



LEGAL, INSTITUTIONAL, AND TECHNOLOGICAL DEVELOPMENT IN FORENSIC SCIENCE IN PAKISTAN

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Abstract

This research paper critically examines the legal, institutional, and technological development of forensic science within Pakistan's criminal justice system. Employing a qualitative thematic analysis methodology, the study draws upon semi-structured interviews with fingerprint examiners and forensic practitioners from major forensic institutions, including the Punjab Forensic Science Agency (PFSA), the National Forensic Science Agency (NFSA), and regional laboratories in Khyber Pakhtunkhwa. The findings reveal that while Pakistan has established a foundational legal framework, primarily through the Qanun-e-Shahadat Order, 1984, and the Punjab Forensic Science Agency Act, significant gaps persist in standardization, judicial training, and the absence of a cohesive national forensic policy. Institutionally, specialized forensic agencies have enhanced the reliability of scientific evidence through DNA profiling, fingerprint analysis, and digital forensics; however, uneven resource distribution, inadequate coordination between police and forensic experts, and infrastructural disparities across provinces undermine systemic efficiency. Technologically, the adoption of Automated Fingerprint Identification Systems (AFIS) and biometric tools marks progress, yet the integration of advanced technologies such as artificial intelligence remains nascent due to financial constraints and skill shortages. Additionally, resource limitations, insufficient training programs, and limited career development opportunities hinder workforce capacity. The study concludes that while forensic science in Pakistan has evolved considerably, realizing its full potential requires comprehensive policy reforms, equitable resource allocation, enhanced inter-institutional coordination, strategic investment in AI and digital forensics, and sustained commitment to professional training and academic development. These measures are essential to strengthen evidentiary reliability, reduce wrongful convictions, and uphold the rule of law.

Keywords: Forensic Science, Criminal Justice System, Pakistan, Qanun-E-Shahadat Order, Digital Forensics, Artificial Intelligence, Institutional Framework, Evidence Admissibility, PFSA, NFSA.

1. Introduction

Forensic science has become an important part of contemporary criminal justice systems that is instrumental in the investigation, prosecution, and adjudication of crimes. It is the use of scientific principles and methods to gather, examine, and interpret physical evidences to help courts to prove fact and deliver justice. The increased use of forensic science in Pakistan can be attributed to a global trend towards evidence-based policing and judicial decision-making whereby scientific evidence is becoming more desirable than conventional techniques, including eyewitness accounts and confessions (Ahmed et al., 2025; Ajmal and Rasool, 2022). This change underscores the need to reinstate legal systems, institutional capacity, and



technological infrastructure in order to improve on the credibility and effectiveness of forensic practices.

The legal implications of forensic science in Pakistan are mainly based on the statutory provision of the Qanun-e-Shahadat Order, 1984 and Code of Criminal Procedure, which governs the admissibility and scrutiny of scientific evidence in the courts. The essential provisions of these laws set the criteria determining the relevance and reliability of the forensic evidence, such as expert testimony and documentary evidence (Abbas et al., 2024). Nonetheless, even after the formal acknowledgement of forensic evidence, there are still difficulties in its uniform application because of legal loopholes, absence of standard admissibility rules and scientific illiteracy of judicial participants (Amin et al., 2025). According to scholars, as courts in Pakistan are becoming more dependent on forensic evidence, the lack of detailed guidelines on its trustworthiness can undermine the justice of court decisions (Farhad et al., 2025).

At an institutional level, Pakistan has also achieved significant advancements through the creation of dedicated forensic institutions like the Punjab Forensic Science Agency (PFSA) and other regional forensic laboratories. These organizations have played an important role in enhancing efficiency in investigations through the provision of highly sophisticated services in DNA testing, fingerprint identification and toxicology and digital forensics (Imtiaz et al., 2024). The adoption of such institutions by the criminal justice system has enabled the law enforcement agencies to associate suspects to crimes in objective scientific ways. Still, institutional factors such as insufficient funding, disparity of forensic facilities, deficiency of training of staff, and coordination between the police and forensic professionals remain a barrier to the optimum use of forensic resources (Ahmed et al., 2025).

Another important aspect of forensic development in Pakistan is technological advancement. The introduction of new methods like DNA profiling, biometric identification systems, automated fingerprint identification systems (AFIS) and digital forensics has changed the nature of criminal investigations. Specifically, the growing utilization of digital evidence, such as mobile data, CCTV footage, and electronic records, has broadened the field of forensic science in criminal and civil cases (Ahmed et al., 2025). Nonetheless, these developments, as well as technological differences, non-standardization, and new issues associated with data reliability and cyber forensics, demand ongoing policy changes and capacity development.

In addition, the significance of forensic science is not only in detecting crimes but also in fair trials and avoiding wrongful convictions (Shah et al., 2025). Effective collection, preservation, and analysis of forensic evidence help in upholding the integrity of the criminal justice process and the rule of law. Research has shown that proper management of forensic evidence including chain-of-custody measures will go a long way in improving the relevance of evidence and citizen trust in the justice system (Imtiaz et al., 2025; Baig & Hameed, 2025). But the systemic problems of bad crime scene management, untrained staffs and inefficiencies of the procedures still plague its potential.

