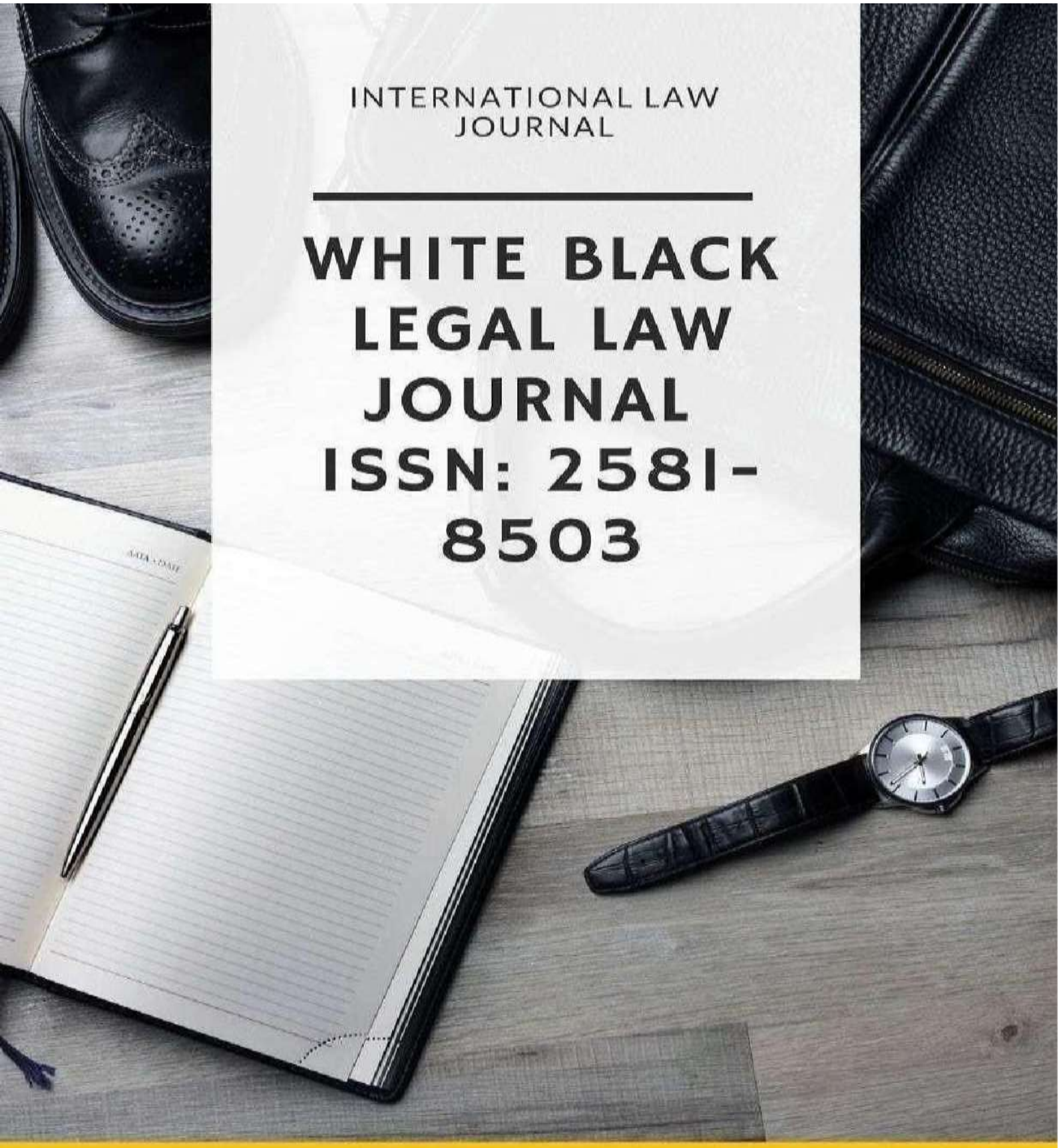

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WHITE BLACK LEGAL is an open access, peer-reviewed and refereed journal providededicated to express views on topical legal issues, thereby generating a cross current of ideas on emerging matters. This platform shall also ignite the initiative and desire of young law students to contribute in the field of law. The erudite response of legal luminaries shall be solicited to enable readers to explore challenges that lie before law makers, lawyers and the society at large, in the event of the ever changing social, economic and technological scenario.

