

DEVELOPMENT OF THE FORENSIC SYSTEM AND ITS EVIDENTIARY VALUE IN CRIMINAL TRIALS IN PAKISTAN

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Abstract

Laboratory Investigation has become an important component of the justice delivery system in Pakistan, as inquiry procedures have changed from relying mostly on eyewitness accounts and confessions towards scientific proof of evidence. This paper analyses the development process, organizational framework, legal standing, significance, and judicial disposition of scientific proof, along with the need for science-based evidence in the context of the Pakistani justice delivery system. It examines the growth pattern from basic chemical testing facilities and fingerprint bureaus to sophisticated provincial facilities and modern institutions such as the Punjab Forensic Science Agency and the National Forensics Agency, established under the National Forensics Agency Act of 2024. The research evaluates the importance of forensic evidence and its admissibility with reference to articles 59 and 164 of the QSO, 1984, relevant provisions of the Code of Criminal Procedure, 1898, and article 10A of the Constitution. Special emphasis will be placed on DNA Analysis, Fingerprint, Ballistics, Toxicology, Computerized Data and Chain of Custody of Evidence. As seen in the case law, judicial practice in Pakistan has turned into a trend to accept forensic evidence as very important but not scientific reports as conclusive. Proper collection, preservation, authentication, lab methodology, expert competence, and continuity of custody are all important for reliability. Some of the biggest systemic issues are lack of consistency between the provinces in terms of infrastructure, lack of specialized personnel, laboratory backlog, weak crime scenes, lack of standards, and poor institutional coordination. The study recommends the formulation of an integrated national forensic architecture with accreditation, uniform protocols, technology up-gradation, and training of forensic specialists, along with optimum coordination among investigators, forensic laboratories, prosecutors, and courts in Pakistan. Improving these factors would improve evidence, reduce wrongful implications, and strengthen protections for fair trial.

1 INTRODUCTION

Forensic science has evolved to its present state to offer scientific methods to aid in the detection, investigation, prosecution, and adjudication of crimes as a result of the presence of physical traces

that can be identified, examined, compared, or interpreted ("Pakistan Penal Code, 1860," 1860). As in Pakistan, this growing dependence on forensic evidence is indicative of the overall shift

in criminal investigation from the traditional investigative process to a more scientific and technologically-driven one ("Code of Criminal Procedure, 1898," 1898). The development process of Pakistan's laboratory investigation system has always been slow and inconsistent in nature. Narratives provided by officers, eyewitness accounts, self-confession statements, documentation, and traditional investigative procedures have played key roles in investigating crimes for many years. Lack of proper laboratories, investigative technicians, protocol or standardized procedures, and systematic crime scene investigation limited investigators' ability to properly utilize scientific evidence.

The next-stage development and establishment of forensic laboratories, especially the establishment of forensic institutions at the provincial level, was an important institutional change. The formation of the Punjab Forensic Science Agency (PFA), later to become one of the country's leading forensic institutes, greatly increased the capacity of Pakistan in many fields such as DNA analysis, toxicology, questioned documents, firearms, fingerprint, narcotics, crime-scene investigation and digital forensics. As in other provinces and federal institutions, this has helped to build up the capacity for scientific investigative services over time. However, the mere presence of forensic facilities does not mean reliable forensic justice, as the value of the forensic material depends on its proper collection, preservation, transport, examination, interpretation, documentation and presentation before the court ("Qanun-e-Shahadat Order, 1984," 1984).

Scientific proof in Pakistani courts is not expressly tied to any particular legislative rules; instead, its relevance emerges primarily from statutes concerning expert witnesses and technical material. The Shahadat Code of 1984 provides the essential evidentiary structure through which professional judgments and laboratory reports can be admitted during judicial hearings. A court may need specialized knowledge not readily available to an ordinary court, in which case, scientific evidence is particularly significant. Expert testimony and forensic reports can therefore help courts to grasp technical issues and help establish

whether or not physical evidence corroborates or undermines a specific prosecution story ("Salman Akram Raja v. Government of Punjab," 2013). A scientifically valid forensic system can be a part of a fair trial guarantee by minimizing reliance on faulty evidence and allowing the courts to examine criminal charges by means of evidence that can be objectively examined. On the other hand, incompetent forensic work can compromise these same ideals if contaminated evidence, flawed procedures, poor documentation, or scientifically dubious conclusions appear to be a legitimate source of evidence ("Anti-Rape (Investigation and Trial) Act, 2021," 2021).

