Maintaining National DNA Databases: Struggle between Necessity and Ethic

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Abstract: *From discovering of double-helix to advanced DNA profiling, science has seen a huge progress in the field of DNA studies. With such advances varied uses have also arisen, like paternity test, genealogy testing, tracing the relatives of missing persons or unclaimed bodies, and most importantly today DNA profiling techniques are being used worldwide in numerous countries and international organization like INTERPOL to trace the culprits of a crime, thus getting punishment for the perpetrators and exonerating the innocent.*

This procedure with its merits and some lacunas has been largely accepted. Rather the uproar is not regarding use of DNA profiling, rather it relates to storing of DNA profiles and other personal data acquired during the investigations, which belong not only to the culprits but also the accused, relatives of either of them, etc. on a DNA Database. This has ensued a long ongoing debate with respect to pros and cons of such Database in view of rights of privacy of individuals and their families and in some countries even voices regarding discrimination and violation of basic human rights have been raised. With a draft bill having been proposed in India this discussion is more important than any other time.

Through this article, basics of DNA profiling, its history and its position around the world have been discussed. Then we foray into the debate of necessity of maintaining such database versus the ethical dilemmas being faced. And in view of the above, the necessary requirements for co-existence of individual rights and DNA Database will be discussed.

Keywords: *DNA Profiling, DNA Database, fight against crime, missing persons, human rights, privacy, ethics*

1. INTRODUCTION:

DNA is an acronym, which stands for deoxyribonucleic acid. Every cell in an individual's body, with the exception of red blood cells and eggs or sperm, contains the full genetic program for that individual in its DNA. The human genome, which consists of about 3 billion base pairs, harbours genetically relevant information that is essential for the characterization of each individual. [1] By continuous researches it has been seen that every person has a unique DNA i.e. no two persons have the same set of DNA sequence. For a long time only identical twins were perceived to have same set of DNA profile, however since 2008 it has been known that people who are identical twins also each have their own set of copy number variants. [2] Infact in their second article on DNA sequences and fingerprinting, Sir Alec Jeffreys who is called the 'Father of modern day DNA fingerprinting' and his team, concluded that the probability of two individuals having the same DNA fingerprint was less than one in 33 billion. It was also discovered that there were several markers in the human genome, which appeared to be passed down through families and were unique to each individual. [3]

This finding had far reaching effects, especially in the field of paternity testing, finding of missing persons and criminal investigation. With the years this method became much more fine-tuned and 'DNA fingerprinting' developed into much more sophisticated 'DNA profiling'. Forensic investigation is a wide-ranging subject area, drawing principally from scientific methods and practical training within criminal investigation. [4] To put is simply, forensics is application of scientific methods to solve criminal (sometimes civil) cases. It can range from analysing of physical evidences to analysing of biological evidences using the technique of DNA profiling. A forensic investigation to paternity testing involves comparison of one sample of DNA or to say DNA profile of one person to that of other(s). When such DNA profiles are stored one after another in a system, what we get is a DNA Database. The issue that we discuss in this paper pertains to development of DNA Databases, their necessity versus the ethical problems that they pose.

2. AIMS AND OBJECTIVES:

The purpose of this paper is to understand basics of DNA profiling, its history and its position around the world. The aim is also to discuss the underlying debate of decades as to whether DNA databases must be maintained or not. It is a relevant discussion in view of draft bill having been proposed in India with respect to DNA profiling and

database. The objective is to deduce as to what will be the happy medium if such database is introduced in India and also to realize the problems that the system may have to encounter.

3. SCOPE:

The scope of this paper is confined to study in brief about DNA profiling and not go into in-depth discussion of scientific methods involved and development of this technique through the years. This study will concentrate on social aspects of this technique and of DNA Database so as to understand its implications on general masses and their private lives.

4. HISTORY OF DNA PROFILING:

DNA profiling, which is sometimes interchangeably also called DNA fingerprinting or DNA testing is a technique that is used to identify individuals by their genetic fingerprint i.e. unique characteristics of DNA of an individual. This is established by the fact that DNA profiling uses repetitive ("repeat") sequences that are highly variable, [5] called variable number tandem repeats (VNTRs), in particular short tandem repeats (STRs), also known as microsatellites, and mini-satellites. VNTR loci are very similar between closely related individuals, but are so variable that unrelated individuals are extremely unlikely to have the same VNTRs.

