
Investigative Frontiers Integration of Science Transforming Criminal Investigation

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Science and Conscience: Ethical and Regulatory Dimensions of Criminal Investigation

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Abstract

The criminal investigation has shifted from tradition to evidence-based scientific investigation with the aid of developments in forensic science and interdisciplinary team work. The theme "Science and Conscience" underscores the importance of ensuring that scientific progress is accompanied by moral responsibility and legal accountability towards achieving justice. This review will discuss how forensic science is contributing to evidence-based justice using objective, reliable and legally admissible evidence, and the importance of multidisciplinary approaches in enhancing the accuracy of investigations. It also outlines the moral values that underpin the practice of criminal investigation, such as integrity, impartiality, professional competence, confidentiality and accountability. In the Indian context, this review examines the regime of criminal investigations such as the Bharatiya Nyaya Sanhita, Bharatiya Nagarik Suraksha Sanhita, Bharatiya Sakshya Adhiniyam, constitutional protection, and forensic regulatory mechanisms. Lastly, the review examines novel ethical and regulatory issues raised by AI, digital forensics, biometric technologies, and electronic evidence. It finds that scientific progress goes hand-in-hand with robust ethical control and proper legal frameworks in order to guarantee fair, trustworthy, and rights-based criminal investigations.

Keywords: Forensic Science; Criminal Investigation; Evidence-Based Justice; Ethics; Legal and Regulatory Framework.

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1 Introduction

Science and Conscience are the two pillars of the investigation of the modern criminal. Science is the systematic use of knowledge gained through observation, forensic technologies and analytical techniques to achieve accurate and reliable objective facts, to identify an offender, and to reconstruct a criminal event. But conscience has a different meaning, it is the moral duty, the integrity and the legal liability that should inform each investigative action. Science has done much to improve investigators' powers of discovery to seek the truth, but technology alone is not enough to achieve justice. It should also be subject to moral guidelines, people's dignity and rule of law. Science and conscience work together to make sure that criminal investigations are effective, fair, transparent and socially legitimate.²

Forensic science has significantly changed the way criminal investigations are conducted from being based largely on the testimony of witnesses and confessions to being based on objective scientific evidence. Modern investigations involve various fields of forensics, such as DNA analysis, fingerprint analysis, forensic pathology, toxicology, digital forensics and crime scene reconstruction, with the intent of creating evidence which can withstand the rigors of court. At the same time, a multidisciplinary approach by forensic scientists, law enforcement, legal staff, medical practitioners, psychologists, and experts in the field of digital investigation has helped to improve the correctness and completeness of investigations. These developments have greatly minimised uncertainty in criminal investigations and enhanced the efficiency of the collection, analysis and interpretation of evidence.³

Despite the scientific advances, there remain a host of ethical and regulatory issues in criminal investigations. The rising deployment of Artificial Intelligence, biometric identification, digital monitoring, genetic databases, predictive analytical tools and more has led to significant questions about privacy, informed consent, algorithmic bias, data protection, proportionality and the misuse of scientific evidence.⁴ It is therefore essential to have strong legal systems, ethical standards for professionals and regulation to ensure that technological innovations are able to serve the cause of justice without infringing on basic human rights. In this context, this review discusses the importance of forensic science in evidence-based justice, the value of

² F. Haziri, "The Role of Forensic Science in Modern Criminal Investigations: Scientific Foundations, Challenges, and Future Directions," *Int. J. Forensic Sci. Crim. Investig.*, vol. 3, pp. 1–2, Mar. 2026, doi: 10.54026/IJFSCI/1007.

³ P. Kothari, "Exploring the Role of Forensic Science in Indian Criminal Justice System," SSRN e-library, pp. 1–15, 2023, doi: <http://dx.doi.org/10.2139/ssrn.4565177>.

⁴ V. Sharma and P. Sood, "Scientific Investigation in the Criminal Justice System: Problems and Prospects," *Education*, vol. 8, no. 9, pp. 7–12, 2022.

multidisciplinary scientific methods, the ethics of criminal investigation, legal and regulatory frameworks that influence investigative procedures, and new challenges arising from advances in forensic technologies.

