

THE ROLE OF FORENSIC SCIENCE IN STRENGTHENING CRIMINAL JUSTICE SYSTEM IN INDIA

Justice Rajesh Bindal

“Control of crime lies in making the punishment more certain rather than severe. Neither brutality nor severity, but it is the certainty that makes punishment an effective deterrent.”

Abstract: Forensic science is vital for strengthening India's criminal justice system by shifting investigation from confession-based to evidence-based approach, a change underscored by new criminal laws. Despite its potential, the field faces significant challenges including inadequate infrastructure (outdated equipment, poor safety, insufficient funding and lack of R&D), a critical shortage of trained personnel (high vacancy rates, cumbersome recruitment and poor working conditions), lack of standardization in procedures and protocols, and coordination gaps between forensic laboratories and law enforcement agencies. These issues contribute to case backlogs and lower conviction rates. Recent government initiatives, such as the National Forensic Infrastructure Enhancement Scheme and the mandate for forensic investigation in serious offences under the new criminal laws, demonstrate a commitment to reform. This article emphasises that, for forensic science to realise its full potential in ensuring timely and fair justice, comprehensive structural and institutional reforms are imperative.

I. INTRODUCTION

In a country grappling with rising crime rates, judicial delays and the demand for more transparent investigations, forensic science emerges as a vital tool to strengthen the justice system. Forensic science is the application of scientific methods to crime-solving. This comprehensive field includes several specialised areas such as DNA analysis, fingerprint identification, toxicology, digital forensics, etc. A significant shift is underway in criminal investigations, moving away from a heavy reliance on oral evidence towards evidence-based scientific approach. The introduction of new criminal laws has underscored this change, with forensic science playing a central role in reforming criminal justice.

Despite its transformative potential, forensic science faces persistent challenges that collectively impede its effectiveness within the criminal justice system. These include widespread infrastructural limitations marked by outdated equipment, inadequate facilities, and a severe lack of proper storage and safety measures in forensic science laboratories (FSLs). There is a critical shortage of trained personnel, with a staggering 40% of sanctioned posts vacant, nearly 70% of which are scientific positions. It is made worse by cumbersome recruitment processes, heavy workloads, and unattractive career opportunities. Furthermore, the field suffers from a pervasive lack of standardisation and quality management. There

exists a significant coordination gap between law enforcement agencies and FSLs, which compromises the chain of custody and also contributes to delays in reporting by FSLs.

Despite these persistent challenges, addressing these bottlenecks is not merely an administrative task but a crucial step in ensuring effective functioning of India's criminal justice system. The objective and scientifically verified evidence provided by forensic science has the transformative potential to significantly enhance conviction rates, especially in heinous crimes where lack of concrete evidence often leads to acquittals. Forensic science can bridge existing evidentiary gaps, offering irrefutable proof that reduces reliance on potentially unreliable and often manipulative human testimony or confessions. This is particularly vital for tackling complex and serious offenses like sexual assaults, homicides, cybercrimes, and narcotics, where forensic expertise can streamline investigations, accelerate case resolution, and help bring perpetrators to justice.

The nation is demonstrating a growing commitment to overcoming the hurdles. Strategic government initiatives, such as the National Forensic Infrastructure Enhancement Scheme, 2024 (NFIES) with a substantial budget of ₹2,254.43 crore, along with recent legislative reforms (enactment of new criminal laws) mandating forensic investigation for

serious offences, underscore a clear intent to fully integrate forensic science into the core of the criminal justice system.

II. WHAT IS FORENSIC SCIENCE (DEFINITION, SCOPE, FUNDAMENTAL PRINCIPLES)

Forensic science is the use of scientific methods or expertise to investigate crimes or examine evidence that might be presented in a court of law. It is a broad, interdisciplinary field that draws extensively from various scientific disciplines, including:

- Forensic Biology: DNA Analysis / Profiling, Serology (blood, saliva, semen analysis), Hair and Fibre Analysis, Botany & Entomology (plant or insect evidence to estimate time of death).
- Forensic Chemistry: Toxicology (poisons, drugs, alcohol detection), Chemical Residue Analysis (explosives, fire debris) and Narcotics.
- Forensic Physics: Ballistics (firearms, bullets, trajectory analysis). Tool Mark Examination, Glass and Paint Analysis.
- Forensic Medicine: Autopsy / Post-mortem Analysis, Medical examination of injury and Sexual Assault Examination.
- Digital / Cyber Forensics: Computer Forensics (data recovery, metadata analysis), Mobile Device Forensics, Network Forensics.
- Questioned Document Examination: Forgery Detection, Handwriting Analysis, Alterations and Erasures.
- Forensic Odontology: Dental Record Matching
- Forensic Anthropology: Skeletal Analysis, Identification of Human Remains with age and sex estimation.
- Forensic Linguistics: Voice Identification.

