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ETHICAL AND LEGAL CHALLENGES IN INDIA'S FORENSIC FRAMEWORK

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ABSTRACT

India's criminal justice system adopts forensic science to support fairness and accuracy. This paper examines the evolving framework and ethical complexities that shape forensic evidence in India. It reviews statutes such as the Evidence Act, detailing expert-opinion provisions, and reforms under the Bharatiya Sakshya Adhiniyam and Bharatiya Nagarik Suraksha Sanhita, and procedures in the Criminal Procedure Code and IT Act that govern the collection and admissibility of scientific and digital evidence. Ethical considerations arise around privacy gaps, sensitive DNA data protection, potential bias from contextual influences, encryption challenges, and cross-border data access in digital forensics. The study highlights infrastructural constraints, laboratory backlogs, shortages of experts, and uneven standards and proposes solutions through enhanced education, NABL accreditation, and the roles of the National Forensic Sciences University and the Directorate of Forensic Science Services. Through analysis of landmark judgments, this research outlines judicial caution and the gradual calibration of evidentiary thresholds. It also explores emerging frontiers like AI-driven analysis, rapid DNA profiling, and advanced biometrics and their ethical ramifications. The paper concludes by endorsing dedicated data-protection legislation for forensic information, an independent regulatory body to enforce uniform protocols, expanded expertise via specialized programs, and targeted public outreach to promote confidence. These measures can develop a strong, ethical, and technology-ready forensic framework that commands trust and delivers justice in India.

Keywords: *Forensic Science, Criminal Justice System, Ethical Complexities, Digital Evidence, Data Protection Legislation*

I. Introduction

Forensic science has emerged as an increasingly important component of the Indian criminal justice system, offering a pathway to ensure fairness and accuracy in the dispensation of justice, particularly in an era characterized by the rising complexity of criminal activities.[1123] The reliance on scientific evidence is gaining momentum as a means to overcome the limitations associated with traditional forms of evidence.[1124] While India's engagement with forensic practices can be traced back to ancient times, its systematic integration into the formal legal framework is a more recent phenomenon, facing constant challenges related to infrastructure and the

[1123] Sunaina Jeevnani, "Role of Forensic Evidence in Indian Criminal Justice System", Indian Journal of Legal Review (IJLR), 4 (4) of 2024, pg. 580-592

[1124] Dr. Kusum Chauhan, "Admissibility and Evidentiary Value of Scientific Evidence: Legislative and Judicial Approach in India", Volume 8, Issue 1, IJRTI, 2023

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availability of specialized personnel.[1125]

Forensic evidence now occupies a position in both the investigative and phases of criminal proceedings.[1126] This is driven by a growing recognition that scientific analysis can provide a more objective and accurate basis for establishing the facts of a case, aligning with societal expectations for scientifically sound evidence for justice.[1127] The application of forensic science aims to bring a level of objectivity and precision to criminal inquiries that traditional methods often lack, leading to a greater demand for its utilization within our legal system.[1128] This article will undertake an examination of the legal framework governing forensic evidence in India, the ethical considerations that arise from its use, the challenges and opportunities associated with its more effective integration into the criminal justice system, and the evolving landscape shaped by landmark precedents and emerging technologies.

II. The Current Legal Landscape of Forensic Evidence in India

The admissibility and use of forensic evidence in India are governed by varied legal frameworks composed of several key statutes.

A. The *Indian Evidence Act*[1129] *of 1872*[1130], serves as the foundational legislation that dictates the principles governing the admission of evidences, which includes forensic evidence.[1131] *Section 45*[1132] is particularly significant as it permits the opinions of experts on points of science, art, handwriting, and finger impressions to be considered relevant facts by the court.[1133] This provision forms the primary legal basis for admitting the testimony of forensic experts across a range of traditional forensic disciplines.[1134] Recognizing the increasing role of technology in criminal activities, the Act was later amended to include *Section 45A*[1135], which specifically addresses the opinion of Examiners of Electronic Evidence, acknowledging the specialized knowledge required for analyzing digital evidence.[1136] Furthermore, *Section 65B*[1137] lays down conditions for the admissibility of electronic records, necessitating a certificate of authenticity to ensure the reliability of such digital evidence.[1138] The Act also empowers the judiciary to directly compare disputed signatures, writings, or seals, including finger impressions, with those admitted or proven to be genuine under *Section 73*[1139].[1140] Additionally, *Section 47A*[1141] addresses opinions related to digital signatures, recognizing the role of certifying authorities in their verification[1142], while *Section 73A*[1143] outlines the methods for proving the authenticity of digital signatures.[1144]

