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Admissibility of DNA Evidence in Criminal Trials: Comparative Analysis of the Daubert Standard, the UK Reliability Framework, and the Indian Evidentiary Vacuum

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ABSTRACT

This paper explores the manner in which DNA evidence has been and is admitted within criminal trial processes in India, in part by comparison with how it has been and is admitted in the USA and the UK. The paper's first objective is to identify and explain the prevailing approach to the legal admissibility of DNA evidence in India. This paper contends that, despite the important and sometimes conclusive nature of DNA evidence in matters of proof, Indian law does not yet offer it any special admissibility standards.

In contrast, the American Daubert model and the UK's regulatory framework both demand a reliability inquiry into the evidence long before the courtroom. This article accordingly suggests a five-factor admissibility standard for India to utilize, with a specific focus on forensic laboratory access, methodological exposure, statistical binary, chain-of-custody standards, and a judicial limine pre-trial admissibility hearing. The author concludes that such accommodation under Article 21 is a necessary obligation for the state to foster the social alignment of DNA science with fairness, legalism, and existing forensics in the criminal adjudicatory context.

Keywords: BSA, DNA evidence, Daubert standard, Forensic Science Regulator Act, NABL accreditation, and, forensic dependability.

I. INTRODUCTION

DNA profiling has proved to be one of the greatest advances in the contemporary criminal investigation that provides very precise methodologies of identifying individuals in both criminal and paternity cases. As forensic science has progressed, courts in jurisdictions have been turning towards DNA evidence due to its scientific accuracy. But the basic principle of criminal jurisprudence “*the guilt must be proved beyond reasonable doubt*” requires that this

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evidence must be not only relevant, but also demonstrably reliable.¹

In India, despite the fact that forensic techniques have become an inseparable aspect of criminal proceedings, the legal framework regulating the admissibility of DNA evidence is quite poor and disjointed. The laws of India in both the procedural and the evidentiary law, have relevant provisions on forensic evidence, but there is no unified standard of their application. Although DNA evidence is occasionally admissible in courts, it is seldom considered definitive, and its value as evidence requires proper collection, preservation, and analysis, and a chain of custody. Issues that often emerge are laboratory practice, inconsistent accreditation, and expert testimony inconsistencies. Here, the importance of expert evidence is critical. However, Indian law does not provide a transparent criterion under which reliability of scientific experts and the techniques they use could be assessed.² Consequently, they leave the stage of appreciation of evidence mostly to judicial discretion, instead of a formal pre-trial inquiry into the scientific soundness of the evidence. This lack of an established “gatekeeping role undermines the quality and predictability of admissibility rulings.

A comparative approach shows a more organized practice in other jurisdictions. The *Daubert v. Merrell Dow Pharmaceuticals* decision in the United States fundamentally redefined the law of expert evidence by imposing a *gatekeeping role on trial judges* to determine the reliability and relevancy of scientific evidence before it is admitted.³ Although not implementing a judicial test that is equivalent to *Daubert*, the United Kingdom has come up with a regulatory framework that enhances the quality and reliability of forensic evidence by institutional oversight, especially with the release of the Law Commission Report No. 325⁴ and the introduction of the Forensic Science Regulator Act 2021.⁵ Conversely, there is no similar standard in India that can be used to raise serious questions about the reliability and consistency of the DNA evidence use in a criminal trial. In the absence of an organized system to evaluate scientific validity at threshold stage, there is a chance of unequal judicial decisions and even miscarriage of justice. This paper will thus attempt to review the admissibility of DNA evidence under the Indian legal system⁶ and how incorporation of structured standards, based on the *Daubert* framework in the

¹ R. Chakraborty, *Criminal Jurisprudence* (3rd edn, Kamal Publishers (Lawmann's) 2023)

² *State of Haryana v. Bhagirath*, (1999) 5 SCC 96; *Daubert et ux., Individually and as Guardians ad Litem for Daubert, et al v. Merrell Dow Pharmaceuticals, Inc.*, 1993 SCC OnLine US SC 104.

³ *Unveiling the Truth: An In-Depth Look into the Forensic Criminal Justice System in India*, 5.2 JCLJ (2025) 41., <http://www.sconline.com/DocumentLink/NBmp4EG3>

⁴ Law Commission of England and Wales. (2011). *Expert evidence in criminal proceedings in England and Wales* (Law Com No. 325). The Stationery Office.

⁵ Forensic Science Regulator Act 2021, c. 26 (UK). <https://www.legislation.gov.uk/ukpga/2021/26/contents/enacted>

⁶ Venter, C. (2020). A critical review of the current state of forensic science knowledge and its integration in legal systems.

United States and the regulatory approach adopted in the United Kingdom, can enhance the integrity, reliability and judicial acceptance of DNA evidence in India.⁷

II. THE UNITED STATES: FRYE TO DAUBERT AND THE DNA STANDARD

A. Frye General Acceptance Test (1923)

Historically, the admissibility of scientific evidence in the United States was regulated by the *Frye* so-called “general acceptance test” that subcontracted the issue of reliability to the scientific community.⁸ This criterion says that expert testimony can only be admissible when there is a consensus in the technique behind it in its field of application.