With this thought, we hereby present to you

SCIENCE ON TRIAL: THE ROLE OF JUDICIARY IN ASSESSING FORENSIC EVIDENCE IN SEXUAL OFFENCE CASES.

AUTHORED BY: - NEHA
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Abstract

Scientific evidence has become indispensable in prosecuting sexual offences in India. With advancements in forensic science, DNA profiling, medico-legal examinations, and electronic evidence are now critical tools. However, their efficacy depends on how the judiciary interprets and applies them during trials. This paper analyses the judicial approach toward evaluating scientific evidence in sexual offence cases, the challenges faced, and the evolution of jurisprudence in this sensitive domain. It also explores the balance courts must maintain between scientific precision and the rights of victims and accused.

Keywords: Scientific evidence, sexual offences, judiciary, forensic medicine, DNA evidence, judicial interpretation, Indian courts.

Research Methodology

This research adopts the doctrinal legal research methodology. Doctrinal research is traditionally used in legal studies to analyze and synthesize legal principles, statutes, case laws, and scholarly commentaries. The objective is to critically evaluate how the judiciary interprets and applies scientific evidence in cases of sexual offences, especially in light of evolving legal standards and forensic technologies.

1. Introduction

The landscape of criminal jurisprudence in India has undergone a significant transformation with the increasing reliance on scientific and technological advancements in the administration of justice, particularly in cases of sexual offences. Scientific evidence once seen as ancillary to eyewitness accounts has now emerged as a powerful tool for both establishing guilt and ensuring the protection of the innocent. In sexual offence cases, where there are often no

independent witnesses and the testimony of the survivor is central, forensic and medical evidence has begun to play an instrumental role in either corroborating or challenging the narrative put forth before the court. In this complex legal matrix, the judiciary serves as the final arbiter in evaluating and interpreting scientific evidence to arrive at fair and reasoned conclusions.

Historically, the adjudication of sexual offences was largely dependent on subjective interpretation of survivor testimony, often clouded by societal prejudices and stereotypes. The absence of physical injuries was frequently interpreted as a lack of resistance or consent. Such narrow and patriarchal perspectives often led to miscarriage of justice. Over time, with the emergence of forensic science—including DNA profiling, toxicology, and digital evidence—there has been a notable shift in how courts perceive and assess evidence in these cases. The transformation from testimonial to scientific paradigms has, however, posed new challenges, particularly in ensuring that judges, lawyers, and investigators are adequately trained to understand and appreciate complex scientific submissions.

In India, the introduction of scientific evidence into criminal trials can be traced back to the adoption of colonial-era laws, notably the Indian Evidence Act, 1872. Sections 45 and 46 of the Act provide for expert opinions in fields such as medicine, science, handwriting, and digital technology. Yet, despite the legislative intent, the practical application of these provisions has often been marred by inconsistencies in forensic procedures, delays in testing, questionable chain of custody, and limited awareness among judicial officers. The result has been a mixed record—while some cases have seen convictions based on robust DNA or medical evidence, others have resulted in acquittals owing to technical lapses or misinterpretation of reports. The rise in crimes against women, especially sexual violence, has prompted legislative and institutional reforms in recent decades. The Criminal Law (Amendment) Act of 2013, passed in the wake of the Nirbhaya gang rape case, expanded the definition of rape and introduced mandatory guidelines for forensic and medical examination of victims. Further, the Protection of Children from Sexual Offences Act (POCSO), 2012, and the latest criminal law codes the Bharatiya Nyaya Sanhita, 2023 (BNS), Bharatiya Nagarik Suraksha Sanhita, 2023 (BNSS), and Bharatiya Sakshya Adhiniyam, 2023 (BSA) have sought to streamline evidentiary procedures and bring greater scientific rigor to criminal trials. However, the judiciary's ability to navigate these changes effectively remains a matter of ongoing scrutiny and debate.

