

SIGNIFICANCE AND CHALLENGES OF DNA PROFILING IN MEDICOLEGAL SETUP OF PAKISTAN

Hafiz Muhammad Abbas¹, Faiqa Erum^{2*}, Ali Hassan Gillani³

¹Crime Scene Unit, Satellite Station Punjab Forensic Science Agency, Lahore.

²Department of Pharmaceutics, Faculty of Pharmacy, the Islamia University of Bahawalpur, Bahawalpur.

³Department of Pharmacy Administration and Clinical Pharmacy, Xi'an Jiaotong University, China.

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ABSTRACT

Deoxyribonucleic acid (DNA) serves as a unique genetic blueprint, inherited from our parents, making it an ideal identifier of individuals. The application of DNA analysis has revolutionized the field, leading to accurate and reliable results that have helped solve complex cases and bring justice to victims. This article focuses on the DNA-based reports in criminal justice system, as well as the accompanying challenges, emphasizing the necessity for particular DNA-based laws. The DNA discovery opened up new paths and the improvement of DNA identification and its incorporation into legal system has offered significant assistance in settlement of criminal and civil matters. Primarily, DNA proofing is used in a paternity dispute in Pakistan. Overall, the integration of DNA analysis into forensic science has significantly enhanced the process of investigating and resolving criminal cases. However, the necessity for laws and standards to allow its use for forensic reasons in Pakistan has long been recognized.

Keywords: DNA technology, Applications, Limitations, Forensics, Justice system.

*Corresponding Author. E-mail: faiqaerum1@gmail.com

INTRODUCTION

Scientific technology is improving day by day and it possesses innovative alterations in human life. In conjunction with the beneficial aspects of these improvements in amenities and lifestyle, these developments have presented a challengeable situation for law enforcement organizations in preventing criminals from misusing technology to commit a crime. The scientific examination of findings yields significant scientific evidences. Forensic Science is an application of science to criminal investigations. These technological improvements have proven to retain a significant influence on administration of justice in a variety of settings. However, wise use of technology has the ability to profoundly alter justice system. It is proved through many researches that forensics have prohibited many people who were falsely charged or

suspected from going to jail [1]. These instances and research demonstrate that, in order to improve the court system, this cutting-edge technology could not be used without having an impact on established legal norms. How to best utilize technology advancements and how much a need there is to change the existing procedures and regulations are still up for dispute. To incorporate scientific advancements, it is crucial to strike a balance among established norms and constitutional rights. A strong protection of human rights, like "Right against self-incrimination and right to privacy" should be present so that they are not violated by these developments [2]. However, it might be challenging to utilize technology without impinging on these human rights during a criminal investigation or when using it in court. For instance,

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it is clear that taking samples for an investigation conflict with one's right to privacy and one's right against self-incrimination. Minimizing the likelihood of a technology being used against the public interest is a crucial problem that demands the serious attention of policymakers [3]

Deoxyribonucleic acid (DNA) has brought up a number of opportunities in the area of forensic sciences. Utilization of DNA technology as a corroboration tool for the guilty or innocent in court has been proven to be effective [4]. The legal perspective of DNA evidence in Pakistan is evolving due to a lack of strong legislative grounds for the use of DNA technology in everyday acts of jurisdiction. It is presently controlled by a few existing rules, despite the fact that Pakistan has been attempting to adopt legislation. This article addresses advancement in DNA technology, its role in crime scene investigations alongside limitations associated with it.

DNA TECHNOLOGY DEVELOPMENT

Discovery of DNA as a universal genetic material in 1950 posed different paths for research and development. For the first time DNA technology was utilized for forensic purposes in England for immigration purposes. The realm of criminal justice underwent a change with the development of DNA technology. Since DNA fingerprinting was first discovered, technology was advance. Although the fundamentals have not changed, every person has a unique DNA that is passed down from one generation to the next and may be used to trace a person's ancestry [5].

Several advancements have been made to Sir. Jeffrey's original Restriction Fragment Length Polymorphism (RFLP) – based DNA technique. A high molecular weight genome or enough DNA (approximately 10 ng) was needed for RFLP. The biological sample often encounters a variety of unfavorable circumstances, including excessive temperature and humidity which weakens the DNA. The sample could also occasionally only be present in minute quantities. In this regard, the 1990 development of the Polymerase Chain Reaction (PCR) greatly contributed to the resolution of the aforementioned problems. DNA analysis using Short Tandem Repeats (STR) is extremely sensitive and may produce a profile even from samples which are partially degraded. It is important to highlight that in the 1990s, the DNA Fingerprinting Congress made important advancements in DNA typing technology. DNA profiling has gained widespread acceptance. Scientists and professionals are becoming interested in DNA phenotyping [6].

