



**FORENSIC SCIENCE AND JUDICIAL ACCURACY: AN ANALYTICAL PERSPECTIVE
ON ITS INFLUENCE IN CRIMINAL ADJUDICATION IN INDIA**

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ABSTRACT

The integration of forensic science into the criminal justice system has emerged as a pivotal development in enhancing judicial accuracy and minimizing miscarriages of justice. In the Indian context, where evidentiary standards have historically relied heavily on ocular testimony and circumstantial inference, the incorporation of scientific evidence represents both a normative and procedural evolution. This research critically examines the influence of forensic science on the adjudicatory process in India, particularly in light of the recent enactment of Bharatiya Nyaya Sanhita (BNS), 2023; Bharatiya Nagarik Suraksha Sanhita (BNSS), 2023; & Bharatiya Sakshya Adhiniyam (BSA), 2023. These legislative instruments signify a paradigm shift from testimonial-centric adjudication to a scientifically informed evidentiary regime. By engaging in a doctrinal analysis of statutory provisions and judicial interpretations, this research interrogates whether the new legal architecture adequately institutionalizes forensic methodologies as reliable and determinative tools in criminal adjudication. While acknowledging the potential of forensic evidence to elevate the epistemic legitimacy of criminal trials, the research also problematizes its uncritical acceptance in the absence of adequate procedural safeguards, infrastructural support, and regulatory oversight. Further, it explores the tension between scientific objectivity and constitutional safeguards, especially in contexts involving bodily privacy, self-incrimination, and due process. It ultimately argues that the transformative promise of forensic science must be anchored in judicial prudence and institutional integrity.

Keywords: Forensic Science, Judicial Accuracy, Criminal Adjudication, Scientific Evidence, DNA Profiling, Digital Forensics, Expert Testimony, Rule of law



The deployment of forensic science in criminal adjudication has emerged as a cornerstone in the pursuit of accuracy, evidentiary reliability, and procedural fairness within modern legal systems. As crime becomes increasingly sophisticated and technologically enabled, traditional investigative techniques premised on oral testimony, circumstantial reconstruction, and witness depositions have proved insufficient in guaranteeing reliable verdicts. Forensic science, encompassing disciplines such as DNA analysis, ballistics, toxicology, digital forensics, and fingerprint examination, provides objective, scientifically verifiable evidence that strengthens the evidentiary foundation of criminal trials. In jurisdictions governed by the rule of law, particularly those aspiring toward constitutional guarantees of fair trial and due process, forensic methodologies serve as indispensable tools that bridge the evidentiary gap between suspicion and guilt, suspicion and innocence (Houck & Siegel, 2015).

In the Indian context, the intersection of forensic science with criminal law has historically been characterized by systemic underutilization and institutional apathy. Despite early legislative recognition of expert testimony in the Indian Evidence Act, 1872 (being replaced by BSA, 2023), forensic evidence was seldom accorded primacy within trial processes, often being subordinated to ocular and circumstantial accounts. Contributory factors included deficient infrastructure, lack of trained personnel, and a rigid procedural framework that did not accommodate the evolving dynamics of scientific inquiry. The adversarial system in India, coupled with an overburdened judiciary and an often-ill-equipped investigative machinery, compounded the marginalization of forensic inputs. Consequently, a considerable volume of criminal adjudications relied heavily on confessions, eyewitness testimony, and testimonial inconsistencies, many of which were prone to manipulation, fallibility, or outright fabrication (Kumar, 2020).

Nonetheless, recent decades have witnessed a gradual paradigm shift, driven by increased awareness of wrongful convictions, international human rights jurisprudence, and technological advancements. High-profile criminal cases have foregrounded the necessity of forensic corroboration, highlighting both the evidentiary utility and judicial probity such science affords. Judicial pronouncements have progressively embraced scientific evidence as a means to enhance fact-finding accuracy, reduce subjective bias, and reinforce the presumption of innocence by establishing empirical truth. This



evolution is particularly significant in the Indian context, where the dual imperatives of delivering justice and safeguarding fundamental rights remain constitutionally enshrined. Forensic science, thereby, emerges not merely as a tool of law enforcement, but as a critical element of substantive justice (Peterson & Murdock, 2009).

