



FORENSIC SCIENCE INDIA REPORT

*A Study of Forensic Science
Laboratories (2013-2017)*

EXECUTIVE SUMMARY



PROJECT 39A
EQUAL JUSTICE
EQUAL OPPORTUNITY



EXECUTIVE SUMMARY

INTRODUCTION

Forensic science is a crucial part of the criminal justice administration. It refers to the application of scientific methods and techniques to assist in the collection, identification, analysis and interpretation of evidence. The results of forensic analysis and the opinions of forensic examiners are considered expert scientific evidence under Indian law. The quality of forensic examination conducted by forensic science laboratories (FSLs) impacts the interests of victims and defendants alike.

Forensic laboratories in India have been in existence since the British colonial era, and are now administered in a three-tiered structure of Central, State and Regional FSLs (CFSLs, SFSLs, RFSLs), with additional district mobile forensic units (MFSUs).¹ Currently, there are 117 functional FSLs, of which 10 are accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL).

There are eight CFSLs, including CFSL Unit in Shimla, governed by the Union Ministry of Home Affairs (MHA) through the Directorate of Forensic Science Services (DFSS). The CFSL in Delhi was under the Central Bureau of Investigation (CBI) until recently. Across the states, there are 31 SFSLs and 78 RFSLs which are currently functional and are administered by each state's home or police departments. RFSLs and MFSUs

¹ See Graphic 1 on the organisation of the forensic science system in India at pg 41.

***References to graphics, tables and page numbers in this document correspond to the *main report*.**

in every state are under the administrative and financial control of the respective SFSL. While the DFSS does not exercise direct control over state and regional laboratories, it provides financial and technical support to all FSLs. Distinct from this framework, forensic medicine is administered by the Ministry of Health and Family Welfare (MoHFW) through the Directorate General of Health Services (DGHS). Autopsies and examinations in medico-legal cases (MLCs) are conducted in government hospitals and medical colleges.

Despite the growing focus on forensics, there is a significant dearth of empirical research on the challenges and needs of FSLs in India. It is also essential to scientifically audit the practice within different forensic divisions within each FSL. Previous reports, including the National Human Rights Commission's 'State of the Art of Forensic Science: For Better Criminal Justice' (1999), and the Ministry of Home Affairs reports 'Perspective Plan on Indian Forensics' (2010) and 'Report on Scientific Performance Audit of DFSS HQ and its CFSLs' (2011) have identified significant concerns regarding the inadequacy of financial, personnel and infrastructural resources within laboratories. However, the recommendations made in these reports have not been implemented.

This Report aims to fill the critical gaps in our understanding of the prevailing conditions and issues within FSLs. In this survey, 61 FSLs were chosen within the sample size, in order to include all CFSLs (8), SFSLs (31) and at least one RFSL (22) from each state. 30 laboratories responded to the survey, comprising three CFSLs, 17 SFSLs and 10 RFSLs.² Out of these participating laboratories, we visited 17 FSLs as part of our fieldwork. The Report integrates quantitative data from the assessment period i.e. 2013-2017, with on-ground narratives of forensic scientists to identify the challenges faced by FSLs regarding budget and expenditure, recruitment, education and training, case management, infrastructure and quality management. Based on their inputs and comparative best practices, we have made recommendations towards addressing these structural problems. The Report also includes a scientific audit of the forensic DNA profiling practices followed in India, given the rising demand for DNA

² See Graphic 2 showing a map of functional FSLs in India at pg 51.

evidence and its position as one of the most advanced forensic disciplines. Finally, we provide an analysis of the law on expert forensic evidence.

To strengthen the current forensic science system, adherence to principles of quality control and quality assurance must be the focus of legislative, executive and judicial interventions on forensic science.

CHAPTER I: BUDGET & EXPENDITURE

Trends

- The central government funds the CFSs and provides financial support to state laboratories through schemes or specific 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 varied. Overall, there is a high variance in the budget and expenditure data between FSLs.³

Receipt

- 18 out of 30 laboratories provided information on sources and amounts of funds received. The proportion of different funding sources in the total fund receipt varies across laboratories⁴ and assessment years.⁵ Central funding is highly inconsistent and no SFSL or RFSL received central funding in every assessment year.⁶ Despite a disparity in state funding across laboratories, six FSLs showed a consistent increase in the yearly receipt of state funds.⁷
- Seven FSLs received more funds overall than their total forecasted budget, while CBI-CFSL and RFSL Nagpur received less than 50% of their total forecast, getting as little as 14% in one year and more than 100% in others.⁸

³ See Graphic 3 on the ranking of FSLs as per total funds received at pg 63.

⁴ See Graphic 4 on the breakdown of funding sources for FSLs at pg 65.

⁵ See Graphic 5 and 6 on year-wise funding received from the central and state governments respectively at pg 68 and 70.

⁶ See Graphic 5 on year-wise funding received from the central government at pg 68.

