THE ROLE OF FORENSIC SCIENCE IN INDIA'S NEW CRIMINAL JUSTICE CODES: AN ANALYSIS OF TRANSPARENCY, EFFICIENCY AND EVIDENTIARY RELIABILITY IN INVESTIGATION

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ABSTRACT

The 2023–24 overhaul of India's criminal justice system through the Bharatiya Nyaya Sanhita (BNS), Bharatiya Nagarik Suraksha Sanhita (BNSS) and Bharatiya Sakshya Adhiniyam (BSA) marks a pivotal shift towards scientific investigation. For the first time, forensic processes, digital documentation and expert evidence have been given explicit, mandatory recognition. This paper examines the key legal changes in the new codes and evaluates how far they strengthen transparency, efficiency, and evidentiary reliability in criminal investigation and trial. Through statutory interpretation, judicial precedent analysis and comparison with earlier laws, the study finds that the new codes substantially centre forensic science within the investigative framework, introducing mandatory forensic examination for serious crimes, strengthening digital chains of custody and revising evidentiary rules to align with contemporary scientific demands. However, doctrinal ambiguities remain concerning the enforceability of timelines, quality standards, admissibility thresholds, and constitutional safeguards regarding privacy and self-incrimination. The paper concludes with legal recommendations to harmonise statutory provisions, enhance judicial oversight, and establish clearer, enforceable forensic protocols to ensure that the forensic turn in Indian criminal law fulfils its intended goals.

Keywords: Forensic Science, New Criminal Justice, Bharatiya Nyaya Sanhita, Bharatiya Sakshya Adhiniyam

1. Introduction

Forensic science has increasingly become the backbone of modern criminal investigation across the world. The evolution of scientific techniques from DNA profiling, ballistics, toxicology, and fingerprint databases to cyber-forensics, digital chain-of-custody systems, and artificial intelligence-assisted analysis has transformed the methods through which truth is established in criminal justice systems.[1] Traditional reliance on eyewitness testimonies, confessions, or circumstantial evidence is increasingly regarded as insufficient in the face of complex crimes, technological sophistication, and rising expectations of accuracy and fairness. Globally, legal systems have progressively gravitated toward evidence-based policing, wherein scientific processes are placed at the heart of investigative and adjudicatory functions. India, too, has witnessed a rapid expansion of forensic capabilities over the past two decades, accompanied by judicial recognition of the value of scientific evidence. Yet, until recently, the statutory framework governing India's criminal justice system did not adequately reflect this scientific turn.

For more than 150 years, India's criminal processes operated under three colonial-era statutes the Indian Penal Code (1860), the Code of Criminal Procedure (1973), and the Indian Evidence Act (1872). While these laws were amended periodically, they did not fully accommodate contemporary forensic techniques or address the legal complexities posed by digital technologies. Critical gaps persisted, such as the lack of mandatory forensic investigation for serious offences, inadequate chain-of-custody protocols, ambiguous standards for expert testimony, and uncertainties in the admissibility of electronic evidence.[2] Investigations often depended on the discretion of police officers in referring evidence to forensic laboratories, and judicial outcomes were frequently affected by delays in forensic reports, contamination of samples, or procedural lapses.[3] These systemic weaknesses contributed to low conviction rates and raised questions about the accuracy, integrity, and reliability of the criminal justice process.

Recognising these structural gaps, the Government of India introduced a sweeping overhaul of the criminal justice framework in 2023 through three major legislations: the Bharatiya Nyaya

[1] Fizza Assad & Komal Gupta, *Evolution of Forensic Science in Criminal Justice Systems*, INTERNATIONAL JOURNAL OF LEGAL STUDIES & SOCIAL SCIENCES (IJLSSS) (2025), https://ijlsss.com/evolution-of-forensic-science-in-criminal-justice-systems/ (last visited Nov. 25, 2025).
[2] Hal S. Stern, Maria Cuellar & David H. Kaye, *Reliability and Validity of Forensic Science Evidence*, 16 Volume 21 (2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3387399, (last visited Nov. 25, 2025).
[3] *Supra note 3*

Sanhita (BNS), replacing the IPC; the Bharatiya Nagarik Suraksha Sanhita (BNSS), replacing the CrPC; and the Bharatiya Sakshya Adhiniyam (BSA), replacing the Indian Evidence Act. Collectively, these new codes signal a decisive shift toward scientific and technology-driven investigation. For the first time, forensic procedures and digital documentation practices are explicitly embedded into the procedural and evidentiary framework. The BNSS mandates forensic examination for offences punishable with seven or more years of imprisonment and requires videography of crime scenes, the presence of forensic experts during evidence collection, and time-bound submission of forensic reports. The BSA modernises evidentiary rules by expanding the scope of digital evidence, clarifying certification requirements, and strengthening the legal foundation for expert testimony. The BNS, while largely substantive in nature, categorises and redefines certain offences in ways that influence the scope of mandatory forensic involvement.[4]

The central problem addressed in this research arises from this major transition: Does the new legal framework meaningfully enhance transparency, efficiency, and evidentiary reliability in India's investigation and trial processes? While the legislative intent behind the new codes is clear – promoting scientific investigation and reducing reliance on subjective or unreliable forms of evidence – whether the statutory language is sufficiently robust, unambiguous, and enforceable remains a critical question. Do these provisions provide clear standards for forensic examination? Do they strengthen chain-of-custody rules or merely restate procedural aspirations? Are the timelines for forensic reports mandatory or directory? How will courts interpret the revised provisions relating to expert evidence and digital documentation? These doctrinal questions require careful unpacking.

The scope of the present study is strictly doctrinal. It does not include empirical data collection, field research on forensic institutions, or a performance assessment of forensic laboratories. Instead, it examines the statutory text, legislative structure, and interpretative possibilities of the BNS, BNSS, and BSA. It relies on judicial precedents, constitutional principles, and comparative legal standards to analyse the legal implications of the new forensic provisions. The study focuses on the internal coherence of the statutory framework, its alignment with principles of criminal justice, and potential interpretive challenges that may arise in courts.

