit. The forensic unknown profile attributed to the suspected perpetrator is searched against their state database of convicted offender and arrestee profiles,” (CODIS, 2016). If a match is made and confirmed, then the identity of the suspect will be obtained (CODIS, 2016). Following this step, the DNA evidence will then go through their specific state’s database of crime scene DNA profiles, this system is called the Forensic Index (CODIS, 2016). If a match is made in the Forensic Index, then it must go through a process to confirm this match, which in turn will link two or more crimes together (CODIS, 2016). This is where law enforcement is able to use the DNA evidence obtained from these databanks in order to find leads in their cases. The DNA database is able to link a suspect to a crime which is beneficial to investigators and prosecutors. It can also be used to clear a suspect from questioning.

Politicians and DNA:

When DNA evidence is present and is being used as incriminating evidence in a criminal trial, there are important factors that come into play. “It should be taken into account that the evidence is a fact produced and interpreted through a collaborative process in which a risk of various kinds of flaws has been continuously present,” (Aarli, 2012). The DNA evidence goes through a series of different professionals through the chain of custody, increasing the possibility of tainting the evidence (Aarli, 2012). The sample of evidence goes from the police officer on scene, to the lab to be analyzed by a geneticist, and then to the prosecutor for contextual interpretation during trial (Aarli, 2012). Lastly, the judge takes that evidence and weighs it based on their discretion (Aarli, 2012). The part of the process that leaves room for error is during the collection phase, and the laboratory phase (Aarli, 2012). There is also the possibility of

communication errors while relaying information between experts, lawyers, and laymen (Aarli, 2012). It is important to understand the weight of evidence in a criminal trial. There is no regulation of how evidence should be validated, nor is there regulation of the quantity of evidence that is necessary for a conviction (Aarli, 2012). “Psychological research thus gives reason to suspect that tries of fact will draw too far-reaching conclusions from DNA evidence too early,” (Aarli, 2012). Defense attorneys argue the credibility of DNA sequencing as evidence due to the possible risks associated with the procedure of collecting and using DNA evidence in court (Aarli, 2012). No matter what message the evidence relays, it is up to the jury, or the judge to determine the weight of that evidence (Aarli, 2012). Therefore, jurors usually determine the weight of the evidence based on the overall comprehensible story (Aarli, 2012).

Generally, there are two standards to determine the admissibility of scientific evidence (Calandro, 2016). The first standard is known as the “Frye standard,” and the second is the “Daubert standard,” (Calandro, 2016). These two standards derived from specific court cases. The first case is the 1923 Fraye versus United States, where the court ruled that admissible scientific evidence must be “sufficiently established to have gained general acceptance in the particular field in which it belongs,” (Calandro, 2016). The Daubert standard is a more recent case from 1993, known as the Daubert versus Merrell Dow Pharmaceuticals (Calandro, 2016). This court case surpassed the Frye standard to say that “evidence must have sufficient validity and reliability to be admitted as relevant scientific knowledge that would assist the trier of fact,” (Calandro, 2016). The first challenge that arose with the admissibility of DNA evidence was with a popular murder case known as New York versus Castro (Calandro, 2016). The piece of evidence that was in question during the pre-trial hearing was the defendant’s watch, which had DNA evidence from a bloodstain (Calandro, 2016). During a pretrial hearing, it is necessary that the scientific community generally