⁷ See Graphic 6 on year-wise funding received from state governments at pg 70.

⁸ See Table 2 on laboratory-wise comparison of forecast, receipt and expenditure of funds across the assessment period at pg 79.

Expenditure

- 20 laboratories provided information on the forecasted budget and 22 supplied information on expenditure. Collectively, laboratories spent only 69.4% of the total forecasted amount, spending only 40.2% of the amount forecasted on equipment & maintenance.⁹ Although the expenditure on equipment consistently increased over time, it was less than 50% of the amount forecasted throughout the assessment period.¹⁰
- Three FSLs recorded a higher overall expenditure than their forecasted budget, while CBI-CFSL and RFSL Nagpur spent less than 50% of their forecasted budget.¹¹
- Received funds were underutilised consistently across years by CBI-CFSL, CFSL Chandigarh, SFSL Bhubaneswar, SFSL Raipur and RFSL Nagpur. SFSL Raipur spent less than 75% of its received funds every year. On the other hand, RFSL Dharamshala, SFSL Lucknow and SFSL Shimla had an overall expenditure-to-receipt ratio of 100% or more.¹²

Challenges

- 15 out of 27 state and regional laboratories in the survey were under the administrative and financial control of the police department. They had more cumbersome budget approval, receipt and disbursal processes. They shared concerns regarding interference with budgetary decisions, determining the priority of cases for forensic examination as well as decision-making in individual cases.
- Inconsistency and delays in central funding cause it to lapse every year, hampering capital-intensive and long-term infrastructure expansion. The cumbersome tender and procurement processes further interfere with laboratories' ability to spend allocated funds before they lapse.
- Laboratory directors have inadequate financial powers to procure

⁹ See Graphic 7 on expenditure and forecast comparison across budget heads at pg 73.

¹⁰ See Graphic 8 on year-wise analysis of forecast and expenditure at pg 74.

¹¹ See Table 2 on laboratory-wise comparison of forecast, receipt and expenditure of funds across the assessment period at pg 79.

¹² See Table 2 on laboratory-wise comparison of forecast, receipt and expenditure of funds across the assessment period at pg 79.

and spend on routine equipment and supplies needed for casework, especially in RFSLs, which carry out a majority of the country's forensic casework but are financially dependent on SFSLs.

- The salaries of the scientific staff at FSLs are not at par with similar positions in other government laboratories. Employee benefits such as medical insurance to cover occupational hazards and allowances are also inadequate, especially for contractual staff.
- None of the laboratories, including CFSLs which are envisioned as centres for research and development (R&D) in forensic science, allocate any funds for R&D.

Recommendations

- DFSS should hold consultations with state governments to separate FSLs from police departments, to ensure the impartiality and reliability of forensic results submitted to courts. This will also secure greater financial independence for FSLs, smoother budgetary processes and improved utilisation of funds.
- Central grants should be earmarked for the development of SFSLs and RFSLs and sub-allocated to ensure appropriate expenditure on different budget heads. Central and state funds should be consistently disbursed at the beginning of every year across laboratories.
- The financial powers of FSL directors, especially in RFSLs, should be revised in light of the routine costs of conducting casework. RFSL directors should be empowered as Drawing and Disbursement Officers (DDOs) under the financial rules and the coordination over financial planning between RFSLs and SFSLs must be improved.
- Financially trained personnel should be available in each FSL for improved budgetary planning and financial analysis. DFSS and its state counterparts should conduct regular needs assessment surveys to enable better financial planning for FSLs.

CHAPTER II: RECRUITMENT, EDUCATION & TRAINING

Trends

Overall Vacancy

- Across the 26 laboratories which provided recruitment-related data, 40.3% (1294 out of 3211 posts) of total sanctioned posts were vacant.¹³ There is a high variance in the vacancy rates across FSLs. SFSL Lucknow observed a vacancy rate of 72.5%, while RFSL Nagpur and RFSL Pune had negative vacancy rates due to the hiring of contractual staff.¹⁴

Scientific Vacancy

- Of the total vacancies (901 posts), 69.6% were for scientific staff.¹⁵ SFSL Lucknow, SFSL Banderdewa, RFSL Berhampur, RFSL Jagdalpur and SFSL Verna had a vacancy rate higher than 50% in the scientific posts even after the inclusion of contractual staff, while three of the four RFSLs in Maharashtra had negative vacancy rates due to contractual scientific staff.¹⁶

Additional Posts Required

- Beyond vacancies in currently sanctioned posts, 17 laboratories expressed the need for additional posts to be sanctioned. In these FSLs, 903 additional posts are required, of which 572 are for scientific staff.