Forensic science is playing a crucial role in criminal trials in Pakistan, especially with the help of DNA evidence. DNA Analysis can exclude an innocent person from suspected crime and biological material found at a crime scene can be used to provide a genetic link to that crime scene and to an individual. Therefore, the probative value of this evidence can be significant, especially when a case of sexual violence, homicide, unidentified body, and/or disputed biological relationship is involved. DNA evidence isn't foolproof, however. The reliability of this depends upon the integrity of the sample, the circumstances in which it is collected, laboratory processing procedures, contamination control, analytical method, statistical interpretation, and maintaining a continuous chain of custody. Fingerprints, firearms exam, toxicology, digital evidence, and other fields of forensics are all similar. In modern practice, the issue with forensic evidence is less whether there is any, and more whether it is the product of sound scientific methods and whether its limitations as evidence are communicated to the court ("National Forensics Agency Act, 2024," 2024).

In Pakistan, forensic science is also becoming more important due to the complexity of modern crimes. Evidence created by criminal activities, such as organized crime, cybercrime, financial fraud and technologically mediated offences, and terrorism, often requires a combination of conventional investigative tools and methods, as well as other specialized skills and expertise. Physical evidence, biological evidence, electronic

evidence, as well as evidence related to the firearm and chemical residues, can offer independent evidence that can confirm or contradict witness statements (I. Ahmed et al., 2025). In Pakistan, the lack of reliability in eyewitness identification, the time lag between crimes and investigations, and the inconsistencies of traditional evidence can pose challenges in establishing criminal responsibility, making this essential. A well-developed forensic system can thus serve as an important preventive measure against wrongful conviction and wrongful acquittal. But it is effective only when institutions are independent, scientists have scientific competence, and there is procedural consistency (M. Ahmed et al., 2025).

The term "evidentiary value" needs to be separated from admissibility. The weight or probative value of evidence is not determined until the trial, and may be evidence that is legally admissible. Just because a forensic report is prepared by an expert or comes from a recognized lab doesn't automatically mean that the report shows guilt. Courts will mandate evaluation of the techniques applied, the specialist's qualifications and proficiency, specimen integrity, transfer logs, coherence with supporting materials, and the potential for differing accounts. In criminal proceedings, this differentiation proves crucial, since the prosecution must demonstrate the respondent's responsibility to a moral certainty (Alenezi, 2023). The value of forensic evidence can be significant, but must be considered in the context of all the evidence. Therefore, the scientific nature of the forensic evidence should support and complement, not supplant, judicial thinking. It is therefore important to study the history of the forensic system, its legal basis, the value of various forensic sciences, judicial attitude, and current weaknesses of the system in order to understand the current and future role of forensic science in criminal trials in Pakistan.

2 Historical Development and Institutional Evolution of Forensic Sciences in Pakistan

2.1 Colonial Foundations and Early Institutional Development

Forensic science in Pakistan had emerged before independence and in the scientific and medico-legal institutions of British India. Punjab is one of the earliest documented establishments involving the use of chemical and toxicological expertise. A historical record indicates that the role of Chemical Examiner to the Punjab Government already existed at the end of the 19th century; a record for 1896-1897, for example, refers to Charles H. Bedford, a Chemical Examiner and Professor of Chemistry and Toxicology at Lahore Medical College. Forensic investigation then expanded into identification and crime-scene examination, which was institutionalized. The fingerprint identification mechanism was initially launched in Punjab during 1896, and the earliest laboratory-based testing facility emerged in Lahore within 1930, situated inside the photographic division of the Detective Bureau. By 1947, the Lahore center had apparently expanded to examine projectile weapons, counterfeit metal pieces, forged banknotes, handwritten and machine-printed documents, alongside other printed and inscribed materials, while additional testing establishments appeared in Peshawar and Karachi (Anjum et al., 2026).

The early system, however, was still disjointed and more closely linked to the police, medical, chemical-examiner, and criminal-investigation organizations than to an integrated, national forensic institution. This historic apportionment also impacted upon Pakistan following the year 1947, when the forensic services were retained with provincial police departments, health departments, medico-forensic institutes, and specialized laboratories. For instance, the present Chemical Examiner Laboratory at Karachi, Sindh was founded as the Chemico-Bacteriological Laboratory in 1950 to assist medico-legal and law-enforcement agencies with its analytical and toxicological services. The Forensic Science Laboratory in Peshawar, KP, is another significant institutional development in the country and was

officially inaugurated in 1976 to offer scientific support to law enforcement agencies in criminal and civil investigations (Bahauddin & Bakhsh, 2024).