2 Role of forensic science in evidence-based justice

Forensic science provides the scientific basis for justice through the use of validated scientific principles and techniques to identify, collect, preserve, examine, and interpret scientific evidence regarding a criminal investigation. Forensic science will give objective, measurable and verifiable information that will help investigators and courts be able to establish facts with greater accuracy and reliability, unlike traditional investigations which primarily rely on eyewitness testimony, confessions or circumstantial evidence. This scientific method avoids subjective interpretation, lessens investigative bias and enhances the validity of judicial proceedings by basing the conclusions on scientific evidence instead of guessing.⁵

Forensic science is not only used during the investigation of a crime but also in all phases of the criminal justice process. Forensic workers at the scene record the scene, gather physical and biological evidence, and ensure the chain of custody remains intact to ensure evidence is not compromised. Laboratory services including DNA, fingerprint, firearm and toolmark, questioned document, trace evidence and digital forensics are used to help identify suspects and victims, reconstruct criminal events, determine the cause of death and recover electronic evidence. These scientific results confirm the witness accounts, link suspects to the crime scene, rule out innocent persons, and support the prosecution case.⁶

Forensic science plays a major role in the fair administration of justice, with its contributions going above and beyond investigation to preventing wrongful convictions, allowing for the review of disputed cases and helping with impartial judicial decision-making. In addition to these developments, forensic examination has become more precise, reliable, efficient and accurate through continuous advances in molecular biology, analytical chemistry, imaging and digital forensic technologies. As a result, forensic science has become an integral part of today's

⁵ B. Banerji, K. V. R. Kumar, and A. Kaur, "Review of Forensic Science in India: Review Paper," *Int. J. Med. Toxicol. Leg. Med.*, vol. 26, no. 1–2, 2023, doi: 10.5958/0974-4614.2023.00031.1.

⁶ S. Keltz, R. Julian, and R. Hayes, "The Impact of Forensic Evidence on Criminal Justice: Evidence from Case Processing Studies," in *Forensic Science and the Administration of Justice: Critical Issues and Directions*, 2015. doi: 10.4135/9781483368740.n7.

evidence-based justice, giving the public more confidence in the criminal justice system with valid scientific evidence that is admissible in court.⁷

3 Integration of multidisciplinary scientific approaches

Modern criminal investigation has become a multi-disciplinary scientific investigation in which professionals from various disciplines work together to reconstruct criminal incidents, determine who is responsible for crime, and assist in judicial proceedings. Crimes frequently include multiple pieces of physical, biological, behavioral, environmental and digital evidence which can not be effectively described or analyzed using one discipline alone.⁸ Thus, combining several scientific tools allows investigators to build up a picture of what may have occurred during an offence and increase the accuracy, reliability and credibility of the forensic results. This co-operative approach helps to compare evidence gathered from various sources, reduce bias in investigations, and enhance the evidence presented to the court.⁹ The following are the major multidisciplinary scientific approaches that are incorporated into the modern criminal investigation:

- i. **Forensic Biology:** Examination of biological evidence such as blood, saliva, semen, hair, tissues, and DNA to identify individuals, establish biological relationships, and link suspects or victims to crime scenes.
- ii. **Forensic Chemistry:** Analysis of drugs, explosives, poisons, toxic substances, paints, glass fragments, petroleum products, and other chemical materials to determine their composition, origin, and evidentiary significance.
- iii. **Forensic Pathology:** Investigation of the cause, manner, and time of death through autopsies and medical examinations in cases involving suspicious, sudden, or violent deaths.
- iv. **Forensic Toxicology:** Detection and interpretation of alcohol, narcotics, pharmaceuticals, poisons, and other toxic substances in biological specimens to evaluate their role in injury, impairment, or death.

⁷ T. Meghwal, "Crime Scene Investigation in India: Legal Framework, Procedures & Challenges," SSRN, 2025, doi: <http://dx.doi.org/10.2139/ssrn.5241244>.