Challenges

- The approval processes for sanctioning new posts and filling sanctioned posts are cumbersome, protracted and irregular. The recruitment processes and the eligibility criteria for every post vary across states.
- There is little adherence to prescribed work norms, which are aimed

13 See Graphic 9 showing an overview of the data on posts filled, vacant and additionally required at pg 96.

14 See Graphic 11 on comparison of total rate of filled and vacant posts at pg 101.

15 See Graphic 10 on scientific posts across FSLs at pg 100.

16 See Graphic 12 on comparison of total rate of filled and vacant scientific posts at pg 103.

at the effective distribution of scientific and non-scientific work and regulating annual caseloads of different divisions to ensure the quality of forensic examination. Further, the work norms, issued by the Bureau of Police Research & Development (BPR&D) in 2002, which were adopted by DFSS, are outdated.

- Scientific staff is extremely dissatisfied due to the heavy workload along with constant pressure from investigative authorities and courts, historical pendency of cases and lack of parity in pay and employment benefits with similarly placed staff working in universities or other administrative services.
- To cope with the delays in recruitment processes, FSLs are compelled to hire contractual scientific staff. Some laboratories have raised concerns regarding the quality of work relating to contractual staff due to a lack of accountability. Contractual staff in FSLs have also shared concerns regarding lower pay and lack of employee benefits as compared to permanent staff.
- FSLs prefer hiring candidates with degrees in pure sciences rather than in forensic science, due to the lack of regulation of forensic science education and standardised curricula with an emphasis on practical learning. Further, the professional practice of forensic science is also unregulated, despite the need to ensure the competence and proficiency of forensic examiners.
- New recruits to the scientific staff in the FSLs do not undergo dedicated training before being assigned casework. Most laboratories conduct 'on-the-job' training with supervision by senior staff. The existing scientific staff is also not provided adequate opportunities for continuous learning on the latest scientific developments and new forensic techniques.

Recommendations

- Towards standardising forensic recruitment, DFSS should organise consultations with FSL directors, concerned officials in state police and home departments, state public service commissions and staff selection commissions to understand the bottlenecks in the recruitment process. It should accordingly devise a National Forensic Recruitment Strategy with NFSU and the proposed Forensic

Council of India (FCOI) which standardises the eligibility criteria and recruitment method for various scientific and non-scientific posts in an FSL and proposes changes to existing recruitment procedures for consideration of central and state governments.

- DFSS and the proposed Forensic Science Regulator (FSR) should prepare new work norms which reflect scientific advancements, caseload trends and the levels of personnel within the FSLs. This should be done through consultation with the proposed expert Scientific Working Groups (SWGs) for different divisions, FSL directors and the respective state police and home department officials.
- DFSS, in its needs assessment surveys, and the FSLs should regularly assess the additional requirement of FSLs for scientific and non-scientific posts based on local caseload trends.
- Towards improving their working conditions, FSLs should address occupational hazards and provide employee benefits like medical insurance, access to psychological support, better pay, research opportunities and travel allowances and maintain parity with analogous positions in other government institutions. DFSS should liaise with state governments to implement the Flexible Complementing Scheme (FCS), which allows for promotions irrespective of vacancy, in SFSLs and RFSLs.
- A Forensic Council of India (FCOI) must be established to regulate the professional practice of forensic science through the registration and licensing of forensic examiners. Such registration should be based on qualifying examinations conducted by FCOI and NFSU. Towards regulating forensic science education, FCOI, DFSS and NFSU must survey existing educational courses and institutions. Based on the survey, FCOI and NFSU must set standards for the curricula, teaching methods, infrastructure and laboratory equipment required for forensic science programmes and approve them accordingly.
- The proposed FSR, with help from NFSU, should standardise training programmes for new scientific recruits in different divisions, and incorporate both theoretical and practical components before assigning any casework. The proposed FCOI in collaboration with NFSU should curate continuous forensic education programmes for

existing forensic staff covering scientific and legal developments.

CHAPTER III: CASE MANAGEMENT

Trends

- Data regarding cases received, examined and pending has been analysed for 29 FSLs that were functional during the assessment period.¹⁷

Case Receipts

- Across all FSLs, the Excise, Toxicology and Biology divisions collectively accounted for 68.7% of the total case receipts.¹⁸ The DNA Profiling and Cyber Forensics divisions saw a consistent increase in case receipts.¹⁹
- As per the mean exhibit-to-case ratio, the Document division receives 16 exhibits per case, while the number is eight for Ballistics and approximately five for Cyber Forensics.²⁰
- Amongst FSLs, the RFSLs in Maharashtra i.e. RFSL Nagpur, RFSL Pune and RFSL Aurangabad had the highest case receipts.²¹ SFSL Banderdewa, SFSL Dehradun, SFSL Shimla, RFSL Dharamshala and RFSL Nashik saw a consistent increase in case receipts.²²

Examination & Pendency in Divisions²³

- The examination rates in Toxicology (116.7%) Excise (106%),

¹⁷ See Graphic 13 on the different divisions in FSLs and the types of evidence they examine at pg 126.

¹⁸ See Graphic 14 on the number of cases received by different divisions across FSLs at pg 131.