Against this backdrop, this paper seeks to critically analyse the legal, institutional, and technological development of forensic science in Pakistan, with special references to identifying the current gaps and suggestions to fill them in. It aims to examine how law systems influence the admissibility of forensic evidence, how the institutional frameworks protect or limit or restrict forensic activities and the ways in which technological advancements are changing the way of investigations. Through these dimensions of analysis, the study also helps in gaining a better understanding of the importance of forensic science in enhancing the criminal justice system in Pakistan and the necessity of incorporating a set of reforms that would help in the overall implementation of the system.

2. Literature Review

2.1 History of the Forensic Laws in Pakistan

The historical development of forensic laws in Pakistan indicates a progressive development of the customary evidence practices to scientific investigation practices. The main law that regulates evidence is the Qanun-e-Shahadat Order that acknowledges the opinion of an expert in Article 59. Such a provision is the legal ground on the admissibility of forensic evidence, such as fingerprint analysis, DNA profiling, and ballistic reports. Nevertheless, researchers note that the legislation was passed at a moment when modern forensic methods were not well-developed; thus, applying it to up-to-date science raised ambiguous



interpretations (Asif and Qayum, 2023). As a result, courts have a tendency to use judicial discretion to ascertain the value of forensic evidence.

To address the arising demands, Pakistan has come up with reforms to empower the legal basis of forensic science. Another important change was the passing of the Punjab Forensic Science Agency Act that institutionalized forensic services and accorded legal status to the scientific processes of investigation. This law made possible the creation of contemporary forensic labs and enhanced the reliability of forensic evidence in court cases. Regardless of these developments, gaps exist in the provincial legal frameworks, especially where there is no overarching legislation that deals with digital forensics and new technologies (Raza et al., 2023).

Also, legal experts note that Pakistan has yet to have a cohesive national forensic policy that will combine all types of scientific evidence into one regulatory system. Lack of uniform guidelines on how evidence should be gathered, stored and produced in court leaves gaps in the proceedings that can undermine prosecutions. Comparative research indicates that those countries that have a specialized forensic legislation have a higher conviction rates as there is a uniform use of scientific evidence (Bhan et al., 2025). Consequently, reforming and enhancing forensic law is one of the key aspects that should be reformed.

2.2 Forensic Science Institutional Framework

The Pakistani institutional structure of forensic science has been changing tremendously especially with the introduction of specialized forensic institutions. The Punjab Forensic Science Agency (PFSA) is considered to be among the top institutions in the area, providing state-of-the-art forensic services, including DNA analysis, toxicology, trace chemistry, and digital forensics. Studies show that PFSA has played a significant role in enhancing the quality and dependability of criminal investigations through the provision of scientifically proven evidence (Afridi, 2021). Its contemporary infrastructure and compliant nature to the international standards have established a standard in forensic institutions in South Asia.

Besides PFSA, there is also the National Forensic Science Agency (NFSA), which is a federal agency that assists various law enforcement agencies in the country. NFSA is instrumental in high-profile and inter-provincial cases and it provides expertise in such areas as cybercrime, narcotics analysis, and questioned documents. Nevertheless, there is literature that institutional development is still uneven among provinces, whereby some regions do not have well-equipped forensic laboratories (Sharafi, 2026). Such an imbalance restricts access to forensic services and the overall effectiveness of the criminal justice system.

Besides, institutional difficulties are not only related to infrastructure, but also to administrative and coordination problems. Researchers comment that police and other law enforcement organizations usually do not interact with forensic organizations, and this results in slow evidence processing, and communication failure (Khan et al., 2025). Inter-agency collaboration is also complicated by a lack of a centralized coordination mechanism. Institutionalization of connections and increased capacity of forensic centres in all provinces are thus necessary to attain a more balanced and efficient forensic system in Pakistan.

2.3 Admissibility and Evidentiary Problem in Law

The legal aspect of admissibility of forensic evidence in Pakistani courts is well established, but in practice, it is complicated. According to the current legislation, expert opinions are allowed, but its persuasive power frequently relies on the opinion of judges and the reliability of forensic experts. Research indicates that in some cases, the courts consider traditional evidence, including eyewitness testimony, more than scientific evidence, which negatively affects a role of forensic science in a court trial (Farhad et al., 2025). This dependence on traditional evidence is not only a form of judicial conservatism but also ignorance of modern forensic methods.

The second significant challenge is the lack of standard procedures to handle the evidence. Lack of proper collection, storage and transportation of forensic samples may cause contamination or degradation, which makes the sample less reliable in court. Researchers suggest that poor practices of chain-of-custody are a major contributor to the rejection of forensic evidence in courts (Bhan et al., 2025). This is a major problem especially when it comes to DNA and fingerprint analysis, where the slightest mistakes can result in undermining the evidence.