⁸ V. Sinha and S. Singh, "Deciphering Secrets: An Interdisciplinary Approach to Forensic Science," Gurukul Int. Multidiscip. Res. J., vol. XII, no. II, pp. 61–67, 2024, doi: <https://doi.org/10.69758/GIMRJ2406IIV12P009>.

⁹ P. M. Barone and E. Di Luise, "A Multidisciplinary Approach to Crime Scene Investigation: A Cold Case Study and Proposal for Standardized Procedures in Buried Cadaver Searches over Large Areas," Forensic Sci., vol. 5, no. 34, pp. 1–16, 2025, doi: <https://doi.org/10.3390/forensicsci5030034>.

- v. **Fingerprint and Impression Evidence:** Examination of latent fingerprints, palm prints, footwear impressions, tire marks, and toolmarks to establish identity and reconstruct activities at the crime scene.
- vi. **Digital Forensics:** Recovery, preservation, and analysis of electronic evidence from computers, mobile devices, cloud platforms, surveillance systems, and digital networks to investigate cyber-enabled and conventional crimes.
- vii. **Forensic Psychology and Psychiatry:** Assessment of offender behavior, criminal profiling, witness reliability, competency to stand trial, criminal responsibility, and psychological factors influencing criminal conduct.
- viii. **Crime Scene Reconstruction:** Integration of physical evidence, bloodstain pattern analysis, trajectory analysis, scene documentation, and witness information to scientifically reconstruct the sequence of criminal events.
- ix. **Ballistics and Firearm Examination:** Identification of firearms, ammunition, gunshot residues, bullet trajectories, cartridge cases, and shooting distances to establish the circumstances surrounding firearm-related offences.
- x. **Trace Evidence Analysis:** Examination of microscopic materials such as fibres, glass, soil, pollen, paint, gunshot residue, and other transferred particles that associate individuals, objects, or locations with criminal activities.

These multidisciplinary scientific methods can be integrated to facilitate the shift from individual evidence analyses to a coordinated and evidence-based investigative process in criminal investigations. Integrating the knowledge of various scientific fields enables investigators to accurately reconstruct criminal events, to corroborate results with other lines of evidence, and to make sure that judicial decisions are based on scientifically valid and ethically gained evidence.¹⁰

4 Ethical Dimensions of Criminal Investigation

Ethics is the moral basis of criminal investigation as it guarantees scientific methods, investigative practices and forensic analyses are carried out honestly, fairly and with respect for human dignity. While forensic science has improved immensely in its ability to identify and solve crime, scientific powers are not sufficient to ensure fairness or justice.¹¹ From processing

¹⁰ R. R. Gupta, "Interdisciplinary integration in forensic science with expanding its horizon," *IP Int. J. Forensic Med. Toxicol. Sci.*, vol. 10, no. 4, pp. 106–107, 2025, doi: <https://doi.org/10.18231/j.ijfmts.35123.1765615698>.

¹¹ I. Erkan, "Evaluation of the ethical dimensions of forensic DNA databases," *Med. Sci. Law*, 2026, doi: [10.1177/00258024261437507](https://doi.org/10.1177/00258024261437507).

the crime scene to presenting evidence in the courtroom, all aspects of the investigation should be conducted in an ethical manner that upholds fairness, accountability, and professionalism. Ethical standards serve to safeguard the rights of victims, suspects and witnesses and strengthen public trust in the criminal justice system. It also ensures that scientific evidence is gathered, analyzed and communicated without damaging the integrity of the evidence or infringing on the basic human rights.¹² The ethical aspects of criminal investigation are:

- i. **Integrity and Honesty:** Investigators and forensic scientists must conduct investigations truthfully by collecting, analyzing, and reporting evidence without fabrication, falsification, concealment, or misrepresentation.
- ii. **Objectivity and Scientific Impartiality:** Investigative conclusions should be based solely on scientific evidence and validated methodologies, free from personal bias, external influence, or preconceived assumptions.
- iii. **Respect for Human Rights and Human Dignity:** Criminal investigations must uphold the fundamental rights of all individuals by ensuring humane treatment, protecting personal dignity, and avoiding coercive or degrading practices.¹³
- iv. **Confidentiality and Privacy:** Personal, medical, genetic, and digital information obtained during investigations should be protected against unauthorized access or disclosure and used only for legitimate investigative purposes.
- v. **Professional Competence:** Investigators and forensic practitioners have an ethical responsibility to maintain scientific competence, apply validated techniques, and continually update their professional knowledge and skills.
- vi. **Accountability and Transparency:** Ethical investigations require proper documentation of investigative procedures, evidence handling, and forensic analyses so that decisions remain open to independent review and judicial scrutiny.¹⁴
- vii. **Integrity of Evidence:** Physical, biological, digital, and documentary evidence must be collected, preserved, examined, and stored in a manner that prevents contamination, alteration, loss, or tampering throughout the investigative process.

¹² P. K. Yadav, "Ethical issues across different fields of forensic science," *Egypt. J. Forensic Sci.*, vol. 7, no. 10, pp. 1–6, 2017, doi: 10.1186/s41935-017-0010-1.

¹³ D. Dhariwal and N. Verma, "Balancing Justice: Human Rights and the Law of Evidence in India," SSRN e-library, 2024, doi: <http://dx.doi.org/10.2139/ssrn.4962336>.

¹⁴ M. Irvita and Asriani, "Transparency and accountability in the justice system: Building public trust and justice," *Priviet Soc. Sci. J.*, vol. 5, no. 4, 2025, doi: 10.55942/pssj.v5i4.367.

- viii. **Avoidance of Conflicts of Interest:** Investigators and forensic experts must remain independent and impartial by avoiding personal, financial, or professional interests that could compromise the credibility of their findings.
- ix. **Ethical Expert Testimony:** Forensic experts are ethically obligated to provide accurate, unbiased, and scientifically supported opinions before the court, presenting both the strengths and limitations of forensic evidence.

All these moral aspects give the moral structure of the modern criminal investigation. They are consistently applied to ensure that the scientific evidence is not only used effectively in the detection of crime, but also is used and applied in a fair, transparent and ethical manner in the administration of justice.

5 Regulatory and Legal Frameworks Governing Criminal Investigation

Criminal investigation effectiveness is not only dependent on scientific developments but also on a solid legal and regulatory system for criminal investigations which are conducted legally, transparently and in accordance with constitutional provisions. Criminal investigation in India is regulated under the combination of constitutional provisions, substantive criminal laws, procedural laws, judicial precedents and regulatory guidelines pertaining to forensic science.¹⁵ These legal procedures aim to reconcile the importance of the state's investigative duties with the respective rights of the individuals, as well as to guarantee that scientific evidence is gathered, analysed and presented in a way that respects the principles of natural justice and the rule of law. The legal framework will continue to be an important component in the regulation of the application of forensic technologies and in maintaining public confidence in the criminal justice system, as these technologies evolve.¹⁶ The following are the most important regulatory and legal provisions relating to criminal investigation in India:

- i. **The Constitution of India:** Fundamental Rights under Articles 14, 20, 21, and 22 guarantee equality before the law, protection against self-incrimination, the right to life and personal liberty, and safeguards against arbitrary arrest and detention. These

¹⁵ P. (Dr. . P. S. Jaswal and P. (Dr. . V. K. Singh, "A Review of Criminal Law Reforms in India: Shaping the Future of Criminal Law in India," SRMUH Law Rev., vol. 2, no. 2, 2024.