B. The *Code of Criminal Procedure*[1145] *of 1973*[1146], stands as the principal enactment that details the framework for criminal investigations and procedures.[1147] *Sections 53*[1148] and *54*[1149] pertain to the medical examination of accused persons, granting the authority to collect critical forensic samples, such as bodily fluids, for further analysis.[1150] *Section 293*[1151] plays a key role by making provisions for the acceptance of forensic reports in court, provided they are

[1125] Nitish Gaur, "Forensic Evidence in Criminal Investigations in India", Record of Law, available at: https://recordoflaw.in/Forensic-Evidence-in-Criminal-Investigations-In-India/, (last accessed on April 20, 2025)
[1126] Supra Note. 3
[1127] *Ibid.*
[1128] *Ibid.*
[1129] Hereinafter IEA
[1130] The Indian Evidence Act, 1872 (Act No. 1 Of 1872)
[1131] Supra Note. 3
[1132] The Indian Evidence Act, 1872 (Act No. 1 Of 1872) S. 45
[1133] Supra Note. 5
[1134] www.indiacode.nic.in, accessed April 21, 2025, https://www.indiacode.nic.in/bitstream/123456789/15351/1/iea_1872.pdf
[1135] The Indian Evidence Act, 1872 (Act No. 1 Of 1872) S. 45A
[1136] Forensics Digest, "Key Case Laws and Rules of Evidence in Forensic Science: An Indian Perspective", available at: https://forensicsdigest.com/Key-Case-Laws-And-Rules-Of-Evidence-In-Forensic-Science-An-Indian-Perspective/, (last accessed on: April 21, 2025)
[1137] The Indian Evidence Act, 1872 (Act No. 1 Of 1872) S. 65B
[1138] Supra Note. 16
[1139] The Indian Evidence Act, 1872 (Act No. 1 Of 1872) S. 73
[1140] Century Law Firm, "The Role and Admissibility of Forensic Evidence in the Indian Criminal Justice System", available at: https://www.centurylawfirm.in/blog/the-role-and-admissibility-of-forensic-evidence-in-the-indian-criminal-justice-system/, (last accessed on: April 21, 2025)
[1141] The Indian Evidence Act, 1872 (Act No. 1 Of 1872) S. 47A
[1142] Supra Note. 16
[1143] The Indian Evidence Act, 1872 (Act No. 1 Of 1872) S. 73A
[1144] Supra Note. 16
[1145] Hereinafter CrPC
[1146] The Code of Criminal Procedure of 1973, (Act No. 2 Of 1974)
[1147]Supra Note. 5
[1148] The Code of Criminal Procedure Of 1973, (Act No. 2 Of 1974) S. 53
[1149] The Code of Criminal Procedure Of 1973, (Act No. 2 Of 1974) S. 54
[1150] Supra Note. 5
[1151] The Code of Criminal Procedure Of 1973, (Act No. 2 Of 1974) S. 293

prepared and submitted through proper legal channels, thereby streamlining their admissibility as primary evidence under specific conditions.[1152] Moreover, *Section 349*[1153] of the *Bharatiya Nagarik Suraksha Sanhita*[1154] *of 2023*[1155], empowers Magistrates to order the collection of forensic samples, including fingerprints and voice samples, from any person, broadening the scope of evidence collection but also raising potential concerns regarding privacy.[1156]

C. The *Information Technology Act*[1157] *of 2000*[1158], specifically addresses the admissibility and legal considerations surrounding digital evidence, which has become increasingly important in today's digital age, especially in cases involving cybercrimes, data theft, and electronic transaction.[1159] This Act establishes a strong framework for the collection and use of digital evidence, ensuring its admissibility in court and facilitating its effective application in investigations and proceedings.[1160] Furthermore, the IT Act brought about amendments to the IEA to explicitly include electronic records within the definition of evidence [1161], a crucial step in formally recognizing digital data as a valid form of proof.