Similarly, judges and legal practitioners are not specially trained, which also makes the admissibility



of forensic evidence difficult. In the absence of proper knowledge on the scientific methodologies, the courts may find it difficult to determine the validity and constraints of the forensic findings. Comparative studies show that the jurisdictions where legal professionals receive forensic training exhibit even more effective use of scientific evidence (Farhad et al., 2025). Thus, to improve the role of forensic science in the Pakistani judicial process, it is necessary to strengthen judicial capacity and set standards of evidentiary requirements.

2.4 The role of forensic institutions in criminal investigations

Forensic facilities are central to contemporary criminal investigations, offering impartial, scientific evidence that improves the accuracy of case outcomes. The studies indicate that the application of forensic analysis to the investigation procedures can decrease the probability of wrongful convictions and enhance the possibilities of identifying those who commit a crime (Barton Harrell, 2025). Fingerprint analysis, DNA profiling, and ballistic examination are some of the methods that can help an investigator to develop a strong connection between suspects and crime scenes.

PFSA and other institutions have implemented new technologies such as Automated Fingerprint Identification Systems (AFIS), national databases of DNA, which have transformed the way crimes are solved in Pakistan. They enable quick identification and comparison of evidence, enhancing the efficiency of investigations. The success of such technologies is however highly reliant on the quality of the input of data and the skills of forensic staff (Afridi, 2021). The potential advantages of forensic technologies might not be realized unless they are properly trained and the procedures are standardized.

In spite of these developments, the literature points to unresolved issues in the process of collaboration between the forensic experts and the law enforcement agencies. Police officers are not always trained to collect and preserve evidence in accordance with the standards, which results in undermined forensic outcomes (Khan et al., 2025). Moreover, the timely analysis and reporting may be hampered by delays in communication and bureaucratic barriers. To ensure the maximum impact of forensic science in criminal investigations, it is important to strengthen the coordination mechanisms and offer some joint training programs to police and forensic experts.

2.5 Digital Forensics and Technology

The emergence of digital technology has drastically changed the nature of the field of forensic science, bringing about new techniques of investigating cybercrime and technologically advanced crimes. Digital forensics is the process that identifies, maintains and examines electronics in gadgets like computers, mobile phones, and servers. Digital forensic methods have started to be embraced by forensic institutions in Pakistan as cybercrime is increasingly becoming widespread (Ibrar et al., 2024). This change is a reflection of the growing relevance of electronic evidence in contemporary criminal investigations.

Alongside the digital forensics, biometric identification methods have also boosted the identification procedures through fingerprint recognition, facial recognition, and iris scanning. The technologies allow law enforcement agencies to swiftly check identities and monitor criminal activities. Integrated biometric databases and forensic systems have enhanced efficiency and accuracy of investigations. Nevertheless, researchers remark that Pakistan continues to struggle with the complete adoption of the latest technologies, including artificial intelligence and machine learning, in the forensic analysis (Liaquat et al., 2025).

Moreover, the technological changes demand huge investments in infrastructure, training, and research. The biggest obstacles to the use of the latest forensic technologies in Pakistan are limited funding and a shortage of technical skills. The country will be at risk of being left behind in the global forensic environment unless there is constant innovation and capacity building. Thus, more funding on technology and cooperation with foreign forensic organizations are necessary in improving forensic capacity in Pakistan.

2.6 Training Gaps and Resource Constraints

The issue of resource constraints is one of the biggest obstacles in the progress of forensic science in Pakistan. The institutions such as PFSA have well-equipped facilities, but the problem is that in many regions, there are no basic forensic facilities and equipment. This gap introduces an unequal access to forensics and compromises the criminal justice system (Sharafi, 2026). The researchers underline the fact that sufficient funding is necessary to build and sustain forensic laboratories, and to purchase the latest equipment.

Among the issues that pose a challenge are infrastructure limitations, shortage of trained forensic



experts in the country. There are few academic courses in forensic science, and this creates a shortage in the number of qualified professionals and the number of people who can be hired. As Farhad et al. (2020) note, the absence of particular education and training courses impedes the formation of an effective forensic community. This problem is also complicated by the lack of a steady professional development among the existing practitioners.

The same applies to the law enforcement agencies which are involved in gathering of evidence and its preservation. Police officers are often untrained and, thus, cannot work with forensic evidence appropriately, contaminating or losing important information (Noor et al., 2025). The solutions to these challenges need to be holistic and entail investing in education, training programs and research and development efforts. Enhancement of human resource capacity is critical in the effective use of forensic science in Pakistan.

3. Methodology

In this paper, a qualitative thematic analysis method is selected to investigate the issues and limitations of the fingerprint analysis in Pakistan. Thematic analysis is one of the most used qualitative methods of identifying, analysing and reporting patterns in data (Braun and Clarke, 2006).