¹⁶ S. Dixit and Chandrika, "The Legal Implications of the Criminal Procedure (Identification) Act, 2022: A Comprehensive Analysis of Constitutional, Criminal, and Forensic Dimensions," Himachal Pradesh Natl. Law Univ. Shimla J., vol. 166, 2022, doi: <https://doi.org/10.70556/hpnlu-slr-v5-I1-2022-08>.

constitutional provisions form the ethical and legal foundation of criminal investigations.¹⁷

- ii. **Bharatiya Nagarik Suraksha Sanhita, 2023 (BNSS):** The BNSS provides the procedural framework for criminal investigations, including registration of information, powers of investigation, arrest, search and seizure, collection of evidence, filing of investigation reports, and conduct of criminal proceedings before courts.¹⁸
- iii. **Bharatiya Nyaya Sanhita, 2023 (BNS):** The BNS defines criminal offences and prescribes punishments, thereby providing the substantive legal basis upon which investigations are initiated and offences are classified.¹⁹
- iv. **Bharatiya Sakshya Adhiniyam, 2023 (BSA):** The BSA governs the admissibility, relevancy, and appreciation of evidence in judicial proceedings. It recognizes scientific and electronic evidence, thereby strengthening the role of forensic science in criminal trials.²⁰
- v. **Information Technology Act, 2000:** This legislation regulates offences involving computers, digital networks, electronic records, cybercrime, and electronic evidence, while providing legal recognition to electronic records and digital signatures.²¹
- vi. **The Protection of Human Rights Act, 1993:** The Act establishes mechanisms for protecting human rights during criminal investigations and provides oversight through the National Human Rights Commission (NHRC) and State Human Rights Commissions to address allegations of custodial violence, torture, and abuse of authority.
- vii. **Judicial Guidelines and Supreme Court Decisions:** Judicial pronouncements have significantly shaped investigative practices by establishing safeguards relating to arrest

¹⁷ I. Y. Brain et al., "Forensic Science in Indian Criminal Law: Legislative Provisions, Legal Implications and Suggestions for Reforms," *Int. J. Law Manag. Humanit.*, vol. 9, no. 2, pp. 2430–2440, 2026, doi: <https://doi.org/10.10000/IJLMH.1111758>.

¹⁸ N. R. D. Cruz, "Criminal Investigation In The Modern Era," *LawFoyer Int. J. Doctrin. Leg. Res.*, vol. 4, no. 2, pp. 308–339, 2026, doi: <https://doi.org/10.70183/lijdlr.2026.v04.163>.

¹⁹ D. O. P. Rai, "Criminal justice reforms in India: a critical study of the Bharatiya Nyaya Sanhita, 2023," *J. Adv. Educ. Sci.*, vol. 5, no. 2, pp. 88–93, 2025, doi: <https://doi.org/10.64171/JAES.5.2.88-93>.

²⁰ S. Nithishkumar and M. V., "Relevancy of Facts Showing State of Mind or Intention : An Analytical Study Under the Bharatiya Sakshya Adhiniyam, 2023," *Int. J. Adv. Res. Sci. Commun. Technol.*, vol. 6, no. 10, pp. 1–9, 2026, doi: 10.48175/568.

²¹ R. K. Bharati, "Chapter 18: Critical Analysis of IT Act, 2000 in light of New Criminal Laws and Technological Advancements," in *Handbook on the Information Technology Act, 2000: Offences, Penalties, and the Impact of New Criminal Laws*, 2025. doi: <https://doi.org/10.70593/978-93-7185-183-1>.

procedures, custodial interrogation, admissibility of evidence, forensic examinations, and protection of fundamental rights. Courts also regulate the evidentiary value of scientific techniques through evolving jurisprudence.

- viii. **Forensic Science Standards and Laboratory Accreditation:** Government forensic laboratories are expected to follow scientifically validated protocols, quality assurance measures, and accreditation standards such as ISO/IEC 17025 for testing laboratories and ISO/IEC 17020 for crime scene inspection, ensuring the reliability and credibility of forensic examinations.
- ix. **National Forensic Infrastructure and Regulatory Institutions:** Institutions such as the Directorate of Forensic Science Services (DFSS), Central Forensic Science Laboratories (CFSs), State Forensic Science Laboratories (SFSs), and the National Crime Records Bureau (NCRB) play a significant role in strengthening forensic capabilities, developing scientific standards, maintaining criminal databases, and supporting law enforcement agencies.