accepts the standards and procedures that are taken in handling that specific DNA evidence in the lab (Calandro, 2016). This is a necessary step in order for the evidence to be admissible in trial and used for a jury conviction (Calandro, 2016). It is essential that the DNA evidence that is used as incriminating evidence in trial is reliable. In this case, however, the laboratory's procedures were questionable as to whether their techniques were generally accepted by the scientific community (Calandro, 2016). It was then proven that the lab had failed to use techniques that were generally accepted and reliable when trying to prove that the bloodstain was that of the victim (Calandro, 2016). Interestingly enough the court allowed the test that ruled out the evidence as the blood of Castro, but did not uphold the tests for inclusion because the process that determines a match is much more intricate than ruling out a match (Calandro, 2016). The New York Supreme Court realized now that they needed a much better process for future discovery phase proceedings (Calandro, 2016). They concluded that for future cases, it is necessary to have "the provision of copies of all laboratory results and reports to the court and defense, explanation of statistical probability calculations, explanations for any observed defects or laboratory errors, and chain of custody documents," (Calandro, 2016). The reliability is a very important factor when determining the admissibility of DNA evidence, or any evidence for that matter. The inadmissibility of evidence is usually due to the validity of techniques that are used to interpret DNA, or the reliability of the lab technician's skills (Calandro, 2016).

Today, the technological advances of DNA sequencing are used to investigate high-profile cases in the courtroom. Politicians have begun to promote the use of DNA sequencing not only nationally, but worldwide. DNA sequencing plays a prominent role in current criminal procedure. Many people have become accepting of the way that police are collecting biological evidence, registering evidence, and using that evidence in trial (Aarli, 2012). The new 'genetic justice

regime' is something that affects the criminal justice system, including criminal procedure (Aarli, 2012). Many different theories and perspectives from the social sciences and jurisprudence are talked about in order to identify that there could be unfavorable aspects of the new procedural regime (Aarli, 2012). "It is not inconceivable that the increased use of DNA sequencing could give rise to the risk of enlarging the gap between the offender and the community acting in response to the offence and making it more difficult to arouse the offender's moral consciousness through the criminal process," (Aarli, 2012). Sociologists have noted that DNA evidence in the criminal justice field has impacted criminal activity as well as how criminal activity will be further investigated (Aarli, 2012). That is not to say that the development of DNA sequencing will deter crime, but it will certainly affect the way in which crimes are carried out and processed (Aarli, 2012).

The First Case:

In November of 1983, Lydia Mann was found raped and strangled (Norris, 2017). This case seemed to be a mystery and sparked a massive investigation that stood at a standstill, until July of 1986 when Dawn Ashworth was found, also raped and strangled (Norris, 2017). Both girls were 15-years-old and their crime scenes were oddly similar, therefore, law enforcement concluded that it is likely that the assailant is the same person (Norris, 2017). Investigators had a suspect for Dawn Ashworth's murder. The suspect in the case was 17-year-old Richard Buckland (Norris, 2017). Buckland confessed to the murder of Dawn Ashworth, but denied any affiliation with the murder of Lydia Mann (Norris, 2017). To prove Buckland's guilt or innocence, DNA was taken from him and the crime scene of Dawn Ashworth and tested against each other (Norris, 2017). The results came back negative, proving that Buckland was not the killer of Dawn Ashworth (Norris, 2017). Following this investigation, the DNA from Lydia Mann's case was tested against

the DNA in Dawn Ashworth's case and came back a match (Norris, 2017). The results were that the DNA samples from each crime scene matched each other, but neither matched the DNA of Richard Buckland (Norris, 2017). The DNA would later help to find the actual killer of both young women, Colin Pitchfork (Norris, 2017). The first time that DNA sequencing was used as a tool to investigators, it was used to exonerate an individual, not to incriminate.

Kirk Bloodsworth Case:

When discussing the benefits that arise from the evolution of DNA sequencing, it is hard not to talk about Kirk Bloodsworth's case. This specific case is one that has not only changed the life of one man, but has also changed the way that people look at the criminal justice system. In 1984 Kirk Bloodsworth was convicted and sentenced to death for the sexual assault and murder of a nine-year-old girl named Dawn Hamilton (Kirk, 2017). A crime in which he did not commit. Approximately nine months prior to his conviction, two young boys, who were fishing on a pond near Dawn Hamilton's home, said that they witnessed her walking into the woods with a man whom they described as skinny, six-foot-five, with a bushy mustache and blonde hair (Kirk, 2017). These two boys were the last to see Dawn alive (Kirk, 2017). Hours had passed and Dawn's body was found by a Baltimore Police Detective (Kirk, 2017). Her body was described to be found lying facedown in the woods (Kirk, 2017). Kirk did not live in the Baltimore area at the time of the murder, nor was he six-foot-five, nor did he have blonde hair with a bushy mustache (Kirk, 2017). Kirk was six foot, with red hair and mutton-chop sideburns, and wore glasses (Kirk, 2017). Not only did Kirk not fit the description that was given, there was also no trace of physical evidence to link him to the crime scene (Kirk, 2017). There were even witnesses that could place Kirk at home, where he claimed to be at the time of the crime (Kirk, 2017). Ultimately, Kirk's conviction was