Before the 1920s, the American courts assessed scientific evidence just like any other evidence with a fairly low standard. Scientific testimony was largely governed by the simple demands of relevance and witness competence as they were reflected in its early cases such as *Spring Co. v. Edgar*.⁹ But a paradigm shift came with the historic decision in *Frye v. United States*¹⁰ that the court could not admit polygraph evidence because it was not scientifically accepted enough. The court gave the view that a scientific principle could be hard to define yet it had to be adequately proved established to have come into widespread use in the specific field to which it pertains among those who are experts in the field and therefore, it had to be able to pass a threshold test. The Frye test had a fundamental change on the role of the judge. By removing the role of judges in determining scientific validity and putting it in the hands of domain experts, the latter can appreciate their inability to judge such technical issues on their own.

This standard was the prevailing principle of admissibility of expert evidence in the U.S. courts over a long time.¹¹ It demanded that the principles that lie behind the scientific technique be dependable, reproducible and rooted in good scientific arguments. This rule was critical in the case of DNA evidence. When DNA profiling first made its way into the US courtrooms, its judges, in the process of applying Frye test, made a granular analysis of the so-called scientific experts, so that profiling methods and statistical interpretation of said methods were not only accurate, but also universal.¹² Such a practice was perceptible in *People v. Castro*¹³ (1989) at

⁷ Primorac, Dragan. (2014). Forensic DNA Applications: An Interdisciplinary Perspective – a new book in forensic science. Croatian Medical Journal. 55. 434-436. 10.3325/cmj.2014.55.434.

⁸ *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923).

⁹ *Spring Co. v. Edgar*, 99 U.S. 645 (1879). United States Supreme Court.

¹⁰ *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923). United States Court of Appeals for the District of Columbia Circuit.

¹¹ Coulthard, M., May, A., & Sousa-Silva, R. (Eds.). (2020). The Routledge Handbook of Forensic Linguistics (2nd ed.). Routledge. <https://doi.org/10.4324/9780429030581>

¹² Venter, C. (2020). A critical review of the current state of forensic science knowledge and its integration in legal systems.

¹³ *People v. Castro*, 144 Misc. 2d 956, 545 N.Y.S.2d 985 (Sup. Ct. Bronx Cty. 1989). Supreme Court, Bronx

which the court engaged in an elaborate examination of the DNA testing procedures in order to ascertain their scientific validity.

Although the Frye standard had been dominant over decades, it was subject to much academic and legal criticism. It depends on general acceptance, which is likely to omit more recent scientific discoveries which may be valid but have yet to be widely accepted. Besides, the test does not give much guidance on the way courts ought to evaluate conflicting scientific opinions in a field.

These restrictions ultimately made the Frye test too inflexible to fit an age of swift technological change. Such deficiencies led to more liberal, judicially-varying Daubert Framework, attempting to bring scientific rigor and modernization of trial judge as a more contemporary form of gatekeeping.

B. Daubert v. Merrell Dow Pharmaceuticals Inc. (1993)

The decision of the US Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals*¹⁴ resulted in a paradigm shift of the law concerning admissibility of scientific evidence in the United States. Before this decision, courts were using the strict general acceptance standard established in *Frye v. United States* that restricted admissibility to methods that were generally accepted by the scientific community. The decision greatly changed the manner in which courts considered scientific testimony by shifting to a position of passive acceptance of expert opinion to a strict evaluation of the underlying science by the judge.¹⁵ In the case of Daubert, the Court established that the Federal Rules of Evidence (FRE) (Rule 702) replaced the limiting Frye Test. the court pointed out that scientific evidence had to meet two conditions of relevance and reliability. The court gave up the position of trial judge by making it the position of a gatekeeper, and the position required to guarantee that the testimony of an expert is scientifically sound and that it can be used in a proper manner to the facts at hand.¹⁶

In order to help the judges perform the gatekeeping task, the Supreme court has described a list of factors (which are not exhaustive) to identify whether a theory or technique is scientifically valid:

- a. Whether the theory or technique is or can be tested (whether it is falsifiable, refutable or

County, New York.

¹⁴ *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993). United States Supreme Court. The four Daubert factors (testability, peer review, error rate, general acceptance) are at pp. 593–594 of the opinion.

¹⁵ Federal Rules of Evidence, r. 702

¹⁶ Ridita Dey, 'Law of Forensic Evidence in India and Abroad: A Comparative Study' (2021) 4 (2) IJLMH accessed 15 November 2024

testable);

- b. Whether the theory or technique is peer reviewed;
- c. The error rate of a method that has been known or is possible;
- d. Whether or not the theory or technique is generally accepted.

All these together will guarantee that the expert evidence is based on the valid scientific principles and not speculative or unproven assertions.¹⁷

This standard was further expanded in *Kumho Tire Co. v. Carmichael*¹⁸ whereby the Court made it clear that the gatekeeping role is not solely applied to scientific evidence, but also to technical and other specialist evidence. This has led to a shift in American courts placing more emphasis on the methodological correctness of expert evidence, instead of just its findings, so as to decrease the chance of junk science or unproven forensic procedures being admitted.

