Navigating The Genetic Frontier: Privacy, Ethics, And Legal Reforms in the Use of Forensic Evidence for Criminal Investigations in India

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ABSTRACT:

Forensic evidence has transformed the field of Forensic Science and has been used to solve crimes and exonerate innocent individuals. But there are a lot of complex ethical and legal issues that come along with its growing use in court procedures, and those need to be taken into account. In light of these challenges, our research finds major loopholes in the existing legal framework and ethical guidelines. Stringent rules are in place for the integrity of Forensic evidence, including continuous chain of custody and approved lab procedures. However, due to inconsistencies among the various forensic laboratories, courts are at risk of wrongful convictions as a result of DNA testing mistakes made at laboratories, including due to such contamination or misinterpretation of data. A significant issue is the public safety versus private rights balance with regard to the storage and re-use of DNA samples. This paper examines the Indian scenario in the broader global debate on the use of Forensic evidence in the justice system in the face of an ever-evolving technological landscape, in order to contribute to the on-going debate on the governance of genetics and balancing national security, public welfare and individual rights in an ever-changing technological landscape.

Keywords: Forensic Evidence, Criminal Justice System, Scientific Evidence, Right to Privacy, Technology Advancement

I. INTRODUCTION

The scope of forensic science encompasses both the legal requirements and the whole range of medicine since it teaches the application of all medical disciplines to the purpose of law. Physiology, biochemistry, anatomy, and medical Sometimes physics and botany come to the rescue, and other times, every one of these scientific fields is required for a court to correctly decide a case affecting someone's life or property. The fields of "medical jurisprudence," "forensic medicine," and "legal medicine" are sometimes used interchangeably to describe the branch of medicine that applies medical principles and expertise to civil and criminal law, although they really mean rather different things. Medical jurisprudence encompasses all matters pertaining to civil or social rights of individuals, as well as cases

involving harm to the person, and so involves the legal system in the interaction between the medical practitioner and the public. Medical jurisprudence encompasses all matters pertaining to civil and social rights of individuals, as well as cases involving harm to the person, and so involves the legal system in the interaction between the medical practitioner and the public. "Consequently, medical jurisprudence deals with the legal components of medical practice, while forensic medicine is concerned with the application of medical knowledge to the administration of law. To sum up, "forensic science" is an overly general term. Forensic science, in its widest definition, is the application of scientific methods to the process by which courts and law enforcement agencies uphold civil and criminal laws.

In 1949, Dr. Stanford Emersion Chaille put forth the idea of "state medicine," which is universally rejected. "Legal medicine" is a popular choice in the United States and Europe. Having said that, the term "forensic medicine" is widely used in most parts of the globe [1]. Generally speaking, forensic medicine in Britain was systematically developed by Andrew Duncan (1744–1828), a professor at the University of Edinburgh's Institute of Medicine. By 1806, Duncan had pushed for the establishment of a reguis by the state. Duncan made the following statement in regard to the general societal value of forensic medicine [2]:

"To handle matters of tangible justice when human life, property, or bodily integrity are at risk; to protect the innocent from the attacks of malicious slander or unfounded accusations; to unearth terrible wrongdoing even when it is well concealed using the most sophisticated techniques [3]."

II. THE EXISTING LEGAL FRAMEWORK GOVERNING FORENSIC EVIDENCE IN INDIA

A. The Bharatiya Sakshya Adhiniyam, 2023

Evidence Act 1872, India deals with the admissibility of expert and judicial opinion. The Act states that the opinions of the forensic experts are an important source of information. That provision [3] does support the use of expert testimony in a forensic investigation, including the use of DNA profiling, fingerprinting and handwriting analysis. To make it relevant to the present times, Bharatiya Sakshya Adhiniyam, 2023 adds a few words and makes it "digital and scientific procedure" [4]. The legislation of 2023 clarifies certain aspects of the Indian Evidence Act that were ambiguous, such as certified electronic records and certification. The new rule is more consistent with the Bharatiya Nagarik Suraksha Sanhita (BNSS) which will make forensic findings more admissible without the need for the expert's presence and both laws permit expert reports to be prepared in court. This change makes the trial process more efficient. The 2023 Act aims for clarity, legal certainty, and better integration with the growing judicial and technological context via its modernised language and vocabulary, which reflect a more current knowledge of forensic science. Whereas the Indian Evidence Act was significant in the past, Bharatiya Sakshya Adhiniyam is a forward-looking law which improves the role of forensic evidence in Indian law.