2.2 Expansion of Provincial Forensic Institutions and Specialized Capacity

The most significant institutional change took place in the 2000s when forensic science was given its own distinctive place within criminal investigation and was no longer limited to supporting a laboratory role. The establishment of PFSA marked a major transition to a more specialized and centralized forensic model where the science was structured in terms of criminal investigation and judicial requirements. The institutional goal was also clearly linked to the quality and neutrality of evidence and the courts' ability to consider and validate the investigative material scientifically. It later became a provincial model, but with varying degrees of institutional development (Baig & Hameed, 2025).

The Forensic Science Laboratory (FSL) at Khyber Pakhtunkhwa was established in 1976 and later computerized the lab management arrangements through Laboratory Information Management System (LIMS) for dispatching reports, submitting exhibits, and dates of FIRs for 2016-17. The annual workload of the laboratory is around 50,000 cases/reports, showing the scale of the forensic demand in the province. There was no separate forensic laboratory; DNA testing was available at Jamshoro, and the SFSA Act was enacted in August 2017 before conducting a review of the forensic system in Pakistan in 2018. In August 2015, the government of Balochistan passed a bill to create a Forensic Science Agency, but in the same evaluation, it was stated that a dedicated forensic lab had not yet been opened. This provincial disparity is significant since having access to sophisticated forensic examination has historically relied significantly on geographical location and institutional capacity (Bakhsh et al., 2025).

2.3 Federal Consolidation and the Emerging National Forensic Architecture

A key aspect of the next phase of development has been the shift from a lack of provincial capabilities to a federal coordination and standardization mechanism for forensics. The proposed National Forensic Science Agency (NFSA) is this evolution. The original project that the Federal government approved in 2002 had provisions for Provincial HQ Forensic Science laboratories, one main lab, and training facilities in Islamabad. The project, however, changed significantly with time. The Central Development Working Party approved the National Forensic Science Agency, Islamabad, with a total cost of Rs. in April 2024, which is the fifth revised PC-I. The total amount is 1,831.114 million, of which the National Police Bureau is the executing agency under the Ministry of Interior (Buckleton et al., 2020).

It is an important institutional development given that the country's forensic system and scientific institutions were already weak and lacking in the past, not only in terms of the presence of laboratories, but also in terms of fragmentation, technical capacity and evidence handling, and the lack of integration between investigators and scientific institutions. These shortcomings are evident in history. In 2007, the Karachi Chemico-Bacteriological Laboratory (KCCL) was described as the only forensic laboratory for both Sindh and Balochistan, and had a significant backlog, a shortage of manpower, and technical limitations. Previous evaluations also found problems with inadequate training, tainted or incorrectly labeled samples, and delayed forensic reporting. The journey of history from the forensic lab in Lahore in the 1930s, to the chemical-examination institution in Karachi in the 1950s, to the laboratory in Peshawar in the 1970s, to the PFSA legislation in 2007, and to the efforts of provincial agencies since 2015–2017, is interrupted by the Rs. In 2024, a 1.831 billion NFSA project was awarded, which reflects a gradual but incomplete shift from the traditional investigative support system to a new, specialized and national forensic system (Casino et al., 2021).

3 Legal and Procedural Framework Governing Forensic Evidence in Pakistan

3.1 Statutory and Constitutional Basis for the Admissibility of Forensic Evidence

The statutory structure that governs forensic proof utilization within Pakistan draws principally from the Qanun-e-Shahadat Order, 1984, the Criminal Procedure Code of 1898, specific penal statutes, and constitutional procedural protections. The foundational framework for evidentiary rules is provided by the Qanun-e-Shahadat Order, 1984, promulgated on 28 October 1984. Article 59 commands particular focus, since it explicitly recognizes expert testimony as admissible information where the specialist's assessment addresses the court's evaluation of matters concerning science, craftsmanship, handwriting, ridge patterns, or the validity and trustworthiness of digital records or data networks. Therefore, a technically qualified expert, such as a forensic scientist, fingerprint expert, handwriting expert, medical expert, digital-forensic expert, and other specialists, can present evidence in their particular areas of expertise. The provision does not, however, render an expert's conclusion conclusive, but rather leaves the evidentiary weight of that conclusion open to judgment (Casino et al., 2022). This has given a solid legal basis for the growing reliance on technologically generated evidence such as electronic and/or digital forensic material. It has become even more important in the context of the growing importance of electronic communications, digital communications, electronic records, CCTV analysis and mobile phone extraction. The constitutional basis is the provision of Article 10A, which was added through the Eighteenth Amendment in 2010, explicitly saying that everyone has a right to a fair trial and due process when determining their civil rights and obligations, or when they are charged with a criminal offense. This forensic evidence is thus evidence twofold in a legal sense: to help the prosecution establish the facts that are in dispute, but also to help the accused have an "objectively assessable evidentiary process. (Cooper & Meterko, 2019)