In the context of criminal justice, forensic science encompasses the following:

- a. Collecting and preserving evidence from the crime scene.
- b. Utilising scientific principles and techniques to analyse evidence to establish links and solve crimes.
- c. Integrating knowledge from various scientific fields and undertaking scientific research and development.
- d. Providing expert opinion and testimonies in court proceedings.

The practice of forensic science is guided by a foundational principle called Lockard's

Principle of Exchange. This cornerstone concept, summarized as "every contact leaves a trace," states that a criminal cannot commit an act without leaving behind or carrying away some form of evidence. Whenever two objects come into contact, there is an inevitable mutual exchange of microscopic particles or trace evidence between them. In the information technology era, we call it digital footprints.

III. HISTORICAL BACKGROUND OF FORENSIC SCIENCE IN INDIA

The use of forensic science in investigations is not a modern phenomenon. Kautilya's Arthshastra, written more than 2000 years ago, had evidence of forensic science, as there is literature about handprints. In 1897, a murder case in Calcutta (Kolkata) became the first in India to use fingerprints for identification. Through this case, India became one of the first countries in the world to use fingerprints in a criminal trial.

Under British rule, several stand alone laboratories and bureaus were established to assist in investigations. The first laboratory (working on the science of toxicology) examining death cases caused by different types of poisons was established in 1849 at Madras, followed by the same in Calcutta (1853), Agra (1864) and Bombay (1870). These laboratories were equipped to handle toxicology studies and analyse human strains in visceral, blood, saliva, semen, etc.

A fingerprint bureau was opened at Calcutta in 1897. A Department of Explosives was established in 1898 at Nagpur with the expertise to provide scientific clues in explosion-related cases. A post of Handwriting Expert for the Government of India was created in 1904. In 1915, a Footprint Section was established under the Crime Investigation Department (CID) and later in 1917, a Note Forgery Section was also set up under the CID. In 1930, an Arms Expert was appointed, and a small ballistic laboratory was set up under the Calcutta Police.

During British rule, the growths of forensic science institutions involved isolated attempts to establish institutions for specific problems. Post-independence, the idea of a consolidated forensic science laboratory with various forensic divisions under one roof was conceived. The first Forensic Science Laboratory (FSL) in India

came into existence at Calcutta for the State of West Bengal on 1st July 1952. It was a brain-child of the then Chief Minister of West Bengal (Dr Bidhan Chandra Roy, who himself was a prominent Indian physician).

In 1957, the first Central Forensic Science Laboratory (CFSL) was established in Calcutta by the Indian government. Later, during 1960-1970 several State and Regional Forensic Science Laboratories were set up to support local investigative agencies. During 1980s, the development of DNA profiling revolutionised forensic science. Significantly, the investigation into the assassination of former Prime Minister Rajiv Gandhi (1991) used DNA technology. Further progress has been made in setting up labs, as we will discuss in the next section.

Today, with the rise of cybercrimes, forensic science has evolved to include digital forensics. With ongoing technological development, new fields such as forensic linguistics, forensic accounting, and forensic pathology have further expanded the scope of forensic science in investigation.

IV. FORENSIC SCIENCE INFRASTRUCTURE IN INDIA

The forensic science laboratories in India function under a three-tiered structure of Central, State and Regional FSLs (CFSLs, SFSLs, RFSLs), with additional district mobile forensic science units (MFSUs).

The Central Forensic Science Laboratories (CFSLs) are, in essence, a wing of the Ministry of Home Affairs (MHA) (Government of India). There are a total of seven CFSLs in India at Hyderabad, Kolkata, Chandigarh, New Delhi, Guwahati, Bhopal and Pune. Their objectives include research and development, providing scientific assistance to the criminal justice system, and offering training to scientists, police, and the judiciary. CFSLs come under the administrative control of the Directorate of Forensic Science Services (DFSS).

DFSS was created by MHA on December 31, 2002 after the bifurcation of Bureau of Police Research and Development (BPR&D) based on the recommendations of the Padmanabhaiah Committee on Police Reforms. DFSS is a Nodal Agency under MHA, which is entrusted with the task of improving and promoting forensic science practices in the country.

The State Forensic Science Laboratories (SFSLs) and the Regional Forensic Science Laboratories (RFSLs) operate under their respective state governments and handle forensic cases within their state, supporting local law enforcement. SFLs are 32 in number, while there are 97 RFLs.