DNA profiling, as it exists today, is a result of two independent discoveries in molecular biology that occurred at the same time. In the USA the polymerase chain reaction (PCR) was invented by Kary Mullis, while in the UK 'DNA fingerprinting' was being discovered by Professor Sir Alec Jeffreys while working at the Department of Genetics at the University of Leicester. [6] On one hand, DNA fingerprinting gave the technique to compare reference sample against the sample retrieved from crime scene, by court order or a dead body and on the other hand PCR helped by providing a technique which greatly amplifies the amounts of a specific region of DNA which means that even a small amount of DNA sample or a degrading sample can be amplified almost indefinitely which gives a greater chance of sample comparison and that too with exponentially reduced chance of discrimination.

The discovery of DNA fingerprinting was a Eureka moment for Sir Alec Jeffreys and his team as it was by chance they discovered that a very small part of Human DNA is distinct from other human beings and that there are repetitive patterns present which are particular to that person and there is some similarity between related persons. Thus, Sir Alec while developing his technique aimed not only to distinguish individuals from one another but also to establish patterns of variations between those who were genetically related. [7] No one knew at that time that the future of this discovery was going to be long and an elaborate one. Now according to Sir Jeffreys, genetic finger-printing's demand as a forensic tool was observed at the very beginning, however the original process was deemed to be inadequate for this, and so from 1985 Sir Alec and his team developed a variation which they called "genetic profiling" for forensic use.

But the first real application of this technique was in an immigration case in March 1985, which gained this technique a lot of support, sympathy and momentum. [8] First paternity case followed suit, and then the floodgate of cases opened. For two years he and an associate were the only laboratory in the world doing this work. He described it as 'exciting but exhausting', and had no regrets when ICI (now AstraZeneca) were granted a licence to set up Cellmark and put the research on a commercial level. [9]

Even Sir Alec stated that if their first case had been forensic, from the day one the technique would have been heavily scrutinized and questioned in the courts, with many claims for discrediting it. And process may well have been damaged in the courts. Thus, when the first forensic case came knocking in 1986, he and his team had already bulked up the public opinion in the favour of the technique, and what further helped was the nature of the case presented to them.

The case was that two young teenage girls were raped and murdered on different occasions Enderby area of Leicestershire, one in 1983 and other in 1986. What was baffling was that a man named Richard Buckland, who had been arrested had confessed to one murder but not the other and he was found innocent of both when semen samples obtained from both scenes surprisingly matched each other but none matched his DNA. So, an area wide hunt was ensued whereby samples were collected from entire male population to find a genetic profile that matched samples taken from the two victims. No match was found, until Colin Pitchfork was overheard boasting of how he had persuaded a friend to give a sample on his behalf. The cases were solved with a great thanks to genetic profiling. [10]

From this point on Genetic or DNA Profiling, as we know it today has undergone paradigm changes due to several advancement in technologies, and Forensic Investigations have gained a new confidence in this technique. DNA profiling is one of the most reliable tool when it comes to solving a crime as, unlike fingerprints and retina imprints, chances of recovering a DNA sample from a crime scene are great, it being present in every part of a human body. In INTERPOL's Global DNA Profiling Survey carried out in the year 2008, which was replied to by 149 of its 172 member countries, it was concluded that over 50% of countries in all regions, except Africa, use DNA profiling in criminal investigations. Results from the survey also showed that 120 countries used DNA profiling in criminal investigations, which is bound to have increased by today. [11]

4. DNA DATABASES

4.1 Introduction

According to the preceding discussion it is clear that by using DNA analysis and other forensic science methods, the samples that are collected from crime scenes or individuals are analysed, which result in a DNA profile. Now DNA profile is a string of numbers it can be stored on a computer database. When a number of DNA profiles are so stored, the resulting database of is known as DNA Database. A DNA Database can be of various types; Private and Government databases, International, National and Regional databases, and then according to usage they may be categorised as Forensic, Genealogical and Medical databases.

If we talk about the first few DNA databases, they were mainly for research purposes and most prominent of them was the compilation of 'A Mitochondrial DNA Concordance', which was prepared by Kevin W. P. Miller and John L. Dawson at the University of Cambridge from 1996 to 1998 from data collected as part of Miller's PhD thesis. [12]

With the exception of few Private, Genealogical and Medical databases, wherein the individuals contribute this DNA samples on their own volition, for research purposes or for medical advancements, most of the DNA Databases are government-owned and are used for forensic purposes. The most important function of the forensic database is to produce matches between the suspected individual and crime scene bio-markers, and then provides evidence to support criminal investigations, and also leads to identify potential suspects in the criminal investigation. [13] Such government owned DNA Databases might also provide support in the cases of missing persons and unidentified bodies.