¹⁹ See Graphic 16 on the continuous increase in cases received by the Cyber Forensics and DNA Profiling divisions, at pg 135.

²⁰ See Graphic 19 on the median exhibit-to-case ratio for different divisions at pg 138.

²¹ See Graphic 20 on the number of cases received by different FSLs at pg 141.

²² See Graphic 21 on FSLs with continuous increase in the number of cases received at pg 143.

²³ See Graphic 15 on examination and pendency rates in different divisions across FSLs at pg 133.

Explosives (105%), Chemistry (102.1%) and Narcotics (100.9%) were greater than 100%, showing that more cases were examined in these divisions than were received.

- Cyber Forensics (111.2%), Ballistics (100.2%) and DNA Profiling (79%) had the highest pendency rates, which compare the number of cases pending at the end of the year compared to the cases received, indicating historical pendency in these divisions.
- Despite receiving the most cases, the Excise division had one of the lowest pendency rates (8%), while Ballistics, Cyber Forensics and DNA Profiling had a higher pendency rate than the examination rate, indicating an urgent need for expansion to handle an increasing caseload.
- The DNA Profiling division's examination rate declined drastically across the assessment period while its pendency rate increased.²⁴ The Cyber Forensics division's examination rate was also consistently lower than its pendency rate.²⁵

Examination & Pendency in FSLs²⁶

- SFSL Bhubaneswar (122.2%), RFSL Nashik (118.3%) and SFSL Raipur (114.1%) had the highest examination rates. SFSL Bhubaneswar and RFSL Dharamshala had an examination rate higher than 100% every year.
- SFSL Imphal (400.7%), RFSL Berhampur (167.7%) and SFSL Thiruvananthapuram (119.4%) had the highest pendency rates. Five other FSLs recorded pendency rates higher than 60%.
- RFSL Nashik receives the third highest number of cases but has one of the lowest pendency rates (13%) against its examination rate (118.3%). On the other hand, SFSL Imphal and SFSL Thiruvananthapuram had a higher pendency rate than the examination rate every year, and SFSL Imphal's pendency rate was consistently higher than 300%.²⁷

24 See Graphic 17 on the year-wise examination and pendency rates of the DNA Profiling division at pg 136.

25 See Graphic 18 on the year-wise examination and pendency rates of the Cyber Forensics division at pg 137.

26 See Graphic 22 on examination and pendency rates in the FSLs at pg 145.

27 See Graphics 23 and 24 at pg 147.

Challenges

- Several laboratories shared that investigative agencies often send a large number of exhibits bearing no forensic value, which contributes to case pendency. To cope with the growing pendency and tight legislative timelines for investigation, some FSLs conduct pendency drives by working overtime to finish casework. However, this leads to serious concerns regarding the quality of forensic examination.
- Many laboratories do not have separate case-receiving sections to ensure that the case exhibits are in a sealed condition while taking custody of the samples and to remove any task-irrelevant information from case documents. Laboratories also lack document management systems to maintain a chain of custody of samples within the FSL, which is crucial with such high pendency and intensive casework.
- Given the lack of adequate scientific staff, laboratories do not conduct a technical review of the casework before submitting their reports. Such reviews are essential to minimise the risk of error and bias and ensure quality.
- Scientists are often called to assist at crime scenes or provide testimony regarding their reports to courts. In light of the high vacancies and caseload, many scientists prefer to avoid such crime scene visits or court attendances as they take several hours or even days and disrupt their casework. However, they acknowledged the importance of their presence at crime scenes to oversee the collection of evidence and their role in the proper appreciation of forensic evidence in court.

Recommendations

- DFSS and the proposed FSR should develop standard protocols for case receipts. Case-receiving sections should be staffed with personnel trained in such protocols, context management procedures and evaluating the chain of custody.
- All cases should undergo a technical and administrative review to ensure the quality of forensic examination in every case. A technical review should include an evaluation of the data and materials underlying the examination and to ensure that the results have been reported correctly.
- A robust, uniform and digitised case management system must be

introduced in all FSLs to ensure efficient management of casework. In every FSL, there should be administrative staff trained in data input and analysis, to closely monitor and compute caseload trends in each division and allow for better internal management.

- DFSS with the proposed FSR should formulate protocols based on best practices for the collection and handling of all types of forensic evidence. NFSU must develop training programmes for police on crime scene management, and FSLs must be adequately staffed so that they can provide such training. The police must also be adequately supplied with the requisite equipment for evidence collection.
- The practice of forensic medicine should be regulated and standards should be developed for medical examination of persons and post-mortem examinations. Further, medical practitioners and staff should be adequately trained to ensure the quality of biological samples.

CHAPTER IV: INFRASTRUCTURE

Trends

- Out of 29 FSLs that were functional during the assessment period, 25 laboratories shared information regarding sanctioned and additional space required by them. Further, 21 laboratories specified the additional equipment required by them.