3.1 Research Design

The current study will follow a qualitative research design to critically analyse the issues and limitations of fingerprint analysis in Pakistan because this method allows exploring complex and context-specific problems in a more in-depth manner, which cannot be adequately addressed using quantitative methodology. Qualitative inquiry is especially appropriate to explore the lived experiences of forensic practitioners, along with the institutional, procedural, and technical limitations defining forensic practices in the context of the real world (Creswell and Poth, 2016; Braun and Clarke, 2006). The paper aims to produce subtle information about the way that forensic work is done in practice and the way that systemic constraints influence evidence results by concentrating on the activities of collection, analysis, and interpretation of fingerprint evidence. The study is informed by a thematic analysis paradigm, which offers a rigorous and systematic procedure of identifying, analysing, and interpreting patterns with respect to qualitative data. This methodology enables grouping of the expert opinions into consistent themes enabling the results to be contextualized significantly in the available literature on forensic science. Moreover, thematic analysis is flexible and methodologically rigorous, which qualifies it as the best method to apply to interdisciplinary studies incorporating the law and forensics. By this design, the study will make analytically rich and contextually informed contributions in the current debates on how to enhance forensic reliability and institutional capacity in Pakistan.

3.2 Area of study and participants

The research was carried out in the major forensic centres in Pakistan to gain a holistic and contextually diverse perspective on fingerprint analysis practices in Pakistan. In particular, the sampled participants were recruited fingerprint examiners in the Punjab Forensic Science Agency (PFSA) in Lahore, fingerprints experts in National Forensic Agency, Islamabad, and fingerprint examination officers in Peshawar, Khyber Pakhtunkhwa (KPK), and included the views across different provinces with diverse institutional capacities and operational structures. The geographic distribution was specifically chosen to embrace possible regional variations in forensic practices, resource base, and procedural guidelines. A purposive sampling approach was used to select the respondents who have first-hand and practical experience in the field of fingerprint analysis, crime scene analysis, and reporting of a crime, to make sure that the information gathered was both pertinent and based on professional knowledge. The study increases the credibility and validity of its findings because it is very specific in terms of the practitioners who are actually involved in forensic work. This methodology will enable the production of deep, experience-based knowledge about the real problems and institutional processes that affect the analysis of fingerprint in Pakistan. As a result, the sampling design is consistent with the principles of qualitative research since it focuses on depth, relevancy, and expertise instead of generalizability.

3.3 Data Collection Methods

This research employed semi-structured interviews to collect information through interviewing fingerprint experts in the sampled forensic institutions. The semi-structured format has been chosen because



it allowed the researcher to apply the same format in the interviews and, at the same time, provide flexibility to the participants to talk about their professional experiences and knowledge. The interviews focused on the practical aspect of the study of fingerprints like the evidence gathering process, the problem of locating latent fingerprints, technological constraints, training and skill acquisition issues and the functioning of automated fingerprint identifying systems. This helped in collecting both the experiential and substantive information at the very point of origin by conducting a survey on the professionals engaged in the forensic practice.

The interviews were conducted both face-to-face and via the telephone, when the respondents were convenient. This dual mode paradigm ensured that there was increased access to the specialists in the different fields and that there was the prospect of an all-inclusive gathering of information.

3.4 Data Analysis

Thematic analysis was used to analyse the collected qualitative data based on the systematic framework suggested by Braun and Clarke (2006) and is widely known to have rigor and flexibility in making sense of the qualitative data. The technique was chosen as it is effective when detecting, examining, and creating useful patterns of textual data complexity. Analysis was initiated by the transcribing of all interview answers, which was followed by repeated reading of all the answers to provide profound familiarization and immersion into the data, where initial observations and recurrent problems were made. After this, a coding process was undertaken in which major parts of data were recognized and given codes that reflected on important concepts, issues and experiences of practitioners. These codes were then scrutinized and then gathered together into broad themes with close similarities in order to bring out the deeper themes that reflect the underlying patterns of the data. The themes were further narrowed down in an iterative format to maintain clarity, coherence, and true depiction of the issues related to fingerprint analysis in Pakistan. Triangulation was used to increase the validity and credibility of the results through the comparison of the emergent themes with existing literature on forensic science so that the interpretations that were made were empirically based and sensitive to the realities of forensic practice in Pakistan.

4. Findings & Discussion

4.1 Strength of Forensic Laws and Policies

The results suggest that Pakistan has a legal framework, which formally addresses the admissibility of forensic evidence in the judicial system, mainly with the Qanun-e-Shahadat Order, which allows admitting expert opinion in court. Institutional changes like the Punjab Forensic Science Agency Act have also added on to this legal acknowledgment giving further force to the functioning and structure of the forensic science in the investigation of crimes. This has led to the progressive move to increased reliance on scientific evidence, especially in areas like DNA profiling and the analysis of fingerprints which are now being introduced in courts to back prosecutor claims. Nonetheless, even with these developments, the research indicates that there exist some consistent gaps in the enforcement of the forensic laws, in part because there are no standardized procedures and a national forensic policy (Asif and Qayum, 2023). These differences bring about differences in the interpretation and use of forensic evidence in various jurisdictions. Thus, the legal infrastructure may seem sufficient in theory, but it is still uneven and context-specific in its practice, which restricts its overall efficiency in enhancing the criminal justice system.