[4] Priyanka B., *Justice under the Microscope: Forensic Science in the Indian Criminal Justice System*, 6(2) *Int'l J. L. Pol'y & Soc. Review* 81 (2024).

The study seeks to answer three central research questions:

1. *Transparency*: Do the new codes embed adequate safeguards to ensure transparency in evidence collection, digital documentation, and chain-of-custody procedures?

2. *Efficiency*: Do the procedural mandates in BNSS improve investigative timelines and reduce delays associated with forensic reports, or do they introduce new procedural burdens?

3. *Evidentiary Reliability*: Does the BSA enhance the admissibility, weight, and credibility of forensic and digital evidence in a manner consistent with contemporary scientific and legal standards?

The significance of this research lies in India's ongoing transition toward a scientific justice system. As courts increasingly rely on forensic reports, DNA results, digital footprints, and expert opinions, the legal framework governing these materials must be precise, enforceable, and aligned with constitutional safeguards. Given that 2023 marks a turning point in India's criminal law history, a doctrinal evaluation of the new forensic provisions is essential for understanding their strengths, limitations, and future interpretive trajectory. This study contributes to that scholarly discourse by assessing whether the new codes genuinely advance the goals of transparency, efficiency, and reliability or whether significant doctrinal gaps remain.

2. Evolution of Forensic Science in India's Criminal Justice System

The role of forensic science in Indian criminal justice has not always been central; rather, it has emerged gradually through a combination of legislative reform, judicial interpretation, and technological influence. Historically, Indian investigations were confession-driven, heavily dependent on eyewitness testimony, and guided by colonial policing models rather than scientific accuracy. As a result, forensic science remained a supplementary tool rather than a primary investigative method for much of India's post-independence history.

2.1 Colonial Investigative Culture and Limited Use of Science

During the colonial era, the 1861 Police Act shaped policing priorities around administrative control rather than scientific crime-solving. British India established early forensic institutions

such as the Anthropometric Bureau (1892) and Fingerprint Bureau (1897), marking the first step toward scientific identification systems.[5] Despite this progress, the courts relied heavily on testimonial and documentary evidence, treating science-based methods cautiously and often with judicial scepticism.

Forensic laboratories that emerged in the early and mid-20th century, including the Central Forensic Science Laboratory (CFSL) in Calcutta (1957), were largely underutilised. Scientific tools were available but not embedded within procedural law or investigative mandates. As a result, forensic science evolved slowly, more as a supporting mechanism than a foundational investigative approach.[6]

2.2 Post-Independence Developments: Gradual Expansion Without Integration

After independence, India saw the development of additional forensic laboratories and specialisations such as ballistic analysis, serology, toxicology, and questioned document examination. However, the absence of statutory integration meant forensic services were often accessed only in high-profile or technically complex cases, such as suspected poisoning or firearm use.

Investigations continued to rely heavily on confessions despite the constitutional mandate under Article 20(3)[7] and the Supreme Court's landmark ruling in Nandini Satpathy v. P.L. Dani (1978)[8], which strengthened safeguards against custodial coercion. The persistence of custodial interrogation culture reflected the limited institutional shift toward science-driven evidence collection.

The 1984 formation of the Directorate of Forensic Science (DFS) under the Ministry of Home Affairs signalled an attempt to systematise forensic administration.[9] Yet, resource shortages, staffing deficits, and a lack of standardised protocols meant India's forensic growth remained uneven across states and disciplines.

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[5] Srishti, *The Impact of Forensic Science on the Legal System in India*, 9(1) *J. Forensic Sci. Res.* 001 (2025).
[6] Rekha Agarwal & Prof. (Dr) Tufail Ahmad, *The Silent Witness: How Forensic Science Shapes Modern Crime Investigations*, 10 *Int'l J. Soc. Dev. & Rsch.* 01 (2025), https://ijsdr.org/papers/IJSDR2504403.pdf (last visited Nov. 29, 2025),
[7] India Const. art. 20, cl. 3.
[8] Nandini Satpathy v. P.L. Dani, (1978) 2 S.C.C. 424 (India).
[9] Directorate of Forensic Science Services, *About Directorate*, MHA-Govt. of India, https://dfs.nic.in/aboutDirectorate.html (last visited Nov. 29, 2025).

2.3 Judicial Influence and the Shift Toward Scientific Evidence

Courts gradually recognised the evidentiary value of forensic science. In State of Himachal Pradesh v. Jai Lal[10], the Supreme Court emphasised that expert testimony must derive from reliable scientific principles. Subsequent judgements insisted on maintaining a secure chain of custody and authenticity of physical exhibits.

DNA profiling emerged as a transformative tool during the late 1990s and early 2000s. Cases such as Santosh Kumar Singh v. State[11] demonstrated the potential of forensic evidence to overturn earlier findings based solely on testimonial inconsistencies. However, judicial confidence in forensic methods remained contingent on laboratory integrity, expert qualification, and investigative adherence to procedure areas frequently found lacking.

2.4 The Rise of Modern Forensics: Technology, Crime Trends, and Policy Push

The proliferation of cybercrime, terrorism, sexual offences, and organised crime created an urgent need for robust forensic systems. The DNA Technology Regulation Bill (2019)[12], although still pending enactment, reflects attempts toward formalising standards for the collection, storage, and use of genetic material. Additionally, the 2022 Criminal Procedure (Identification) Act allowed expanded biometric and behavioural sample collection from accused persons—marking a legislative leap towards data-driven policing.

Government reports acknowledge that conviction rates in crimes against women, economic offences, and cybercrimes remain low, partly due to weak evidentiary frameworks. For example, in many rape cases, conviction hinges on survivor testimony rather than forensic corroboration, despite guidelines recommending immediate medical examination and sample collection.