Another important development in creating forensic science infrastructure in India is the setting up of the National Forensic Sciences University (NFSU). Initially established in 2008 by the Gujarat government at Gandhinagar as Gujarat Forensic Sciences University. Later, the Government of India, through National Forensic Sciences University Act, 2020, upgraded the University to a national university.

NFSU is unique as the world's first and only university dedicated solely to forensic science and allied subjects. It currently has 11 campuses across India and one international campus in Uganda. Envisioned to address the acute shortage of forensic experts globally, NFSU promotes teaching and research to achieve excellence in forensic science, cybersecurity, behavioural sciences, and criminology.

NFSU has become a hub for international collaboration and training. It serves as an empanelled training institute for the Ministry of External Affairs under the Indian Technical and Economic Cooperation Programme (ITEC) scheme of the Government of India, drawing officers, judges, and forensic scientists from over 65 countries for specialised programs. Under this scheme, the university has trained more than 2,800 foreign officials, alongside over 19,500 Indian officials from various sectors like police, judiciary, armed forces, banking, and vigilance.

To support its advanced curriculum and training, NFSU provides specialised facilities which include: Cyber Defence Centre (CDC), Ballistics Research & Testing Centre, Centre of Excellence for Narcotics Drugs and Psychotropic Substances (NDPS) and a Forensic Innovation Centre aimed at developing new methods and technologies in forensic science.

V. IMPORTANCE OF FORENSIC SCIENCE IN CRIMINAL JUSTICE SYSTEM

Forensic science can fundamentally transform criminal investigations in India by providing an approach grounded in science and objectivity.

The scientific approach significantly increases the precision and reliability of investigations and helps reduce errors in criminal justice, which can prevent injustice.

The application of forensic science leads to faster case resolution. Law enforcement and judicial processes rely heavily on timely and accurate forensic analyses. By providing concrete, scientifically verified evidence, forensic science can streamline the investigative phase, allowing for quicker identification of suspects and reconstruction of events, thus speeding up the overall criminal justice process. The risk of human loss of memory is ruled out.

Studies indicate a significant correlation between the careful handling of forensic evidence and conviction rate, particularly in serious crimes like rape and murder. For instance, forensic evidence played a vital role in court rulings, leading to convictions in about 50% cases. In a large number of cases, acquittals took place, usually because of lack of forensic evidence.

A significant factor contributing to the low conviction rate in heinous offenses is faulty or deficient investigation, which frequently hinders the prosecution's ability to meet its burden of proof. As per the National Crime Records Bureau the crime conviction rate of murder is at 43%, rape at 27.4%, kidnapping & abduction at 33.9%, rioting at 24.9% and NDPS cases at 82.2%. Addressing this systemic issue requires a robust forensic science infrastructure, as the accurate and reliable evidence provided by advanced forensic techniques would be crucial in bolstering prosecuting agencies' capacity to secure convictions.

We will now look at some notable examples that underscore the significance of forensic science in criminal justice.

In *Ghurey Lal v. State of U.P.*, the accused was acquitted solely on the basis of an opinion rendered by the ballistic expert. In the said case, the prosecution had argued that the accused fired a single shot from a shotgun, which led to the death of one individual, and injured another. On examination, the ballistic expert found that although the bullet that killed the deceased was fired from the shotgun alleged to have been used, the pellet that injured the other individual was fired from another weapon, as a cartridge cannot contain both pellets and bullets. Based on this opinion, the Supreme

Court concluded that this fact was inconsistent with the prosecution's story and hence acquitted the accused.

In *Santosh Kumar Singh v. State thru. CBI (Priyadarshini Mattoo case)*, DNA evidence played a crucial role. Santosh Kumar Singh was convicted of raping and murdering law student Priyadarshini Mattoo in 1996. Although the trial court acquitted him due to lack of evidence, the Delhi High Court and later the Supreme Court, overturned the acquittal and convicted Singh, based largely on DNA evidence linking him to the crime. This case showed the value of DNA profiling in rape and murder cases, particularly when other evidence is insufficient.

In *Sushil Kumar Sharma v. Union of India and Ors.*, (Tandoor murder case), forensic science proved to be the backbone of both the investigation and prosecution. This case is India's earliest and most high-profile use of several modern forensic techniques. It bolstered the potential of forensic science in establishing the crime, linking the accused to the murder, and confirming the identity of the victim.