The qualitative observations of the forensic and legal professionals also underscore the difficulties of the practical application and interpretation of forensic legislation in Pakistan. According to one forensic legal expert, *“our laws are conscious of forensic evidence, where they are applied, but that the application requires judicial wisdom, which is not always uniform, and that judicial competency is vital in establishing the evidentiary worthiness of forensic contributions.”* This finding implies that the lack of judicial training and awareness can be an obstacle to the proper application of scientific evidence in courts. The other specialist noted that, *“due to the lack of a broad legal framework of emerging evidence, such as digital forensics, there is a lack of clarity in the court process, due to the dynamic nature of forensic science and the failure of current laws to keep up with the technological changes.”* All these points imply that the drawbacks of the existing system are not both legislative but interpretative and procedural (Bhan et al., 2025). Moreover, lack of legal provisions to address new areas of forensics brings ambiguity and inconsistency in court verdicts. Thus, although the forensic legal system in Pakistan offers a requisite framework, its usefulness is limited by the



lack of modernization, standardization and capacity building in the legal system.

4.2 Institutional Support

The results show that institutional facilitation has been central in promoting the development of the capacity of forensic science in Pakistan, especially by the formation of specialized agencies like the Punjab Forensic Science Agency (PFSA) and the National Forensic Science Agency (NFSA). These facilities have brought forth advanced scientific methods and standardized laboratory activities, and this has greatly improved the dependability and validity of forensic evidence in the criminal investigation. Consequently, the quality of the investigative process has improved noticeably, and there is increased dependence on scientific techniques, including DNA analysis, fingerprint analysis, and toxicology. This development is backed by empirical studies, which show that well-equipped forensic facilities can lead to increased conviction rates and general strengthening of the criminal justice system (Afridi, 2021). Furthermore, the agencies have established standards of forensic excellence in the country and have shown the potential effects of investing in a sophisticated forensic infrastructure. But even with such successes, not all parts of Pakistan have enjoyed the fruits of such institutional developments.

The qualitative results indicate that there are high differences in institutional capacity and resource distribution that restrain the effectiveness of forensic services in general at the national level. According to one senior forensic practitioner, *“PFSA is very developed, yet most areas do not even have the basic forensic facilities, and this reflects the unequal distribution of forensic facilities.”* This imbalance leads to a scenario in which some provinces enjoy access to state-of-the-art forensic services, whilst others persist in having little or outdated equipment. Another scholar commented, that *“it is not the lack of institutions, but an unequal allocation of resources and access, and that structural inequalities, and not institutional absence is the main issue.”* These views indicate that the forensic development in Pakistan is physically centralized resulting in the variation of the quality and availability of forensic services in different jurisdictions (Sharafi, 2026). Moreover, there is a lack of coordination and sharing of resources across provinces, which worsens these gaps, hindering the scalability of forensic developments. Thus, although institutional support has certainly empowered forensic science in Pakistan; to influence the whole country, equal allocation of resources and planned growth of the forensic infrastructure is needed.

4.3 Collaboration Between Experts and Police

The results highlight that the successful cooperation between forensic professionals and the police is an important element of the successful criminal investigation, but there are still considerable coordination issues in the Pakistani setting. Crime scenes are usually the first to be visited by police officers and so they are expected to collect and preserve the first forensic evidence, although many have no proper training on the correct methods of evidence handling. This information overload frequently results in the contamination, degradation, or improper handling of important forensic evidence, which undermines their credibility and admissibility in legal proceedings (Khan et al., 2025). Moreover, these challenges are complicated by the lack of clearly defined and standardized procedures related to joint work of law enforcement and forensic staff. In the absence of organized coordination systems, the handover of evidence between crime scene and laboratory becomes unreliable and subject to procedural mistakes. Consequently, the quality of forensic evidence is often undermined even prior to expert’s examination. The results indicate that collaboration cannot simply be operational; it is heavily reliant on training, standardization, and institutional alignment.

The qualitative data of the participants also help to see the practical implications of this lack of connection between forensic professionals and police officers. According to one forensic expert, *“evidence is usually contaminated by the time it reaches us because of poorly executed work at the crime scene, which is the irreversible effect of early-stage procedure errors.”* This fact demonstrates the extreme relevance of the correct management of the crime scene as the premise of the credible forensic examination. Equally, a law enforcement officer commented, *“we are supposed to gather forensic evidence, but we are not provided with the necessary training or means, indicating institutional failures in capacity building and resource allocation.”* All these statements indicate a structural divide between the expectations and preparedness of the criminal justice system. This is further widened by the absence of mutual understanding and coordinated training of the forensic and police departments. In turn, the conclusions made suggest that in order to enhance



the cooperation, it is not only necessary to train the individuals technically but also to build the integrated operational frameworks that will guarantee the competent management and transfer of the forensic evidence.