The recent legislative reforms through the BNS, 2023, BNSS, 2023, & BSA, 2023 mark a legislative acknowledgment of this transition. These new codes seek to mainstream scientific investigation and elevate forensic evidence from an ancillary role to a determinative factor in adjudication. By mandating the use of technology in investigations, expanding the admissibility of electronic and forensic evidence, and redefining the evidentiary hierarchy, the reforms aim to align Indian criminal law with global best practices (Verma, 2019).

CONCEPTUAL FRAMEWORK

Forensic science, as a multidisciplinary application of scientific principles to legal processes, constitutes an indispensable element in contemporary criminal adjudication. It encompasses a wide array of specialized domains including, but not limited to, DNA profiling, ballistic analysis, fingerprint examination, digital and cyber forensics, toxicology, serology, and forensic anthropology. Each sub-discipline provides a methodologically rigorous approach to the collection, preservation, analysis, and interpretation of physical evidence. Unlike testimonial or circumstantial evidence, which is often susceptible to human error, bias, or manipulation, forensic evidence offers an objective, empirical foundation upon which legal fact-finding can reliably rest. In the Indian legal context, the integration of such scientific tools has historically been peripheral; however, the emergent statutory reforms signify a paradigm shift towards their institutional mainstreaming (Saferstein, 2013).

The term “judicial accuracy” refers to the fidelity of adjudicatory outcomes to factual and legal truths, ensuring that decisions are both just and correct. It is assessed through indicators such as the minimization of wrongful convictions, the assurance of rightful acquittals, and the consistency of judicial reasoning with evidentiary material. From a doctrinal perspective, judicial accuracy is integral to the constitutional promise of due process under Article 21 of the Indian Constitution, which guarantees fair trial rights. The integrity of the criminal justice system is compromised when verdicts rest on conjecture or deficient investigative processes. Hence, accuracy is not merely a procedural



aspiration, but a substantive legal imperative that undergirds the legitimacy of the rule of law and the credibility of judicial institutions (Saks & Koehler, 2005).

Forensic evidence plays a pivotal role in augmenting judicial accuracy by furnishing courts with scientifically verifiable data that can corroborate or contradict testimonial narratives. In cases involving serious offences such as sexual assault, homicide, or cybercrime, forensic techniques like DNA analysis or digital recovery can decisively establish elements of guilt or innocence, often beyond reasonable doubt. Moreover, it aids in resolving evidentiary ambiguities and mitigating the risk of miscarriage of justice, especially in jurisdictions like India where investigative lacunae are rampant. The recent enactment of BSA, 2023, which broadens the admissibility of electronic and forensic evidence, underscores the legislature's recognition of its probative value. Nevertheless, the utility of such evidence must be balanced against procedural safeguards to ensure its authenticity, chain of custody, and resistance to manipulation, thus, reinforcing both accuracy and fairness in adjudication (Basu, 2018).

FORENSIC SCIENCE IN THE INDIAN CRIMINAL JUSTICE SYSTEM: AN OVERVIEW

The integration of forensic science within the Indian criminal justice system has been historically peripheral, marked more by sporadic utilization than systemic incorporation. In the early decades following independence, India's criminal adjudication process continued to rely heavily on confessional statements, eyewitness testimony, and circumstantial evidence, often gathered through conventional police methods. While rudimentary forensic capabilities such as fingerprinting and ballistic examination existed, their application remained underutilized due to the lack of legal imperatives and institutional investment. The trajectory of forensic science, therefore, reflects a reactive rather than proactive evolution, driven more by high-profile miscarriages of justice and international influence than by internal systemic reform (Ministry of Law and Justice, 2023).