- Autopsy and X-ray analysis revealed gunshot wounds as the actual cause of death.
- Ballistic experts matched bullets recovered from the skull and scene to Sushil Sharma's licensed revolver.
- DNA testing conclusively identified the body as that of Naina Sahni (deceased, wife of Sushil Kumar Sharma), by matching genetic material from her parents.
- Bloodstains, hair strands, and other biological traces linked the murder to Sharma's flat and car, while forensic pathology established that the body was burned post-mortem.
- Together, these scientific findings held strong against political pressure and circumstantial ambiguity. This case reinforced how science can be a decisive force in the delivery of justice.

In *Vikas Yadav v. State of U.P. & Ors (Nitish Katara murder case)*, where the victim's body was severely burned, DNA profiling matched with the parents was used to identify the deceased, leading to the conviction of the accused.

In *Mukesh & Anr. v. State (NCT of Delhi) & Ors. (Nirbhaya Case)*, DNA evidence was pivotal in connecting the offenders to the crime, significantly aiding their detection and conviction. This evidence's scientific and

trustworthy quality ensured a swift trial and conviction within a year.

VI. STEP TOWARDS SCIENTIFIC INVESTIGATION: ENACTMENT OF NEW CRIMINAL LAWS

The legal framework governing forensic science in India has undergone a significant overhaul with the enactment of the new criminal laws, which came into force from July 1, 2024. These laws replaced the Indian Penal Code (IPC) of 1860, which was in force for 164 years, the Indian Evidence Act of 1872, which was in force for 152 years, and the Criminal Procedure Code (CrPC) of 1973, which was in force for 51 years. This shift aims to make the criminal justice system more evidence-based, efficient, and technologically advanced.

The focus of the new criminal laws towards adopting technology in criminal justice can be ascertained from the Statement of Objects and Reasons of BNSS:

“2. Fast and efficient justice system is an essential component of good governance. However, delay in delivery of justice due to complex legal procedures, large pendency of cases in the Courts, low conviction rates, low level of uses of technology in legal system, delays in investigation system, complex procedures, inadequate use of forensics are the biggest hurdles in speedy delivery of justice, which impacts poor man adversely.”

The admissibility of forensic evidence in Indian courts was governed primarily by the Indian Evidence Act, 1872 (IEA), and now by, the Bharatiya Sakshya Adhiniyam (BSA), 2023. Section 45 of the IEA is pivotal since it allows courts to consider expert opinions when the subject matter requires specialised knowledge in science, art, or foreign law, or as to the identity of handwriting or finger impressions. Corresponding to Section 45 of IEA, Section 39 of BSA broadens the scope of expert opinion by including the expression "any other field".

The most important and the game-changing provision is Section 176(3) of Bharatiya Nagarik Suraksha Sanhita (BNSS). It mandates forensic investigation into offences made punishable with imprisonment for 7 years or more. It also requires the audio-video recording of the entire process of collecting forensic

evidence, preferably using a mobile phone or any other electronic device.

Section 105 of BNSS mandates that the process of search and seizure, including the preparation of the list of seized items and witness signatures, be recorded through audio-video electronic means. This recording must be forwarded to the Magistrate without delay. Sections 180(3) & 183 of BNSS allows and in certain cases, mandate audio-video recording of statements made to the police and confessions/statements recorded by a Magistrate.

VII. CHALLENGES:

As discussed in the previous section, Section 176(3) of BNSS mandates forensic investigation into serious offences. This new provision would dramatically increase the workload and demand for forensic science. The question remains whether the present infrastructure is prepared to handle the mandate of Sec. 176(3) of BNSS, which would come into effect in five years of its enactment.

In the present section, we will see that some persistent and deeply entrenched challenges impede forensic science from functioning at its full potential, which makes the current infrastructure insufficient for a total integration into the criminal justice system.

VII.(A). Insufficient and irregular funding:

The Central government funds the CFSLs and provides financial support to state and regional laboratories through schemes and special grants. SFSLs and RFSLs are primarily funded by the respective state governments. The process of budget approvals, fund disbursement and expenditure approvals is complex and inconsistent. Overall, there is high variance in the budget and expenditure data between FSLs.

The NLUD, Project 39A Study (Supra) showed that FSLs collectively spent only 69.4% of their total allocated budget, with a particularly low expenditure-to-forecast ratio of just 40.2% for equipment and maintenance. This underutilization is not merely due to receiving fewer funds than necessary, but is also attributed to cumbersome procurement processes. For instance, the study notes that one CFSL and one RFSL received less than 50% of their projected funds, sometimes as little as 13% in a given year. This highlights severe inconsistency in funding patterns when

compared to other FSLs that consistently underutilise their received funds, with one Raipur spending less than 75% of its funds every year.