C. Application Of the Daubert Standard to DNA Evidence

The Daubert standard has greatly affected how DNA evidence is evaluated in criminal trials in America. Since DNA profiling is technical and highly probative, the courts have always used the criteria of reliability in Daubert to make sure that this type of evidence is of the highest quality before it is presented to the jury. In this framework, the courts will examine, whether the DNA testing methods follow sound scientific principles, which are sufficiently tested and are backed by peer-reviewed studies. The attention of courts is especially focused on the due process of forensic laboratories, such as handling samples, documentation and statistical interpretation. This questioning is not only in the theory of DNA profiling but also in how the analysis is done in a particular case. Consequently, exclusion of evidence can occur due to problems like contamination, poor handling of samples and absence of transparency in the methods.

The adoption of the Daubert standard has also resulted in the courts using a more organized and scientifically intensive method of DNA evidence. DNA profiling should not be generally accepted, though, the courts must also require that the results obtained are backed up by the relevant statistical indicators, specifically the *Random Match Probability (RMP)* because a DNA match has little evidentiary value without showing that there is a probability that the match will occur by chance. Moreover, adherence to accepted scientific standards, such as compliance with guidelines provided by organizations such as the Scientific Working Group on DNA

¹⁷ Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993)

¹⁸ Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999). United States Supreme Court.

Analysis Methods (SWGDM) and accepted laboratory accreditation standards is considered a critical aspect of reliability.¹⁹ This method has been heavily informed by the *1996 report of the National Research Council, The Evaluation of Forensic DNA Evidence* which highlighted the need to have a clear methodology and sound statistical interpretation in the determination of DNA evidence.²⁰

Moreover, judicial decisions are an example of this scrutiny. The court in *People v. Castro* had gone through a comprehensive pre-trial study of the DNA testing process and emphasized the need to observe the accepted scientific standards. Although it appreciated, the overall validity of DNA identification, the fact that unreliable laboratory practices can compromise the evidentiary value was noted. On the same note, in *Schwartz v. State*²¹, DNA evidence was inadmissible because laboratory failed to report its procedures and data on which it was based thus making it impossible to verify independently.

The Daubert Standard helped to create more uniform and rigorous method of admissibility of DNA evidence through such a framework. Notably, it puts into the limelight the shifts of the emphasis on the absolute acceptance of DNA as a trustworthy science towards a more subtle question of the reliability of its application in the case in point. This method reduces chances of wrong conviction due to poor forensic techniques and the evidentiary value of DNA as an effective investigative resource remains intact.

III. THE UNITED KINGDOM: AN INSTITUTION-REGULATORY MODEL

A. The Common Law Reliability Requirement and *R v. Adams* Principle

In the United Kingdom, traditionally, the admissibility of scientific and expert evidence has been informed by the common law principle as opposed to a strict admissibility test. and not by a strict exclusionary test, English courts have concentrated on whether the evidence will be of effective help to them in solving the problem in question. Their strategy is based on expert testimony whose responsibility is to be independent, objective, and geared towards serving the court instead of representing one side or the other. These principles were set out in *The Ikarian Reefer*²², subsequently written into law in *the Criminal Procedure Rules, 2020*²³, which requires

¹⁹ Scientific Working Group on DNA Analysis Methods (SWGDM). (2017). Interpretation guidelines for autosomal STR typing by forensic DNA testing laboratories. FBI Laboratory. <https://www.fbi.gov/services/laboratory/biometric-analysis/codis/swgdam>

²⁰ National Research Council. (1996). *The evaluation of forensic DNA evidence*. National Academies Press. <https://doi.org/10.17226/5141>

²¹ *State v. Schwartz*, 447 N.W.2d 422 (Minn. 1989). Minnesota Supreme Court.

²² *National Justice Compania Naviera SA v. Prudential Assurance Co. Ltd (The Ikarian Reefer)*. [1993] 2 Lloyd's Rep 68 (QBD Comm Ct).

²³ Nick, I.M., & Blewitt, K.E. (Eds.). (2026). *The Routledge Handbook of Ethics in Forensic Linguistics* (1st ed.).

experts to report their methodology and be aware of the boundaries of their expertise.

Though the method is still flexible, it has been complemented by institutional guidance *The Law Commission Report No.325* that established four pillars of common law: assistance, relevance, impartiality, and expertise. the necessity to be transparent has been strengthened, e.g., in *R v. Dlugosz*, the court underlined that expert opinions should be based on provably sound and clear scientific methods.²⁴

Growing sophistications on DNA evidence, have presented special challenges. In the landmark case of *R v. Adams*²⁵, the Court of Appeal had to deal with the application of Bayesian statistical reasoning to interpret the DNA matches. The defense tried to introduce a mathematical model-*Bayes' Theorem*, in order to influence the jury to assess probability. This strategy was not accepted by the court who noted that such practices might complicate instead of helping the jury to understand what is being said. The decision stipulated that DNA profiles are highly convincing but need to be done in a simple and easy to understand format. This is to make sure that the jury is free to combine scientific evidence with their own common-sense rationale to balance detail with necessities of the justice system.

B. The R v. T Problem and The Limits of Statistical Interpretation.

The difficulties surrounding the interpretation of statistical evidence were even more evident in the case of *R v. T*²⁶. though the case involved footwear evidence, the reasoning provided by the Court has a wider applicability to forensic science, in general, and DNA analysis specifically. The Court of Appeal warned that where there is no credible statistical basis the application of likelihood ratios or Bayesian techniques might be unsuitable where such techniques can mislead the jury.