based on his very poor resemblance to a composite drawing that was drawn by the two young boys (Kirk, 2017). The other major factor that led to his conviction was that three eye witnesses could identify Kirk Bloodsworth in a lineup, but one of the witnesses could only identify him after the publicity of the case on television (Kirk, 2017). Kirk maintained his innocence throughout the entire process and never gave up on the only thing keeping him sane; the truth. He believed that sooner rather than later, the police would realize that he was innocent and that they had the wrong man behind bars (Kirk, 2017). Sadly, this nightmare only grew worse for Bloodsworth. Bloodsworth was held in the Maryland State Penitentiary for nine painstakingly long years (Kirk, 2017). From the confines of a 6x9 cell, he tried to prove his innocence (Kirk, 2017). In 1993 Kirk won back his freedom due to the evolution of new technology called “genetic fingerprinting,” (Kirk, 2017). His story is revolutionary because he was the first death row inmate to be exonerated by DNA sequencing (Kirk, 2017). Not only is Kirk Bloodsworth an inspiration, but it also goes to show that even an innocent man can be arrested, convicted, and executed. Luckily for Bloodsworth, DNA sequencing was able to save not only his life, but provide him the one thing that he always stood behind; the truth.

Expert Witness:

In the Massachusetts case of Commonwealth versus Tassone, the DNA analyst was unavailable for trial, which led chemist Roy to take their place on the stand (Steele, 2016). This case brought up an important issue with expert witnesses. In this specific case, the expert witness that the prosecution called to the stand was a state police officer, whom was not involved in the testing or handling of the DNA in the case (Steele, 2016). Therefore, it was ruled that this expert witness was not able to give any information that would be meaningful to the defendant in order

for cross-examination, due to the fact that she was not a part of the testing (Steele, 2016). The DNA was tested at Cellmark, a lab in Texas (Steele, 2016). The witness was unfamiliar with the procedures that are used at Cellmark, therefore, could not testify to their process (Steele, 2016). In the appeal the issue was, “[W]hether an expert witness may offer an opinion that the DNA profile generated from a known saliva sample of the defendant matched a DNA profile obtained from a swab taken from eyeglasses that were left at the scene of a robbery where the expert had no affiliation with the laboratory that conducted the DNA testing of the eyeglasses swab,” (Steele, 2016). Basically, the problem arises when the expert witness testified against someone when they had no direct affiliation with the investigation or handling of evidence (Steele, 2016). This goes against the defendant’s rights. The defendant is allowed to have a “meaningful opportunity to cross-examine the expert about her opinion and the reliability of the facts or data that underline her opinion” (Steele, 2016). Since Roy, the chemist, was not directly involved with the process at Cellmark, she could neither confirm or deny that it was the correct profile (Steele, 2016). It is not only important that the evidence is reliable, it is important that the witness is directly affiliated with the investigation and can properly give their expert opinion.

Conclusion:

DNA sequencing has not only been a scientific breakthrough, but it has been beneficial to investigators, police officers, and attorneys. Over the last 50 years DNA sequencing has gone from a tool to define the difference between every individual, to a tool that is used in many different disciplines. Although there are certainly reliability factors that come into play when dealing with DNA sequencing, its accuracy is truly revolutionary. The fact that DNA sequencing is able to give

a statistic as accurate as a one in two billion, makes it a very reliable source in the realm of criminal trials and criminal justice.

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