The funding problem is more complicated in the case of SFLs and RFLs, which face an additional problem of dependency on Police Departments. A significant number of SFSLS and RFSLs fall under the administrative and financial control of state police departments. This arrangement leads to cumbersome budget approval processes and concerns about interference with budgetary decisions.

A significant area of concern is the absence of dedicated Research & Development (R&D) funding. Critically, no laboratories, including CFSLS, which were envisioned as centres for R&D, allocate any separate funds for research and development. This neglect is partly due to overwhelming case loads and insufficient staff, but it severely hinders the development of indigenous technologies and the continuous adaptation to new scientific advancements.

VII.(B). Inadequate and outdated Infrastructure:

Forensic science laboratories across India suffer from outdated equipment and poor facilities. There is a limited number of fully functional forensic laboratories at both central and state levels, leading to delays in processing evidence and significant backlogs. These FSLs are often overburdened and underfunded. Absence of advanced technologies in many laboratories restricts their ability to handle complex cases like cybercrime and DNA analysis. Many labs lack separate areas for scientific and non-scientific work and mechanisms to restrict access to examination areas, which can compromise the quality and integrity of forensic examinations and contribute to contamination.

Inadequate infrastructure of forensic laboratories contributes to an increased pendency of cases before existing facilities, consequently delaying the conclusion of trials. There is around 3,900 pendency at CFSL and more than 5 lakhs pendency at SFSLS.

The Laboratories operate without adequate safety measures, exposing staff to significant risks. Many personnel lack essential personal protective equipment such as lab coats, gloves, and protective eyewear. Chemistry divisions often rely on insufficient natural ventilation

instead of proper fume hoods, and there are widespread deficiencies in the safe disposal of hazardous biological and chemical waste. Furthermore, a critical lack of emergency preparedness is evident, with many labs missing crucial safety equipment like showers, eyewash stations, and sufficient fire extinguishers.

Observations by the Jharkhand HC regarding the "primitive" state of the State's FSL at Ranchi highlighted the infrastructure problem. The HC was hearing a plea over the murder of Dhanbad's Additional Sessions Judge after an autorickshaw rammed into him while he was on a morning walk. The HC noted that urine and blood tests for the accused persons could not be carried out by the SFSL Ranchi due to the non-availability of the said facility, and the IO informed that the samples were sent to the FSL at Delhi. In this case samples were sent to FSL Delhi, but in many cases, this process is not followed, and case may fail due to lack of scientific evidence. This incident is not isolated, as many FSLs across the country grapple with similar challenges. This incident makes us wonder if there is a lack of facilities for even high-profile cases, then what must be the condition of investigation in regular cases?

VII.(C). Shortage of Trained Personnel:

There is a persistent shortage of qualified forensic experts and trained personnel in India. The supply of skilled professionals has not kept pace with the increased demand for forensic expertise. In a survey of 26 laboratories, 40.3% (1294 out of 3211 posts) of total sanctioned posts were vacant, the majority of which are scientific posts, indicating a clear gap in core expertise.

To cope with recruitment delays, FSLs are compelled to hire contractual staff. This is a dangerous trend since contractual or irregular hiring is a temporary fix and does not address the root of the problem. It can make matters worse as there are concerns regarding the quality of work due to a lack of accountability, their lower pay, and lack of employee benefits compared to permanent staff.

More manpower and mobility would be required to support a system where forensic experts are expected to be present at the crime scene for collecting evidence, as this takes

considerable time and disrupts their case-related work.

VII.(D). Lack of Standardisation and Uniform Protocols:

A majority of FSLs do not have their working procedure manuals or Standard Operating Procedures (SOPs) for case work. Absence of uniform standards and protocols across various forensic laboratories affects the quality and consistency of forensic analyses. This variability in methods and inconsistent results can reduce the validity of forensic evidence and lead to disputes in court.

FSLs do not follow a uniform method for receiving case materials from investigative authorities. There is also absence of robust and digitised case management systems, hindering efficient management and proper chain of custody documentation within laboratories. The integrity of evidence is preserved through clear tracking across all handlers with signed records, which is known as the chain of custody. Breaks in this chain can question authenticity and lead to rejection, as evidenced in cases like *Prakash Nishad v. State of Maharashtra*, where a DNA report was deemed unreliable due to a broken chain of custody.