B. The Bharatiya Nagarik Suraksha Sanhita, 2023

The forensic evidence requirements of the Code of Criminal Procedure, 1973 were continued and strengthened by the Bharatiya Nagarik Suraksha Sanhita, 2023 (BNSS), which superseded it on 1 July 2024.[5] The BNSS's Section 185 replicates the content of the previous CrPC's Section 53A, allowing for the medical evaluation of a rape suspect and the collecting of biological samples (such as swabs, blood, semen, and hair follicles) for DNA analysis. At the request of a police officer of a certain level, a certified medical practitioner retains the wider authority to examine the accused under Section 184. Legislative recognition that scientific evidence is now fundamental to contemporary criminal procedure is shown in the BNSS's explicit

reference to forensic inquiry as an important component of the investigating process. The courts are anticipated to interpret Section 349 of the BNSS, which is similar to the former Section 311A of the CrPC, as authorising a Magistrate to order the examination of any individual for the purpose of identification. In some cases, this provision is thought to include DNA sample.[6] The An important new provision in the BNSS is Section 176(3), which, for crimes carrying a sentence of seven years or more in prison, requires a forensic expert to visit the scene of the crime whenever feasible and, in particular, examines the scene for biological trace evidence. However, similar to its predecessor, the BNSS fails to address important procedural concerns by failing to provide a thorough framework for the collecting, preservation, analysis, and presentation of DNA data in court.

C. The DNA Technology (Use and Application) Regulation Bill, 2019 and Forensic evidence

The goal of the DNA Technology (Use and Application) Regulation Bill, 2019, is to establish regulations that will control the procedures for using DNA-based technologies to identify individuals in legal and illegal matters [7]. In order to advance India's forensic evidence procedures, it is crucial. The collection, storage, analysis, and use of DNA samples must adhere to strict scientific and ethical guidelines, which is why a DNA Regulatory Board is being proposed. A national DNA database and regional data banks are also suggested in the bill [8]. The Bill seeks to improve the credibility and veracity of evidence offered in court via forensic investigations, especially in instances involving heinous crimes like rape, murder, and missing people [49-58]. Control of the generation and use of the DNA profiles can help alleviate concerns of contamination, abuse, or wrongful conviction [11]. To further ensure personal privacy, the proposed law specifies when it is acceptable to acquire DNA samples without permission in criminal situations [13] and when it is necessary to get agreement for DNA sample collection in civil issues [12]. Although well-intended, privacy groups and law professors are concerned with data protection and misuse, and limited oversight [14]. Still, the Bill is a huge deal for forensic science since it will finally allow for the criminal justice system to use cutting-edge genetic technology, which will boost the credibility of forensic evidence and lead to more reliable scientific investigations.

III. ROLE OF EXPERT IN TAKING FORENSIC EVIDENCE

Furthermore, the new Act does not define the word "expert," which creates ambiguity and interpretational problems [15]. A domain determines whether an expert comes from a scientific or non-scientific background. The term "forensic expert" is used to describe scientists. Forensic reports provide supplementary evidence in court proceedings as expert opinion is not absolute. A formidable obstacle stands in the way of minimising the impact of erroneous expert opinion. Concerns about the proper use of procedure in forensic opinions have been brought to light by the recent examination of many major problems by the Supreme Court of India. Judgemental review has cast doubt on either the forensic method or its application in a number of cases, such as Anokhilal v. State of M.P.[16] and Rahul v. State (NCT of Delhi) [17]. Potentially sparking the Innocence Movement in India, the Anokhilal case is a watershed moment in DNA exoneration. The significance of forensic competence to the judicial system was further highlighted in the Anokhilal case, which took place in Madhya Pradesh on March 19, 2024, and was the first DNA exoneration of a death row convict after the third trial. By bringing India in line with international jurisprudential norms, this change would help resolve claims of innocence and put an end to the atrocities that have befallen innocent people [18]. The current provisions of Section 39 of the Bharatiya Saksha Adhiniyam, 2023, concerning experts, are quite similar to those of Section 45 of the Indian Evidence Act, 1872, with the inclusion of the