These issues are also applicable in the case of DNA evidence where statistical interpretation has a key role. Courts have noted that a DNA match alone is not significant until an explanation of how often such a match could occurrence within a specific population is provided. Simultaneously, the judiciary is worried about letting statistical models stand in the place of the evaluative role of the jury, there is a strong aversion to letting the numerical or probabilistic reasoning take over the role of fact-finding, especially when such approaches tend to give undue

Routledge. <https://doi.org/10.4324/9781003391074>

²⁴ “Law Commission of England and Wales, Expert Evidence in Criminal Proceedings in England and Wales, LAW COM No. 325 (2011)” ; *R v. Dlugosz* [2013] EWCA Crim 2.

²⁵ *R v. Adams*. [1996] 2 Cr. App. R. 467; [1996] EWCA Crim 222. Court of Appeal, Criminal Division (England and Wales).

²⁶ *R v. T*. [2010] EWCA Crim 2439; [2011] 1 Cr. App. R. 9. Court of Appeal, Criminal Division (England and Wales).

weight to the scientific evidence at the cost of other material facts.

These issues were identified by the Law Commission in its 2011 report, which recommended the implementation of a statutory reliability test of expert evidence, which would have required judges to determine whether expert evidence passed a minimum test of scientific validity. Nevertheless, the lack of legislative enforcement of this suggestion has exposed the UK to the will of the courts and standards of guidance. Consequently, the courts still embrace a balanced approach that treats statistical evidences as strongly probative, but as not to oust the overall assessment of all the available evidence.

C. The Forensic Science Regulator Act 2021: The Institutional Answer

The United Kingdom has established a strong institutional framework to ensure reliability and integrity of forensic evidence in lieu of a test of judicial admissibility. The United Kingdom has changed to a regulatory approach that considers scientific validity at the pre-trial phase through *Forensic Science Regulator Act 2021*.²⁷ It is one of the major developments that provide statutory power to the *Forensic Science Regulator (FSR)* ²⁸and that the Regulator may make binding Codes of Practice that regulate the quality standards in the field of forensic science such as the DNA analysis. Adherence of these codes has become a compulsory requirement of forensic service providers that are involved in the criminal justice system. This will see that the laboratories meet a set of standards in order to be accredited, apply validated scientific standards, keep good records and apply validated methodologies. Accredited facility forensic reports therefore have a presumption of procedural soundness, such that the courtroom attention is not on whether the science is valid, but whether a particular interpretation of the results is valid within the context of the case.

This institutional method greatly alleviates judicial work overload by lowering the complexity of the wearisome admissibility hearings in each case. This model is used in the UK to reduce chances of unreliable or mismanaged evidence being introduced into the court. In most respects, this methodology delivers a similar result as the Daubert standard, but via a regulatory test as opposed to a judicial one. Thus, the forensic evidence reliability is not presupposed but is constantly ensured with the help of organized control.

It is also governed by the *Protection of Freedoms Act, 2012* in addition to it this oversight

²⁷ Forensic Science Regulator Act 2021, c. 26 (UK).
<https://www.legislation.gov.uk/ukpga/2021/26/contents/enacted>

²⁸ Joseph, A., Rao, I., Singh, N. (2025). Enhancing forensic DNA quality: a comprehensive review of the integrated ISO centric standards from the crime scene to the courtroom. *Problems of Forensic Sciences*, 2025, 281-292. doi: <https://doi.org/10.4467/12307483PFS.24.017.21383>

functioning in parallel with *National DNA Database(NDNAD)* in the same act.²⁹ This act governs the use, storage and collection of DNA profiles. These mechanisms combine to form an overall system balancing investigative efficiency and procedural fairness and individual rights. *In toto*, these mechanisms create a comprehensive system that balances investigative efficiency with procedural fairness and individual rights.

UK Mechanism	Legal Source	Function
Expert independence duty	CPR 2020, Part 19	Requires disclosure of methodology and limitations
DNA match probability	R v. Adams [1996] [1998]	Court-comprehensible statistical presentation required
FSR Codes of Practice	FSR Act 2021	Statutory quality standards for DNA labs — mandatory compliance
Accreditation requirement	FSR Act 2021, §2	ISO 17025 accreditation required for DNA service providers
National DNA Database (NDNAD)	Protection of Freedoms Act 2012	Database governance with independent oversight

Uk institutional framework for DNA evidence

IV. INDIA: THE ANATOMY OF AN EVIDENTIARY LACUNA

A. The Procedural Landscape and Statutory Framework.

DNA profiling is among the most powerful forensic tools in contemporary criminal justice, where investigators can isolate and compare genetic materials on biological specimens such as blood, hair or semen to the reference samples. Where no profiled match is, a suspect can be conclusively ruled out but when there is a match, statistical models measure the likelihood of a chance match. Nonetheless, this accuracy does not mean that there is a specific law to govern the treatment and admissibility of DNA evidence in India. Rather the legal system is based on generalized statutes that were not originally intended to deal with the specifics of genetic evidence.