VII.(E). Procedural and Bureaucratic bottlenecks:

Effective forensic investigations require seamless coordination between law enforcement agencies and forensic laboratories. These agencies often operate in silos, resulting in poor communication and procedural miscoordination. Forensic evidence may lose its evidentiary value if not handled, packed, sealed and transferred properly between agencies. As discussed above, poor documentation and failure to maintain a clear chain of custody often lead to evidence being challenged in court.

This coordination gap also manifests in that the police (or investigative agencies) lack fundamental understanding of forensic science. As a result, investigative agencies often submit a large volume of exhibits that hold no forensic value. It is like sending the whole haystack to find a needle. This influx of irrelevant materials directly contributes to the overwhelming caseload and severe pendency.

VIII. SCOPE FOR IMPROVEMENT

To address the multifaceted challenges hindering forensic science in India, comprehensive solutions focusing on funding, infrastructure, staffing, standardisation, and procedural bottlenecks are essential.

VIII.(A). Autonomy of FSLs

At the outset, a critical solution to address several systemic problems within the forensic science infrastructure is separating the FSLs from the police administration and bringing them under the Home Department of the respective state. Currently, many SFSLs and RFSLs fall under the administrative and financial control of state police departments, leading to concerns about interference.

The separation would also ensure greater financial independence and reduced delays in receipt and utilisation of funds, as such approval would come directly from the Home Department of the respective states. The separation is also crucial for impartiality and transparency,

This separation aligns with the broader objectives of police reforms as directed by the Supreme Court in *Prakash Singh & Ors. v. Union of India & Ors.* The Court issued detailed instructions principally on the recommendations of the National Police Commission (1977-1981), one of them being:

“...The investigating police shall be separated from the law and order police to ensure speedier investigation, better expertise and improved rapport with the people.”

Several states have established FSLs that operate independently from their respective police departments and are directly under the purview of the Home Ministry. However, in most states, the position remains the same.

VIII.(B). Addressing Funding & Upgrading Infrastructure

Given the high capital investment required for equipment and regular upgradation, consistent central grants should be specifically earmarked for the infrastructural development of FSLs at the State and regional levels. Autonomy of FSLs would also go a long way in ensuring that cumbersome budget approval processes are avoided and funds get released directly from the Home Department. The Central government

should, at least at the CFSL level, allocate separate funds towards R&D for fostering indigenous research.

First and foremost, there should be a comprehensive survey of all the FSLs across the country to identify the specific needs for space, equipment and safety gear at each FSL. The FSLs may collaborate with NFSU or the DFSS for this purpose. After this survey is completed, the Government should come up with infrastructural planning and protocols to maintain basic infrastructure.

Substantial investment is also required towards the modernisation of FSLs with state-of-the-art technologies, including advanced DNA sequencing, automated fingerprint systems, and AI-powered analytical tools. The Government of India's "Scheme for Modernization of Forensic Capacities" with an outlay of more than ₹2,000 crore provides financial assistance for upgrading laboratories and procuring mobile forensic vans. It is a positive step in this direction. This scheme provides financial assistance to States and Union Territories to upgrade forensic science laboratories with advanced machinery, equipment, and mobile forensic vans. Around ₹200 crore has already been sanctioned for 20 States/UTs to support laboratory modernization, while procurement of 433 mobile forensic vans has been approved across 23 States/UTs.

The Government should also double down on supporting collaboration between government agencies, private forensic firms, and academic institutions under a Public-Private Partnerships (PPP) Model. This can improve forensic infrastructure, research, and innovation. India has only recently begun exploring such partnerships, and there is substantial potential for growth. The process in the beginning can be in areas where manual intervention is minimal and the lab is monitored by some state agency to maintain integrity of the process.

VIII.(C). Addressing the Staff Shortage

The staffing problem cannot be solved overnight; it would require long-term planning and efforts to build an ecosystem where employment in the forensic science sector is lucrative and rewarding so that it can attract the best talent pool. The first step should be to improve working conditions. Pay and employee benefits should be improved to maintain parity

with analogous positions in other government institutions. The second step should be to streamline the recruitment process. The DFSS, in collaboration with NFSU, should devise a recruitment strategy to standardise eligibility criteria and recruitment methods.

VIII.(D). Establishing a new Indian Foreign Science Service (IFSS)

As a suggestion, establishing a new Indian Foreign Science Service (IFSS) can be considered. IFSS can act as an organised service with a cadre structure, suitably designed to address the staff needs of forensic science institutions. This new cadre can be added by the name of Indian Foreign Science Service (IFSS), acting similar to the Indian Service of Engineers (Irrigation, Power, Buildings and Roads), the Indian Forest Service and the Indian Medical and Health Service function.