Space

- Of the 25 FSLs which provided data regarding space, 13 required additional space, with RFSL Nagpur, RFSL Nashik and SFSL Bhubaneswar requiring the most space for their functional divisions.²⁸ Seven FSLs required more than double the currently allocated space for their functional divisions, and seven required additional space in more than half of their functional divisions.
- Across FSLs, the divisions that required the most space were Biology, DNA Profiling and Ballistics.²⁹ Four divisions required more than

²⁸ See Graphic 25 on additional space required by FSLs for functional divisions at pg 169.

²⁹ See Graphic 27 on additional space required for functional divisions across FSLs at pg 173.

double the space currently sanctioned for them, of which Ballistics, DNA Profiling and Cyber Forensics had higher pendency rates than examination rates.

Equipment³⁰

- Of the 21 FSLs which expressed the need for additional equipment, 13 FSLs needed it in more than half of their functional divisions. Out of these, CFSL Shimla, SFSL Banderdewa, RFSL Ranipool and RFSL Thrissur required additional equipment for all their functional divisions.
- 12 FSLs require additional equipment for their Chemistry divisions, 11 for their DNA Profiling divisions, nine for their Biology divisions. These divisions ranked amongst the highest divisions in terms of case receipts. Of the five FSLs that require equipment for non-functional divisions, four laboratories need it for their Cyber Forensics division.

Challenges

- Laboratory design and establishment should consider the needs of scientific and technical work within different divisions, health and safety requirements and contamination minimisation measures. Such planning is lacking in many FSLs as ordinary buildings planned by police departments are often repurposed into FSLs and are not tailored to the basic needs of a laboratory.
- There is a severe shortage of space for proper storage of samples in appropriate temperature, humidity, light and ventilation conditions. Further, many FSLs do not have separate areas for scientific and non-scientific work nor mechanisms to restrict access to examination areas, which impacts the quality and integrity of forensic examinations.
- Due to lengthy procurement processes and the lack of space, FSLs are unable to purchase essential equipment or expand divisions despite increasing casework. They lack instruments to control the ambient conditions for scientific equipment, backup equipment to ensure continuity of casework, and Annual Maintenance Contracts (AMCs)

30 See Graphic 28 on additional equipment required by FSLs for functional divisions at pg 176.

for the regular calibration and maintenance of equipment. Without the equipment functioning optimally, the quality and accuracy of casework can be compromised.

- Despite the potential exposure to hazardous materials and chemicals, FSLs do not have proper safety procedures, personal protective gear for personnel, appropriate physical infrastructure or waste disposal mechanisms. They also lack security measures to protect the integrity of stored samples and the safety of staff for laboratories in high-risk areas.

Recommendations

- DFSS should conduct a needs assessment survey with NFSU to understand the infrastructural needs of FSLs, conceptualised by experts in forensic science, health and safety, architecture and civil engineering and security. This should be towards developing a national plan to address these needs and DFSS should coordinate with states towards ensuring that adequate funds are earmarked for these purposes.
- DFSS and the proposed FSR should create minimum infrastructural standards for the planning and construction of an FSL, including measures for contamination minimisation, health and safety, waste disposal and workflow management.
- FSLs should be monitored by the proposed state DFSS and regularly audited by the proposed FSR to ensure adherence to the minimum infrastructural standards, especially the health and safety protocols therein, and address any challenges in their implementation.
- As the purchase of equipment is capital-intensive, a central grant earmarked for the infrastructural development of state laboratories should be consistently released. DFSS and the proposed FSR should standardise equipment across FSLs in order to explore centralised procurement, which will avoid delays related to financial approvals.

CHAPTER V: QUALITY MANAGEMENT

Trends

- Quality management in forensic science, comprising quality control and quality assurance processes, is critical to ensure the accuracy and reliability of forensic examinations relied on by courts. Quality management systems are necessary to detect and minimise errors, especially given the grave implications they may have within the justice system.
- Data on quality management processes, including working procedure manuals (WPMs), proficiency tests, training, error rate calculation and accreditation, was received from 27 FSLs.
- Of the 24 FSLs which provided data on WPMs, only six have formulated their own WPMs for some or all of their functional divisions. 19 laboratories follow the manuals prepared by DFSS in their divisions while 12 FSLs use manuals or reference materials such as textbooks published by external bodies.³¹
- Only five FSLs had their own quality manual, while 16 did not. Further, only five FSLs were accredited by NABL and only four laboratories besides them had participated in proficiency testing. Only three FSLs calculated error rates.

Challenges

- FSLs lack quality management systems, and view quality management only as a requirement for accreditation and not as a part of routine casework. Additionally, developing quality management systems requires significant investment and resources. Without adequate space, equipment or trained personnel, laboratories are unable to prioritise it while grappling with a heavy caseload.
- Internal validation of every forensic technique is crucial to test and demonstrate its reliable operation within the particular setup of each division of an FSL. However, FSLs do not internally validate testing methods as the methods may have been developmentally validated or they believe that internal validation is limited to new and novel technologies developed by the laboratories.