India's legal framework for forensic evidence has undergone significant changes with the enactment of new criminal laws. The *Bharatiya Sakshya Adhiniyam*[1162] *of 2023*[1163], which has replaced the IEA, introduces modifications concerning expert opinions, including those related to electronic evidence, aiming to modernize the approach to expert testimony.[1164]

The BNSS which has replaced the CrPC, mandates forensic testing for offences punishable by imprisonment of over seven years under *Section 176*[1165].[1166] This signifies a strong push towards integrating forensic science into the investigation of serious crimes, potentially increasing the workload on existing forensic laboratories.[1167] Additionally, the *Criminal Procedure (Identification) Act of 2022*[1168], which repeals the *Identification of Prisoners Act of 1920*[1169], expands the scope of data collection to include biological samples and their analysis, such as DNA, reflecting advancements in forensic technology and aiming to modernize identification processes, which in turn raises concerns regarding privacy and data retention.[1170]

III. Ethical Considerations in Forensic Evidence Application

The application of forensic evidence within the Indian criminal justice system is entangled with several ethical considerations, particularly concerning privacy, data security, the potential for bias, and the risk of misinterpretation.

Forensic analysis, especially in the domains of DNA profiling and digital forensics, involves handling of sensitive personal information.[1171] This necessitates the implementation of stringent regulations to safeguard against the misuse of DNA data, including the potential for discriminatory practices and unwarranted surveillance.[1172] A significant gap is the absence of a comprehensive data protection framework tailored explicitly for forensic data.[1173] In the

[1152] Supra Note. 5
[1153] The Code of Criminal Procedure Of 1973, (Act No. 2 Of 1974) S. 349
[1154] Hereinafter BNSS
[1155] The Bharatiya Nagarik Suraksha Sanhita, 2023 (Act No. 46 Of 2023)
[1156] Project 39A Criminal Law Blog, "Criminal Law Bills 2023 Decoded #17: Forensic evidence", available at: https://p39ablog.com/2023/11/Criminal-Law-Bills-2023-Decoded-17-Forensic-Evidence/, (last accessed on: April 21, 2025)
[1157] Hereinafter IT Act
[1158] The Information Technology Act, 2000 (Act No. 21 Of 2000)
[1159] Supra Note. 5
[1160] *Ibid.*
[1161] Tejas D. Karia, "Digital Evidence: An Indian Perspective", Digital Evidence and Electronic Signature Law Review, Vol 5, 2008
[1162] Hereinafter BSA
[1163] Bharatiya Sakshya Adhiniyam, 2023 (Act No. 47 Of 2023)
[1164] Supra Note. 16
[1165] Bharatiya Sakshya Adhiniyam, 2023 (Act No. 47 Of 2023) S. 176
[1166] Supra Note. 16
[1167] Akshat Jain, "What new criminal law says about forensic evidence & how this could put 'immense stress' on labs", ThePrint, available at: https://theprint.in/Judiciary/What-New-Criminal-Law-Says-About-Forensic-Evidence-How-This-Could-Put-Immense-Stress-On-Labs/2164108/, (last accessed on: April 21, 2025)
[1168] The Criminal Procedure (Identification) Act, Act No. 11 Of 2022
[1169] The Identification of Prisoners Act, Act No. 33 Of 1920
[1170] Rakesh P. S, Dr. Harigovind P. C, "Five Decades of Criminal Procedure Code and its Influence on Appreciation if Forensic Evidence in India", Volume: 2, Issue: 2, NFSU Journal of Forensic Justice, 2023
[1171] Dharmendra Satyanarayan Chawla, "The Role of Forensic Evidence in Criminal Investigations in India", Volume 11 Issue X, International Journal for Research in Applied Science & Engineering Technology (IJRASET), 2023
[1172] Farha Khan, Akansha Mer, "The Ethical Considerations of DNA Profiling for Resilience in a Forensic Setting in India: A Comparative Study with International Guidelines", Emerald Publishing Limited, 2024
[1173] *Ibid.*

domain of digital forensics, ensuring data security presents challenges, surrounded by issues such as encryption, the use of anti-forensic tools by perpetrators, and the complexities of cross-border data access in investigations with international dimensions.[1174] The global nature of cybercrime further complicates matters related to data security and jurisdictional authority in digital forensic investigations.[1175] The withdrawn *DNA Technology (Use and Application) Regulation Bill of 2019* underscored the significant ethical debates surrounding the collection and storage of DNA data in our country, primarily due to concerns about privacy and the potential for its misuse.[1176] The withdrawal of this bill highlights the ongoing need to address these pressing issues within a strong framework.[1177]