words "any other field" to include a wider range of disciplines. According to an examination of Sections 45 and 39, the word "expert" is implied to mean a "particularly skilled person" rather than being defined specifically. Experts are those with extensive expertise in a particular field who advise the Court on matters of international law, science, art, or the authentication of signatures, fingerprints, or handwriting. Any use of the word "forensic" throughout the whole Evidence Act is puzzling. The constitutional courts of India have dealt with the problem of defining "expert" on several occasions due to the lack of a precise definition. The Supreme Court emphasised in the case of State of H.P. v. Jai Lal [19] that an expert is required to have specialised training or education in order to be considered "especially skilled" under Section 45. That is why it is essential for an expert to have extensive knowledge and proficiency in the field.

In the case of State of Karnataka v. J. Jayalalitha, (2017) 6 SCC 263, the court accepted advisory expert testimony that aimed to provide scientific standards for assessing the reliability of conclusions. Professionals in the field do not testify as witnesses to the facts. The court is required to provide an impartial verdict after considering all relevant facts and expert evidence. No court should ever give up its authority or defer to an expert's opinion; rather, expert testimony should be considered alongside other forms of evidence. The decision in Basheera Begam v. Mohd. Ibrahim (2020) 11 SCC 174 states that no expert witness can establish anything beyond a reasonable doubt. The danger of adopting an expert's opinion is not due to the fact that experts aren't trustworthy witnesses, but rather to the fact that human judgement is imperfect. The accuracy of fingerprint identification systems has greatly improved, but handwriting recognition is still not perfect. In the case Sri Chand Batra v. State of U.P. [20], the Supreme Court of India recognised the Excise Inspector as an expert under Section 45 to evaluate the unlawful nature of the liquid by olfactory testing, thanks to his extensive expertise in similar instances. The public's trust in the judicial system may take a nosedive and false convictions can occur as a result of experts interpreting the law subjectively and incorrectly. In order for the court to reach a fair conclusion, it is the responsibility of the expert witness to provide an accurate report based on their expertise, which should be backed up by logic. Remember that the court doesn't have to take the expert's word for it, and that advisory evidence is never binding [21].

IV. CONSTITUTIONAL PRINCIPLES AND LIMITS ON DNA TESTING: ARTICLES 20(3) AND 21

Despite advancements in DNA technology, its use must be consistent with constitutional safeguards that preserve individual dignity and the rights of the accused. The use, admission, and acquisition of DNA in criminal proceedings are regulated by the normative bounds laid forth in Article20 (3) and Article 21 of the Constitution.

Article 20(3): Right against Self-Incrimination: "No person accused of any offence shall be compelled to be a witness against himself [22]." According to the Indian Constitution, this is stated in Article 20(3). Given the Supreme Court's stringent definition of the word, this mainly prevents testimony from being coerced.

The Supreme Court determined in the landmark decision of State of Bombay v. Kathi Kalu Oghad [23] that evidence such as fingerprints, blood, or handwriting cannot be considered testimony given under coercion. Since DNA samples are considered tangible evidence, they are not protected by Article 20 (3). The distinction between "testimonial" and "nontestimonial" evidence was upheld by the Supreme Court in the case of Selvi v. State of Karnataka [24]. Brain mapping and narco-analysis were found to be involuntary techniques that violated the Constitution due to their testimonial and coercive nature. However, the Court emphasised that authorised collection of

biological samples does not infringe against the Constitution.