In the examination of several criminal and civil cases, DNA evidence is regarded as being of utmost

importance [7]. The development of a personal identity is crucial in this regard. There are several methods used to identify a person, including fingerprinting, poroscopy and anthropometry. However, it has certain limits when it comes to identifying disfigured bodies, body identifiers and bones etc. In this case, the only technology that could help in making a determination is DNA technology [8].

DNA not only made it easier to catch the criminal but also prevented the innocent from being wrongfully imprisoned. Human trafficking has been discovered to be a huge problem, and DNA has been found to be a huge help in dealing with it through criminal and civil case adjudication. According to UNICEF statistics, a staggering 300 million children worldwide are the victims of child abuse and exploitation. In addition, unlawful adoption is a significant problem for society. DNA has clearly demonstrated that it is the ideal instrument for identification and restoration. In keeping with this, it is interesting that a mission was backed by the Spanish government in 2006. The main goal of this initiative is to identify and rehabilitate children and women who may become victims of human trafficking. A DNA PROKID Kit makes it simple to collect the sample since it reduces the possibility of contamination. More than 900 children have been identified and returned to their families as a result of this effort. The "DNA PROKID" database could be a useful tool for addressing the issue of unreported adoption [9].

ROLE DNA EVIDENCE IN COURTS

According to the theory that it was derived from the experimental and research DNA carries a unique genetic code, the DNA report is acceptable in court. It is commonly known that no two people can have the exact same DNA profile. The development of genetic research had a significant effect on society and the criminal justice system [10]. DNA evidence has been nicknamed the "new gold standard" in forensic science since it has been demonstrated to be a very accurate method of proving a person's identify [11].

However, a number of nations have rejected DNA technology for a variety of reasons. Despite the criticisms, the adoption of modern technology has revolutionized the legal system. DNA evidence now has more validity as a result of technological improvements, which is effective enough to help with the administration of justice. Legal arguments and cases have raised substantial questions about the validity of the evidence. Internationally, there are a number of rules or procedures, such as the Frye test, Daubert test, prejudicial impact test, and usefulness standard, to establish the relevance and

admissibility of scientific evidence. Validity is determined by whether or not the evidence creates false or contradictory perceptions [12]. In addition, excellent laboratory protocols, the collecting, packaging, and mailing procedures must ensure that the chain of custody is unbroken. A number of variables affect an expert's opinion's credibility.

The determination of paternity is of prime importance of human identification. The socio-legal issues of paternity and legitimacy have long been contested in the legal system. Laws and scientific progress must coexist. Here, it is important to keep in mind that legitimacy is a phenomenon of law, but paternity is connected to a child's family history and may be established with a DNA test. Legitimacy has been safeguarded on a social and legal level. As a result, this legal clause grants the father legal parental rights while the DNA test just reveals the child's putative father [13].

Marriage and legitimacy are related legally. In conclusion, it may be said that if the husband cannot show that he has no contact with his wife, the kid will be seen as legitimately belonging to the pair.

Paternity and relationship testing are genetic tests used to determine biological relationships between individuals, such as parentage, siblingship, or grandparentage. These tests analyze DNA samples from the individuals involved to assess genetic similarities and differences, providing valuable information about their biological connections. They are commonly used in legal cases, immigration procedures, and personal situations where certainty about biological relationships is necessary. DNA profiling is commonly used for paternity and relationship testing. It involves analyzing specific regions of an individual's DNA to determine genetic similarities or differences between two or more people.

The main methods used in DNA profiling for paternity and relationship testing are: 1. Short Tandem Repeat (STR) analysis; 2. Polymerase Chain Reaction (PCR); 3. Capillary Electrophoresis; and 4. Allele Frequency Database.

ETHICAL CHALLENGES OF DNA PROFILING

The CJS was significantly influenced by the development of genetics and the finding of DNA. It is essential to investigate the DNA test's reliability before adopting it as proof. New maxims have been developed as a result of the enormous developments in science. These innovations have also brought forth more obstacles and ethical dilemmas. Medical science innovations have opened up a number of new options. The stem cell transplantation, blood transfusion and bone marrow transplantation are just

a few of the notable developments that have transformed the life of the average man [14].