³¹ See Graphic 30 on WPMs used by FSLs in their functional divisions at pg 208.

- Based on internal validation, every laboratory must create its own detailed WPM for each division to ensure standardisation in scientific testing procedures across casework. Such documents cannot be adopted from other laboratories without determining their appropriateness to the laboratory's procedures, equipment and infrastructure. Despite this, a majority of FSLs do not have their own WPMs and rely on external manuals prepared by DFSS or other sources. Further, FSLs have also reported that they refer to different materials within the same division, which raises concerns regarding standardisation and the basis for deviations in casework.
- Proficiency tests are routine discipline-specific examinations to evaluate the competence of forensic scientists and to identify areas for improvement. Most FSLs do not participate in proficiency testing, often believing it to only be a requirement for accreditation. The few laboratories that conduct internal and interlaboratory proficiency testing do not conduct blind testing, which is necessary to accurately test an examiner's competence.
- Accreditation is a certification by an independent institution, like NABL, that an FSL conforms to set quality standards. Despite being aware of the importance of accreditation, FSLs lack the technical guidance, financial support and personnel trained in quality standards and quality management procedures to dedicate to pursuing it.

Recommendations

- DFSS, NFSU and the proposed FSR should organise consultations with FSL directors and senior scientific staff to build a common understanding of the importance and components of quality management systems. Such consultations will help identify and provide targeted interventions for the hurdles each FSL faces in complying with quality standards.
- DFSS should design a phased Action Plan with tailored timelines for all FSLs to gradually move towards implementing quality management. Each proposed state DFSS should accordingly provide funds, resources, training and support to FSLs to enable them to complete each phase.

- FSLs must be guided by DFSS and the proposed FSR to prepare their own WPMs in a time-bound manner, supported by internal validation studies. To guide on drafting WPMs, the WPMs prepared by expert groups constituted by DFSS should be widely circulated amongst FSLs. Laboratories must regularly review and update their WPMs based on changed laboratory setups or technological advancements.
- Towards formalising quality management, FSLs must be supported by the proposed state DFSS in getting accreditation, through the provision of additional resources and consultations with accredited laboratories, the proposed FSR and NABL assessors. As many FSLs agreed, accreditation must eventually be made mandatory through flexible timelines which account for the current realities of the forensic system.

CHAPTER VI: FORENSIC DNA PROFILING IN INDIA

Trends

- There has been an increase in the use of forensic DNA profiling in India, following technological advancements and legislative changes towards introducing DNA evidence in sexual violence cases. In light of this, Part B of the survey sought information from the DNA profiling divisions of the FSLs towards conducting a model scientific review of DNA profiling practices in India. 15 laboratories (two CFSLs, nine SFSLs and four RFSLs) had a functional DNA profiling division.
- Different types of DNA profiling vary in their applications in forensic casework. There was a variance in the types of DNA profiling examinations that FSLs conduct as well as in the commercially available DNA kits used by them for each step of the DNA profiling process. Only RFSL Pune used software for the interpretation of mixed DNA samples.
- Only three of the 15 laboratories had developed their own WPMs for the DNA profiling division. Further, DNA kits require thresholds to be set for the DNA profiling process after internal validation, such as a minimum limit of detection of DNA for it to be reliably analysed. Such standards were absent in many FSLs, while those set by other laboratories raised concerns about whether internal

validation studies had been appropriately conducted before fixing the thresholds.

- It is necessary to conduct a statistical analysis to assign meaning and significance to a DNA 'match', based on the frequency of the observed DNA profile within a population. Statistical analysis is a core step of forensic DNA profiling, without which a DNA examination cannot be considered complete. However, only four FSLs conduct statistical analyses.
- Quality management procedures to minimise contamination, such as the separation of work areas for processing DNA samples, are particularly crucial in DNA profiling due to the sensitive nature of the evidence. Two laboratories did not have separate working areas to process DNA samples. Towards quality control, a majority of FSLs conduct technical reviews of the DNA profiling process before the final report is furnished.

Challenges

- Given the susceptibility of DNA samples to contamination, it is crucial to follow strict contamination minimisation protocols. However, FSLs do not have adequate contamination control protocols and the equipment to implement them. The shortage of space in the FSLs to delineate for different parts of the casework also poses a high risk of contamination. Laboratories also presently lack a staff elimination database to investigate instances of contamination.
- The standards set by the FSLs for the DNA profiling process show that its procedures were not internally validated, despite the DNA kits requiring it. Without internal validation, the necessary thresholds to be followed during DNA profiling cannot be determined, and the reliability of the DNA profiling process within a laboratory cannot be confirmed.
- A majority of the DNA samples received by FSLs are mixed DNA samples, whose interpretation is inherently more difficult and subjective. However, laboratories lack validated protocols for DNA mixture interpretation, which in turn raises doubts about the accuracy and consistency of mixture analyses. Further, FSLs do not use software for such analyses, which would provide a better basis for

interpretation.