Despite its foundation in scientific principles, forensic evidence remains exposed to human error and various forms of bias.[1178] The presence of varying standards across different forensic laboratories can lead to inconsistencies in analysis and an increased potential for biased judgments.[1179] The lack of uniform standards across these laboratories can compromise the overall reliability and impartiality of forensic evidence presented in court.[1180] Forensic scientists must also be acutely aware of the risks associated with contextual bias and conformational bias, which can inadvertently influence their interpretation of evidence.[1181] Maintaining strict impartiality is paramount for forensic experts, who must avoid any perception of advocating for either the defence or the prosecution.[1182]

To reduce the risks and errors in forensic evidence, it is crucial to address potential issues arising from unreliable evidence gathering, processing, or interpretation, which can lead to disputes and possible injustices.[1183] Studies have shown instances of misinterpretation underscoring the serious consequences that can arise when professionals handling forensic evidence lack the necessary expertise.[1184] Therefore, ensuring proper training and promoting expertise among forensic professionals are essential steps in minimizing errors and upholding the integrity of the forensic process.[1185]

IV. Integrating Forensic Science into India's Criminal Justice System: Challenges and Opportunities

The effective integration of forensic science into the criminal justice system is full of challenges and promising opportunities.

One of the primary challenges lies in overcoming the existing infrastructural and resource limitations. Forensic laboratories across India often scuffle with an inadequate number of specialist personnel and constraints in the infrastructures.[1186] This shortage of resources contributes to prolonged delays in the production of forensic reports due to substantial backlogs, inefficient case management systems, and a general lack of adequate resources.[1187] The backlogs in forensic labs directly impede the timely delivery of justice.[1188] Further, financial constraints often hinder the ability of these laboratories to procure and maintain modern equipment and technology necessary for advanced forensic analysis.[1189]

[1174] Deepali, Prof. (Dr.) Radhika Dev Verma, "Role of Digital Forensics and Criminal Investigation in India", Vol 5, no 11, pp 87-94, International Journal of Research Publication and Reviews, 2024
[1175] *Ibid.*
[1176] *Ibid.*
[1177] Withdrawal Of DNA Technology (Use And Application) Regulation Bill, 2019 - IASToppers, Accessed April 21, 2025, Https://Www.Iastoppers.Com/Articles/Withdrawal-Of-DNA-Technology-Use-And-Application-Regulation-Bill-2019
[1178] Srishti, "The Impact of Forensic Science on the Legal System in India", J Forensic Sci Res. 2025; 9(1): 001-006.
[1179] *Ibid.*
[1180] *Ibid.*
[1181] Ankita Pandey, Dr. Shammi Kesh Roy, "Forensic Science and the Law: Exploring Legal and Ethical Challenges in Criminal Justice", Vol (5), Issue (10), pp. 4232-4237, International Journal of Research Publication and Reviews, 2024
[1182] *Ibid.*
[1183] Supra Note. 59
[1184] Linzi Wilson-Wilde, "Misinterpretation and Fallacies in Forensic Evidence", ResearchGate, 2023
[1185] Supra Note. 59
[1186] Supra Note. 5
[1187] Supra Note. 59
[1188] *Ibid.*
[1189] Dr Shivalingappa S. Angadi, Dr Theju Kumar C, "Development of Forensic Science and Criminal Prosecution in India: Progress, Challenges, and