A critical limitation in this context has been the chronic inadequacy of forensic infrastructure across the country. India has long suffered from a severe shortage of forensic laboratories, both in terms of quantity and technical competence. Most states rely on overburdened State Forensic Science Laboratories (SFSs), with Central Forensic Science Laboratories (CFSs) being limited in number



and accessible primarily in exceptional cases. The backlog in forensic analysis has frequently led to significant delays in trials, thereby undermining the probative value of scientific evidence. Furthermore, the lack of uniform standard operating procedures (SOPs) and accreditation of forensic experts raises serious concerns about the reliability and admissibility of such evidence, particularly in light of the Daubert standard or Frye test used in jurisdictions like the United States (National Forensic Sciences University, 2022).



LIST OF CFSL'S IN INDIA

The network of Central Forensic Science Laboratories (CFSLs) in India, highlighting the key locations, Kolkata, New Delhi, Hyderabad, Chandigarh, Guwahati, Bhopal, and Pune, each playing a pivotal role in strengthening forensic infrastructure and supporting scientific investigation across the country.

Source -

<https://www.google.com/url?sa=i&url=https%3A%2F%2Fnfsmuseum.com%2Fcfsl.php&psig=AOvVaw2E4DnkBdyWpfpqGO9ISbdi&ust=1749827482776000&source=images&cd=vfe&opi=89978449&ved=0CBcQjhxqFwoTCNjOrL6V7I0DFQAAAAAdAAAAABAE>



This underdevelopment has had direct implications on conviction rates and the broader efficacy of the criminal justice system. Data from the National Crime Records Bureau (NCRB) and Law Commission reports have consistently pointed to alarmingly low conviction rates in serious offences, such as sexual assault and homicide, where scientific evidence could play a determinative role. Simultaneously, there has been a burgeoning backlog of pending trials, exacerbated by the time-consuming process of forensic reporting. The over-reliance on oral evidence and the culture of hostile witnesses has led to frequent acquittals, thereby compromising both justice delivery and public faith in the system. The absence of reliable forensic corroboration has created a vacuum that, in some cases, allows for impunity or wrongful conviction based on fallible human testimony (NCRB, 2021).

Legally, the Indian Evidence Act, 1872 provided a skeletal framework for expert testimony under Sections 45 to 51. Forensic experts were categorized merely as those “specially skilled” in subjects such as handwriting, fingerprinting, or toxicology. However, the Act did not confer any binding force to expert opinions, treating them as merely corroborative or advisory in nature. Courts retained complete discretion in accepting or rejecting such opinions, often based on subjective standards. Moreover, the Act did not envisage the rapid developments in forensic science, particularly in areas like DNA profiling, cyber forensics, or digital surveillance, leaving vast interpretive gaps in admissibility and evidentiary weight (Joseph & Prasad, 2018).

Similarly, the Criminal Procedure Code, 1973 (CrPC) failed to institutionalize the role of forensic investigation in criminal procedure. While Sections 293 and 164A of CrPC allowed for the use of expert reports and medical examination in certain cases, there was no mandate for mandatory forensic analysis in crimes of a serious nature. Investigating officers, constrained by time, budget, and training, often chose expediency over scientific rigour. The lack of procedural safeguards for the collection, preservation, and chain of custody of forensic material further diluted the effectiveness of such evidence in trial. As a result, forensic science remained an ancillary tool rather than a foundational pillar of investigation and adjudication, a lacuna that the new criminal laws now attempt to redress (Basu, 2018).



The BNS, 2023 marks a paradigmatic shift in India's approach to criminal adjudication by embedding scientific methods within the investigative architecture. Recognizing the evidentiary limitations of the oral and ocular-centric model under the Indian Penal Code, 1860, the BNS incorporates provisions mandating the systematic use of forensic tools, including DNA profiling, fingerprint analysis, and mandatory videography of search and seizure operations. Such legislative innovations aim to curb investigative arbitrariness, mitigate wrongful convictions, and fortify the evidentiary chain. Importantly, the shift reflects an attempt to align Indian procedural practice with the jurisprudence of "due process" and evidentiary precision as envisaged under Article 21 of the Constitution (Ministry of Law and Justice, 2023).