2.5 Systemic Gaps: Infrastructure, Training, and Backlog

Despite infrastructural expansion—more than 30 state forensic laboratories and multiple CFSLs—the system suffers from severe strain. Multiple studies indicate that laboratory

[10] N. Scurich et al., *Scientific Guidelines for Evaluating the Validity of Forensic Feature-Comparison Methods*, 13 (2023) https://www.pnas.org/doi/10.1073/pnas.2301843120 (last visited Nov. 20, 2025).
[11] Santosh Kumar Singh v. State Through CBI, (2010) 9 SCC 747.
[12] DNA Technology (Use and Application) Regulation Bill, 2019, Bill No. LXVII of 2019 (India).

backlogs may delay reports from weeks to several years. Such delays compromise justice delivery, enabling defence challenges based on contamination, procedural lapses, or data degradation.

Moreover, forensic personnel shortages remain critical. The National Crime Records Bureau (NCRB) has repeatedly noted that many laboratories operate below 50% sanctioned staffing strength[13]. Police training academies have only recently introduced structured forensic modules, and field officers often lack the skills needed for proper evidence collection, preservation, and documentation.

2.6 Public Trust, Ethics, and Scientific Credibility

Public confidence in forensic processes remains fragile. Cases involving fabricated evidence, mishandled DNA samples, or questionable narco-analysis raised ethical and legal concerns. The Supreme Court's decision in Selvi v. State of Karnataka[14] prohibiting involuntary narco-analysis, polygraph tests, and brain mapping demonstrated the tension between investigative innovation and fundamental rights.

Forensic science thus stood at a crossroads: increasingly necessary, yet unevenly developed, inconsistently applied, and lacking a standardised legislative foundation.

3. Key Forensic Provisions Under the New Criminal Codes (BNS, BNSS, BSA)

The enactment of the Bharatiya Nyaya Sanhita (BNS) 2023, the Bharatiya Nagarik Suraksha Sanhita (BNSS) 2023, and the Bharatiya Sakshya Adhiniyam (BSA) 2023 marks the most significant restructuring of Indian criminal law since the colonial-era statutes of the 19th century. One of the core goals of this reform initiative is the systemic integration of forensic science into the criminal justice process to enhance reliability, reduce discretionary abuse, and align India with internationally accepted evidentiary standards. Collectively, the new codes reframe forensic evidence not as optional or supplementary but as a mandated component of investigative and prosecutorial processes for serious offences.

[13] *The Hindu*, "Staffing Strain Inside Telangana's Forensic Labs," Nov. 26, 2024.
[14] Selvi v. State of Karnataka, (2010) 7 SCC 263

3.1 Mandatory Forensic Investigation in Serious Offences

One of the most transformative provisions appears in the BNSS, which mandates forensic investigation in offences punishable with seven years of imprisonment or more. This contrasts sharply with the previous system under the Code of Criminal Procedure (CrPC), where forensic use was discretionary, largely dependent on police capacity, awareness, or case-specific complexity.

Mandatory forensic involvement means that in cases such as:

- Murder and homicide,
- Rape and aggravated sexual assault,
- Terrorism,
- Trafficking,
- Organised cybercrime,
- Serious financial crime,

The police must ensure forensic collection, documentation, analysis, and reporting.

This provision signals a structural shift from confession-driven policing to scientific investigation. However, it also implies a substantial institutional burden, requiring sufficient trained personnel, forensic facilities, and logistical capacity to implement the mandate consistently.

3.2 Strengthening Chain of Custody and Documentation Requirements

Under the BSA 2023, the authenticity and admissibility of forensic evidence hinge on maintaining an unbroken and verifiable chain of custody. The law recognises that scientific evidence is only as reliable as the process used to collect, preserve, and present it.

The new framework mandates:

- Proper labelling and sealing of samples,
- Digital tracking of sample transfer,

- Certified storage protocols,
- Recordkeeping of every officer handling the material, and
- Authentication of expert reports through digital signature mechanisms.

Such structured protocols seek to prevent contamination, manipulation, or evidentiary tampering problems frequently flagged by Indian courts in the past.

3.3 Digital and Electronic Evidence Recognition

The BSA 2023 significantly expands the admissibility of electronic and digital evidence, marking a decisive evolution from the older Evidence Act framework. The new law[15]:

- Defines electronic evidence as a primary form of proof,
- Recognises artificial intelligence–generated forensic records,
- Codifies the admissibility of digital chain-of-custody records, and
- Validates video conferencing and electronic depositions from forensic experts.

This is particularly relevant in cases involving cyber offences, financial fraud, trafficking, and crimes involving digital footprints. Additionally, the codes seek to reduce trial delays caused by expert unavailability by enabling remote testimony verified through authentication requirements.

3.4 Standardisation of Forensic Reporting and Expert Qualifications

The BSA introduces clear expectations for expert testimony by requiring standardised structure, accreditation of forensic laboratories, and uniform reporting practices. While earlier systems allowed expert evidence without strict qualification criteria, the new provisions enhance accountability by requiring[16]:

- Institutional certification of laboratories,

[15] Bharatiya Nyaya Sanhita, 2023, No. 45 of 2023, Acts of Parliament, 2023 (India).
[16] Bharatiya Sakshya Adhiniyam, 2023, No. 47 of 2023, Acts of Parliament, 2023

- Clearly recorded methodologies,
- Reproducibility of scientific conclusions,
- Peer-reviewed or validated techniques, and
- Cross-examination rights against expert findings.

This aligns India with international forensic standards such as the ISO/IEC 17025 accreditation model used by global forensic laboratories.

3.5 Integration with Medical and Scientific Examination in Sexual Offences

The BNS retains and modernises provisions for medico-legal examinations, especially in sexual offence cases.[17] The BNSS makes it mandatory for prompt medical examination by trained personnel and requires that forensic kits and sexual assault evidence collection protocols be standardised nationwide.

This reform responds to longstanding criticism that delays in evidence collection, improper handling, and the absence of forensic corroboration weakened prosecution in crimes against women.