Enhancing the training and expertise of forensic personnel is another critical area requiring attention. There is a recognized shortage of adequately trained forensic experts, necessitating improved education and training programs for both police officers and forensic scientists.[1190] Establishing specialized training programs and promoting partnerships with international forensic organizations and educational institutions can play a key role in addressing this need.[1191] The National Forensic Sciences University[1192] has emerged as a key institution dedicated to expanding the pool of skilled forensic experts through its various campuses and specialized programs[1193], holding a critical role in overcoming the shortage of trained forensic manpower in the country.[1194]

Establishing substantial quality control and standardization procedures is essential for ensuring the reliability and admissibility of forensic evidence. Currently, we lack a cohesive and comprehensive legal structure to effectively supervise its forensic laboratories and ensure adherence to strict Standard Operating Procedures[1195].[1196] There is an urgent need for the standardization of forensic practices across the nation, encompassing all stages from evidence gathering and preservation to analysis and submission in court.[1197] Adopting globally recognized standards for forensic laboratories and seeking accreditation from bodies like the *National Accreditation Board for Testing and Calibration Laboratories*[1198] are essential steps towards achieving this goal.[1199] NABL accreditation is crucial for ensuring the quality and reliability of forensic evidence presented in the courts.[1200]

The *Directorate of Forensic Science Services*[1201] plays an important role as the nodal agency for promoting best practices and regulating the forensic science sector by issuing quality manuals and guidelines aimed at standardization.[1202]

Finally, promoting public awareness and trust in forensic science is essential for integration. The public often holds a sceptical view of forensic science, leading to doubts about its dependability and accuracy.[1203] This suspicion can also impact the system and law enforcement, underutilising forensic resources. To address this, it is crucial to implement awareness-raising initiatives such as seminars, educational events, and specialised training for law enforcement and personnel.[1204] The media plays a significant role in shaping public perception of forensic science, sometimes leading to misconceptions and unrealistic expectations.[1205] Efforts to increase public awareness through academic institutions and government-led campaigns are important for building confidence in the field among the public.[1206]

V. Landmark Court Cases and the Evolution of Legal Precedents

Several landmark court cases have significantly shaped the legal precedents concerning forensic evidence, particularly in DNA, fingerprint, ballistics, and digital evidence.

In the realm of DNA evidence, the Supreme Court of the United States in *District Attorney's Office for the Third Judicial District et al. v. Osborne,*[1207] affirmed the admissibility of DNA evidence as a scientifically reliable means of establishing guilt or innocence. The *Nirbhaya Gang Rape Case*[1208] stands as a key instance

Future Directions", Volume 9, Issue 1, International Journal of Novel Research and Development, 2024
[1190] Supra Note. 59
[1191] *Ibid.*
[1192] Hereinafter NFSU
[1193] Supra Note. 48
[1194] *Ibid.*
[1195] Hereinafter SOPs
[1196] Vishal Kumar, "Forensic Law Forensic Science Law in India", available: https://manupatracademy.com/legalpost/forensic-law-forensic-science-law-in-india, (last accessed on: April 21, 2025)
[1197] Supra Note. 59
[1198] Hereinafter NABL
[1199] Supra Note. 16
[1200] *Ibid.*
[1201] Hereinafter DFSS
[1202] Supra Note. 59
[1203] *Ibid.*
[1204] *Ibid.*
[1205] Vikrant Singh, Keya Pandey, Rakhi Rajput, "Shedding Light on Forensic Science: Public Awareness and Understanding", Indian Journal of Forensic Medicine and Toxicology, Volume 19 No. 1, 2025
[1206] *Ibid.*
[1207] District Attorney's Office for the Third Judicial District Et Al. v. Osborne, 2009 SCC Online US SC 73
[1208] Mukesh v. State (NCT of Delhi), (2017) 6 SCC 1

where DNA profiling played a crucial role in identifying and convicting the perpetrators.[1209] Similarly, DNA evidence was central to the convictions in the *Priyadarshini Mattoo Case*[1210] and the *Nithari Killings Case*[1211]. The Apex Court in *State of Gujarat v. Kishanbhai*[1212] underscored the importance of proper investigation and the role of DNA technology in criminal cases.[1213] However, in *Premjibhai Bachubhai Khasiya v. State of Gujarat*[1214], the Court set a crucial precedent that positive DNA results alone are insufficient to definitively prove guilt without corroborative evidence, highlighting the judiciary's caution in solely relying on DNA findings for conviction.