In fact In 2009 Interpol reported there were 54 police national DNA databases in the world at the time and 26 more countries, including India, planned to start one. [14] Interpol itself has a DNA database comprising of contributions made by various member countries and all these databases aim at fighting crime and terrorism. Few of the important national DNA databases belong to, (i) **United States**, which has the largest database of DNA samples with over 11 million samples is termed as CODIS, which is the acronym for the Combined DNA Index System. With the U.S. Supreme Court decision that police can take samples from arrestees, even without a warrant and expanded database laws, such as the DNA Fingerprint Act of 2005, the database size will increase even more. Today more than 90 law enforcement laboratories in over 50 countries use the CODIS software for their own database initiatives; (ii) **Great Britain's** National DNA Database (NDNAD) until held the samples of nearly seven million. However by passing the Protection of Freedoms Act 2012, which required that those suspects not charged or found not guilty or who committed minor offenses would have their DNA data deleted from the Database, six million of such profiles were deleted. In addition, samples must now be destroyed after six months; (iii) The **Australian** national DNA database is called the National Criminal Investigation DNA Database (NCIDD) and has over 7 million samples stored; (iv) In 2015 **Kuwait** became the first country to mandate DNA testing and filing of all its citizens and permanent residents, in its fight against terrorism. It passed a law making it mandatory for all its 1.3 million citizens and 2.9 million foreign residents to have their DNA entered onto a national database.

Apart from above many other countries have such DNA databases with varying degree and rules of inclusiveness, with the objective to fight crime and for locating and identifying missing persons and disaster victims and trace origins of unidentified bodies. [15]

4.2 Prevailing Dilemma: Debate between Necessity and Ethical Issues raised due to DNA Databases

There is no doubt in our minds about the importance of DNA analysis in forensic investigation. In fact there are few cases that highlight this fact:

Case 1:

In 1988, Timothy Wilson Spencer was the first man in Virginia to be sentenced to death through DNA testing, for several rape and murder charges. He was dubbed "The South Side Strangler" because he killed victims on the south side of Richmond, Virginia. He was later charged with rape and first-degree murder and was sentenced to death. He was executed on April 27, 1994. David Vasquez, initially convicted of one of Spencer's crimes, became the first man in America exonerated based on DNA evidence. [16]

Case 2:

Seminal stains were admitted as potential evidence even before DNA fingerprinting or DNA profiling. However, the matches were based only on a probability or possibility of kind of donor. In 1977, a 16-year-old girl Cathleen Crowell was found by a police officer standing on the side of road in suspicious conditions. She claimed to have been kidnapped, raped and wounded by three young men while she was leaving work. After medical examination and collection of samples, she worked along with a sketch artist and was shown mug shots of potential culprits. She identified one Gary Dotson, who was arrested the next day and identified in a lineup. Along with Crowell another key witness was against Dotson, a forensic specialist who claimed that the stain from the victim's underpants came from a type B secretor, which the defendant was. Since only about 10 percent of the population fits this profile, there was a good chance that Dotson was the source. The specialist also testified that the hairs recovered from the victim were "microscopically similar" to Dotson's; the prosecutor would later claim that they actually

matched. The evidence was enough to persuade the jury. Dotson was convicted of rape and aggravated kidnapping and given concurrent sentences of 25 to 50 years. However in March 1985, the 'victim' expressed her guilt to her pastor. She informed him that she had fabricated the rape allegation as a cover story because she and her boyfriend had feared she was pregnant. She tried to knock the doors of Judiciary but she was not heard even when she was ready to stand trial for perjury. The national media picked up the story. Journalist Civia Tamarkin recruited former assistant state's attorney Thomas Breen to take up the case. Edward Blake, then described as "the number-one forensic geneticist in the country," was brought on, and a new test was conducted on the seminal stain and blood samples from Dotson. In August 1988, the test results excluded Dotson as a potential source of the semen. In 1989 Dotson was finally exonerated 10 years after his original conviction. [17] In a 2009 report, it was stated that in US Some 240 convictions had been overturned in 33 states and the District of Columbia, according to the Innocence Project, a nonprofit advocacy group that works to free the wrongly convicted. Seventeen people had been released from death row after DNA evidence cleared them. [18]

With the initial successful cases and the recent ones, and the contribution of DNA analysis in tracing the remains of loved ones that go missing in general situations or in mass tragedies like Uttarakhand floods, the question arises as to why there is even a discussion as to maintenance of DNA Databases. Well there is no doubt as to the fact that the national DNA Databases have proved to be an indispensible tool in the fight against crime, in fact we may very well urge that it is necessary to curb crime as a 2017 study has shown that databases of criminal offenders' DNA profiles in US states have "deter(ed) crime by profiled offenders, reduce crime rates, and are more cost-effective than traditional law enforcement tools." [19] But what concerns the society is the effect of such databases when the matter concerns to privacy rights and human rights. This concern stems from the reason that such databases that were established for containing genetic information on convicted criminals, have evolved to contain information stemming from a much larger group of people.