Forensic reports most commonly get into the criminal process via the Code of Criminal

Procedure, 1898. Section 509 provides for the deposition of medical witnesses and Section 510 is devoted to reports of Chemical Examiners, Serologists, fingerprint experts, firearm experts, forensic scientists and handwriting experts. The provision does not require the expert who has prepared the report to attend each hearing, but the court may still summon and examine the expert in a hearing where the interests of justice so require. Importantly, the amendments of 2022 extended the reach of Section 510 by explicitly adding the role of forensic scientist, a recognition of the breadth of forensic science expertise in modern times. The revised framework also provides for scientific reports, analyses and opinions generated using contemporary forensic techniques and methods, such as forensic computers and cyber evidence (Curley et al., 2020).

3.2 Procedural Requirements, Chain of Custody and Judicial Evaluation of Forensic Evidence

The admissibility of forensic evidence should not be confused with its reliability and final probative value. The forensic process starts at the crime scene with the identification, documentation, collection, sealing, labeling and transmission of the biological material, fingerprints, weapons, cartridges, narcotics, documents, electronic devices and other physical traces for scientific analysis. Every exhibit transfer results in a potential evidentiary vulnerability that the identity and integrity of the exhibit must be demonstrated from the collection to the lab to the production before the court. The accuracy of the forensic conclusion, even if the method of analysis is scientifically valid, can be significantly reduced if the specimen is poorly preserved or misidentified. Section 510 of the Criminal Procedure Code is of particular importance because it establishes that a report by a forensic expert is admissible as evidence and allows for the judge to order the forensic expert's attendance. This system is meant to provide efficient procedures, but not void of judicial oversight. A court can review the elements of the expert's analysis, the consistency of the analysis, the forensic conclusion, the remaining evidence in the prosecution case, and the

relationship of the forensic conclusion to the other evidence presented in the prosecution case. This is particularly pertinent in cases involving DNA (Dror et al., 2020).

Although a DNA match may provide evidence of a biological connection between a person and a specimen, factors such as the type of collection, the reasonable exclusion of contamination, the proper sealing and transport of the specimen, and the fact that the genetic match proves the occurrence of the crime but not contact with the item or location must still be taken into account by the court. The National Forensics Agency Act 2024 is another development in the law. This enactment creates a federal organizational framework, and clearly states that the Agency's conclusions and expert views shall be acceptable in courts and other decision-making fora pursuant to Section 510 of the Procedural Code and Articles 59 and 164 of the Qanun-e-Shahadat, Order 1984. This forges an explicit nexus between the national forensic body and the central evidentiary rules applicable across Pakistan. The law further grants the Agency functions relating to educating judicial personnel and prosecutorial officers in both conventional and electronic examination methods, partnership with regional authorities and scientific centers, exploration and professional development, and opinion-giving and guidance assistance to judges or provincial offices (European Network of Forensic Science, 2015).

Thus, in Pakistan, the current forensic-evidence system is based on three interdependent pillars: scientific relevance, procedural integrity, and judicial scrutiny. The lawful collection, preservation, and continuity of the evidence is of procedural importance; the forensic examination can help the court with a disputed fact is of scientific importance; and the weight eventually given to the forensic conclusion is of judicial importance. It has thus grown to a more broad-based statutory recognition of DNA, the digital, the cyber, the fingerprint, the firearm, the forensic toxicological and other fields, where formerly it was only traditional government experts who were given such recognition. But the mere fact that a case is allowed under the statute is no assurance of

the reliability of the justice (Government of Pakistan, 2024).

4 Types, Reliability and Evidentiary Value of Forensic Evidence in Criminal Trials

4.1 DNA and Biological Evidence

The use of genetic markers in Pakistan's crime labs marks the most important achievement in forensic science as it establishes a direct relationship between the accused, victim/survivor, and place of crime. Sometimes such a link cannot be established based on the victim/witness testimony. According to Articles 59 & 164 QSO 1984, the nucleic acid evidence falls under the professional and modern category of evidence. Appellate jurisdictions in Pakistan have always accorded considerable importance to genetic testing as laboratory-based evidence, especially for violent crimes and homicide offenses. Lahore Appellate Bench has held that genetic tests enjoy legislative approval since process procedures 53-A, 164-A & 164-B of the Criminal Procedure Code recognize biological sampling in particular instances of sexual transgression (Interpol, 2023).