IFSS can also play a significant role in advancing the idea of standardisation within forensic science infrastructure by ensuring human resource stability. The establishment of an IFSS would necessitate an amendment of Article 312 of the Constitution and the All India Services Act, 1951. The salary burden for this new cadre might be borne by the Central Government, as a form of financial support.

VIII.(E). The proposed Forensic Council of India (FCOI)

Merely, fixing working conditions and recruitment cannot solve the staffing problem. It is equally important to produce skilled individuals for the job since forensic science is a highly specialised field. The establishment of NFSUs has helped significantly in increasing the quality of forensic science education and training. But the role of NFSUs is limited as educational and research institutions. There is a need for a regulatory body like the proposed Forensic Council of India (FCOI) since there is currently no standard-setting body for forensic science courses offered in India. Unlike fields such as law or medicine, which have regulatory bodies like the Bar Council of India (BCI) and the National Medical Commission (NMC) that regulate educational standards, there is no overarching body for forensic science education.

The FCOI's regulation of education can ensure that forensic science graduates are indeed competent and well-prepared for the profession. The FCOI would be responsible for evaluating

and approving forensic science courses and institutions based on the standards it sets, which can ensure a baseline quality across all programs. Syllabus and courses would be decided by the experts in the field in consultation with academicians.

Beyond just education, the FCOI is also envisioned to regulate the professional practice of forensic science through the registration and licensing of forensic examiners. This mechanism ensures the competence and proficiency of forensic examiners, and the unregulated nature of the profession would change. This is especially important given the significance of a forensic expert's opinion during investigation and trial, as discussed in previous sections.

IX. SOME THOUGHTS FROM THE AUTHOR

While the public discourse and the Government's attention have now started to focus on solving the deeply rooted problems of forensic science in India, it would be worthwhile to focus on the following aspects as well.

Automation should be considered as a crucial step towards enhancing the efficiency and reliability of forensic science services in India, with the potential to reduce errors, streamline processes, and ensure consistency in results. This approach aims for minimum human interference in the execution of forensic procedures. Examples of such technological upgrades include the investment in advanced DNA sequencing and automated fingerprint systems. The adoption of automation should be coupled with effective human oversight through manual checks to minimise the risk of error and bias, ensure quality, and to keep intact human accountability.

Further, while the need for a central regulatory body has been felt for long, and the government had made proposals, it should be considered that instead of creating an altogether new body, the Government can strengthen the DFSS, which already exists and is functioning. DFSS can ensure seamless coordination between law enforcement agencies, forensic laboratories, and judicial authorities. DFSS personnel can come to state and regional labs on deputation, similar to how CAG Officers come to the State auditing bodies on deputation. This would increase

quality standards, consistency and transparency, further increasing accountability.

Another area for focus should be Cyber Forensics. Enhancing capabilities in digital forensics with specialised training and advanced tools is critical to address rising cybercrimes. To strengthen cybercrime investigations and enhance digital forensic capabilities, the Government of India has established the National Cyber Forensic Laboratory (NCFL) at the Central Forensic Sciences Laboratory in Hyderabad, with six more NCFLs approved across major cities at a total outlay of ₹126.84 crore. In parallel, the e-Forensics initiative under the Inter-Operable Criminal Justice System (ICJS) has operationalised an online case registration and tracking system that connects 117 forensic laboratories nationwide. This digital integration enables faster, more accurate, and reliable forensic reporting, significantly improving coordination between examiners, police, and other investigative agencies.

While the aim should be to foster FSLs as an all-rounder organisation, the development of focused laboratories with domain expertise can ensure higher quality, more specialized analysis and reporting within specific forensic disciplines, ultimately leading to more accurate and reliable evidence for legal proceedings. For instance, CFSL Chandigarh has four independent units: Sexual Assault and Homicide Unit, Paternity Unit, Human Identification Unit and DNA Unit. More of such specialised units are required across all laboratories. In addition, automation and standardisation will significantly reduce errors. This will streamline the process and ensure consistency in results. Hence, minimum human interference is desirable.

With the advent of Artificial Intelligence, Deep Fake and cyber crime being on rise, we need to have robust tools to stay one step ahead of the criminals. Since these offences have no boundaries we must keep our territorial differences t back end to take this menace head on. It is an undeniable fact that a peaceful society is always a progressive society.

The State of Punjab came out with the Forensic Document Examiners Regulatory Rules, 2014 with an object to regulate the service of forensic service document examiner working in the field as private practitioners in the State. Challenge to the validity of aforesaid rules was upheld by the

High Court of Punjab & Haryana . The matter is stated to be pending before Supreme Court.