Fingerprint evidence has also been the subject of significant scrutiny. The Supreme Court has consistently emphasized the need for proper fingerprint analysis techniques and a well-maintained chain of custody for its admissibility.[1215]

Cases involving ballistics evidence have also set important precedents. The Supreme Court has often relied on forensic ballistic reports in cases involving firearms.[1216] In *Ashok Kumar Singh Chandel v. State of U.P.*[1217] the Court affirmed using ballistic data to link a suspect to a murder weapon.[1218]

The admissibility of digital evidence has been shaped by several key court decisions. The Supreme Court has upheld the admissibility of electronic evidence if it is proven in accordance with *Section 65B*[1219] of the IEA.[1220] The case of *Anvar P.V. v. P.K. Basheer*[1221] emphasized the essential requirement of a certificate under *Section 65B*[1222] for the admissibility of electronic evidence.[1223]

Beyond these specific types of forensic evidence, the Apex Court's decision in *Selvi and Ors v. State of Karnataka and Anr.*[1224] stands as a landmark judgment, addressing the admissibility of narco-analysis, brain-mapping, and polygraph tests. The court ruled that these techniques violate the constitutional right against self-incrimination and cannot be forcibly administered, establishing limitations on the use of such intrusive scientific methods in India and underscoring the importance of fundamental rights.[1225]

VI. The Horizon of Forensic Science: Ethical and Legal Implications of Emerging Technologies in India

Forensic science rapidly evolves with new technologies, bringing enhanced capabilities and unexplored ethical and legal implications.

Artificial Intelligence[1226] is increasingly being integrated into various aspects of the criminal justice system, including forensic analysis, for tasks such as crime prediction, facial recognition, and the analysis of complex evidence.[1227] However, this integration raises significant ethical concerns, particularly regarding the potential for bias in AI algorithms, violations of privacy due to the massive collection of data required to train these systems, and a lack of transparency in their decision-making processes.[1228] The risk of AI perpetuating existing biases present in training data is a challenge that demands careful consideration.[1229] Further, legal frameworks are still tussling with establishing clear lines of accountability for errors made by AI-driven systems and determining the admissibility of

[1209] Benson Rajan, Devaleena Kundu, Sahana Sarkar, "Rape, Popular Culture, and Nirbhaya: A Study of India's Daughter and Delhi Crime", Volume 49, Issue 2, Journal of Communication Inquiry
[1210] State (Through CBI) v. Santosh Kumar Singh, 2007CRILJ964
[1211] Surendra Koli v. State Thru C.B.I., 2023:AHC:199091-DB
[1212] State of Gujarat v. Kishanbhai, (2014) 5 SCC 108
[1213] Chatrapal Singh, "DNA Technology in Criminal Investigation in India", Volume 11, Issue 9, JETIR, 2024
[1214] Premjibhai Bachubhai Khasiya v. State of Gujarat, 2009 SCC Online Guj 12076
[1215] Supra Note. 3
[1216] *Ibid.*
[1217] Ashok Kumar Singh Chandel v. State of U.P., 2022 SCC Online SC 1525
[1218] Supra Note. 3
[1219] Supra Note. 17
[1220] Supra Note. 5
[1221] Anvar P.V. v. P.K. Basheer and Ors., 2014 INSC 645
[1222] Supra Note. 17
[1223] Supra Note. 16
[1224] Selvi And Ors v. State of Karnataka and Anr., [2010] 5 S.C.R. 381
[1225] Supra Note. 16
[1226] Hereinafter AI
[1227] Supra Note. 59
[1228] General Information Brochure, "National Accreditation Board for Testing and Calibration Laboratories (NABL)", Issue No: 01, 2022
[1229] Meena Rani, "Impacts and ethics of using Artificial Intelligence (AI) by the Indian Police", Vol. 27 No. 2, pp. 182-192, Emerald Insight

evidence generated by AI in the Courts.[1230]