- A majority of FSLs do not conduct statistical analyses, since laboratory protocols and courts do not clearly mandate it and the scientists lack the requisite training for it. The population genetics data necessary for such statistical evaluation is also lacking.

Recommendations

- DFSS, NFSU and the proposed FSR should conduct a detailed scientific audit of the functional DNA profiling divisions across FSLs, with experts in the field. This will identify and allow for targeted interventions to address areas for capacity building. The aspects of the DNA profiling practice that require validation should also be identified, and a plan devised for appropriate validation studies to be conducted.
- DFSS and the proposed FSR should develop contamination detection and prevention guidelines for DNA divisions, and FSLs must update their WPMs to reflect them. Such guidelines should be developed based on the scientific best practices followed in other jurisdictions.
- For the scientific and legal legitimacy of forensic DNA results, statistical analyses must be conducted routinely by every FSL. Towards this, scientific staff should be adequately trained by NFSU with the proposed state DFSS on different statistical models and their application to genetics data.
- An expert group on genetics must be constituted to evaluate existing population genetics studies on Indian and South Asian populations. It should prepare indices to enable statistical analysis in DNA profiling, which should be disseminated to all FSLs. Further population genetics studies should also be funded by the government and conducted by premier scientific research organisations with NFSU.

CHAPTER VII: LAW ON EXPERT EVIDENCE

- The law relies on the accuracy and precision of scientific findings to inform its judgements. Therefore, forensic science should be practised validly and reliably, and the law needs to consider the empirical basis for each forensic discipline, its inherent limitations and its potential rate for error before forming its conclusions. Given the perpetual revisions in science and emerging research reviewing the scientific foundations of different disciplines, the law must adapt and not be bound by judicial precedent in determining the admissibility and weight of forensic evidence. This requires judges and lawyers to develop a working understanding of different forensic disciplines.
- Section 45 of the Indian Evidence Act, 1872 (IEA) allows for reliance on the opinions of experts in a diverse range of specialised areas, including forensic science. As per the case law under Section 45 IEA, including *State of Himachal Pradesh v. Jai Lal*, for a person to be an expert, they must have the special skills, qualifications and experience in that particular area of knowledge. In the context of forensic science, this means expertise in the specific forensic discipline and even the particular technique or method of examination applied in a case. Examining the expertise of forensic examiners is particularly crucial in light of the various issues with forensic science education, training and recruitment criteria and the rotation of staff between divisions.
- Further, the evidence provided by an expert to courts must be “intelligible, convincing and tested” as per *Jai Lal*. The decisions under Section 45 IEA emphasise the importance of the intelligible, reasoned and reliable nature of expert scientific opinions, towards enabling independent verification of the conclusions reached. However, they do not create a cogent framework for determining what constitutes ‘science’ and the manner of examining expert evidence. As a result, the admissibility of such evidence is determined by judges based on relevance, leading to unguided and subjective decision-making which may not reflect current scientific research on the forensic

discipline. Therefore, the Supreme Court should develop practice directions for trial courts on how to judge the foundational validity and reliable application of scientific techniques.

- Courts have consistently held that the ‘data and materials’, which form the underlying basis for an expert opinion, must be furnished for a judge to independently review the findings. However, due to the lack of clear legal standards, it is unclear which documentation must be submitted with the forensic report in each forensic discipline. This leads to variance in reporting practices across FSLs and courts, impacting the right of the defence to meaningfully challenge forensic evidence. Thus, the Supreme Court should specify the material required to be provided as part of the forensic report.
- Under Indian evidence law, the stages of determining the admissibility and weight of evidence are not well-defined. Since its admissibility is determined after both parties have led their evidence, judges as the fact-finders may be vulnerable to confirmation bias. To prevent this, the Supreme Court must specify the stage at which to determine the admissibility of expert forensic evidence.
- Section 293 of the Code of Criminal Procedure, 1973 (CrPC) provides an exemption to certain categories of government scientific experts from appearing in court for examination as a witness. Despite the practical consideration of limiting time spent away from casework, it is necessary to cross-examine every expert, irrespective of their designation, to assess their competence and evaluate the reliability of the results they have provided. The section is a major hurdle in examining the reliability of forensic evidence and its legality must be reconsidered, given its impact on the right to a fair trial guaranteed under Article 21 of the Constitution.
- The gaps within the legal framework to examine expert forensic evidence are exemplified by the court’s treatment of DNA evidence. Encouragingly, courts have consistently emphasised the need to ensure proper collection, packaging, handling and transport of biological samples and maintenance of the chain of custody. However, they have also emphasised adherence to quality control and quality assurance standards, but have not identified any specific quality standards or the consequences of non-compliance.