The aforementioned considerations must be made legally since they are extremely important for DNA profiling. Misuse of assisted reproductive techniques (ART) has made it extremely difficult to identify someone for forensic reasons [15,16].

Few instances of ART abuse from Western nations are underscoring the urgent necessity for attention of this issue. To stop the abuse of ART and encourage the moral use of in vitro fertilization (IVF), several nations have created restrictions. The new regulations stop men from disguising an adulterous conduct by claiming to be a sperm donor in the name of assisted reproductive technology. Women who used condom sperm to inseminate their children legitimately became the child's father in State of Louisiana according to DNA evidence [17]. Several ethical difficulties with DNA have already been highlighted. When employing DNA testing for legal purposes, the notions of DNA theft, DNA fabrication and other problems with DNA databanks are major considerations. In the UK, DNA theft is now officially considered a crime [18]. It is impossible to overlook the potential for fraudulent biological sample implantation or any biological sample that makes DNA analysis easier. There is currently no technology that can distinguish between real samples and ones that have been deliberately or erroneously inserted at crime scenes. Based on various methylation patterns, Frumkin et al proposed a method to distinguish between real and synthetic samples of DNA [19]. Additionally, it has been shown that a physical sample is not always necessary for DNA synthesis [20]. In addition to contact DNA, DNA recovery from chewing gum has been documented.

In Pakistan, this subject appears to remain under discussion among legal and scientific professors and researchers. Secondary and tertiary DNA transfer has also sparked serious ethical problems worldwide. Furthermore, the need of defined standards for determining what constitutes a match has been underlined for proper interpretation of DNA test results. Several ethical concerns have been raised in relation to the DNA databank. Ethical and legal issues may restrict the possibilities of DNA testing [20].

DNA DATABASE

DNA databases play a crucial role in DNA profiling. They store DNA profiles from individuals, helping law enforcement and forensic experts identify suspects or match evidence to known individuals. By comparing DNA samples collected from crime scenes or unidentified remains to the profiles in the database, investigators can link potential suspects to

the case, narrow down leads, and help solve crimes. DNA databases are valuable tools in criminal investigations, providing critical information for identifying perpetrators, exonerating innocent individuals, and ensuring accurate justice. However, it's essential to balance the benefits of DNA databases with privacy concerns and ethical considerations.

CHALLENGES IN DNA PROFILING

1. DNA samples can degrade over time, especially in adverse environmental conditions, making it challenging to obtain accurate results from old or poorly preserved samples.
2. In cases where DNA from multiple individuals is present at a crime scene, separating and interpreting mixed DNA profiles can be complex and requires advanced analysis techniques.
2. DNA profiles are often subject to interpretation, and the likelihood ratio used in court can be difficult to explain to juries or non-experts.
3. Sometimes, the available DNA quantity may be very limited, making it difficult to generate a complete and reliable profile.
4. DNA is easily contaminated by external sources, such as handling, storage, or contact with other materials, leading to potential false results or difficulties in interpreting mixed DNA profiles.

LIMITATIONS OF DNA TESTING

1. While DNA profiling can identify close family relationships, it is not precise enough to pinpoint specific individuals within a family group.
2. DNA profiling relies on specific genetic markers, and genetic mutations in those markers can lead to inaccuracies or inconclusive results.
3. Certain ethnic populations might share similar DNA profiles, leading to potential

misidentification or difficulties in distinguishing between individuals from the same population.

4. The use and storage of DNA profiles raise privacy concerns, as they contain highly sensitive information about individuals and their genetic predispositions.
5. There are ethical dilemmas associated with the retention and use of DNA profiles, particularly when it comes to innocent individuals' data and potential misuse. Despite these challenges and limitations, DNA profiling remains a valuable tool in forensic investigations and can significantly aid in solving crimes and identifying individuals in various scenarios. However, it is essential to understand and address these issues to ensure accurate and responsible use of DNA profiling technologies [21, 22].

CONCLUSION

For criminal investigation, the progress of DNA profiling has provided new possibilities. Specific legislation and legal changes are necessary to handle the legal dogmas, paradoxes, and implementation of DNA profiling in connection to Pakistan society's rapidly changing socioeconomic concerns. Pakistan's government aims to adopt DNA legislation. The sensitive information of DNA profile may be misused; therefore, an ethical execution of DNA proofing is utmost important and there should be a harmony among scientific techniques, legal proceedings and human rights.

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