The role of the judiciary in this evolving framework is not merely passive. Judges are expected to critically evaluate expert testimonies, understand the reliability and admissibility of forensic results, and apply evidentiary standards such as "beyond reasonable doubt" without losing sight of the trauma faced by survivors. Moreover, in an adversarial system like India's, the judge must maintain a delicate balance between skepticism toward scientific claims and deference to genuine expert analysis. It is in this interpretative space that the judiciary exercises its discretion deciding what constitutes credible scientific evidence, whether its collection and preservation were legally valid, and how much weight it deserves in the overall matrix of the trial. Numerous landmark cases have shaped judicial thinking on this subject. For instance, in State of Punjab v. Gurmit Singh, the Supreme Court stressed that the absence of injuries does not discredit the survivor's testimony. In Santosh Kumar Singh v. State through CBI, the conviction rested heavily on DNA evidence, reaffirming its significance in sexual offence trials. At the same time, cases like Tukaram v. State of Maharashtra (the Mathura rape case) highlighted the deep-rooted flaws in how courts historically viewed both testimony and medical evidence. These decisions underscore the evolving, and at times inconsistent, judicial approach toward scientific evidence. As India moves toward modernizing its criminal justice system, the need for a judiciary that is scientifically literate, gender-sensitive, and procedurally aware has never been greater. The success of any forensic or technological innovation ultimately depends on how well it is understood, appreciated, and applied by the courts. This research, therefore, seeks to critically examine the role played by the Indian judiciary in assessing scientific evidence in sexual offence cases, with a view to identifying gaps, highlighting best practices, and recommending systemic reforms.

2. Concept of Scientific Evidence in Sexual Offences

Sexual offences are among the most heinous crimes that not only affect the bodily autonomy and dignity of the victim but also leave long-lasting psychological and social scars. In adjudicating such offences, courts have traditionally relied on the testimony of the victim and circumstantial evidence. However, with the advancement of forensic science and technology, scientific evidence has emerged as a powerful tool in corroborating the survivor’s testimony, establishing the identity of the perpetrator, and ensuring fair and accurate justice. Scientific evidence, when correctly obtained and judiciously evaluated, offers objectivity, precision, and credibility to a criminal trial particularly in cases of sexual offences where direct evidence or eyewitness testimony is rare. Scientific evidence refers to information derived through

systematic, replicable, and verifiable scientific methods, including observation, experimentation, testing, and analysis. It includes physical, biological, and digital materials that can be tested using recognized scientific techniques. In the context of sexual offences, it typically includes:

- Forensic medical evidence (e.g., injuries, semen, vaginal swabs)
- DNA profiling
- Toxicology reports
- Electronic and digital evidence (e.g., CCTV footage, GPS records, chats, emails)
- Clothing, hair, and trace evidence

The main objective of using scientific evidence in sexual offence cases is to support or refute claims made by the parties involved by offering an objective assessment of the facts. It acts as a supplement to oral evidence, thereby strengthening the case and aiding the judge in reaching a reasoned and fair conclusion.

Types of Scientific Evidence in Sexual Offence Cases

1. Medico-Legal Evidence

One of the earliest and most critical forms of scientific evidence in sexual offences is the medico-legal examination of the victim and, where available, the accused. This includes examination of the genitals, collection of biological samples, documentation of physical injuries, and preparation of a medico-legal report (MLR).

- Genital and bodily injuries may support the claim of force or resistance.
- Swabs and smears from vaginal, anal, and oral cavities are examined for presence of semen, spermatozoa, and foreign DNA.
- Torn clothing, bruises, bite marks, or lacerations may also indicate struggle or assault.

However, it is critical to remember that absence of physical injuries does not disprove rape, especially in cases involving minors, persons with disabilities, drug-facilitated assaults, or where the survivor was unconscious or intimidated into submission. The Indian judiciary, especially post-2013, has increasingly moved away from rigid insistence on physical resistance and instead adopted a more nuanced understanding of consent and trauma.

2. DNA Profiling

DNA evidence has emerged as the gold standard in identifying perpetrators of sexual crimes. It involves extracting DNA from biological samples (blood, semen, saliva, skin, hair) and

matching it with the DNA profile of the accused. In India, the use of DNA evidence was first judicially recognized in Santosh Kumar Singh v. State through CBI, where the Delhi High Court and subsequently the Supreme Court relied on DNA to convict the accused. DNA evidence is often considered highly reliable because of its near-unique identification capability—except in cases involving identical twins. The DNA Technology (Use and Application) Regulation Bill, 2019, although still pending, seeks to regulate the use of DNA technology for identifying victims, accused, and missing persons. The bill emphasizes privacy, consent, and regulated use, showing the potential of DNA as both a tool of justice and a domain requiring stringent safeguards.

3. Toxicology Reports

In several sexual offences, especially those involving drug-facilitated sexual assault (DFSA), toxicological evidence becomes crucial. Substances such as alcohol, benzodiazepines, rohypnol, GHB (gamma-hydroxybutyrate) are commonly used to sedate victims. Blood and urine samples, if collected in time, can help establish the presence of such substances in the victim's system.