In fact in an earlier statement the DNA pioneer Sir Alec Jeffreys stated it would be "criminally irresponsible" not to maintain the database and would mean that rapists and murderers who are now identifiable would be able to continue unstopped [20], while in a later statement he showed his displeasure against the proposed rules of UK government to retain the DNA profiles of innocent people who are arrested for serious offences, but not convicted, for 12 years and those arrested for minor offences for six years, calling this 'presumption not of innocence but of future guilt' (emphasis supplied). [21] Though few years after this the UK government greatly curtailed its database, however the question remains that in garb of fighting with crime can the governments go on to circumvent the human rights of their citizens and residents. This fear is true in wake of databases containing a large number of DNA profiles of minorities, innocent persons or only arrestees, who may have been arrested on suspicion but they have not been convicted as is the case with over 20 states of United States of America.

The second issue relates to privacy concerns. First concern relates to those incidents where DNA samples that are taken without the consent of individuals and then are used for forensic investigation. Second issue relates to retention of samples of unconvicted individuals, who were only arrestees or were just questioned on the basis of suspicion. In an appeal against the rule of UK government to retain DNA profiles of innocent people, the appellants argued that the retention of their DNA samples and profiles would unfairly discriminates against their entitlement to privacy and therefore contravenes their right to fair and equal treatment outlined by Article 14 of the ECHR 13. In other words, that in allowing the police the power to retain their DNA, the legislation created a discriminatory distinction between the appellants (as once charged but unconvicted) and the larger unconvicted population. [22]
Thirdly, in this age of digitization any information saved on computers especially when they are connected over a network is susceptible to hacking and data theft. Thus, privacy is threatened not only in collection of DNA samples but it also exists as a threat of genetic privacy breaching. And this fear is not baseless, as in recent times hackers have leaked sensitive national information and taken over bank transactions. Now DNA profile may include highly private matters such as information about a disposition towards a certain genetic illness, or the birth gender of a transsexual person, and such information can be manipulated by introducing false markers, misused for blackmailing. This information, if leaked, can also become a basis for wrongful denial of jobs, visas or insurance.

When a DNA analysis of a crime stain is conducted, and only a close match is traced instead of a true match, it is believed that the perpetrator is a close relative of the databased person. This is called 'Familial DNA Database Searching'. [23] This technique is supplemented by making a family tree of the databased person, and then excluding members based on various markers like gender. A 'probable' suspect is traced and then a warrant to collect his DNA is perused. This technique of familial searching has been called a bad policy as there arises possibilities of innocent relatives of criminals being wrongfully pursued for a crime, thus making them susceptible to unreasonable searches and seizures and devalues their fundamental rights central to privacy. Though this technique has helped to solve a number of serious crimes. However, there are concerns that it could lead to significant abuses by allowing investigators or anyone who infiltrates the database to track down the relatives of political dissenters or to pursue enemies or identify paternity and non-paternity for personal, commercial or criminal reasons. [24]

One of the major concerns is that DNA testing is not infallible as DNA can be damaged by environmental factors such as heat, sunlight and bacteria. This may affect the accuracy of tests carried out. False matches between an

individual's DNA profile and a crime scene DNA profile can occur by chance. Poor laboratory practices can lead to cross-contamination or mislabelling of samples, and test results can be misinterpreted or mismatched, leading to false matches. And as the size of a DNA database increases the number of false matches is expected to increase and can be disruptive for investigators in carrying out a timely and proper investigation and can lead to potential debacles waiting to happen by destroying the fairness of DNA investigation process, which it claims to possess.

5. CONCLUSION AND SUGGESTIONS

What we have been able to deduce from the discussions above is that we cannot do away with the presence of National DNA databases and they are acutely necessary in the fight against crime and terrorism, by offering more reliable investigation at reduced cost. They also have the ability to eliminate innocent suspects from investigations. It also provides respite and closure to the families of many missing persons and provides an identity to the unidentified bodies. Also the genetic profiles contributed by good Samaritans provide a great help in cases of medical research. Genetic information is also saved by many medical institutions for donor programs, like bone marrow transfusions, etc. which is a great help for victim of diseases worldwide. However, we have also seen multiple reasons to oppose their existence, rather be afraid of them.