But the value of the DNA evidence is not only dependent on the existence of the "match" but also on the integrity of the biological sample. Blood, semen, saliva, epithelial cells, and hair roots shall be collected using appropriate procedures and shall be separately packaged, sealed, labeled, and transferred without contamination. A DNA association can show whether or not there is a person's biological material or a DNA association, but does not necessarily show when, where or how it was placed. As a result, Pakistani courts have started considering the results of DNA with medical, ocular, circumstantial and documentary evidence. The value of the forensic report is enhanced when collection procedures, chain of custody and laboratory methodology are proven to be reliable (Jan, 2025).

4.2 Fingerprints, Ballistics, Toxicology and Trace Evidence

The science of fingerprints has been one of the oldest and most established sciences in Pakistan. It is directly relevant to the law, as Article 59

expressly mentions expert opinion on the identity of the fingerprints as relevant evidence. Forensic examination of fingerprints found on objects or surfaces (such as weapons, doors, vehicles, and documents) can link an individual to an object or location. Their evidential value, however, does rely on the quality of the latent impression, the technique used to recover the impression, and the crime scene documentation and the examiner's skills. A fingerprint association is similar to DNA evidence; it does not prove the entire crime. In firearm-related offenses, ballistic examination has a similar role (Kassin et al., 2020).

Investigators may examine the cartridge case, bullets, and/or the gun and firearm characteristics to help determine if the gun fired that ammunition and if the recovered gun and ammo are from the same gun. Poisoning, narcotics, alcohol, and suspected drug-facilitated offenses are areas where toxicological and/or chemical evidence can be particularly helpful. The use of expert opinion in scientific matters is explicitly provided for in Article 59, and specific recognition was given historically to Chemical Examiners as well as other technical experts, through the procedure. The reliability of these disciplines is based on calibrated instruments, validated analytical procedures, appropriate reference samples, and proper sample preservation. As a result, the forensic result must be taken into account in conjunction with the condition of the exhibit and the methodology used to arrive at the result (Kasuri, Abbas, et al., 2024).

4.3 Digital and Electronic Forensic Evidence

Digital forensics has greatly extended the scope of forensic evidence, with mobile phones, computers, CCTV systems, electronic communications, social-media content, location information, photographs, audio recordings and more becoming more central to a criminal investigation in this era. The courts have therefore accorded equal importance to digitally recorded material, insofar as it is found to be of significance for evidence and can be shown to be authentic and produced in security (Kasuri et al., 2024; Raza et al., 2025).

The most frequent issue with digital evidence is how easy it is to make copies, make changes, delete, or manipulate electronic information without any physical evidence. Forensic acquisition should therefore preserve the original device or data source, document the chain of custody, apply appropriate forensic techniques to the extraction of the data, and preserve relevant metadata. Authentication, Chain of custody, and Forensic Verification are some of the emerging issues in the consistency of the probative value of digital evidence, which are highlighted in recent legal scholarship in Pakistan. The statements of what the computer-generated record (CCTVs) or mobile phone or electronic communication appears to depict is not the only consideration in assessing the evidentiary weight of the communication in these circumstances; the prosecution must prove the authenticity, integrity and continuity of the communication from the time it was captured to the time it was presented in court (Khan & Bhatti, 2023).

4.4 Reliability, Probative Weight and Judicial Evaluation of Forensic Evidence

The key rule about forensic evidence is that science-based evidence doesn't always prove anything. The concepts of admissibility, reliability and probative value are different. Article 59 introduces qualified expert opinion, and Article 164 allows evidence obtained by use of modern devices and techniques, but neither of these provisions will compel, in any case, a court to accept every opinion of an expert without questioning. The courts then have to evaluate the qualifications of the expert, the scientific method used, sample condition, sample contamination potential, chain of custody, analytical qualifications, and consistency with the rest of the evidence. This is especially crucial since there is a possibility for uncertainty in forensic conclusions. Interpretation can be complicated with degraded samples, secondary transfer, and by the presence of DNA mixtures and low-level biological material. Likewise, the value of digital evidence can present authentication issues, and fingerprint and ballistic conclusions are reliant upon the quality of the

recovered material and examination techniques(Mahmood et al., 2025).

In recent years, the forensic practice has become more and more focused on an analysis of the strength of the evidence, rather than on absolute certainty. For instance, statistical models and likelihood ratios can give a clearer-cut expression of the strength of the competing propositions than categorical statements that evidence is simply “conclusive.” The judicial practice in Pakistan, therefore, respects forensic evidence to a high degree, but with a caveat that it must be corroborated and the process followed(Yaacoub et al., 2021). Lahore High Court has found the DNA evidence to be valuable and made it a part of the statutory framework of expert evidence (Articles 59 and 164). The final value of forensic science as evidence is thus dependent on the continuity of the process from crime scene recovery to preservation, to laboratory analysis, to the expert interpretation and to the judicial evaluation. Forensic evidence can therefore significantly support the prosecution case and help to exclude innocent suspects when there is good science and procedure; however, when there is a lack of that science and procedure, even sophisticated forensic evidence may have limited probative value(Mahmood et al., 2024).