Complementing the BNS, the BNSS, 2023 introduces procedural streamlining with an emphasis on technologically guided adjudication. It builds upon the lacunae of the CrPC, by introducing provisions that institutionalize electronic documentation, digital evidence, and real-time monitoring of investigations. BNSS mandates that statements and confessions, particularly those recorded under custodial settings, be video-recorded, thereby enhancing transparency and judicial confidence in testimonial integrity. These procedural improvements aim not only to expedite trials but also to diminish the scope of coerced confessions and fabrication, longstanding issues that have plagued the Indian criminal system (Sethi, 2024).

The BSA, 2023, as the successor to the Indian Evidence Act, 1872, provides a reconfigured evidentiary framework where scientific and electronic evidence assumes primacy over oral testimony. It redefines "document" and "evidence" to include digital and biometric records, thereby formally integrating forensic science into the core of adjudicatory relevance and reliability. Sections dedicated to the admissibility of expert reports, chain of custody documentation, and the presumption of authenticity of certified forensic records reflect a legislative intent to reduce dependency on human testimony, which is often marred by fallibility and manipulation. This pivot to objectivity underscores a renewed commitment to accuracy in evidentiary interpretation (Ministry of Law and Justice, 2023).

Nevertheless, a critical appraisal reveals that while the legislative intent is progressive, implementation remains a formidable challenge. India's forensic infrastructure remains underdeveloped and disproportionately distributed. Forensic labs face chronic underfunding, delays



in report generation, and lack of qualified personnel. Moreover, the absence of standardized protocols for DNA collection, storage, and analysis threatens to render scientific evidence unreliable or challengeable in court. The absence of statutory protections concerning data privacy and misuse of biometric data further complicates the uncritical acceptance of forensic tools. Courts must therefore exercise caution in equating technological sophistication with infallibility (Choudhury, 2021).

There is a danger of judicial over-reliance on forensic evidence, treating it as conclusive rather than corroborative. The perception of scientific evidence as infallible, the “CSI effect”, may risk undermining the principle of *proof beyond reasonable doubt* if not appropriately contextualized. There also exists the peril of overlooking procedural fairness during evidence collection and analysis, especially in the absence of independent forensic regulatory authorities. Hence, while the new criminal laws signify a much-needed modernization of Indian criminal jurisprudence, their efficacy in promoting judicial accuracy hinges on institutional capacity-building, ethical safeguards, and sustained judicial vigilance (Cole & Dioso-Villa, 2007).

JUDICIAL PERSPECTIVE

In *State of Maharashtra v. Praful Desai* [(2003) 4 SCC 601], the Supreme Court of India laid down a foundational precedent for the admissibility of digital and electronic evidence, a ruling that presaged later legislative recognition under the IT Act, 2000 and, more recently, the BSA, 2023. The Court held that the term “evidence” under Section 3 of the Indian Evidence Act, 1872, included electronic records and sanctioned video conferencing as a valid mode of recording evidence. This marked a jurisprudential departure from strictly oral and physical forms of testimonial evidence, acknowledging the changing landscape of information transmission. Although pathbreaking, the ruling also underlined the judiciary’s cautious approach to digital evidence, highlighting that such material must still pass through the sieve of authenticity, integrity, and procedural fairness to attain admissibility.

In *Selvi v. State of Karnataka* [(2010) 7 SCC 263], the apex court scrutinized involuntary scientific techniques such as narco-analysis, polygraph tests, and brain electrical oscillation signature profiling. The Court held these techniques to be unconstitutional when conducted without consent, invoking Article 20(3) and the right against self-incrimination. Importantly, the judgment reaffirmed the principle that evidentiary utility cannot come at the cost of constitutional safeguards. While forensic



science was not outright rejected, the Court insisted on voluntary participation, procedural safeguards, and corroborative value. This established judicial framework wherein scientific evidence must harmonize with constitutional morality and individual rights, thus restraining forensic innovation within the bounds of legal permissibility.

Post-enactment of the BSA, 2023, judicial discourse is still evolving, though emerging High Court decisions indicate an affirmative posture toward forensic material as a core evidentiary pillar. However, judicial anxiety persists regarding procedural lapses, chain of custody, and expert credibility. Thus, while the new evidentiary framework elevates forensic material to a quasi-conclusive status, the judiciary remains vigilant against potential misuse or investigative overreach (Deshpande, 2024).