The law of DNA evidence is now shifting towards the new laws of a new legislative era that

²⁹ Protection of Freedoms Act 2012, c. 9 (UK). <https://www.legislation.gov.uk/ukpga/2012/9/contents/enacted>

replaces the colonial-era laws. The two main legal foundations- the Indian Evidence Act, 1872, and the Code of Criminal Procedure, 1973, are now substituted by the Bharatiya Sakshya Adhiniyam³⁰, 2023 and the Bharatiya Nagarik Suraksha Sanhita, 2023 (BNSS)³¹, but both of the new laws do not include rules that are specifically aimed at addressing.

BSA (previously in the Evidence Act) under Section 39 (previously under Section 45) establishes DNA evidence as opinion of persons, particularly skilled; it ranks alongside handwriting analysis or ballistics, thus creating a huge gap in reliability.³² Indian law does not clearly mandate that the prosecution demonstrate that a DNA profile was created under the scientifically validated procedures, that the lab was of international quality, or that the statistical information that they are using to declare that they have a match is founded on the use of relevant population databases. Even though Section 317 of the BNSS (previously Section 239 of the CrPC)³³ permits submission of forensic reports without the personal appearance of the analyst, subject to judicial discretion and under Section 176(3) of the BNSS forensic investigations become mandatory in the case of serious crimes, these provisions are about administrative procedure, not about scientific accuracy.³⁴

The growth of state power in this field is also emphasized by the *Criminal Procedure (Identification) Act, 2022 (CrPIA)*.³⁵ This act enabled *National Crime Records Bureau* to gather, store, process and share genetic information and expanded the list of individuals where biological measures, such as DNA samples, can be gathered without consent. This act was extremely important in raising the amount of genetic material to be presented in the justice system but it did not create any parallel protection of data privacy or accreditation of the laboratory.

Currently, there is no dedicated regulatory authority in India that could regulate the use of DNA, but an effort has been made to legislate on the topic with the “*DNA Technology (Use and Application) Regulation Bill, 2019*”.³⁶ The bill had suggested the creation of a regulatory body, required the accreditation of the DNA technology based laboratories, created a national DNA data bank with access grading and contained numerous safeguards to the DNA profiling information. The Bill lapsed when Parliament was dissolved in 2023 but no other legislation

³⁰ Bharatiya Sakshya Adhiniyam, No. 47 of 2023 (India).

³¹ Bharatiya Nagarik Suraksha Sanhita, No. 46 of 2023 (India).

³² BSA s. 39: Bharatiya Sakshya Adhiniyam, No. 47 of 2023, s. 39 (India).

³³ BNSS s. 317: Bharatiya Nagarik Suraksha Sanhita, No. 46 of 2023, s. 317 (India).

³⁴ BNSS s. 176(3): Bharatiya Nagarik Suraksha Sanhita, No. 46 of 2023, s. 176(3) (India).

³⁵ Criminal Procedure (Identification) Act, 2022, No. 11, Acts of Parliament, 2022 (India).

³⁶ DNA Technology (Use and Application) Regulation Bill, 2019 (India). Bill No. 28 of 2019.

has been passed in its place.

B. Judicial Treatment: Recognition without Regulation

The Indian jurisprudence regarding DNA evidence represents a slow, yet cautious development - one which acknowledges the increased significance of forensic science, but nonetheless does not develop a definite and consistent evidentiary standard. Throughout the decisions, the use of DNA profiling by the courts has been increasingly accepted as an effective investigative instrument although their treatment of admissibility has been largely ad hoc and therefore a haphazard collection of case law has been created.

The judiciary took a conservative approach in its initial years. In *State of Haryana v. Bhagirath*³⁷, the Supreme Court considered expert opinion, such as DNA evidence, to be insufficient in nature, unless corroborated by other means. This hesitation extended to subsequent cases like *Santosh Kumar Singh*³⁸ and *Mukesh*³⁹ where DNA evidence was recognized to be highly probative, especially in serious crime cases but still in a corroborative capacity. Although it might be the most powerful piece of evidence, DNA has seldom been considered as such, which shows that the courts tended to consider it a component of a larger evidentiary context instead of making it occupy the position of a standalone piece of evidence.

Meanwhile, the procedural integrity of forensic evidence has been highlighted by another line of jurisprudence. The *Vikram Singh case*⁴⁰, where the DNA evidence was thrown out because of the chain of custody lapses, was an eye opener to the fact that even scientifically sound evidence could be compromised by the lack of procedures. Likewise, *State of Gujarat v. Kishanbhai*⁴¹ brought to light the systemic problems in preservation of evidence, and emphasized the necessity of enhanced forensic responsibility. The cases show that the courts are not merely interested in the scientific basis of the DNA profiling, but also the validity of the procedures in which such evidence is processed. Nevertheless, although these determinations emphasize the need of protective measures, they do not have written standardized procedures, so their implementation is mostly improvised.

This landscape is also predetermined by the constitutional aspect. In *Selvi*⁴², the Court also placed restrictions on the use of involuntary forensic methods by basing them on the safeguarding against testimonial compulsion in Article 20(3). This was subsequently explained

³⁷ *State of Haryana v. Bhagirath*, (1999) 5 SCC 96.

³⁸ *Santosh Kumar Singh v. State*, (2010) 9 SCC 747.

³⁹ *Mukesh v. State (NCT of Delhi)*, (2017) 6 SCC 1.

⁴⁰ *Vikram Singh v. State of Punjab*, (2010) 3 SCC 56.

⁴¹ *State of Gujarat v. Kishanbhai*, (2014) 5 SCC 108.