What we need is a balance between the public good and individual rights.

Initially, DNA Databases for forensic use aimed at serious crimes, then they moved on to include profiles of all the offenders. Till this point there were not many concerns as retention of DNA profiles of offenders is right in view of the fact that there is a considerable chance of repeat offences. However, when governments went on to store the profiles of mere suspects who were found to be innocent, their decision was opposed by masses. As discussed earlier, even Sir Alec Jefferys, who is the father of this technique, opposed this as 'presumption of future guilt'. It is also seen that ethnic minorities and young people are over-represented in these databases, in fact, two-in-five black men have their DNA on record, as against fewer than one-in-ten whites. [25]. One way of resolving this issue of infringement of civil rights of minority groups and arrestees or suspected individuals is that every citizen and resident of the nation is 'fingerprinted' and their profiles are saved as is done in Kuwait. However, it is easier said then done.

Firstly, many argue that if databases were extended beyond just convicted criminals, everyone would be seen as possible suspects. Secondly, we are already facing the problems related to privacy and security of saved genetic profiles on DNA Databases. If sensitive and highly protected information like NSA data can be leaked, genetic information which is being stored around the world by Laboratories, educational institutions, and governments, is highly vulnerable and susceptible to be breached.

This breach can lead to misuse of this data by health insurers or employers, for denying insurance claims on basis of genetic disease marker or denying jobs on basis of criminal history in the family. Now steps have been taken to ensure that apart from the collection agencies others who have access to the forensic data do not have access to identifiers such as name, address, race or locality. Specifically if an individual is volunteering his genetic information, it is his property and this information should only be used if it helps the individual, for instance if there is a treatment for any disease. However, even this option is not viable, as a study has shown that it is possible to discover the identity of genome donors by cross-referencing their genetic markers with demographic information in public databases. [26]

In view of the above the governments will have to frame more comprehensive privacy regulations that would prevent them or collection agencies from sharing DNA profiles with other groups. There are already a few protective mechanisms and laws like Genetic Information Non-discrimination Act of 2008 (GINA) enacted by US Legislation, to protect the genetic privacy of the public, including research participants and then there is INTERPOL Handbook on DNA Data Exchange and Practice, closest thing to universal regulation, aims at detailing the latest standards, techniques, and applications in DNA profiling for countries and agencies around the world and also addresses the need to fight crime at the international level and provides the latest information as criminal tactics and technologies change. [27] However, these rules, in view of the above-discussed studies, are quite redundant now, as INTERPOL Handbook was last revised in 2009, whereas technology and technique has by-passed them by leap and bounds.

In wake of the landmark judgment of nine-judge bench of the Supreme Court of India given on 24 August 2017, which categorically lays down that the right to privacy is a fundamental right enshrined under Article 21 of the Constitution of India, there will be a paradigm shift in the way the government deals with personal information. Now that everything needs to be connected with Aadhaar number and over that proposal of establishing DNA Database for the first time, government will be forced to frame rules that guide when an individual's personal information can be accessed and in what manner it can be used. In India there has been little or no protection of personal information and large amounts of citizen data are freely available on government databases on the Internet, [28] and this needs to change otherwise both biometric and genetic identity of citizens will become common knowledge on just a click of mouse.

If we want that DNA Databases and an individual's human and fundamental rights and right to privacy and live with dignity can co-exist together, a composite and common set of rules, which provide a sense of protection to the genetic profile donors must be introduced on a world-wide level. These rules must comprehensively entail various details, such as: who should be databased in National Forensic Databases, who should have access to this data and for what duration such profiles can be saved, what enhanced protection mechanisms must be introduced so that genetic privacy of the public remains intact and it is not possible to discover the identity of genome donors by cross-referencing their genetic markers with demographic information in public databases and to ensure that efficient and updated legislations are enacted to protect participants from being exploited in any way, make it mandatory for the collection agencies to allow the with participants to make an informed choice that there is a chance of their privacy being breached, and lastly, measures must be undertaken so that chances of contamination, mix-ups and breakdown of DNA based investigation are highly reduced and process maintains its fairness.

What we need to understand is that DNA based or genetic investigations, research and DNA databases are not our foe, if a proper system is in place to protect the information and our rights, and governments need to strive for this balance.

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