3.6 Technology-Assisted Policing: Video Recording and AI-Based Evidence

The BNSS mandates video recording of search and seizure procedures, custodial interrogation, and forensic collection processes where feasible. This ensures transparency in investigative steps and safeguards the rights of the accused while enhancing evidentiary reliability.

Additionally, the BSA recognises the probative potential of AI-assisted evidence evaluation. While the law does not explicitly define scope or limits, the recognition of computerised and algorithmic records signals movement towards next-generation forensic tools in areas such as[18]:

- Ballistic pattern matching,

[17] Manoj B. Patekar, Ashish M. Pathak & Amol B. Shinde, *Changes in Laws Against Sexual Offences in BNS — Its Legal Implications*, 10(3) *IP Int'l J. Forensic Med. & Toxicol. Sci.* 67, 67–72 (2025).
[18] "Bharatiya Sakshya Adhiniyam 2023: The New Evidence Law for Modern India," The Prayas India, Oct. 31, 2025, https://theprayasindia.com/bharatiya-sakshya-act-2023.

- Facial recognition,
- Gait analysis,
- Digital pattern analytics.

3.7 Alignment with Human Rights and Privacy Considerations

While the new codes expand forensic reach, they also embed procedural safeguards reflecting constitutional rights. For instance, the use of forensic bodily samples must follow lawful authorisation, ensuring compliance with privacy protections following Justice K.S. Puttaswamy v. Union of India[19].

The law recognises that forensic expansion must not become disproportionate state surveillance, especially regarding biometric databases and DNA profiling.

4. Transparency and Accountability in Forensic Procedures

Transparency has long been a missing link in India's criminal investigative process. Historically, forensic science was deployed selectively and inconsistently, often without clear documentation, verification standards, or procedural oversight. Investigations remained opaque, contributing to wrongful convictions, delays, procedural irregularities, and public mistrust. The reformulation of forensic procedures under the BNSS and BSA seeks to change this landscape by embedding transparency mechanisms into every stage from evidence collection to courtroom presentation.

4.1 From Discretion to Mandatory Procedure: Reducing Arbitrary Investigative Practices

One of the key reforms lies in shifting forensic involvement from discretionary use to a mandated investigative requirement in certain categories of offences. By requiring forensic examination for serious crimes, the BNSS attempts to eliminate arbitrary decision-making influenced by personal experience, bias, or external pressures.

Mandatory recording of forensic procedures, particularly crime scene documentation—prevents selective evidence gathering and provides courts with a traceable record of

[19] K.S. Puttaswamy v. Union of India, (2017) 10 SCC 1 (India).

investigative rigour. This shift is expected to:

- Improve consistency in evidence handling,
- Minimize contamination risks,
- Reduce reliance on subjective testimonial interpretation, and
- Strengthen the evidentiary foundation of prosecutions.

Transparency here becomes structural rather than optional.

4.2 Digital Documentation and Video Recording: Creating Audit Trails

The new legal framework introduces compulsory videography of critical investigative steps to create an irrefutable visual record. Video-recorded procedures—including search, seizure, and forensic evidence collection serves as audit trails that enable courts to verify authenticity and procedural compliance.

Such recordings:

- Strengthen defence rights by preventing fabricated or planted evidence.
- Assist judges in evaluating procedural fairness.
- Protect investigators against allegations of misconduct. and
- Serve as repeatable instructional material for training purposes.

Digitisation transforms transparency into a measurable and reviewable component of procedural justice.

4.3 Chain of Custody: Preventing Tampering and Loss of Evidential Integrity

The BSA's structured chain-of-custody requirements are central to accountability. Every transfer from the crime scene to the forensic laboratory to the courtroom must be documented electronically or via written record.[20]

[20] *Supra note 18.*

This prevents long-standing issues, including[21]:

- Undocumented storage,
- Unauthorised handling,
- Substitution or destruction of samples, and
- Manipulation of forensic reports.

A well-documented chain of custody strengthens the probative value of scientific evidence and aligns Indian practice with global forensic norms.

4.4 Laboratory Accreditation and Expert Accountability

Accreditation of forensic laboratories and professional qualifications introduces institutional checks on scientific reliability. Under previous frameworks, the weight of expert testimony varied depending on laboratory reputation, individual qualifications, and judicial familiarity with methodology.

Accreditation and standardised protocols improve accountability by requiring:

- Validated forensic methodologies,
- Periodic audits of laboratory functioning,
- Documentation of instruments and error margins,
- Traceability of procedures.

This prevents untrained analysts from issuing unverifiable opinions, enhancing both transparency and expertise credibility.

4.5 Transparency in Court: Expert Testimony and Cross-Examination

Expert testimony under the BSA must now follow structured reporting formats with

[21] *Supra note 18.*

documented reasoning, methodology, and degree of certainty.[22] Courts are empowered to examine the basis of scientific conclusions rather than merely accepting expert opinion.

This shift prevents conclusory testimony without a scientific basis, a common weakness in earlier proceedings. Remote deposition via video conferencing further improves accessibility to experts, reducing case delays and ensuring rigorous courtroom scrutiny.

4.6 Public Interest, Privacy, and Ethical Transparency

A critical challenge in forensic expansion is balancing transparency with privacy, especially in biological and biometric data handling. The Puttaswamy privacy judgement applies directly to forensic data collection, requiring that:

- Collection is lawful and non-arbitrary,
- Use is proportional to investigative necessity,
- Retention is time-bound and purpose-specific,
- Individuals retain rights against misuse.

Thus, transparency in forensic investigation cannot become blanket surveillance. Instead, it must be grounded in constitutional principles of necessity and proportionality.

4.7 Reducing Custodial Violence and Confession-Based Policing

The integration of science-based tools reduces the system's reliance on coercive interrogation tactics, historically associated with custodial violence and forced confessions. Transparency in forensic reliance contributes to human rights compliance by shifting investigative culture from confession-centred methods to evidence-based analysis.