Article 21: Right to Privacy, Dignity and Fair Procedure: It is illegal to remove someone's life or personal liberty without following the correct procedures, as stated in Article 21 of the Constitution. The right to privacy, bodily autonomy, and a fair trial are among the substantive and procedural rights that rest on this article. The Supreme Court's decision in Justice K.S. Puttaswamy v. Union of India [25] established the right to privacy as a basic human right. The gathering and storage of DNA data necessitates a rationale grounded on need, proportionality, and legality due to the fact that this information might reveal an individual's identity, medical history, and even family tree. These basic rights might be violated if DNA testing is done too often or without a good reason. This case reversed a previous decision by the High Court that had mandated DNA testing in a property dispute civil action (Ashok Kumar v. Raj Gupta), on the grounds that the previous decision lacked adequate rationale. It is not desirable to routinely or systematically demand DNA testing in situations involving marital or custody disputes, according to the Supreme Court's opinion in Bhabani Prasad Jena v. Orissa State Commission for Women [26]. DNA testing should only be done as a last resort. Case law has shown that DNA testing, although potentially useful in a legal system, must not be administered recklessly or in response to coercion. The state's interest in determining the efficiency of the criminal investigation by the courts must be balanced with each person's right to due process, privacy, and dignity.

V. THE EVIDENTIARY VALUE OF DNA REPORTS

The prior position of the Supreme Court was that in rape cases, the prosecutrix's testimony required some kind of confirmation in order to get a conviction [27] or to prevent the rape suspect from being unjustly implicated [28].Therefore, the Court tends to favour confirmation of victim evidence as a precaution, even if no statute requires it [29]. When a subject contains complex scientific or technological difficulties that a layman would not be able to comprehend, Section 45 of the IEA permits the view of an expert. The evidence presented by the expert must be based on trustworthy principles, and they must have specific understanding of the relevant topic. Note that an expert's judgement is not deciding but rather advising in character, and that it acts as corroborative evidence rather than circumstantial evidence. There are three requirements that, according to the general rule, must be met for circumstantial evidence to be considered conclusive. The first step in establishing guilt beyond a reasonable doubt is to gather all of the evidence. Secondly, the evidence must support the idea that the accused is guilty. Third, everything has to be crystal clear and have a propensity to rule out everything except the one hypothesis that needs to be verified. In conclusion, there must be sufficient evidence to support the conclusion that the accused is innocent [30]. Only when all circumstantial evidence is demonstrated to be inconsistent with the accuseds or another person's innocence can a guilty finding be sustained in a situation where the evidence is based only on circumstantial evidence. These conditions must be related to the primary truth that is being inferred from them and must be confirmed with absolute certainty [31]. The prosecutrix's testimony alone may be sufficient to secure a conviction in a rape case, according to a Supreme Court ruling [32]. The need to verify such statements is not mandated by law, but it is considered a "guideline of prudence" that may be satisfied in the event of strong grounds. Nonetheless, the court may look for direct or circumstantial evidence to back up her claims if it has trouble accepting the testimony. The Supreme Court has used DNA evidence to support circumstantial evidence in key instances. Genomic analysis proved that the rape victim's vaginal swabs contained the sperm of the accused in the Priyadarshini Mattoo case. Along

with the DNA test findings, the court based its decision on very damning circumstances, and it deemed the likelihood of error to be remote [33]. Genomic fingerprints found on the prosecutrix's (and her friend's) clothing, the iron rod used to attack them, and other artefacts from the Nirbhaya case's gang rape, brutal assault, and victim's death all matched those found on the victim. The Supreme Court's decision was supported by other documents, including three dying statements, medical evidence, and the wounded witness's testimony, with the matching DNA profiles serving only as corroborative evidence [34]. Ocular and medical-scientific data bolstered circumstantial evidence in the case of Ravishankar v. State of Madhya Pradesh. The appellant was found guilty of sexually assaulting the girl who had died because DNA evidence was used to show it [35]. The Supreme Court noted, based on prior decisions, that DNA evidence was practically correct from a scientific standpoint [36]. On a separate occasion, the Supreme Court rejected the idea that DNA evidence alone could prove guilt, citing the existence of procedural errors and the near-total absence of convincing evidence as reasons. With regard to DNA testing requests made after a conviction, forensic evidence may be used to clear a person's name by establishing his innocence. Nevertheless, the specific steps to take in order to exercise this privilege are unclear, and the legislation is vague on the matter. Because of this present level of legal uncertainty, post-conviction litigation is expected to be lengthy, costly, and difficult [37].