4.4 Technology and AI Factor

The results reveal that the use of technology has been very influential in enhancing forensic activities in Pakistan, especially in the area of digital forensics and biometric identification systems. Automated Fingerprint Identification Systems (AFIS) and specialized digital forensics laboratories have also helped in improving the speed and accuracy of criminal investigation so that there is more efficient processing and analysis of evidence. The technologies are also being applied in more complicated situations, such as cybercrime, financial fraud, and identity verification, where the use of conventional investigative techniques is not always adequate (Ibrar et al., 2024). Biometric systems have also enhanced the accuracy of suspect identification, eliminating the need to rely solely on manual identification techniques, and minimizing human error. This has led to more data-driven and technologically aided forensic investigations, which have led to the improvement of evidentiary results. Nevertheless, even though these advances represent a substantial breakthrough, they are more of a reflection of the uptake of the underlying technologies than state-of-the-art innovations. This indicates that the forensic system in Pakistan is at the transitional stage in its progression, slowly shifting to modernization but not yet up to date with world technological requirements.

In spite of these developments, the results demonstrate that the adoption of innovative technologies, especially artificial intelligence (AI), is still weak in the Pakistani forensic environment. A digital forensic analyst pointed out, *“we have simple digital tools, yet AI-enhanced analysis is still in its infancy in Pakistan, which illustrates the difference between current abilities and new international standards.”* This weakness is also supported by structural issues like inadequate finances, deficiency of technical skills and inadequate access to sophisticated training courses. Another specialist noted, as an additional point, *“that we do not have the funding and technical expertise to implement the latest technologies, which highlights the fact that we have limited resources to advance technologies.”* These observations indicate that basic digital tools exist, but the lack of AI systems restricts the capabilities of working with large-scale, complicated data and complex pattern recognition problems. As a result, the forensic system of Pakistan might not be able to match with the changing types of crime that are becoming more and more dependent on digital and technological advances (Liaquat et al., 2025). On the whole, the results show that strategic investment, capacity building, policy support are necessary to promote the incorporation of advanced technologies and securing the future preparedness of forensic science in Pakistan.

4.5 Resource and Training Limitations

The results show that the resource constraints could be a major obstacle to the successful execution of forensic science in Pakistan especially with regard to infrastructure, equipment's, and monetary investment. Although some institutions like the Punjab Forensic Science Agency (PFSA) show high standards and availability of modern equipment, in most other regions, the forensic centres are still working with few or old-fashioned equipment. This unequal distribution is a symptom of larger structural disparities in resource distribution, with forensic development being concentrated in particular urban centres. The lack of funding also inhibits the growth of forensic services, as it cannot purchase the latest equipment or create new laboratories in under-served regions (Sharafi, 2026). Consequently, the quality, uniformity, and dependability of forensic investigations differ quite extensively among provinces. Such discrepancies do not only influence the quality of evidence that is generated and this is related to delays in the investigation and judicial processes. As a result, issues of resource constraints become a system problem that compromises the effectiveness of forensic science in the nation.

Besides infrastructure issues, the research notes that there is also a serious lack of trained forensic specialists and lack of capacity-building programs among law enforcement staff. Respondents stressed that the increasing demand in forensic services is not accompanied by the supply of qualified specialists, which puts a strain on the current staff and influences the quality of analysis. According to one of the specialists, *“there are not sufficient trained forensic scientists to match the increasing demand, which can be interpreted as the necessity of increasing the number of professionals working in this field.”* Moreover, the lack of police officers training in handling the evidence still endangers the quality of the forensic materials in the first step



of investigation. A second interviewee remarked that *“police officers are not often trained in the proper handling of evidence and therefore the information is often lost, which is a very critical issue with regard to the preparedness of operations.”* These observations prove that human resource constraints are equally important as technological shortcomings in determining forensic results. Thus, the results highlight the value of the long-term commitment to training and professional growth, as well as institutional capacity building to improve the overall efficacy of forensic practices in Pakistan (Noor et al., 2025).

4.6 Skill and Career Development

The results indicate that forensic science is slowly gaining as a viable career in Pakistan, with the growth of major institutions like the Punjab Forensic Science Agency (PFSA) and National Forensic Science Agency (NFSA). These advancements have demanded greater proficiency among professionals in special fields such as DNA examination, fingerprint analysis, and digital forensics. Meanwhile, colleges have started offering courses in forensic science, which also led to the cultivation of a professional workforce and indicated a change in the direction of the formal professionalization of the field (Farhad et al., 2025). Such institutional and scholarly expansion can be seen as a wider appreciation of the role of forensic science in enhancing the criminal justice system. It also shows that new career opportunities are emerging to students and professionals who may be interested in this field. But as the increase in opportunities is positive, the results indicate that the rate of skill development has not been able to match the increased demand. Consequently, the possibilities of this new area are not fully fulfilled in the existing system.