As a result, there is variance in how different courts evaluate DNA evidence, which is further exacerbated by the lack of clarity on which 'data and materials' underlying the DNA analysis must be furnished by FSLs to the court. Further, Indian courts, unlike their foreign counterparts, do not enforce statistical analysis as a requirement for the admissibility of DNA reports. This is the primary reason for laboratories not conducting such analysis or providing its outcome as part of their reports, despite it being a core step of the DNA profiling process. Courts must enforce scientific standards through judicial scrutiny for the scientific practice within DNA divisions to improve.

CHAPTER VIII: OVERALL RECOMMENDATIONS³²

- This chapter proposes an overarching regulatory framework to strengthen the foundations of various facets of the forensic science system and tackle the roots of the different challenges faced by FSLs. The recommendations are based on the observed trends across FSLs, narratives of forensic scientists and best practices in other jurisdictions. We propose an expansion of the roles of existing central and state administrators and educational institutions and the creation of two new statutory bodies, whose roles should be fulfilled by existing bodies until such creation.

Existing Bodies in Forensic Administration

- **DFSS:** DFSS has a wide mandate to oversee the forensic science system in India, especially through promoting R&D, formulating plans for capacity-building and promoting quality management through the development of scientific standards and uniform protocols for forensic practice, which should be disseminated widely. DFSS should be expanded and appropriately staffed to have an Administration wing to assist FSLs with their budget, infrastructure and quality management, and a Human Resources wing to cover recruitment, training and employee welfare. DFSS must create a framework to regularly conduct needs assessment surveys of FSLs in India towards enabling guided interventions and effective policymaking on

³² See Tables 3-9 at pg 274.

forensics. Further, it should make laboratory-wise annual statistics on case intake, examination and pendency across divisions publicly available.³³

- **State DFSS:** To ensure impartiality and transparency in forensic work and ensure smoother administration, SFSLs and RFSLS must be administered independent of the police department by a state DFSS modelled on the central DFSS, headed by a high-ranking scientific officer. This would reduce bureaucratic delays, provide better financial and technical support and improve centre-state coordination. The state DFSS would monitor compliance with the policies, standards and protocols developed by the central DFSS or the proposed FSR.
- **NFSU:** The recently established NFSU has a wide mandate under its parent Act, including developing capabilities for research, education and training in forensic science, assisting governments in policymaking, establishing forensic databases and creating standards for forensic work. It should assume greater responsibilities, including in surveying the needs of FSLs, recruitment and the development of various protocols.

Proposed Legislation on Forensic Science Regulation

- Despite DFSS having a wide mandate, it does not have direct control over SFSLs or RFSLS, which carry out the bulk of forensic examinations in India. It also cannot enforce compliance with scientific or quality standards in the absence of legislative authority. Therefore, a Forensic Science Regulation Act (FSR Act), with the aim to establish a regulatory system for forensic science practitioners, forensic laboratories and forensic education, must be drafted and tabled before the Parliament. Under this Act, a Forensic Science Regulator (FSR) modelled on the UK FSR must be established, to develop a code of conduct for FSLs and monitor compliance with it. A Forensic Council of India (FCOI) must also be set up to monitor education in and the professional practice of forensic science, to ensure that qualified personnel conduct forensic examinations.
- **FSR:** The FSR should be established at the central and state level,

33 See Table 3 on overall recommendations at pg 274.

comprising experienced scientists, forensic examiners and representatives of different stakeholder groups. It shall develop a code of conduct for government and private FSLs and forensic examiners, monitor adherence to the code, investigate non-compliance and restrict further casework in the FSL until resolution of the non-conformity. It shall also provide technical guidance to FSLs and establish discipline-specific Scientific Working Groups (SWGs) to develop best practices and scientific guidelines to aid FSLs in developing their own protocols and WPMs. The FSR shall ensure compliance with its standards through regular scientific audits of FSLs, towards providing the requisite technical guidance and enabling targeted resource interventions.³⁴

- **FCOI:**³⁵ The FCOI should be established at the central and state level similar to the Bar Council of India (BCOI) and the National Medical Commission (NMC), comprising forensic experts, heads of NFSU, DFSS, state DFSS and the proposed FSR, retired judges and eminent lawyers. It shall set standards for forensic education in India in consultation with NFSU, and evaluate and accredit forensic courses and institutions based on such standards. Thus, new courses and institutions would have to seek approval from FCOI and fulfil the standards for curricula and infrastructural capabilities to support experiential learning.

FCOI shall also collaborate with NFSU to conduct examinations to licence and certify forensic examiners in different disciplines, based on which they would be recruited to FSLs. A registry of licensed forensic examiners shall be maintained by FCOI at the central and state levels. Further, FCOI shall establish standards for professional conduct and ethics to be followed by forensic examiners, monitor and investigate non-compliance and accordingly revoke licences following due process requirements.

34 See Table 3 on overall recommendations at pg 274.

35 See Table 5 on recommendations related to Recruitment, Education & Training at pg 276.



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