⁴² *Selvi v. State of Karnataka*, (2010) 7 SCC 263.

in *Ritesh Sinha*⁴³ and re-enforced in *Rahul Aggarwal*⁴⁴, with DNA and other material of the same type classified as physical, non-testimonial material, so as to reinforce their admissibility. However, despite these determinations clearing up some ambiguous issues in the constitution, they fail to answer the larger question on how such evidence should be systematically judged by the courts.

Combined, the comparative analysis of judicial tendencies shows that there is a definite trend: Indian courts acknowledge the evidentiary nature of DNA and have added valuable principles connected with corroboration, chain of custody, reliability, and constitutional boundaries. Nevertheless, these principles are not consolidated into a single legal standard but are still dispersed in the decisions. Scientific reliability or admissibility is yet to be tested using a standardized or formalized test. Indian legislation on DNA evidence can, therefore, be conceived as a kind of recognition and no regulation law- where practice has grown ahead of the formulation of a systematic and predictable evidentiary system.

C. Structural And Regulatory Deficiencies in DNA Evidence: Procedural Lapse to Fair Trial Issues

In addition to the ambiguity of the doctrines, the effectiveness of DNA evidence in India is undermined by institutional weaknesses in sample collection, storage, and analysis. Because all a DNA profile can be is as good as the integrity of the process, the failure of any segment in the chain of custody can jeopardize the fairness of a trial.

Courts have realized such gaps and the Supreme Court ruling in the case of *Katvelli@Devakar v. State of Tamil Nadu* (2025)⁴⁵ provides detailed instructions on how DNA evidence is handled. These standards require close attention to record keeping of sample collection, case details and validation by the appropriate authorities; transportation of samples to forensic laboratories within a stipulated time; stringent preservation measures that prevent any unauthorized handling and storage; and the upkeep of an official chain of custody list that captures all evidence transfers. The court also highlighted that investigating officers should be systematically trained and that the forensic procedures should also be standardized across jurisdictions. Although these guidelines are a huge judicial intrusion, they are not statutory. They are not legally binding and therefore have no legal penalties against non-compliance which means they are not consistently adopted in different states and agencies. A formal legislative framework cannot be substituted

⁴³ *Ritesh Sinha v. State of Uttar Pradesh*, (2019) 8 SCC 1.

⁴⁴ *Rahul Aggarwal v. The State of West Bengal & Anr.*, 2025 LiveLaw (SC) 1002.

⁴⁵ *Kattavellai @ Devakar v. State of Tamil Nadu* (2025) LiveLaw (SC) 703.

by judicial intervention, which can only bring these needs into the limelight.

India's forensic infrastructure encounters major shortcomings that have rendered to use DNA technology in real life. There are huge backlogs in criminal analysis because there aren't sufficient trained people and there are not any standard accreditation standards. Quality is indicated with accreditation, but not a precondition to use forensic reports as evidence in court. This creates a very dangerous situation as a growing legal demand to have a mandatory forensic test done on serious crimes might place an unwarranted strain on an already overloaded system. The push to use more DNA evidence might result in less quality evidence, unless the push is supported by the right institutions, because the evidence may be contaminated or misinterpreted, and this may result in false convictions.

V. COMPARATIVE ANALYSIS AND THE EMERGING CASE OF LEGISLATIVE CHANGE

A. Three Jurisdictions, Two Models, One Common Principle.

In a comparison of the legal systems of the *United States, the United Kingdom, and India*, the most basic difference can be seen in the manner in which the DNA evidence is treated. Although the three countries cherish the abilities of genetic testing, the U.S and the U.K have shifted towards a system that requires proving reliability of scientific evidence before it is accepted. In opposition to this, India continues to follow a model that is based on judicial discretion, where emphasis is made more on the applicability of the evidence, rather than its scientific accuracy.

The American system does this by way of Daubert Standard, which turns judges into gatekeepers who should consider evidence in terms of peer review, error rates and testability prior to the commencement of a trial. The British system attains it by using quasi-structured model whereby statutory rules and independent forensic regulator are used to assure standards. These two models both guarantee that DNA evidence is thoroughly vetted prior to it having an effect on a verdict. India achieves neither.

India, however, applies more general principles of evidentiary analysis based on the Bharatiya Sakshya Adhiniyam, 2023, in which DNA analysis is considered a general opinion of an expert.

The main differences between the law of the United States, the United Kingdom, and India revolve around the principles of reliability underlying the law and the place of judiciary in the screening of scientific evidence.

- **The criterion of reliability and judicial supervision:**

The greatest point of departure is the standard governing and who is to evaluate the scientific validity. In the United States, both the *Daubert Standard* and the *FRE Rule 702* require the trial

judge to serve as a gatekeeper, requiring evidence to pass peer review and testability requirements.⁴⁶ A comparable degree of scrutiny is ensured in the United Kingdom by the FSR Act 2021 and CPR Part 19⁴⁷, with a special Forensic Science Regulator and the responsibility of the expert to the court placed as the main protections. In contrast, India is governed by Section 39 of the BSA (and Section 45 of the IEA) which does not have a particular level of reliability threshold; as such, there is no specific person or body to determine scientific validity and instead reliability is presumed in the law.