The Indian context, however, presents challenges—delayed reporting, poor awareness among medical personnel, and limited availability of advanced toxicology labs often make such evidence unusable. Judicial recognition of these challenges can be seen in cases where courts have directed time-bound medical examinations and preservation of samples.

4. Electronic and Digital Evidence

With the increasing digitalization of life, digital trails such as WhatsApp messages, call records, GPS data, emails, and CCTV footage have become vital forms of corroborative evidence.

For example: Call Detail Records (CDRs) may establish location and contact patterns. CCTV footage may visually capture events or movements. Digital chats and messages may reveal coercion, threats, or grooming patterns.

Under the Information Technology Act, 2000, read with Section 65B of the Indian Evidence Act, electronic evidence is admissible, provided it is accompanied by a certificate of authenticity. However, courts often struggle with the technicalities involved in verifying digital evidence, chain of custody, and safeguarding against manipulation.

3. Significance of Scientific Evidence in Sexual Offences

Scientific evidence performs multiple roles:

1. Corroborates the Survivor's Account: Scientific findings can support the testimony of the victim, thereby enhancing the credibility of the narrative.

2. Identifies the Offender: DNA and trace evidence can link the accused to the scene of crime or the victim.

3. Refutes False Accusations: Objective evidence may also exonerate the falsely accused by disproving the presence or contact.

4. Minimizes Witness Reliance: In cases where the victim is traumatized, unconscious, or unable to testify, forensic evidence becomes essential.

4. Judicial Approach to Scientific Evidence in India

The Indian judiciary has historically exhibited a cautious yet evolving approach to scientific evidence in criminal trials, particularly in cases involving sexual offences. Scientific evidence, though rooted in objective facts and technologies, must be interpreted through the lens of legal admissibility, relevance, and credibility. The judiciary plays a crucial role in assessing not only the technical correctness of such evidence but also its utility in corroborating the broader narrative of the case. With the enactment of the Bharatiya Sakshya Adhiniyam, 2023 (BSA) which replaces the colonial-era Indian Evidence Act, 1872 India has taken a significant step toward modernizing its evidentiary framework. The BSA emphasizes clarity, digital compatibility, and integration of scientific advancements in criminal trials. Sections relevant to scientific and expert evidence in the BSA include:

Section 39: Recognizes the opinion of experts in fields such as science, medicine, and digital forensics.

Section 40: Pertains to facts bearing on the opinions of experts.

Section 63: Allows for admissibility of electronic and digital records, aligning with current technological realities.

These provisions empower the judiciary to consider expert and scientific inputs on par with oral or documentary evidence, provided the evidence meets procedural.

Evolving Judicial Trends

Over the years, courts have moved from a narrow, suspicion-laden view of scientific evidence to a more informed and nuanced engagement. In State of Punjab v. Gurmit Singh [(1996) 2

SCC 384], the Supreme Court emphasized that absence of injuries or medical evidence does not negate the occurrence of rape. Similarly, in Santosh Kumar Singh v. State through CBI [(2010) 9 SCC 747], DNA evidence was pivotal in overturning the earlier acquittal and securing a conviction. The judiciary has also cautioned against overreliance on science without adequate procedural safeguards. In State of Himachal Pradesh v. Jai Chand [(2008) 11 SCC 157], the Court reaffirmed that medical or expert opinion is merely corroborative and must be assessed in conjunction with other material facts.

Current Judicial Standards Under BSA

Under the Bharatiya Sakshya Adhiniyam, 2023, courts are expected to:

1. Scrutinize the credibility of expert witnesses: Courts now assess not just the content but also the qualifications, neutrality, and consistency of expert testimony.
2. Ensure the chain of custody: In forensic and DNA evidence, judicial recognition of sample integrity and procedural compliance has become a key standard for admissibility.
3. Promote digital authentication: The BSA strengthens the admissibility of digital evidence with clearer certification requirements under Section 63, helping courts verify electronic data with greater confidence.

1. Admissibility under the Indian Evidence Act, 1872

Sections 45 and 46 of the Indian Evidence Act, 1872 deal with expert opinion and its relevancy. Courts are not bound by expert evidence but must assess it carefully in light of all circumstances. In State of Himachal Pradesh v. Jai Chand [(2008) 11 SCC 157], the Supreme Court emphasized that medical evidence is only corroborative and cannot replace ocular testimony.