In case of Dharm Deo Yadav vs State of Uttar Pradesh , Supreme Court held that the criminal justice system in this country is at cross-roads and time has come when traditional methods of investigation have become outdated. In this age necessity is there to strengthen forensic science for crime detection. Relevant paragraph 30 is extracted below:

“30. The criminal justice system in this country is at crossroads. Many a times, reliable, trustworthy, credible witnesses to the crime seldom come forward to depose before the court and even the hardened criminals get away from the clutches of law. Even the reliable witnesses for the prosecution turn hostile due to intimidation, fear and host of other reasons. The investigating agency has, therefore, to look for other ways and means to improve the quality of investigation, which can only be through the collection of scientific evidence. In this age of science, we have to build legal foundations that are sound in science as well as in law. Practices and principles that served in the past, now people think, must give way to innovative and creative methods, if we want to save our criminal justice system. Emerging new types of crimes and their level of sophistication, the traditional methods and tools have become outdated, hence the necessity to strengthen the forensic science for crime detection. Oral evidence depends on several facts, like power of observation, humiliation, external influence, forgetfulness, etc. whereas forensic evidence is free from those infirmities. Judiciary should also be equipped to understand and deal with such scientific materials. Constant interaction of judges with scientists, engineers would promote and widen their knowledge to deal with such scientific evidence and to effectively deal with criminal cases based on scientific evidence. We are not advocating that, in all cases, the scientific evidence is the sure test, but only emphasising the necessity of promoting scientific evidence also to detect and prove crimes over and above the other evidence.”

With this perception in mind when the author was President of Board of Governors of the Chandigarh Judicial Academy, two workshops were held in 2016. In these workshops scientific experts, lab technicians, doctors, police officers, Judges and prosecutors from Chandigarh, Haryana and Punjab were in attendance. Discussions were held to make

forensics tools more effective. The problem and experience were shared by all stakeholders.

The idea was to come out with a handbook on forensic science cogniting all issues pertaining to collection, packing, preservation, transfer, and security-endurance of the samples so as to make such evidence admissible in courts.

In the handbook from various disciplines of forensic science, crime scene management and collection of material evidence with technicalities involved therein, up to chain of custody have been dealt with. This book is accomplishing the objective of overcoming the issues involved in all these elements, to a considerable extent, so that every fragment of forensic evidence stays admissible in court of law.

Inputs were taken from Mr. S.K. Jain, the then Director of CFSL, Chandigarh. Compilation was made by Mr. Pradeep Mehta, Joint Director Prosecution (Retd.) Punjab a faculty member of the Academy. This book was circulated widely in various institutions and concerned departments in Punjab, Haryana and Chandigarh. If translated in local language also for better understanding at ground level.

Section 329 of BNSS makes report of certain scientific experts admissible as evidence in inquiry, trial or other proceedings. By expanding the list of designated experts, the provision can be more effectively utilized. This change would reduce delays and lessen the burden on a limited pool of experts, thereby improving the efficiency and efficacy of trials involving scientific evidence.

Recording of evidence through video conferencing (VC) can further the object of the new Criminal laws. Proviso to section 330 of BNSS provides that, no expert shall be called to appear in court, unless the report of such expert is disputed by any of the party to trial. By using VC, courts can quickly address challenges to expert reports without causing significant delays, thus ensuring the timely disposal of cases and a more modern, technology-driven justice system.

IX. CONCLUSION

Forensic science stands at the cusp of becoming a cornerstone of India's criminal justice system. With the enactment of new criminal laws

mandating forensic investigations for serious offences, the country has taken a crucial step toward evidence-based investigation. However, this legal shift must be accompanied by robust structural and institutional reforms. The current gaps in infrastructure, manpower, and standardisation risk overwhelming the system and undermining the very purpose of these reforms.

Bridging these gaps demands a comprehensive and sustained effort—upgrading laboratories, filling vacancies, setting national standards, and building coordination between investigating agencies and forensic institutions. Equally important is investing in training and education to ensure the availability of skilled professionals. The recent government initiatives, including financial outlays for modernisation and new criminal laws, reflect a growing recognition of the role science must play in justice delivery. Yet, unless these are implemented effectively and supplemented by a central regulatory framework, forensic science will remain an underutilised resource. For India to ensure timely, transparent, and fair trials, forensic reform is not just desirable; it is imperative.

The fact cannot be lost sight of that forensic science is a vast field. The author has only floated food for thought, being not an expert in the subject. Its sharing of some experience. Nothing is perfect, and there is always scope for improvement everywhere. The basic requirement is change of mindset.