The Indian legal and regulatory environment is constantly evolving to meet the changing face of technology and crime. Recent changes in the Bharatiya criminal laws have boosted the recognition of scientific and electronic evidence, and placed importance on efficiency, transparency and victim-centric justice. However, these will need to be continually updated, formalised to meet quality requirements, and staffed with investigators and forensic experts who are regularly trained and who are observant of constitutional protection. A well-managed investigative mechanism, in the end, ensures that the scientific innovations become a factor in fair, accountable, and effective criminal justice administration in India.

6 Emerging Ethical and Regulatory Challenges in Modern Criminal Investigation

The progress of forensic science and digital technologies has been very fast in India, which has given a boost to criminal investigation but also brought along with it some complicated ethical and regulating issues. The increasing use of artificial intelligence, facial recognition systems, biometric identification, digital surveillance, drone technology, and predictive analytics has enhanced investigative efficiency while simultaneously raising concerns regarding privacy, data security, algorithmic bias, and accountability. The use of DNA profiling and biometric data has facilitated the identification of offenders and victims, but has also raised ethical issues about informed consent, retention of genetic data, and sensitive personal data. Further, the reliance on electronic evidence from mobile devices, cloud storage, social media and encrypted

communication applications creates issues with maintaining data authenticity, chain of custody and protection of constitutional rights in digital investigations.²²

In India these problems are more important especially since the introduction of the Bharatiya criminal laws which have been more inclusive of electronic and scientific evidence. Although these changes have occurred in legislation, inadequacies in the forensic infrastructure, lack of accredited laboratories, lack of trained forensic experts, and delays in forensic examination remain a problem for the efficiency of investigations. Other ethical issues such as custodial treatment, inappropriate use of surveillance devices, and the tension between national security interests and the fundamental rights of privacy, also highlight the need for robust regulatory controls. To tackle these challenges, forensic capacity needs to be continually updated, investigative procedures need to be standardized, judicial oversight needs to be strengthened and the criminal justice system needs to account for scientific innovation and respect individual rights while maintaining public trust in the criminal justice system.²³

7 Conclusion

The principles of scientific innovation and ethical responsibility are complementary and form the foundation of modern criminal investigation, embodying the spirit of "Science and Conscience. Forensic science has revolutionized the criminal justice system by supplying objective, reliable, and scientifically-based evidence that increases the accuracy of investigations and the decision making process. Multidisciplinary scientific methods have enhanced the capability to reconstruct a crime, determine the perpetrator and give facts with greater accuracy. The success of scientific enquiry is, however, not just about technology, it is also about moral principles like integrity, impartiality, accountability, professional competence and respect for human rights. The law of the land in India, which combines constitutional protection, the Bharatiya criminal laws, the Information Technology Act, along with accepted forensic rules, offers a legal framework for regulating scientific investigations while safeguarding individual liberties. Despite these advancements, there are new ethical and regulatory concerns that arise with emerging technologies, such as artificial intelligence, digital surveillance, biometric systems and advanced forensic databases, which are constantly evolving

²² E. Riambon, J. Dayag, B. Mangwag, and D. J. Tindowen, "Issues and Challenges Affecting the Conduct of Criminal Investigation Procedure," *Int. J. Soc. Sci. Res. Rev.*, vol. 8, no. 4, pp. 210–221, 2025, doi: <http://dx.doi.org/10.47814/ijssrr.v8i4.2598>.

²³ V. Kumar and Y. Singh, "Forensic science in the Indian legal framework: Challenges and opportunities in criminal investigations and trials," *Int. J. Civ. Law Leg. Res.*, vol. 4, no. 2, pp. 213–220, 2024, doi: <https://www.doi.org/10.22271/civillaw.2024.v4.i2c.107>.

and that need constant adaptation and monitoring by legal frameworks. To overcome these challenges, there is a need for strengthening the forensic infrastructure, standardisation of scientific practices, improved professional training, and robust governance. The process of balancing science, ethics and law will further enhance public trust in the criminal justice system and facilitate the fair, transparent and evidence-based administration of justice.

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