Advanced DNA profiling techniques are also transforming forensic investigations. Emerging technologies such as rapid DNA analysis, 3D genomics, and AI-driven DNA analysis offer remarkably enhanced capabilities for identification and linking individuals to crimes.[1231] However, these advancements bring along critical ethical and legal implications related to the privacy of highly sensitive genetic data, the necessity of informed consent for its collection and use, and the potential for misuse of this information.[1232] The increased power of these techniques, specifically the ability to create and maintain extensive DNA databases, raises ethical concerns about the storage and potential for unauthorized access or misuse of data.[1233] Frameworks must also adapt to address the challenges of ensuring proper chain of custody and the admissibility of results generated by rapid DNA systems, which may be positioned outside traditional settings.[1234]

The use of forensic biometrics, including technologies like facial recognition, fingerprint analysis, and voice analysis, is becoming increasingly prevalent in criminal investigations.[1235] While these technologies offer substantial potential for identifying suspects and linking them to crimes, they also raise concerns related to privacy violations, bias in their application, and the security of the vast amounts of biometric data collected and stored.[1236] The use of biometric data for tracking and surveillance purposes, often without explicit consent, poses privacy concerns and highlights the risk of unauthorized use.[1237] The framework in India needs to develop to effectively address the challenges presented by the widespread adoption of these technologies.

VII. Conclusion

Integrating forensic science into the criminal justice system presents an interplay of frameworks, ethical considerations, and practical challenges. While India has made pace in recognizing the importance of forensic evidence, mainly through legislative enactments like the IT Act and the recent Bharatiya Sakshya Adhiniyam and Bharatiya Nagarik Suraksha Sanhita, several areas require further attention to ensure ethical and practical application.

There is a need for specific legislation addressing data protection for forensic information to strengthen the framework, especially concerning DNA databases and digital evidence. This legislation should outline the scope of data collection, storage, usage, and deletion, incorporating securities against misuse and unauthorized access. Further, as emerging technologies and advanced biometrics become more prevalent in forensic investigations, the framework must be adapted to address their unique ethical and legal implications, including bias, transparency, and accountability issues.

Establishing an independent regulatory body for forensic science is crucial for ensuring standardization, quality control, and adherence to ethical practices across all forensic laboratories and by individual experts. This body could mandate accreditation for laboratories and individual practitioners, set uniform standards for evidence collection, analysis, interpretation, and reporting, and conduct regular audits to maintain quality and integrity.

Enhanced training and programs for forensic experts are paramount to address the existing shortage of qualified personnel and to ensure a high level of competence and ethical conduct

[1230] Aishwarya Sharma, Shivangi Chauhan Sharma, Srishti Dixit Soni, Pooja Agrawal, Pratishtha Mishra, Geeny Mourya, "Artificial Intelligence in the Indian Criminal Justice System: Advancements, Challenges, and Ethical Implications", Journal of Lifestyle and SDGs Review 5(1):e04877
[1231] Supra Note. 59
[1232] Supra Note. 58
[1233] GeneWatch UK comments on: THE DNA TECHNOLOGY (USE AND APPLICATION) REGULATION BILL, 2019
[1234] Salem Khalifa Alketbi, "Emerging Technologies in Forensic DNA Analysis", Perspectives in Legal and Forensic Sciences, 1 (1), 10007, 2024
[1235] LawWiser , "Role of Forensic in the Indian Criminal Justice System", available at: https://lawwiser.com/videos/role-of-forensic-in-the-indian-criminal-justice-system/, (last accessed on: April 21, 2025)
[1236] C.E. Pratap, "Ethical Aspects of Forensic Expert Evidence in Criminal Cases", Volume 7, Issue 3, International Journal of Novel Research and Development, 2022
[1237] *Ibid.*

within the profession. These programs should focus not only on the technical aspects of forensic science but also on ethical responsibilities, impartiality, and avoiding bias in their work.

Promoting public awareness about the role and limitations of forensic science is essential for building trust in the justice system. This can be achieved through educational initiatives, media engagement, and transparent communication about forensic procedures and their impact on legal outcomes.

Finally, promoting collaboration between forensic scientists, legal professionals, policymakers, and academic institutions is important. This collaboration can facilitate the development of evidence-based policies, the integration of scientific advancements into legal practices, and the continuous improvement of forensic science services, ultimately leading to a more ethical, practical, and just criminal justice system.