The Supreme Court's observations in cases such as D.K. Basu v. State of West Bengal[23] and Selvi v. State of Karnataka[24] reinforce that transparency mechanisms act not only as procedural

[22] Sai Adhithya, *Expert Evidence in the Bharatiya Sakshya Adhiniyam, 2023: Expanding the Role of Forensic and Technical Experts in Judicial Proceedings*, (Oct. 8, 2025), SSRN Paper No. 5578931, https://ssrn.com/abstract=5578931.
[23] D.K. Basu v. State of West Bengal, (1997) 1 SCC 416 (India).
[24] Selvi v. State of Karnataka, (2010) 7 SCC 263 (India).

safeguards but also as structural deterrents against abuse.

4.8 Improving Public Trust in the Criminal System

Section 4 reforms contribute to wider institutional legitimacy. When citizens observe that forensic processes are standardised, documented, and open to scrutiny, trust in police investigations and court verdicts increases. Transparency thus becomes a social outcome not merely a legal requirement.

In high-profile cases involving sexual assault, terrorism, or mob violence, reliable forensic evidence prevents the collapse of public confidence resulting from flawed investigations. It also protects the accused from wrongful implication, reducing miscarriages of justice.

4.9 Forensic Integration and Efficiency in Criminal Procedure

One of the central goals of India's new criminal codes is to address the chronic inefficiencies that plague the justice system: delayed investigations, low conviction rates, and huge case backlogs. The integration of forensic science is framed as a structural solution to these systemic weaknesses. Scientific evidence, if applied uniformly and accurately, promises quicker fact-finding, reduced reliance on unreliable witness testimony, and increased adjudicatory precision.

However, efficiency is a function not only of legal provisions but also of institutional readiness, technological capacity, equitable access, and effective implementation. This section evaluates the impact of forensic mandates on investigative speed, evidentiary strength, trial efficiency, and overall justice delivery.

5. Institutional and Capacity Barriers to Effective Forensic Integration

The integration of forensic science into India's new criminal justice framework under the BNSS, BNS and BSA represents a pivotal shift toward evidence-driven policing. However, strengthening legal provisions alone cannot guarantee improved investigative or judicial outcomes. The success of the forensic-driven model is deeply contingent on the readiness, accessibility, quality, and credibility of India's forensic infrastructure—both institutional and human. Presently, systemic challenges across infrastructure, training, technology, administrative coordination, and oversight threaten to undermine the intended benefits of these

legal reforms.

5.1 Faster Crime Scene Reconstruction and Investigation

In traditional policing models, early-stage delays often compromise evidence recovery, leading to inconclusive or incongruent case theories. The introduction of mandatory forensic involvement in serious offences compels police to adopt prompt and professional forensic protocols. Rapid extraction and scientific analysis of fingerprints, DNA, ballistic markings, mobile data, and trace materials enable[25]:

- Quicker identification of suspects
- Earlier corroboration of victim testimonies
- Reduced scope for speculative investigation
- Prevention of avoidable procedural errors

As a result, the initial phase of investigation critical to building a strong case becomes more objective and streamlined.

5.2 Reduced Dependency on Eyewitnesses and Confessions

Indian courts have long recognised the frailties of eyewitness testimony:

- Memory distortion over time
- Influence of fear, coercion, or bias
- Reconciliation or compromise under social pressure

Similarly, confessions have historically been vulnerable to custodial violence, leading to miscarriages of justice. Forensic integration shifts the burden of proof toward scientifically validated data, making prosecutions stronger and convictions less contentious.

This structural reform supports a human-rights–focused investigative philosophy grounded in

[25] *Supa note 22.*

evidence, not intimidation.

5.3 Faster Trials and Reduced Case Backlogs

A major contributor to trial delays is evidentiary inconsistency, poor documentation, missing links, and unreliable expert opinions require repeated hearings, recollection of evidence, or procedural corrections. Scientific evidence, when properly collected and authenticated, can accelerate trial progression because[26]:

- It offers clear probative value,
- It reduces the need for extraneous witness examinations,
- It limits defense challenges rooted in speculation, and
- Remote expert testimony prevents adjournments caused by logistical issues.

Thus, forensic reliability translates into judicial efficiency, with judgments based more swiftly on irrefutable facts.

5.4 Improving Conviction Rates in Serious Offences

India's conviction rates, particularly in crimes such as sexual assault, homicide, and organised crime, have historically been low due to weak evidentiary foundations.[27] Forensic support enables law enforcement to establish:

- Presence or absence of the accused at the crime scene,
- Mode and manner of offence,
- Biological and trace linkages to criminal activity,
- Verification of alibis using digital location data,

[26] Century Law Firm, *The Role and Admissibility of Forensic Evidence in the Indian Criminal Justice System*, Mondaq (May 27, 2024), https://www.mondaq.com/india/crime/1469694/the-role-and-admissibility-of-forensic-evidence-in-the-indian-criminal-justice-system.
[27] *Ibid.*

- Credibility of both victim and accused narratives.

Consequently, the enhanced forensic infrastructure can lead to both higher conviction rates for the guilty and proper acquittals for the innocent.

5.5 Efficiency Gains Through Digital and AI-Based Tools

The new codes embrace technological assistance for:

- Facial and gait recognition in video surveillance,
- Digital trail analysis in cyber and financial crime,
- Automated ballistics matching,
- AI pattern recognition for complex cross-border networks.

Technology accelerates comparative analysis and reduces manual backlogs. It supports investigators in cases with a high volume of data, where human review alone would cause penalties of delay.

5.6 Infrastructure Demands and the Risk of Procedural Delays

While forensic expansion promises efficiency, inadequate infrastructure risks the opposite outcome. India currently faces[28]:

- Severe shortages of accredited forensic labs,
- Overburdened experts,
- Delays in DNA testing,
- Limited availability of crime scene units,
- Unequal access between urban and rural regions.