A comparative reading of Sections 45–51 of the Indian Evidence Act with the corresponding provisions in the BSA, 2023 reveals a paradigm shift. Whereas the former provided for admissibility of expert opinion as “relevant” but not “conclusive,” the latter codifies broader categories of expert inputs, including digital forensics and cyber profiling, as admissible and potentially determinative, subject to compliance with procedural integrity. This structural enhancement addresses prior ambiguities regarding the scope and weight of forensic testimony. Nonetheless, the probative value of such evidence remains contingent upon the satisfaction of evidentiary thresholds, source reliability, expert qualification, and the method’s general acceptance within the scientific community (Ministry of Law and Justice, 2023).

Crucially, expert cross-examination continues to be the principal mechanism by which courts assess the robustness of forensic testimony. Indian jurisprudence maintains that an expert is not a witness of fact but of opinion, and such opinion cannot substitute the judge’s own reasoning unless found cogent and coherent upon scrutiny. Cross-examination thus functions not merely as a procedural formality but as a substantive safeguard against over-reliance on potentially flawed science. The new laws do not dilute this standard but rather reinforce it by placing the onus on investigating agencies to ensure scientific transparency and evidentiary traceability. Consequently, the evolving judicial stance underlines a tempered yet progressive trust in forensic methodologies, balanced by procedural due diligence and judicial skepticism.



Lack of Infrastructure: A Foundational Impediment

Despite the progressive legislative shifts encapsulated in the BNS, 2023 and allied enactments, the forensic science infrastructure in India remains grossly inadequate to meet the demands of a modern criminal justice system. The paucity of functional forensic science laboratories, both in terms of quantity and quality, substantially hampers timely investigation and judicial decision-making. Most states have under-resourced and understaffed laboratories, resulting in significant delays in forensic analysis and submission of expert reports. These backlogs, in turn, affect the pace of trials and compromise the constitutional mandate of speedy justice under Article 21. Moreover, the disproportionate distribution of facilities across states further accentuates regional inequities, denying uniform access to scientific evidence. This systemic deficiency renders the forensic potential of the new criminal statutes largely aspirational unless supported by targeted infrastructural investments (Basu, 2018).

Human Resource Deficit and the Crisis of Competency

Equally troubling is the acute shortage of trained forensic scientists, technical experts, and investigative personnel proficient in the application and interpretation of forensic tools. Even where facilities exist, the absence of adequately skilled professionals undermines their optimal utilization. The investigative agencies, particularly the police, often lack the requisite scientific temperament and procedural understanding to collect, preserve, and transmit evidence in a manner admissible under evidentiary norms. Prosecutors and judges, too, frequently display a gap in technical literacy, leading to either the undervaluation or misapprehension of forensic inputs. This deficiency underscores the urgent necessity for structured capacity-building programmes, including institutionalized training modules and continuing legal education, to create a cohort of forensic-literate legal actors capable of engaging with scientific evidence both critically and competently (Joseph & Prasad, 2018).

Absence of Standardization and Quality Control Mechanisms

The utility of forensic evidence is contingent not merely on its availability but on its scientific reliability and procedural integrity. Unfortunately, India currently lacks a centralized regulatory framework to ensure uniformity in forensic methodologies, equipment calibration, documentation



practices, and reporting formats. The absence of nationally codified forensic standards allows for discrepancies between laboratories, undermining the evidentiary value and judicial trust in forensic conclusions. Inconsistencies in procedural protocols, such as DNA collection, chain of custody, and toxicological analyses, create ample scope for defense challenges, weakening the probative force of such evidence in court. In this context, the establishment of an autonomous statutory authority to accredit laboratories, prescribe uniform operating procedures, and conduct regular audits is an indispensable reform to align Indian forensic practice with global best standards (Choudhury, 2021).