The qualitative insights also indicate major gaps in high-level training, research prospects, and career advancement in Pakistan among forensic professionals. According to one of the specialists, *“there is little advanced training and research in forensic science in Pakistan, which indicates limited opportunities to develop higher-level skills and innovations.”* This weakness denies professionals an opportunity to be exposed to the latest techniques and global best practices. The other professional explained, *“students are interested in forensic careers, but they do not get the right guidance and exposure, and a lack of academic interest correlating with practical career support.”* These observations indicate that, although there is an increasing interest in forensic science, there are no well-developed institutional frameworks that foster and direct this interest. Lack of career advancement and mentorship also contributes towards the lack of professional development in this sector. Thus, the results highlight the importance of reinforcing the academic programs, encouraging the international cooperation, and creating the organized training and career advancement plans to facilitate the process of development of forensic skills in Pakistan.

5. Conclusion

The general overview of the development of forensic science in Pakistan shows that the system is in the process of evolution and still has some structural and operational issues. Legal statutes, including the Qanun-e-Shahadat Order and institutional legislation, such as the Punjab Forensic Science Agency Act, have provided a solid basis on admissibility and institutionalization of forensic evidence. Such advancements have boosted the role of scientific inquiry in the area of criminal justice and the reliability of evidence presented in a court. Nevertheless, the application of these laws is not uniform because of the lack of standardization, insufficient judicial knowledge, and the lack of a national forensic policy.

At the institutional level, the existence of the sophisticated agencies like the Punjab Forensic Science Agency and the National Forensic Science Agency can be seen as a strong step towards improving the forensic capacity. Nonetheless, the lack of coordination between police and forensic experts, unequal distribution of resources, and unequal access to facilities across provinces still plague the efficiency of the system. Efforts in digital forensics and biometric, among other technological improvements, have enhanced efficiency in the investigative process but have not been exploited fully as a result of insufficient investment and knowledge in other emerging fields such as artificial intelligence.

In addition, the research draws attention to some of the most problematic aspects surrounding resource scarcity, lack of training and career advancement opportunities in the field of forensic. The deficit of talented workforce, insufficient training of the law enforcement, and insufficient research and development efforts undermine the overall forensic infrastructure. Although the field has good career opportunities, its development is limited due to lack of academic programs and exposure to professionals. On the whole,



forensic science in Pakistan demonstrates a significant improvement, but it needs extensive reforms and long-term investments to achieve its potential and become efficient to serve the criminal justice system.

6. Recommendations

6.1 Policy Reforms

A major concern is the necessity to come up with a well-organized and integrated national forensic policy, which standardizes the evidence collection and preservation procedures, as well as their admissibility in all provinces. The legal systems need to be revised to explicitly include the current forensic methods such as digital and biometric evidence to curb confusion in the interpretation of the law. Moreover, special training to judges and legal practitioners should be offered to enhance their knowledge on forensic evidence. Enhancing chain-of-custody measures and making sure that they are strictly followed can also increase the credibility and reliability of the forensic evidence in the court.

6.2 Strengthening and Coordination of Institution

They should move to increase the forensic infrastructure to areas outside the major urban centres to give equal opportunity to access forensic services in all parts of the country. To minimize the disparities, setting up well-equipped forensic laboratories in the underdeveloped areas will be highly beneficial in enhancing the efficiency of investigations. In addition, more coordination systems between the police and forensic specialists ought to be established by way of mutual training courses and combined operational systems. Delays can also be reduced and cooperation among institutions can be enhanced by developing a centralized communication and case management system.

6.3 Research and Development of Technology and AI

The government must focus its investment in new forensic technology, especially in artificial intelligence, machine learning, and digital forensics. Modernization of the current systems and the implementation of AI-assisted tools can be of great help to speed up and make investigations effective. It can be possible to transfer knowledge and build capacity through partnerships with international forensic institutions and technology providers. Moreover, the policies must be concerned with ethical issues and data protection to implement responsible usage of the emerging technologies in the forensic science.

6.4 Resource Allocation and Training

Proper funding should be assigned towards enhancing the forensic infrastructure, purchase of modern equipment, and also fund research and development projects. Both forensic professionals and law enforcement officers should be trained on the technical skills and knowledge on handling evidence. High standards of practice can be maintained by the provision of continuous professional development opportunities, such as workshops and certifications. To enhance the effectiveness of forensic science in Pakistan generally, investing in human resources is necessary.

6.5 Career and Skill Development

Colleges are advised to increase the number of forensic science courses and offer specialized courses according to the international standards. Scholarships, internship and exchange programs can also give the students a hands-on exposure and foster interest in forensic careers. The creation of effective career development and professional accreditation systems will further facilitate workforce development. Raising awareness about forensic science as a good and efficient professional choice will assist in attracting talented members and securing the further development of the sphere.

