

Forensic evidence: History, development and Pakistani scenario

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Abstract: This qualitative study aims to delve into the broader ramifications of forensic evidence concerning the criminal justice system, as studies navigate the complex junction of science, law, and ethics. Forensic science has solved cold cases and stopped false convictions, ushering in a new age of transparency, accountability, and technology that the legal system is only now starting to understand. Before moving on to a comprehensive overview of the criminal investigation process, justice, and will, the article concludes by emphasizing the significance of understanding that forensic science is an ever-changing discipline. Forensic evidence has gained importance in Pakistan's criminal justice system, especially following advancements in DNA testing, digital forensics, and other investigative tools. The Pakistani courts increasingly rely on forensic science to resolve disputes, especially in high-profile criminal cases such as terrorism, murder, and sexual assault. There are obstacles persist in the collection, preservation, and interpretation of forensic evidence. The credibility of this evidence is additionally subject to judicial examination as stipulated in Article 164 of the QSO, 1984, which confers upon

the court the authority to admit evidence acquired through contemporary technologies.

INTRODUCTION

Forensic evidence has become the missing piece in the jigsaw puzzle of modern criminal investigations, which strongly emphasizes the intersection of science and justice. Starting with the earliest forms of evidence, this study traces the evolution of forensic evidence's function through the chronicles of human history. Forensic science has many interconnected threads, and each one helps fill out the picture of what happened. Digital forensics, which reveals the mysteries of electronic devices, follows in the footsteps of other forensic disciplines like fingerprinting, DNA analysis, ballistic trajectory analysis, and microscopic examination of DNA. Forensic evidence is an integral component of criminal law proceedings, rather than just an observer. It can guide investigators through complex crime scenes and aid in the identification of perpetrators. There are more evidentiary disputes than ever before because of the tremendous developments in contemporary forensic science. Recognizing the potential for human error and contamination, the article delves into dependability difficulties and outlines specific processes employed in forensics that have limits. It also highlights the importance of continuously improving quality control measures to boost accuracy levels. Disputes regarding permissible have characterized the legal landscape, despite its obvious scientific integration. Examining the challenges and debates that have accompanied the introduction of forensic evidence into court, this article breaks down the legal environment. This is also a matter for the judgment of experts. Concerns regarding privacy, permission, and the ethical use of technology have long hungover forensic evidence. Forensic experts must be well-versed in their ethical responsibilities because of the fine line that must be drawn between the pursuit of justice and the protection of individual rights.

PROBLEM STATEMENT

Due to poor infrastructure, training, and legal issues, Pakistan's criminal justice system struggles to integrate forensic evidence. Traditional evidence over scientific approaches might delay case resolution and lead to incorrect convictions or acquittals. The lack of a strong regulatory framework for forensic laboratories and defined processes for evidence collection and storage further reduces the reliability and effectiveness of forensic evidence in court proceedings. These difficulties must be addressed through amendments in related law to improve forensic science's credibility and utility in Pakistan's courts.

HISTORICAL DEVELOPMENT

From its origins in the dark arts to its ascent to the level of pure science; the fascinating journey of forensic evidence spans centuries, if not millenniums. Forensic science has its origins in the pursuit of justice in ancient societies, which used crude techniques to solve crimes. Fingerprints were an early form of personal identification in ancient China, used as signatures on clay seals. The ancient Egyptians revealed a basic understanding of forensic principles in their documentation of medical procedures and examinations in the Edwin Smith Papyrus (Stelfox, 2013). In addition, the practice of physically testing a defendant to establish his guilt or innocence emerged in the Middle Ages. On the other hand, medical and anatomical understanding started to grow during the Renaissance, laying the groundwork for more organized forensic science. Marcello Malpighi, whose work on the microscopic structure of tissues helped advance forensic medicine, and Ambroise Paré, often recognized as the "father of forensic pathology," were the forefathers of forensic medicine. In the nineteenth century, forensic science emerged as a distinct academic field. Alphonse Bertillon, the father of modern fingerprinting, tried to create several forms of identification based on body measurements; nevertheless, fingerprinting ultimately supplanted his efforts. Developments in toxicology and ballistics, meantime, enriched the forensic toolbox (Casey, 2011). Karl Landsteiner made significant progress in the early 20th century when he discovered the ABO blood type, which allowed for the possibility of bloodstain analysis. Simultaneously, the establishment of forensic laboratories, such as the one established by the FBI in 1932, signified the initial substantial stride towards the institutionalization of forensic procedures.