Data Privacy and Constitutional Concerns under Article 21

The increasing reliance on forensic science, especially DNA profiling, biometric surveillance, and digital forensics, raises profound constitutional concerns relating to privacy and bodily autonomy under Article 21. The absence of a robust data protection law and independent oversight mechanisms has rendered individuals vulnerable to intrusive and potentially irreversible state practices. The use of DNA databases without informed consent, indefinite storage of biometric data, and opaque investigative surveillance risk creating a techno-legal regime of disproportionate state power, incompatible with the privacy jurisprudence articulated in *Justice K.S. Puttaswamy v. Union of India* [AIR 2017 SC 4161]. Forensic tools, while promising objectivity, must not become instruments of overreach. A jurisprudential balance must be struck between investigative efficiency and individual rights, mandating judicial scrutiny, procedural safeguards, and legislative circumscription of state power (Verma, 2019).

The transformative potential of forensic science in bolstering judicial accuracy has found significant articulation in Indian jurisprudence through landmark decisions. In *State of Maharashtra v. Praful Desai* ((2003) 4 SCC 601), the Supreme Court recognized the admissibility of electronic evidence and allowed video conferencing as a valid mode of testimony, expanding the evidentiary landscape beyond traditional norms. This shift was further nuanced in *Selvi v. State of Karnataka* ((2010) 7 SCC 263), where the apex court ruled that involuntary administration of narco-analysis, polygraph tests, and brain-mapping violated Article 20(3), reinforcing that scientific evidence must respect constitutional safeguards. More recently, courts have relied on DNA evidence in cases such as *Mukesh & Anr v. State (NCT of Delhi)* ((2017) 6 SCC 1), the Nirbhaya case, where forensic corroboration was pivotal in affirming guilt beyond reasonable doubt. These cases illustrate a



growing judicial receptiveness to forensic methodologies while underscoring the necessity of procedural integrity, chain of custody, and the right against self-incrimination as guiding principles in evidentiary admissibility.

Systemic Integration and Policy Cohesion

The aforementioned challenges are not isolated deficiencies but are structurally interconnected, pointing to a deeper crisis of systemic integration. The forensic science apparatus cannot function in silos, its utility is premised on its seamless integration with policing, prosecution, judiciary, and legislative policy. The new criminal laws signal a welcome shift toward evidentiary objectivity, but without an ecosystem that ensures institutional readiness, infrastructural adequacy, and normative coherence, the intended reforms may fail in translation. A coherent national forensic policy is needed, complemented by financial allocations, inter-agency coordination, and rights-based frameworks, to realize the full potential of forensic science as an instrument of judicial accuracy. Until then, the forensic promise of the BNS, 2023 and its companion legislations will remain more rhetorical than real (Sethi, 2024).

CONCLUSION & THE WAY FORWARD

The integration of forensic science into the Indian criminal justice system, particularly in light of the newly enacted criminal laws, represents a long-overdue paradigm shift from a predominantly testimonial and circumstantial evidence model to a scientifically corroborated adjudicative framework. While the legislative intent underpinning these statutes clearly acknowledges the exigency for accurate, technology-driven investigation and prosecution, the actual realization of forensic science as a fulcrum of judicial accuracy remains contingent upon a robust and synchronized implementation architecture. Despite statutory recognition, forensic evidence continues to grapple with institutional lacunae such as inadequate laboratory infrastructure, prolonged evidence analysis cycles, and the lack of standardized protocols across forensic institutions. Moreover, judicial ambivalence in the probative assessment of expert opinion under the erstwhile Section 45 of the Indian Evidence Act, 1872, now retained in principle under the BSA, 2023, necessitates the evolution of interpretative jurisprudence that squarely addresses issues of admissibility, evidentiary reliability, and procedural fairness. Moving forward, an interdisciplinary framework is imperative, one that synergizes legislative clarity, judicial sensitization, forensic capacity-building, and technological



modernization, while ensuring procedural safeguards to protect individual rights against the potential misuse of scientific tools. It is only through a convergence of normative reforms, institutional recalibration, and rights-oriented judicial vigilance that forensic science can transform from a peripheral aid to a core instrumentality of truth-finding in Indian criminal adjudication.

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