5 Judicial Treatment of Forensic Evidence and Emerging Trends in Pakistan

Over the years, the judiciary of Pakistan has gradually accepted forensic science as an integral part of modern criminal adjudication, but in general the judicial attitude has been conservative and not accepting forensic evidence as conclusive. In one of the strongest cases of corroborative evidence available today, DNA evidence has been described by the Supreme Court, and it has emphasized that its scientific reliability can help the courts determine the identity of the offender, exclude possible suspects, and prevent false accusations(Wickramasekara et al., 2024). In Criminal Petition No. 513 of 2020, the Supreme Court explicitly identified DNA as a “gold standard” for establishing identity and that it is one of the best pieces of corroborative evidence, and also noted that it is valuable depending on the

proper collection and preservation of the underlying samples. The courts have then made a clear distinction between the scientific strength of forensic technology and the evidentiary reliability of a specific exhibit of forensic evidence. This difference becomes more apparent with respect to DNA(Meterko & Cooper, 2022).

Several times, Pakistani courts have demanded that the prosecution trace the biological material from its collection to its transportation to the lab and its examination and production in court. Lahore High Court in Abdul Wahid alias Budho (PLJ 2022 Cr.C. 1273) had determined that prosecution failed to prove safe custody and secure passing of the vaginal swabs sent for DNA analysis. The unexplained custody of the samples created a break in the evidentiary chain, despite being able to claim the accused could not be excluded as a contributor to the DNA profile(Van Nierop & others, 2022). The court thus ruled that the forensic report was not reliable and gave the benefit of the doubt to the accused. This showcases that a laboratory that has scientifically advanced results can resolve a lack of information before the evidence arrives at the lab. In Meer Nawaz alias Meero v State (PLJ 2022 Cr.C. 955), the Lahore High Court discussed the collection, packaging, preservation and dispatch of the DNA samples. The court emphasized that the matching of the DNA samples should be done in accordance with the safety measures in place and the prosecution should detail how the samples were transferred from the medical officer to the police and then to the forensic lab(Morgan & Levin, 2021).

The court noted some problems with the way the vaginal swabs were handled regarding both routing and custody and found that an intact chain of custody was not formed. It also noted that in cases of uncertainty in forensic reports, forensic experts can be summoned by the court to explain the reports. The judicial solution thus includes procedural integrity with scientific accuracy: a DNA profile might be accurate in itself, but the evidentiary value of such profile is significantly reduced if it cannot be shown that the subject of the DNA test was, in fact, the correct individual for whom the DNA profile was drawn, and that

the DNA test was performed properly(Ullah et al., 2026). The judiciary also has become more sensitive to the fact that the examination of forensic evidence is to be done in the context of the body of evidence, and not in isolation thereof. Evidence that corroborates ocular, medical, recoveries and circumstantial evidence is DNA, fingerprints, ballistic reports, toxicological findings, and digital evidence, but it will be up to the courts to decide whether the evidence as a whole meets the criminal standard of proof. This is especially significant as evidence, often presented to the court at trial, can only assist in proving a connection between a person and an offense and does not prove every element of the offense itself. Even when a DNA profile is found to identify the source of the biological material as a specific person, further evidence might be required to establish when the material was deposited and its exact connection with the alleged offence. This is the same with fingerprints found at a place or object(Morrison & Stoel, 2021).

A significant development in the contemporary times is the establishment of Pakistan's national forensic architecture through the enactment of National Forensics Agency Act, 2024 (24 December 2024). The Act has created the National Forensics Agency, which has jurisdiction across the whole of Pakistan and is entrusted with the job of examining forensic material and issuing opinions to courts, tribunals and authorities (Thompson & Scurich, 2021). This helps to establish a better statutory link between institutional forensic examination and courtroom evidence. This Agency will also help facilitate training, research, coordination and technical assistance, which may help to diminish the fragmentation that has historically existed between the provincial laboratories and criminal justice institutions. The other trend is the growth of forensic evidence from the traditional DNA, fingerprints, firearms and toxicology to digital and cyber forensics. The use of mobile phones, computers, CCTV recordings, electronic communications, metadata, and digitally stored information is more and more relevant to criminal investigations(Munir et al., 2021).