Genomic profiling was a game-changer in the second part of the twentieth century. Sir Alec Jeffreys' 1984 discovery of DNA fingerprinting allowed for a level of accuracy in forensic genetics that had never been achieved before. When it comes to solving crimes and acquitting wrongfully condemned individuals, this primary method of identification is now crucial.

When solving crimes that involve electronic evidence, digital forensics has emerged as a leading field in the modern day. Of course, technological progress has also influenced forensic methodologies, which in turn have shaped the environment of crime investigation. Throughout the annals of scientific inquiry, empirical data has helped humans make sense of previously inexplicable phenomena (Casey, 2011). The Chinese legal system went so far as to acknowledge the possibility of a case involving a transition between humans and other animals. On the other hand, forensic evidence has evolved differently from one country's system to other forensic laboratories, such as the one established by the FBI in 1932, which signified the initial substantial stride towards the institutionalization of forensic procedures. Genomic profiling was a game-changer in the second part of the twentieth century. Sir Alec Jeffreys' 1984 discovery of

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HOW FORENSIC EVIDENCE IS MADE?

The Youth Self-Report (YSR/11-18) remains a valuable tool in assessing behavioral and emotional problems among adolescents, particularly when combined with the multi-informant approach. As globalization and cultural shifts continue to influence adolescent development, it becomes increasingly important to consider the socio-cultural context in which adolescents navigate their mental health challenges. Arab adolescents in Israel face unique pressures, including the tension between traditional values and modern influences, which contribute to a higher prevalence of eating disorders and psychological distress. Moreover, sleep quality, which plays a critical role in adolescent well-being, continues to be an area of concern, particularly in light of recent global disruptions.

DNA TESTING: A GAME-CHANGER IN FORENSIC SCIENCE

In the field of criminal investigation, the application of genetic analysis has been a game-changer and a major force in forensic research. Genomic profiling offers an unparalleled tool for linking individuals to crimes due to the unique and precise nature of each person's DNA. As a result of the increased quality of professional data it provides, it has changed the way investigations are conducted and increased trust in forensic evidence. Forensic analysis holds the promise of linking the perpetrator to the location of the crime in cases where biological samples (such as blood, semen, or hair) are relevant. A person's unique identity can be determined by trained forensic scientists by analysing the genetic material included in these biological samples. This, which is similar to a genetic fingerprint, has persisted for thousands of years and uniquely identifies each person.

DNA profiling is the process of comparing and analyzing certain portions of an individual's DNA. You can find STRs, or short tandem repetitions, in these areas. As a consequence, every person has a distinct profile, which has become an invaluable tool for forensic experts trying to determine whether or not DNA samples taken at a crime scene belong to a suspect. A DNA examination may provide information about a person's family ties or even their paternity. Additionally, it can be used to identify unidentifiable remains. It can determine if someone is guilty or innocent and even resolve cold cases to exonerate the wrongfully accused. Nothing like this has ever been done before. The use of DNA evidence has undeniably revolutionized forensic investigative methods and the way a criminal justice system functions. In addition, the new standard for evaluating forensic evidence in the quest for truth and justice relies heavily on its correctness and dependability, which are now paramount in guaranteeing uniform fairness and justice in the resolution of criminal cases (Roux, C., Crispino, F., & Ribaux, O. 2012). Murder, honor killings, and rape trials now require DNA evidence. One notable case is *Sohail Ikram v. The State* (PLD 2015 Lahore 56), in which the Lahore High Court recognized DNA testing's importance as conclusive evidence in criminal cases. To guarantee the accuracy of DNA analysis, the court stressed the significance of forensic specialists' testimony and an appropriate chain of custody. The consistent implementation of DNA technology across the country is challenged by difficulties such as a lack of technological facilities and training for police officials, notwithstanding the gains.