- **Laboratory Standards, Disclosure and Methodology:**

One of the areas of divergence is on the transparency of the methodology and laboratory accreditation. The U.S. and the U.K. both demand strict disclosure of methods and rates of error, under Daubert Factors and FSR Codes of Practice, respectively, so that the court can make a decision about the how of the science. Moreover, in such Western jurisdictions laboratory accreditation is a pre-requisite, with the U.S. imposing compliance with ASCLD/SWGDAM and the U.K. with ISO 17025. Under the Indian system, though, neither methodology nor disclosure of error rate is necessary as a precondition of admissibility. Although the NABL accreditation could be granted in India, the evidence is not obligatory regarding the court.

- **Statistical Probability and Burden of Proof**

The last criteria of divergence relate to the treatment of statistical probability and the weight of burden of proof to be admissible. The U.S. and U.K. systems impose the legal obligation on the prosecution to prove reliability prior to the trial of the evidence, and see the British case of *R v. Adams* as a typical example of requiring the presentation of the *Random Match Probability (RMP)* in a form accessible to a layperson. India, on the other hand, operates under a presumptive admissibility model, which is backed by Section 317 of the BNSS; under which statistical probability is not a compulsory measure to admissibility. This is to say that whereas in Western countries a match has to have a statistical denominator to ensure that it is not a simple claim, in India courts can admit DNA evidence in the absence of a standardized means of ensuring its scientific validity.

This comparison shows that there is a structural difference between Indian and Western Jurisdictions in terms of scrutinizing DNA evidence. In the US and the UK, both the prosecution

⁴⁶ Swift, E. (2000). One Hundred Years of Evidence Law Reform: Thayer's Triumph. *California Law Review*, 88(6), 2437–2476. <https://doi.org/10.2307/3481220>

⁴⁷ Nsiah Amoako, Emmanuel, McCartney, Carole, "The UK forensic science regulator: Fit for purpose?", *WIREs Forensic Science*, 2021

and the defense have the legal burden of demonstrating scientific reliability of evidence before it is accepted into court. In the United States and the United Kingdom, the legal burden is on the prosecution to prove scientific reliability before evidence is admitted. This is by either compulsory judicial gatekeeping (the Daubert Standard in the U.S.) or statutory regulation by a forensic science regulator in the U.K. these systems impose pre-determined and rigorous admissibility tests based on scientific validation inclusive of disclosures of error rates, methodology and statistical probability , and lab accreditation (ISO/ASCLD) is strictly mandatory to ensure scientifically By contrast, India functions under a presumptive admissibility model, reliability is not a legal requirement or even regularly questioned.

This difference shows that in theory, Indian courts accept DNA evidence, but there is no standard method to verify the scientific integrity of such evidence, which further worsens the evidentiary vacuum. The absence of formal standards not only causes inconsistency in the cases, but also implies that judges must overly depend on their own interpretations rather than on objective scientific standards.

B. The Weakness of the Corroboration Principle

It might be said that the tendency of the Indian judiciary to consider DNA evidence as corroborative instead of conclusive offers a viable alternative to an explicit standard of reliability. The reason behind this is that, should the courts fail to convict using the DNA evidence alone, but require alternative supporting evidence to support the evidence, the dangers that such forensic analysis can never be relied on are kept at a bare minimum.

This argument is not so strong as it may appear to be at first sight due to four reasons.

To begin with, the corroboration principle addresses weight to be placed on DNA evidence once it has been presented, rather than whether it should be presented in the first place. Methodologically flawed evidence is not made reliable merely because it conforms itself to other aspects of evidence. The fact that weak or unverified information is built up can never substitute a wide-ranging enquiry on scientific validity.

Second, the practice is not the same to all. Well-presented DNA evidence seems to some benches as virtually conclusive, particularly where the defence lacks conflicting forensic evidence- a common occurrence given that accused individuals frequently cannot afford independent analysis.

Third, DNA evidence is commonly viewed as a perfect testimony, in part due to its scientific jargon, and the high level of credibility of the government-operated laboratories. But these pieces of evidence can be rested on unvalidated methodologies, inaccurate methods of analysis

or statistically invalid interpretations based on inappropriate population databases. The requirement of corroboration does not challenge any of these problems: it merely puts the evidence into a more extensive set of facts without looking at its scientific foundation.

Fourth, even the principle of corroboration cannot prevent the particular risk that the Daubert framework is aimed at: evidence that appears authoritative due to being stated in scientific terms and being officially certified, but that is actually founded on a proven methodology or analysis performed in an erroneous manner.

The Indian approach basically substitutes evidentiary precaution with scientific examination, and the basic question of whether the DNA evidence has passed minimal standards of reliability remains open.

C. Five-Factor Statutory Standard

The above discussion justifies the legislative action. The question of whether reform is necessary or not is now replaced by what kind of a structure this should be in the actualities of Indian criminal courts.

Using the model of the Daubert used in the United States wholesale might appear attractive, though it is not likely to be effective in India. The American system is based on trial judges who serve as the gatekeepers and who make profound scientific evaluations prior to a trial being started. This is effective when the caseloads are manageable and the judges are trained in forensic investigative techniques, in India where the trial courts are overworked a request to the sessions judge to personally certify himself on the finer points of the STR kits or population genetics would probably bring more confusion than enlightenment. The UK's approach offers a much more realistic blueprint for India. Instead of subjecting the judge with the scientific burden, the UK emphasizes a source. They demand the forensic laboratories to comply with some quality standards before even their reports will find their way to the courtroom. The UK model has the basis in India. The NABL is based on ISO 17025 requirements- the very same standard that the UK is basing on. It is not science that India is lacking; it is the law. This accreditation is today more a gold star than a necessity in order to get evidence in court.