[28] Vajiram & Ravi, *What is National Forensic Infrastructure Enhancement Scheme (NFIES)?*, Vajiram & Ravi (June 22, 2024), https://vajiramandravi.com/current-affairs/national-forensic-infrastructure-enhancement-scheme-nfies/ (last visited Nov. 29, 2025)

If mandatory forensic investigation becomes the rule without expanding capacity, cases may slow rather than speed up. Legal reform without logistical readiness can create compliance burdens rather than efficiencies.

5.7 Training and Human Resource Constraints

Policing efficiency depends on professional skills and procedural literacy. Many police personnel lack:

- Knowledge of proper evidence handling,
- Familiarity with forensic tools,
- Awareness of contamination risks,
- Capacity to document chain-of-custody requirements.

Without large-scale training initiatives, forensic dependence may result in technical errors rendering evidence unusable, thereby failing the very purpose of reforms.

5.8 Ensuring Equitable Efficiency Across India

Efficiency must be uniformly available not only in major cities. Disparities currently exist:

Region	**Access to Forensic Support**	**Likely Impact**
Metropolitan Areas	High	Faster case disposal
Tier-2/Tier-3 Cities	Moderate	Mixed efficiency
Rural/Remote Districts	Low–Very Low	Delayed justice

If not corrected, reforms may unintentionally widen gaps in justice outcomes based on geography and resource access.

5.9 Strengthening Inter-Agency Coordination

Efficiency also requires seamless cooperation between:

- Police

- Medical examiners
- Forensic laboratories
- Prosecutors
- Judicial institutions

The new criminal codes encourage integrated systems, but operational coordination must evolve through shared databases, standardised communication protocols, and accountability measures for delays.

Forensic integration under the new criminal laws has significant potential to enhance investigative precision and reduce systemic delays. Yet efficiency remains contingent on capacity-building, technological investment, and professional training across the full criminal justice chain. If implementation mismatch persists, mandatory forensic involvement could create new bottlenecks even as legal reforms strive toward faster justice.

6. Global Comparative Lessons and Policy Directions for India

As India transitions toward a forensic-centric criminal justice system through its new criminal laws—the Bharatiya Nyaya Sanhita (BNS), Bharatiya Nagrik Suraksha Sanhita (BNSS), and Bharatiya Sakshya Adhiniyam (BSA)—it becomes essential to situate these reforms within global developments. Most countries that have modernised their investigative and evidentiary frameworks did so through coordinated strategies involving science, technology, institutional capacity building, and robust rights protections. A comparative analysis offers lessons on what works, what fails, and what practices India can adapt to ensure transparency, efficiency, and evidentiary integrity.

6.1 United States: Standardisation, Accreditation, and Due Process

The U.S. forensic evolution accelerated after wrongful convictions exposed through DNA exonerations highlighted unreliable forensic practices, flawed lab analysis, and untrained experts.[29] This led to systemic changes anchored in:

[29] U.S. Dept. of Justice, *Forensic Science*, Office of Legal Policy (OLP), https://www.justice.gov/olp/forensic-science (last visited Nov. 29, 2025).

- Mandatory accreditation of forensic laboratories
- Proficiency certification of forensic examiners
- The Daubert standard requires courts to admit only scientifically validated and peer-reviewed evidence
- The Innocence Project, which operationalised post-conviction DNA review mechanisms

The U.S. model underscores two lessons for India:

1. Science must be subject to judicial scrutiny, not accepted uncritically.
2. Oversight bodies are essential, especially where state institutions themselves generate evidence.

India currently lacks an independent national forensic oversight body, and adopting one would reduce bias, ensure transparency, and improve public trust.

6.2 United Kingdom: Integrated Training and Crime Scene Management

The UK places strong emphasis on forensic training at the police level. Crime scene officers (CSOs) are specialised professionals rather than ordinary law enforcement personnel.[30] Additionally:

- Digital chain of custody systems ensure traceability.
- The Forensic Science Regulator issues binding standards.
- Courts rely heavily on expert testimony subject to strict admissibility filters.

This approach emphasises professionalisation rather than treating forensic handling as an administrative add-on. For India, this suggests the need to create:

[30] S. Jhalani, *UK Parliamentary Inquiry Reports in Forensic Science*, *Forensic Sci. Int. & L.* (2024), https://doi.org/10.1016/j.fsil.2024.101343.

- Dedicated forensic units at the district level
- Specialist crime scene documentation personnel
- Public-private partnerships for technological upgrades

6.3 European Union: Ethical Governance and Data Protection

EU forensic science is embedded within strong human rights safeguards. Regulations on:

- Data storage
- Use of biometrics and DNA
- Cross-border evidence sharing
- Consent and privacy obligations

ensure that forensic expansion does not compromise fundamental liberties. The GDPR provides a comprehensive legal framework governing personal data, including biometric and genetic information.[31]

India's rapid expansion of forensic databases, particularly DNA and digital evidence, requires similar legal guardrails. Without a dedicated privacy and data protection statute, there is potential for misuse, profiling, and mass surveillance.

6.4 China and Singapore: Technology-driven Forensic Integration

China and Singapore represent models where forensic tools are embedded within broader governance systems using AI, biometrics, video forensics, and predictive analytics.[32] Their crime control strategies include:

- National DNA repositories

[31] *Regulation of Biometric Data under the General Data Protection Regulation*, Clarip Privacy Blog (last visited Nov. 29, 2025), https://www.clarip.com/blog/regulation-of-biometric-data-under-the-gdpr/

[32] Oxford Institute of Technology and Justice, *China: AI-embedded Criminal Justice System* (2025), https://www.techandjustice.bsg.ox.ac.uk/research/china.

- Real-time integration with policing systems
- AI-assisted forensic analysis

While technology-driven approaches offer efficiency, they also raise questions around civil liberties and algorithmic bias.[33]

India's legal culture anchored in constitutionalism and judicial review may require a balanced middle path: adopting advanced forensic tools while ensuring procedural fairness, transparency, and community accountability.