VI. JUDICIAL APPROACH: EVOLUTION OF JUDICIAL PERSPECTIVES ON FORENSIC EVIDENCE

The first instance in which DNA evidence was accepted by an Indian court was Kunhiraman v. Manoj [38]. The first paternity case that used DNA evidence was tried by the Chief Judicial Magistrate of Thalassery, Kerala. The case had been handled at the Center for Cellular and Molecular Biology (CCMB) in Andhra Pradesh (A.P.). The impact of this case was felt by every court and news source in India.

Facts of the Case: In an effort to support her son Manoj, Vilasini, a rural girl, filed a lawsuit against Kunhiraman, Manoj's partner, according to the case summary. The birth of Manoj into her family, she claims, was the result of their secret affair. Her spouse disowned her and cast doubt on her son's paternity. The C.J.M. mandated that CCMB in Hyderabad, Andhra Pradesh, India, conduct a DNA test on the couple and their kid. Forensic scientist Dr. Lalji Singh and colleagues conducted a procedural investigation and a DNA test to confirm Kunhiraman's paternity. Forensic Science Laboratory (FSL) analysis of the BKm 2(8) probe, a hypervariable minisatellite DNA sequence created by Sir Alec Jeffreys that allowed for multi-locus DNA fingerprinting, was permitted in M.C. No. 17 of 1988 (the Vilasini case). By assessing genetic variation across several loci, this technique—one of the first applications of DNA profiling in India—made highly personalised identification possible [39].

Held: The Chief Justice of India reasoned that DNA evidence constitutes a scientific inquiry and that the expert belief of a microbiologist or biological specialist is admissible, similar to the opinion of an analytical chemist or fingerprint expert, in accordance with Section 45 of the Indian Evidence Act, which permits the admission of expert opinions. According to the Kerala High Court, a DNA test might be enough to prove paternity on its own [40].

The Decision of Pattu Rajan v. State of Tamil Nadu (2019) Regarding the Use of DNA Alone as Proof [41] –

Case details: The investigation into Santhakumar's abduction and murder in 2001 was the central issue in Pattu Rajan v. State of Tamil Nadu. An additional first information report (FIR) was filed for the purpose of murder under Section 302 of the Indian Penal Code (IPC) after the discovery of the corpse, whereas the first FIR was lodged under Section 364 of

the IPC for the purpose of abduction. In upholding Rajan's conviction based on testimonial and circumstantial evidence, the Madras High Court upheld the outcome. [42]

Problems with:

1. Can many FIRs for related occurrences be legitimately filed?
2. How trustworthy are forensic and scientific findings, particularly those that rely on the judgement of experts, such as DNA analysis?

While DNA testing was not central to this case, the Court did make some significant statements about its legal status [43]. According to the Supreme Court, DNA evidence is not binding since it is considered an expert opinion, just like any other kind of expert opinion, according to Section 45 of the Indian Evidence Act of 1872. According to the bench led by Justice Shantanagoudar, expert scientific opinion alone cannot be used as a basis for judgement. Actually, its significance can range from negligible to paramount, all dependent on the details of each individual situation. It has been presented under section 45 of the Evidence Act, which means that the Court is not bound by the expert's view. DNA analysis is only one piece of the puzzle that has to be considered [44]. Another point made by the court was that DNA evidence might be inadmissible or provide equivocal results due to a "mishandling of evidence," a broken chain of custody, or a lack of confirmation. In spite of the enhanced investigative capabilities granted to the Court by scientific instruments like DNA analysis, the Court cautioned against relying on scientific evidence in lieu of judicial scrutiny or as an infallible method [44]. By considering strong circumstantial evidence and convincing witness testimony, the Supreme Court sustained the conviction and reiterated the notion that scientific evidence is not the only component of the evidential matrix. Here, the DNA evidence and the basic principles of evidence law serve as the standards in the courts.