As a whole, the recognition of modern forensic techniques by the law, along with the national framework for institutionalization in 2024, suggests a trend towards a technologically integrated evidentiary system. Meanwhile, digital evidence raises new challenges in the areas of authentication, preservation, extraction techniques, metadata integrity, and chain of custody. As a result, courts should increasingly examine in the future whether digital evidence has been altered from the time it was captured to the time it is presented in court(Smith & Neal, 2021). The emerging judicial trend is thus from forensic evidence being used in a manner that it confirms or corroborates to evidence that is scientifically evaluated, undergoing strict reliability testing. Recent research on Pakistan's DNA jurisprudence reveals that the conflict between the scientific utility of DNA and the judicial demand for corroboration, especially when the chain of custody is not established, continues. In conclusion, four principles can be summarized in the development of the position of Pakistani courts: Forensic evidence is legally relevant; Scientifically strong evidence can have significant probative value; Improper collection and/or custody can have significant probative value; The determination of guilt is a judicial prerogative(National Research, 2009).

6 Challenges, Institutional Gaps and Future Development

6.1 Institutional Capacity, Infrastructure and Human-Resource Deficiencies

The main problem of Pakistan in relation to scientific evidence is not that it is not backed by law but that the capacity to produce scientific evidence is not equal. A forensic evaluation of the country in 2018 had pointed out that Pakistan lacked the capacity of the labs to handle the number of criminal cases and recommended improvement in the laboratories of Sindh, KPK and Balochistan. The geographical demand-lab capacity mismatch was clearly exemplified at that time when the population of Punjab was well over 110 million, and the province only had one forensic lab at the provincial level. However, the shortage has been repeatedly highlighted in more

recent reports; in July 2024, experts at a forensic-investigation workshop in Karachi said there were just five forensic labs with a few specialists in Pakistan who were relevant to the investigation and that critical crime-scene evidence was often lost due to the lack of proper training and modern equipment among law-enforcement officials(Noor et al., 2025).

The human-resource issue is not very different. DNA analysis, forensic pathology, toxicology, ballistics, questioned documents, fingerprints, crime-scene investigation, and digital forensics are specialized fields of forensic science. However, in Pakistan, there have been times when the ratio of trained specialists has not matched the forensics institutions. According to an assessment in 2026, there were still hundreds of trained forensic-science graduates who were jobless or under-utilized in the face of the growing demand for scientific investigation. Evidence from earlier in Khyber Pakhtunkhwa shows pressure being experienced by the personnel of the lab, as there were 78 staff members to examine about 2,500 cases in 1978, whereas in 2010, 82 staff members had been appointed and processed 52,721 cases, which equals 643 cases per staff member annually. These figures show that growth in institutions does not always go hand in hand with the growth in staff, equipment and operational budget(Overill & Collie, 2021).

6.2 Procedural Weaknesses, Backlogs and Fragmentation of the Forensic Chain

The second problem is that of the integrity and coordination of the forensic process from examination of the crime scene to courtroom presentation. Inadequate photography of a crime scene, improper collection techniques, insufficient labeling of exhibits, allowing for the contamination of evidence, too long a delay in transporting the evidence, and failing to record the transfer can lead to the loss of significant probative value. The above-described weaknesses are especially significant for the biological evidence, as DNA testing can be scientifically accurate, but still have evidentiary flaws when the identity and/or continuity of the sample is unknown. Forensic cases have been repeatedly

heard before Pakistan's courts, and the courts' focus has been on the chain of custody, which clearly shows that the sophistication of the laboratory is not a substitute for deficiency in the chain of custody. Inequality in infrastructure and institutions across the provinces exacerbates the situation(President's Council of Advisors on Science and Technology, 2016).

A national review in 2018 noted a general trend of greater reliance on forensic evidence and a backlog of pending cases and delays at laboratories. It especially expressed the need for further forensic laboratories and capacity building efforts in Pakistan, as existing facilities were not sufficient to handle the volume of crime committed by Pakistan's population. A more recent evaluation also points to continuing systemic weaknesses such as poor coordination between police and forensic officers, lack of uniformity in resources and infrastructure across provinces, and the lack of standardization. This is of special concern because there are no consistent national standards. The equipment, staffing, procedures, and reporting of a particular institution may vary. Another disparity between the crime scene and the laboratory may exist, in that the crime-scene teams may be less trained in the science of forensics than laboratory specialists. This leaves an advanced forensic system where complex forensic findings can rely on relatively poor evidence-gathering methods. Standardized national protocols for crime-scene management, evidence packaging, transferring evidence to the laboratory, chain of custody documentation, and laboratory analysis and expert reporting are therefore needed for Pakistan. Accreditation and quality assurance are also critical as forensic conclusions must be drawn using recognized procedures and processes and validated staff, not simply because of the availability of high-spec instruments (Provoost & others, 2020).