2. Medico-Legal Evidence

The judiciary has often been criticized for misinterpreting medical reports. In State of Punjab v. Gurmit Singh [(1996) 2 SCC 384], the Court rejected the necessity of physical injuries as proof of rape, recognizing the complexities involved in trauma responses. Similarly, in Tukaram v. State of Maharashtra [(1979) 2 SCC 143], the infamous Mathura rape case, the absence of injuries led to acquittal, later criticized for ignoring psychological trauma.

3. DNA Evidence

DNA has become the gold standard. In Santosh Kumar Singh v. State through CBI [(2010) 9

SCC 747], DNA played a decisive role in convicting the accused. However, courts have held that DNA evidence must be subjected to strict standards of admissibility, such as proper collection and non-contamination.

4. Digital and Circumstantial Evidence

The Information Technology Act, 2000, allows the inclusion of electronic records. In Mahender Singh Dahiya v. State of Haryana [(2011) 3 SCC 109], call detail records (CDRs) were crucial in establishing location and movement.

5. Challenges in Judicial Assessment of Scientific Evidence

Despite the increasing reliance on scientific evidence in sexual offence trials, the Indian judiciary faces numerous challenges in its effective assessment and application. These challenges are not merely procedural or technological—they also stem from deep-rooted structural issues, capacity limitations, and interpretative inconsistencies within the legal system. While scientific evidence offers precision and credibility, the pathway from forensic labs to courtroom conviction is riddled with barriers.

1. Lack of Scientific Literacy Among Judges

One of the most pressing issues is the limited scientific literacy and technical training of judicial officers. Most judges come from legal backgrounds and have little or no formal exposure to forensic science, medical procedures, or digital evidence evaluation. As a result, they often rely heavily on expert testimonies without fully understanding the methodology or limitations behind such evidence. This gap sometimes leads to either over-reliance on flawed expert reports or undue skepticism toward valid scientific findings.

2. Poor Quality of Forensic Reports

The quality of forensic and medico-legal reports in India remains inconsistent due to the absence of uniform protocols, lack of trained personnel, and overburdened forensic laboratories. Courts frequently encounter reports that are vague, incomplete, or poorly documented, making judicial scrutiny difficult. In many cases, the forensic expert is unavailable for cross-examination, weakening the evidentiary value of the report.

3. Chain of Custody and Evidence Tampering

Scientific evidence, especially DNA samples, blood, semen, and electronic records, is highly

sensitive to contamination, loss, or tampering. The judiciary often has to assess whether the chain of custody has been preserved from the time of collection to presentation in court. Even minor procedural lapses—such as delayed sealing, improper labeling, or unauthorized access—can cast doubt on the credibility of the evidence. Courts frequently grapple with the question: is the evidence reliable if the process was flawed?

4. Delay in Forensic Analysis

Forensic labs in India are notorious for delayed processing of evidence due to severe infrastructural and manpower shortages. Months—sometimes years—may pass before a DNA report or toxicology test is submitted, compromising the trial's timeliness and allowing the accused to exploit procedural gaps. These delays not only affect judicial assessment but also violate the victim's right to speedy justice.

5. Misinterpretation and Stereotypes

Courts sometimes fall prey to outdated stereotypes—for instance, assuming that absence of injuries implies consent or disbelieving the survivor's testimony in the absence of scientific corroboration. This rigid approach undermines trauma-informed jurisprudence and reflects a limited understanding of how sexual violence impacts the human body and psyche. Scientific evidence should be seen as corroborative, not conclusive or dismissive of the survivor's account.

6. Conclusion

In the intricate and emotionally charged realm of sexual offence adjudication, the role of scientific evidence is no longer peripheral—it is central, pivotal, and often decisive. As India continues to grapple with an alarming rate of sexual violence, the judicial system stands at a critical juncture. The integration of science into legal processes is a powerful response to demands for transparency, objectivity, and accountability. Yet, this integration is not seamless. The judiciary must play an active, informed, and sensitive role in ensuring that the promise of science translates into meaningful justice—justice that is timely, trauma-informed, and rooted in both law and ethics. The journey of scientific evidence in Indian sexual offence jurisprudence has been a gradual evolution—from neglect and mistrust to cautious acceptance and increasing reliance. Medico-legal reports, DNA profiling, toxicology, electronic records, and digital footprints now form the bedrock of prosecutorial strategies. However, this transition has not been without friction. Courts are often caught between traditional modes of reasoning

and emerging scientific paradigms. The tension between human testimony and technological proof continues to challenge the balance of evidentiary assessment.