Contribution of Authors

All the authors participated in the ideation, development, and final approval of the manuscript, making significant contributions to the work reported.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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Informed Consent

Informed consent was obtained from all individual participants included in the study.



Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Data Availability

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

References

- Abbas, A., Sipra, S. Z., Falak, M. W., & Khan, S. M. (2024). A critical case study on the role and admissibility of forensic science evidence in the criminal justice system of Pakistan. *Pakistan JL Analysis & Wisdom*, 3, 232.
- Afridi, N. (2021). The current status of forensic science and its impact on administration of criminal justice system in Pakistan: An analytical study. *Available at SSRN 3781586*.
- Ahmed, I., Rehman, T. U., & Ali, S. H. (2025). DIGITAL EVIDENCE IN PAKISTAN: LEGAL FRAMEWORK, FORENSIC CHALLENGES, AND JUDICIAL RELIABILITY. *Contemporary Journal of Social Science Review*, 3(1), 12-20.
- Ahmed, M., Hussain, N., Khan, I., Ajmal, S., & Ahmed, T. (2025). Forensic Science's Relevance in Pakistan's Criminal Justice System. *Journal of Political Stability Archive*, 3(2), 1068-1076.
- Ajmal, A., & Rasool, F. (2022). Forensic evidence in criminal justice system in Pakistan. *Global Legal Studies Review*, 7(3), 25-31.
- Amin, F., Said, I., & Butt, M. A. (2025). AI-based cybersecurity solutions: Securing information and privacy in the evolving digital age. *Journal of Engineering and Computational Intelligence Review*, 3(2), 142-158.
- Asif, M., & Qayum, S. (2023). Analyzing the Admissibility of Forensic Evidence in the Criminal Justice of Pakistan: Issues, Challenges and Scope. *Pakistan Journal of Criminology*, 15(3), 61.
- Baig, K., & Hameed, M. S. (2025). An Analysis of the Role of Forensic Evidence from the Commission of Offence to the Trial. *Pakistan Journal of Criminal Justice*, 5(1), 27-45.
- Barton Harrell, S. L. (2025). Prosecuting Attorneys' Experiences and Perceptions of Evidence That Most Often Leads to Wrongful Convictions at the Pretrial Stage.
- Bhan, S., Kumar, N., Singh, V. P., Gope, S., & Aqib, M. Challenges In Admissibility Of Forensic Evidence: A Comparative Analysis Of Legal Standards Across Jurisdictions. *International Journal of Environmental Sciences*, 11(14s), 2025.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.
- Farhad, A., Ali, R. N., & Maryam, B. (2025). Forensic Science in Court: Assessing the Legal Response to Emerging Reliability Concerns in Pakistan. *ASSAJ*, 4(02), 2017-2024.
- Ibrar, M., Yin, S., Li, H., Karim, S., & Laghari, A. A. (2024). Comprehensive review of emerging cybersecurity trends and developments. *International Journal of Electronic Security and Digital Forensics*, 16(5), 633-647.
- Imtiaz, U., Ahmad, B., Sajid, M. H., Abbas, Q., Qureshi, M. A., Rasheed, S., & Khan, A. (2025). An Integrated Machine Learning Framework for Structural Health Monitoring of Bridges: A Case Study on Soan Bridge. *The Asian Bulletin of Big Data Management*, 5(2), 194-207.
- Imtiaz, U., Malik, S., & Khan, A. (2024). Blockchain-Driven Cybersecurity Framework for Smart Homes: Integrating IoT and Machine Learning for Secure Automation. *The Asian Bulletin of Big Data Management*, 4(4), 570-583.
- Khan, S. M., Yaqoob, A., Khokhar, J. A., & Malik, F. (2025). An Examining the Legal Framework for Criminal Investigations in Pakistan: Gaps and Reform Needs. *The Critical Review of Social Sciences Studies*, 3(1), 1957-1969.



- Liaquat, I., Islam, A., & Ahmad, B. (2025). Forensic Science and Artificial Intelligence in Criminal Investigations: An Analysis of Operational Realities in Punjab, Pakistan. *Journal for Current Sign*, 3(4), 2278-2293.
- Noor, S., Azeem, A., & Maqsood, W. (2025). Enhancing Forensic Evidence Management in Pakistan's Criminal Justice System: A Criminological Analysis. *Journal of Political Stability Archive*, 3(4), 438-453.
- Raza, M. S., Ahad, A., Nawaz, R., Ahmad, M., Hassan, J. U., & Mehmood, U. (2023). A systematic review: on sexual assaults, forensic investigation and legal system in Pakistan. *Biol. Clin. Sci. Res. J*, 465.
- Shah, S. M. H., Amin, F., & Khan, A. (2025). Cyber-Resilient Mobile Edge Computing: A Deep Neural Approach for Secure and Efficient Task Offloading. *The Asian Bulletin of Big Data Management*, 5(1), 200-215.
- Sharafi, M. (2026). *Fear of the False: Forensic Science and the Law of Crime in Colonial South Asia* (p. 276). Cornell University Press.