Case Law: DNA Evidence in Serious Crimes (Mukash & Anr v. State (NCT of Delhi) (2017) [45]

A juvenile girl was gang-raped and killed on December 16, 2012, and the case of Mukesh & Anr v State (NCT of Delhi) is a landmark decision on the admissibility of DNA evidence in criminal trials. While riding a luxury bus through New Delhi, she and her male friend were both attacked.

Facts and DNA Evidence: Police utilised CrPC s 53A, which was instituted after 2005 for the purpose of collecting DNA in rape cases, to seize blood-stained clothing, swabs, and other biological evidence from the accused and the bus after the incident. After analysing the materials, three reputable forensic labs came up with DNA profiles that matched the accused to the victim's clothes and the blood on the bus. The prosecution relied heavily on these DNA findings to establish the accused's bodily involvement in the crime and to scientifically connect them to the crime scene.

Held: In its decision, the Supreme Court heavily emphasised DNA profiling's scientific rigour:

- Official Acknowledgement: The Court determined that DNA profiling is now part of the legal framework, enabling the use of scientific analysis in investigations of sexual offences, since Section 53A CrPC was enacted in 2005.
- Probative Weight: As mentioned in paragraphs 213 and 224, DNA findings are very persuasive unless the accused can establish errors in the collection or the procedures utilised to gather the samples. According to the court, the DNA profiles proved beyond a reasonable doubt that the defendant was associated with the site of the crime [46].
- Legal Criteria: The Court reiterated in paragraph 450 that, when properly collected and analysed, DNA evidence may constitute incontestable proof of guilt, subject to greater evidential and legal examination [47].

- The death sentences were affirmed by the Court, who relied on DNA evidence that was supported by eyewitness accounts and other circumstantial evidence. This means that scientific evidence may be used to convict people of terrible crimes.

VII. CONCLUSION

The role and admissibility of forensic evidence is changing in India's criminal justice system. Despite these challenges, the use of forensic evidence in a science-based, responsible, and ethical way is increasing. Forensic science, with the cooperation of scientific and legal experts and advances in technology, can play a significant part in the proper and effective administration of justice. The use of forensic evidence has several hurdles. Typical practical difficulties range from problems with infrastructure, problems with education, to complicated issues of law and science.

India's forensic infrastructure is plagued by under-staffing, lack of funding and lack of equipment. The judicial process might be hampered as a result of backlogs and delayed decisions. The federal and state governments have started making changes to forensic facilities in different ways, but these changes need to continue to meet the demand.

If the analysts who analyze the forensic evidence are not competent, then the evidence cannot be trusted. Continual education and training in state-of-the-art techniques is of the utmost importance. It is thought that knowledge gaps can be bridged and the quality of forensic practice in India can be improved by collaborating with foreign organisations and institutions.

Among the more specialist areas, which are expected to lead the way in Indian forensic science in the future is Neuro forensic science, the study of the relationship between criminal behaviour and neurological disorders. The Indian court has been receptive to the newer scientific methods, and therefore the credibility and validity of forensic evidence have increased significantly, as three new criminal laws were enacted in India recently, which has given a greater impetus to the role of forensic evidence in Indian criminal justice system. The incorporation of forensic knowledge into the legal system has made great strides forward with this development. The rules now emphasize the importance of verifying laboratory activities and require the forensic expert to be on scene as soon as information is received about a major crime. However, it is highly imperative to bolster the forensic system, with the adequate recruitment of trained experts, investment in their education and professional development, and an enhancement of their capacity, while ensuring the protection of people's rights and privacy. To minimize the use of fraudulent forensic reporting methods, the problems associated with sample coding and decoding need to be addressed. There is an urgent need to appoint a legally-empowered ombudsman for forensic services in India. Today, the forensic science in the country is flourishing and a new era of 'Viksit and Surakshit' Bharat is emerging.

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