This research has critically examined how Indian courts assess scientific evidence in sexual offence cases. It has identified that while statutes such as the Indian Evidence Act, 1872 (now replaced by the Bharatiya Sakshya Adhiniyam, 2023) and judicial precedents offer a legal structure for admitting expert evidence, the actual assessment depends heavily on the discretion, competence, and sensitivity of judges. Scientific evidence is not self-proving; it must be contextualized, verified, and weighed alongside other evidence. Judges are called upon not just to admit or reject scientific inputs but to interpret them within the emotional, psychological, and legal narratives of the survivor and the accused. A major finding of this research is that scientific evidence is only as strong as the system that collects, processes, and presents it. Poor training among police officers, outdated forensic infrastructure, delays in sample analysis, and improper chain of custody frequently undermine the value of otherwise conclusive evidence. This, in turn, places an unfair burden on the judiciary, which must evaluate not only the content of the report but also its integrity and origin. In many cases, courts are forced to either disregard flawed scientific evidence or accept it with caveats—both scenarios introduce ambiguity and risk miscarriage of justice.

Another key challenge highlighted is the judiciary's lack of scientific literacy. Most judicial officers, especially at the trial court level, have limited exposure to forensic science, medical jurisprudence, or digital evidence procedures. They must rely on expert witnesses who may themselves be undertrained, biased, or inconsistent. In such a setting, scientific evidence loses its objective sheen and becomes subject to interpretation, persuasion, and at times, judicial misunderstanding. The Bharatiya Sakshya Adhiniyam, 2023, offers a much-needed reform by introducing a modern, clearer, and technologically aware legal framework. Its recognition of electronic and expert evidence, along with emphasis on authenticity and procedural regularity, marks a step forward. Sections dealing with expert opinion (Sections 39 and 40) and electronic records (Section 63) are particularly relevant for sexual offences, which increasingly involve both digital and biological forensic trails. However, laws alone cannot solve the problem. Their true potential will only be realized when the judiciary is trained to apply them with competence, consistency, and compassion.

The gendered dimension of sexual offence trials must also be acknowledged in the judicial

evaluation of scientific evidence. Courts must be mindful of the trauma that survivors undergo—not only during the incident but also during the trial process. Misuse or misunderstanding of scientific evidence can retraumatize victims, reinforce harmful stereotypes, or result in unwarranted acquittals. For example, courts should not treat absence of injuries or sperm as indicators of consent or fabrication. Nor should they dismiss a survivor's testimony if scientific evidence is inconclusive, especially when delays in reporting or flawed collection processes are responsible. A trauma-informed judicial approach that contextualizes scientific findings within the lived realities of survivors is essential. This research also brings into focus the need for judicial reforms that go beyond legislation. India must invest in continuous education and capacity-building for judges. Specialized training modules on forensic medicine, DNA analysis, chain of custody, toxicology, and digital evidence should be institutionalized at the Judicial Academies. District courts, which handle the bulk of sexual offence cases, must be equipped with trained medical-legal consultants and access to forensic advisors to assist judges in real-time.

Moreover, there is a pressing need to standardize medico-legal and forensic protocols across the country. Courts must insist on strict adherence to national guidelines while evaluating the credibility of scientific evidence. A checklist-based judicial scrutiny framework may be developed, wherein courts assess whether evidence was collected within the ideal time window, whether it was preserved properly, and whether the report adheres to accepted scientific standards. Another recommendation is the creation of forensic benches or expert panels in High Courts to offer guidance on complex scientific matters. These panels can act as amicus curiae or independent evaluators in cases involving contested scientific claims. Judicial engagement with forensic experts must not be adversarial but collaborative, aiming to extract the truth rather than trap inconsistencies.

In this journey, the judiciary must also walk the tightrope between scientific finality and legal flexibility. Science may offer probability, but the law demands proof beyond reasonable doubt. Courts must ensure that the seductive allure of "objective" evidence does not override the presumption of innocence or the rights of the accused. Simultaneously, they must not allow procedural lapses to sabotage credible findings, especially when those lapses are not the survivor's fault. Ultimately, the role of the judiciary is not just to be an arbiter of facts but a guardian of justice. In the context of sexual offences, this duty becomes even more solemn, for the stakes involve not just liberty and punishment, but dignity, healing, and societal trust.

Scientific evidence can empower the judiciary to fulfill this duty—but only when it is treated not as a magic bullet, but as one cog in the complex machinery of justice.

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