6.3 National Forensic Reform, Technological Modernization and Future Directions

The principal bureaucratic undertaking of recent date is the National Forensics Agency Act, 2024, which has been ratified and holds jurisdiction

across the entire country. The National Forensics Agency is formed under the Act to scrutinize evidentiary materials and furnish authoritative judgments to courts, hearing panels, and state entities. Its published mandate encompasses conventional scientific areas including post-mortem analysis, skeletal biology, nucleic acid identification, chemical poison detection, narcotic substances, ridge pattern matching, secretion testing, weapon/explosive testing, tooth examination, insect study, material scrutiny, and scene inspection. Notably, the bill also explicitly acknowledges new technologies such as artificial intelligence and deepfakes in the institutional structure. This is a significant step on the road towards a nationalized forensic architecture, instead of entrenched and isolated provincial capacity. The development in the future should therefore be focused on three aspects at the same time: capacity, standardization and accreditation, and technological integration(Punjab Forensic Science, 2023).

For one, more regional laboratories should be set up, so there is no need to unnecessarily transport biological, toxicological, ballistic and digital exhibits. Second, recruitment should be related to the workload of the laboratories, and continuous professional training should be conducted for forensic scientists, police investigators, prosecutors, and judges. Thirdly, Pakistan needs to have uniform national protocols to capture evidence and manage the chain of custody and increase laboratory information-management systems to allow for real-time tracking of exhibits. Fourth, the laboratories should strive to obtain internationally recognized accreditation and proficiency-testing systems to enhance the reliability and courtroom defensibility of the forensic findings. The same is true for technological modernization(Saddique et al., 2024).

Technologies such as Advanced DNA Profiling, Forensic Databases, CCTV Analytics, and AI-aided examination of mobile devices can greatly expand investigative capacity but only if trained personnel and secure infrastructure, along with proper safeguards, are all in place. The 2024 National Forensics Agency framework will be an

institutional framework to support this modernization, which will also include functions associated with research, training, coordination and technical assistance. The ultimate goal should not only be to obtain sophisticated instruments, but to create a complete, connected system of evidence collection, examination, interpretation and challenge in the crime scene, laboratory, prosecution, and court. These changes would help in minimizing backlogs of cases, enhance the reliability of forensic evidence, increase prosecutions for serious crimes, prevent false identification of accused persons, and ensure forensic science becomes a more uniform part of Pakistan's constitutional duty of fair and just criminal adjudication(Salam et al., 2022).

Conclusion

In Pakistan, the growth of Forensic Science shows a shift from a traditional police investigation system to a system based on scientific findings. Forensic functions have historically developed from chemical examinations, fingerprint identification, the medico-legal investigation, and early laboratory services, but were institutionally divided for decades. The establishment of specialized regional bodies, notably the Punjab Forensic Science Agency through the Punjab Forensic Science Act 2007, substantially boosted the nation's genetic profiling, poison analysis, projectile examination, ridge identification, and other criminalistics capabilities. The National Forensics Agency Act, 2024 represents another administrative shift toward nationwide coordination and standardization in evidentiary service delivery. The regulatory landscape has similarly progressed to acknowledge the mounting recognition of empirical proofs value. The principal foundations of specialist testimony, scientific data, digital records, and laboratory findings are established under Articles 59 and 164 of the QSO, 1984, along with other pertinent clauses of the Criminal Procedure Code, 1898. Article 10A of the Constitution additionally associates reliable laboratory examination with constitutionally protected entitlements to impartial adjudication and procedural fairness. However, forensic evidence is not conclusive; it is

only admissible. Ultimately, its probative value relies on its scientific soundness, expertise, collection, preservation, chain of custody, laboratory procedures, and judicial review. DNA, Fingerprint, Ballistic and digital evidence have been increasingly considered valuable investigative and corroborative tools by Pakistani courts, which have also held that procedural shortcomings can significantly impact the probative value of such evidence. However, there are significant problems to be overcome, such as unequal provincial capacities, a lack of specialist personnel, laboratory backlogs, poor crime-scene management, a lack of institutional coordination, and poor standardization. A well-integrated forensic system can bring benefits to investigations as it can help ensure investigations are accurate, wrongful implication is avoided, prosecution cases are strengthened, and public confidence in investigations is boosted. Finally, forensic modernization should go beyond technological progress and towards the ultimate goal of accurate, transparent, and constitutionally fair criminal justice.

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