Indian law is not unfamiliar with the concept of needing to be certified prior to admitting evidence. As a matter of fact, it is already a proven term within the context of electronic evidence. In accordance with *Section 65B of the Bharatiya Sakshya Adhiniyam*, digital records should be signed with a certificate that they are authentic and complete. This has been

emphasized by the Supreme Court in a number of cases such as *Anvar P.V. v. P.K. Basheer*⁴⁸ and *Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantyal*⁴⁹. This argument is a good analogy to forensic evidence, especially DNA profiling. When the courts demand strict certification even of electronic records, it is hard to explain why a more lax attitude to DNA evidence, which is scientifically tricky and can have a far-reaching impact on the freedom of an individual, should be justified. A similar requirement, e.g. compulsory NABL or ISO 17025 accreditation of forensic laboratories, would make sure that the soundness of the DNA evidence is institutionally confirmed in the first place. This would enhance the reliance on judicial discretion and introduce greater consistency, credibility, and scientific rigour to the admissibility of forensic evidence in India.

It is against this backdrop that a five-factor criterion is suggested as an amendment to the Bharatiya Sakshya Adhiniyam, 2023. These standards are intended to be simple to check, effective to our institutions and based on the current Indian legal customs.



Five-factor statutory standards

The proposed framework proposes a means through which the Indian forensic law can be enhanced without complicating the matter. Currently, DNA evidence is considered as a wide umbrella of the so-called expert opinion, and places far too much in the hands of the individual judge. That is what this model does. It ensures that there are regulations such as lab accreditation

⁴⁸ *Anvar P.V. v. P.K. Basheer*, (2014) 10 SCC 473.

⁴⁹ *Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantyal*, (2020) 7 SCC 1.

and clear methodology to preclude science even before it reaches the judge. An aspect of this approach is that it makes use of what is already familiar to our legal system. Based on the certification model applied to electronic evidence in Section 65 B IEA/ it suggests a corresponding certificate of chain of custody of DNA be issued, and thus the transition to the practice of the same will be easier.. Notably, the framework demands statistical clarity, whereby a DNA match is not confused to be a certainty but is offered with an appropriate probability. Simultaneously, this does not add any unnecessary complexity, as it introduces a triggered system of scrutiny-where in-depth scrutiny is only necessary in case the evidence is contested. By doing so, the model ensures scientific reliability and keeps the judicial efficiency intact, balancing rigor and practicality in a practical manner.

VI. CONCLUSION

The comparison that has been made in this paper provides a result that is easy and expansive. Two of the three systems examined have come up with resolved solutions to the acute problem of courts establishing the scientific reliability of the DNA evidence: one through judicial gatekeeping, and the other through institutional regulation. The third one has not pondered on this question.

The use of the Indian Evidence Act (or its equivalent in the Bharatiya Sakshya Adhiniyam)⁵⁰ Section 45 by India is a mismatch of category since it is most often linked to introducing DNA evidence. This was intended to be a device of what a good man thought about art or science in the early 1800s. It was by no means intended to be used in problems of automated genetic profiling system output, electropherogram interpretation, and random match probability in population databases. Using it in this manner is comparable to playing a video game with a gun without ever having the thought of shooting anyone offline.

The implications of mismatches like this are very real. Indian courts have stated sentences that even extend to death and life imprisonment, and have made decisions of the paternity and identity, in some cases where DNA evidence that was presented would not have passed a Daubert test in the U.S. or would not even have been obtained from a lab that is accredited under British FSR standards. Notably, this does not imply that these decisions were inaccurate, since DNA profiling, often reliable, is being used even in India's current state of institutions. However, reliability that has not been tested doesn't provide a guarantee, it is just a mere assumption. Assumptions must be substituted by proven guarantees in criminal trials, where the

⁵⁰ Indian Evidence Act, No. 1 of 1872, s. 45 (India). (Repealed and replaced by the Bharatiya Sakshya Adhiniyam, 2023.)

life and freedom of the accused depend.

The five-factor statutory test that the Indian legislature is being offered to adopt resembles the method adopted by the United States Congress in their amendment of *Federal Rule of Evidence 702*⁵¹, and the Parliament at Westminster in the creation of the Forensic Science Regulator Act 2021: to insist on the presence in criminal cases of a credible assurance that there are no methodological issues. India has the institutional capability to implement this with the help of NABL. It has a constitutional responsibility under Article 21⁵². What is missing is the legislation that makes these two things link.

Forensic gold standard can only be as good as the legal standard that it is so. A model of the Indian criminal courts should have the option of DNA evidence to be presented in the records since the science is proven- just a report by a government laboratory is insufficient.

⁵¹ Federal Rule of Evidence 702. (2023). In Federal Rules of Evidence. United States Courts. <https://www.uscourts.gov/sites/default/files/rules-of-evidence.pdf>

⁵² Constitution of India, art. 21.