6.5 Japan: Judicial Caution and Scientific Modesty

Japan offers a contrasting example. Despite high technological capacity, courts rely on forensic evidence cautiously, particularly where validation is incomplete. The emphasis is on:

- Avoiding over-dependence on technology
- Ensuring corroboration
- Maintaining high admissibility thresholds

This approach is instructive for India, where forensic enthusiasm is growing, but validation frameworks remain inadequate. A forensic-driven justice system must avoid placing blind faith in science without rigorous scrutiny.[34]

6.6 Lessons India Can Adapt

A synthesis of international experiences suggests five guiding principles:

1. Create a National Forensic Standards and Accreditation Authority

A regulatory body independent of police and executive control should oversee:

- Laboratory accreditation

[33] *Ibid*
[34] *Supra note 31*

- Examiner qualifications
- Research benchmarks
- Ethical compliance
- Continuous audits

Training should not be limited to investigators. Prosecutors, judges, and defence lawyers must be equally capable of interpreting scientific evidence.

2. Guarantee Privacy and Rights-Based Safeguards

Any national forensic database must be governed by:

- Clear retention rules
- Court oversight
- Limited access protocols
- Protection against discriminatory profiling

4. Expand Infrastructure with Regional Equity

A forensic revolution should not privilege urban India. Tier-III districts must receive:

- Mobile forensic vans
- Digital investigation labs
- Specialised medico-legal experts

5. Promote Research, Innovation, and Academia-Industry Collaboration

Countries with strong forensic systems invest heavily in research. India must integrate:

- Universities
- AI labs
- Biotech institutions

- Cyber forensics centres

Into forensic development and policy.

Global experience demonstrates that forensic-driven criminal justice reforms succeed only when grounded in strong governance, institutional coordination, rights-based safeguards, and scientific accountability. Technology alone cannot transform justice; it must be accompanied by trained personnel, standardisation, transparency, and independent oversight. For India, the path forward is not simply to replicate foreign models but to adapt them thoughtfully—balancing efficiency with constitutional values of fairness, dignity, and due process. The comparative landscape offers both inspiration and caution, signalling that the promise of forensic justice must be matched by deliberate and sustained reforms across policy, infrastructure, and practice.

7. Policy Recommendations for Strengthening Forensic-Led Justice in India

India's new criminal justice codes—the Bharatiya Nyaya Sanhita (BNS) 2023, Bharatiya Nagrik Suraksha Sanhita (BNSS) 2023, and Bharatiya Sakshya Adhiniyam (BSA) 2023—mark a transformative step toward integrating forensic science into investigations and trials. While the reforms are ambitious in scope, their ultimate effectiveness depends on careful policy implementation, capacity enhancement, and systemic alignment across policing, laboratories, prosecution, and judiciary. Drawing from domestic experiences and global best practices, the following policy recommendations aim to strengthen forensic-led justice in India.

7.1 Establish a National Forensic Regulatory Authority

A central regulatory authority is critical to ensure quality, standardisation, and accountability. Its mandate should include:

- **Laboratory Accreditation and Certification**: Establish mandatory ISO-compliant standards across all forensic disciplines, including DNA, cyber forensics, toxicology, and ballistics.

- **Professional Certification of Analysts**: Regular proficiency testing for forensic examiners to maintain competence.

- **Ethical Oversight and Audit**: Independent review of laboratory processes to prevent

evidence tampering, procedural lapses, and bias.

- **Research and Development Coordination**: Promote innovation and adoption of international best practices in forensic methodologies.

Such an authority would reduce inter-lab variability, strengthen public confidence, and provide courts with more credible and standardized evidence.

7.2 Expand and Modernise Forensic Infrastructure

The legal reforms must be matched by physical and technological capacity:

- **Regional Forensic Hubs**: Establish labs in Tier-2 and Tier-3 cities to ensure equitable access.
- **Mobile Forensic Units**: Deploy units capable of rapid crime scene investigation in remote or rural areas.
- **Advanced Analytical Technology**: Upgrade existing labs with high-throughput DNA sequencing, AI-assisted digital forensics, chemical analysis, and ballistic testing equipment.
- **Maintenance and Upkeep Plans**: Long-term budgeting for calibration, replacement, and continuous operation of instruments.

Infrastructure expansion is fundamental to avoiding procedural delays and ensuring timely case resolution.

7.3 Human Resource Development and Training

Capacity-building must encompass all stakeholders:

- **Police Training**: Courses on crime scene management, sample collection, chain of custody, and digital evidence handling.
- **Judicial and Prosecutorial Training**: Judges, prosecutors, and defence lawyers must understand forensic principles, evidentiary weight, and limitations of scientific findings.

- **Interdisciplinary Training Programs**: Encourage collaboration between law enforcement, medical personnel, cyber specialists, and forensic analysts to foster integrated investigation approaches.

- **Continuous Professional Development**: Mandate refresher courses to keep personnel updated on emerging forensic techniques.

Without skilled personnel, even the most advanced forensic infrastructure cannot yield reliable outcomes.

7.4 Legal and Procedural Safeguards

Strengthening forensic justice requires clear procedural and legal frameworks:

- **Codify Forensic Evidence Admissibility Standards**: Provide explicit guidelines on the conditions under which forensic reports are admissible.

- **Ensure Chain of Custody Integrity**: Digitally document every transfer of evidence, with audit trails accessible to courts and stakeholders.

- **Rights-Based Collection Protocols**: Protect individual privacy, prevent coercive sampling, and comply with constitutional standards.

- **Protocols for AI and Algorithmic Evidence**: Define validation criteria, error rates, and cross-examination standards for AI-generated forensic evidence.

Procedural safeguards prevent misuse of forensic science and enhance the credibility of courts in interpreting complex evidence.

7.5 Integrate Forensic Science into Criminal Justice Workflows

Forensic evidence should not function as a standalone input but as part of an integrated investigation and trial ecosystem:

- **Pre-Trial Forensic Consultation**: Analysts should advise investigators during the initial stages of evidence collection.

- **Centralised Digital Repositories**: Create national databases for DNA, fingerprints,

ballistic markings, and cyber footprints accessible to authorised agencies.

- **Inter-Agency Coordination**: Improve communication and standardisation between police, laboratories, prosecutors, and the judiciary.
- **Case Management Systems**: Use digital platforms to track evidence, report timelines, and laboratory outputs, ensuring accountability and efficiency.

Integration ensures that forensic science enhances investigation and adjudication rather than becoming a bureaucratic obligation.

7.6 Promote Public Awareness and Victim Support

Effective forensic-led justice also depends on public engagement:

- **Awareness Programmes:** Educate citizens on reporting mechanisms, forensic procedures, and rights regarding evidence collection.
- **Victim-Centric Approach**: Ensure timely forensic sampling, access to medical and counselling support, and minimal trauma during evidence collection.
- **Legal Aid**: Extend forensic advisory support to legal aid lawyers and underprivileged victims to prevent unequal access to justice.

Public confidence in forensic processes is critical for societal acceptance and reporting of crimes.

7.7 Encourage Research, Collaboration, and Innovation

A forward-looking forensic policy requires continuous scientific evolution:

- **University and Industry Collaboration**: Partner with academic and private research institutions to develop new analytical methods, digital tools, and data modelling techniques.
- **Global Knowledge Exchange**: Study best practices from the U.S., EU, Japan, and Singapore, adapting them to Indian socio-legal contexts.

- **Pilot Projects**: Implement small-scale technology-driven forensic projects in select districts before national roll-out.

Innovation ensures that India's forensic system remains up-to-date and capable of addressing emerging forms of crime.

India's forensic reforms are a promising leap toward a more transparent, efficient, and scientifically reliable criminal justice system. However, legal mandates alone cannot produce transformational outcomes. A holistic approach encompassing institutional capacity, professional training, procedural safeguards, technological investment, rights-based regulation, and public awareness—is essential. By adopting international best practices while tailoring them to Indian realities, India can achieve a forensic-driven criminal justice system that is not only faster and more efficient but also fair, accountable, and constitutionally sound.

Conclusion

The integration of forensic science into India's criminal justice system through the Bharatiya Nyaya Sanhita (BNS) 2023, Bharatiya Nagrik Suraksha Sanhita (BNSS) 2023, and Bharatiya Sakshya Adhiniyam (BSA) 2023 represents a transformative step toward modernising investigation, enhancing evidentiary reliability, and improving judicial efficiency. Forensic science, when applied effectively, has the potential to reduce wrongful convictions, accelerate case resolution, and strengthen public trust in the legal system. Yet, the promise of forensic-led justice depends on more than legal reform—it requires systemic alignment, infrastructural investment, human resource development, procedural rigour, and ethical safeguards.

India has historically struggled with investigative opacity, delayed justice, and an overreliance on testimonial evidence and confessions. The new codes seek to correct these systemic weaknesses by mandating forensic involvement in serious crimes, formalising admissibility standards, emphasising scientific documentation, and enhancing procedural transparency. Measures such as digital chain-of-custody records, laboratory accreditation, expert certification, and crime scene video documentation establish a framework where scientific evidence can be collected, analysed, and presented with integrity. These reforms aim to ensure that justice is not dependent on luck, discretion, or anecdotal evidence but grounded in verifiable, reliable, and reproducible scientific methods.

However, legal reform alone cannot achieve these goals. India faces significant institutional and capacity barriers: an insufficient number of accredited laboratories, uneven distribution of facilities across urban and rural regions, a shortage of trained forensic experts, and inadequate inter-agency coordination. These structural gaps risk transforming forensic mandates into procedural bottlenecks, delaying investigations rather than expediting them. Additionally, technological expansion—particularly in digital forensics and AI-driven analysis—raises concerns about privacy, data misuse, and algorithmic bias. Without careful regulation, forensic science could inadvertently compromise rights while attempting to secure convictions.

Global experiences underscore that effective forensic systems are those that combine scientific rigor with institutional accountability and rights-based safeguards. Lessons from the United States, the United Kingdom, Japan, Singapore, and the European Union highlight the importance of independent oversight, standard operating procedures, professional training, privacy protections, and continuous innovation. These examples demonstrate that forensic science must be integrated within a broader ecosystem of policy, governance, and judicial competence. Blind reliance on technology or isolated statutory reforms is insufficient.

To realise the full potential of forensic-led justice, India must adopt a holistic strategy. Key policy imperatives include the creation of a national regulatory authority for forensic standards, expansion of laboratory infrastructure and regional access, intensive human resource development for investigators, prosecutors, and judges, integration of forensic workflows within the criminal justice system, robust procedural safeguards, and public awareness programmes. Research, innovation, and international collaboration should be institutionalised to ensure that forensic practices remain scientifically credible and socially relevant.

Ultimately, the success of India's forensic reforms hinges on balancing efficiency, transparency, and reliability with constitutional protections, human rights, and equitable access. A rights-based, victim-centric approach ensures that forensic science serves not merely as a tool of conviction but as a mechanism to deliver fair, timely, and accountable justice. By embedding scientific evidence within a framework that respects due process, procedural integrity, and societal trust, India can modernise its criminal justice system while upholding constitutional ideals.

In conclusion, the new criminal justice codes provide a robust foundation for forensic-driven investigations and trials, marking a significant step toward modern, evidence-based justice.

Yet, the real test lies in operationalising these reforms: building institutional capacity, ensuring procedural compliance, protecting rights, and maintaining public confidence. Forensic science has the potential to transform Indian criminal justice, making it faster, more reliable, and more transparent, but only if legal, technological, and institutional reforms are implemented in tandem. The pathway forward is not simply about rewriting statutes; it is about rebuilding the criminal justice ecosystem to ensure that transparency, efficiency, and evidentiary reliability are not aspirational ideals but operational realities.