THE PROCESS OF FINGERPRINTING

Fingerprint analysis is a tried-and-true technique in forensic science that has consistently garnered great reviews for its precision. Among the most ancient methods of forensic identification, fingerprints serve as instantaneous, one-of-a-kind markers. Because this imprint is permanent and won't fade, fingerprints can serve as search engine matches to link suspects to their respective crime scenes. In contrast, fingerprinting entails documenting and classifying the patterns, details, and counts of ridges on the skin's friction ridges. Even in cases of monozygotic twins, no two people will ever have the same fingerprints because of how unique they are. Forensic scientists now have a solid means of positively identifying an individual thanks to fingerprint analysis. When comparing latent prints, which are unintentionally left at a crime scene, with prints from suspects or other individuals pertinent to the inquiry, fingerprinting has been utilised in criminal investigations. Professionals must meticulously inspect ridge patterns and fine details at this stage. This approach has consistently produced fruitful results in criminal investigations (Hussain, N., Khan, A., & Chandio, L. A. 2023).

Fingerprint matching is now more efficient than ever before thanks to technological advancements. Automated Fingerprint Identification Systems (AFIS) maintain digital versions of extensive fingerprint databases. Latent prints can be successfully and quickly matched to a large database of records. Therefore, the identification process can be significantly accelerated with the use of AFIS. The quality of forensic investigations has been greatly improved by this technological advancement. Beyond what was previously achievable with manual processes, it has also expanded the scope of cross-referencing and matching. Therefore, fingerprinting will perpetually play a pivotal role in forensic identification using its conventional expertise and cutting-edge methods. Police data shows that this strategy is effective; each person's distinct fingerprints are a powerful tool in the pursuit of justice (Osterburg, J. W., & Ward, R. H. 2013).

Ballistics is a subfield of forensic science that analyses the behavior of projectiles, ammunition, and guns to decipher their enigmatic secrets. Suppose forensic professionals thoroughly examine bullet patterns, cartridge cases, and gunshot residue. In that case, they can establish important connections between weapons and crimes, find out the bullet spacings, and understand a shooting occurrence better. Ballistics, on the other hand, aims to address the most fundamental concerns regarding weapons and their use in criminal activity. Ballistics analysis includes the study of bullets found at crime scenes, which is a significant feature. Striations and grooves, which are imprints made on bullets during their production in a gun shop, are among the specific traits that experts examine. When compared, these features may be able to identify the weapon that discharged a given bullet. Examining the projectiles' remnants is another facet of ballistics investigation. Markings produced by the gun's chamber and firing pin provide important details. For instance, experts can examine many crime scenes methodically to determine if the cartridge cases recovered there are consistent with one other. If so, it could indicate that the same weapon was used in more than one incident (Khan, Hussain, and Oad, 2023).

Additionally, ballistic investigations rely heavily on the identification of gunshot residue. We may learn a lot about the assailant's proximity to the victim or crime scene from the particles produced when a pistol is discharged. By analyzing this residue, a forensic specialist may roughly determine the range of a shot. Imagine for a second that the same expert investigates the location and make-up of gunshot residue. If that's the case, the test findings can help them estimate the shot's range, which is crucial for piecing together what happened. Simply said, forensic science has an enormous capacity to help the field of ballistics understand the nuances of gun occurrences. Forensic scientists can provide answers regarding a heinous crime by conducting thorough investigations. In the end, it's the gun itself that helps us comprehend how a shooting truly occurs more thoroughly. Here it is! By carefully analyzing ballistics, forensic professionals help law enforcement connect firearms to crimes or piece together

events, which is crucial for criminal investigations. By doing so, they contribute to a more refined understanding of what transpires during gunshots (White,2016).

INVESTIGATING DENTAL EVIDENCE FOR FORENSIC ODONTOLOGY

Forensic odontology is a subfield of forensic science that concentrates on the identification of persons or their connections to crime scenes via the examination of dental evidence. The primary individuals responsible for locating bite marks and comparing them to dental records are forensic odontologists. When other traditional forms of identification aren't working, this becomes even more crucial. The bite mark patterns and distinctive dental characteristics are like dental "fingerprints." Forensic specialists can offer vital evidence in cases ranging from assaults to homicides (Wright, 2012; Newburn, 2012; Williamson, 2012). The cold spots of concealed dental evidence can show something about the identities of the people engaged in criminal investigations forensic odontologists defend this specialized expertise.

INVESTIGATING THE MIND IN COURT OF LAW: THE FIELD OF FORENSIC PSYCHOLOGY

Importantly, forensic psychology bridges the gap between the fields of psychology and law. New understandings of the intricacies of the human mind as they pertain to forensic investigations are uncovered. Forensic psychologists are versatile professionals with backgrounds in both psychology and law. Their detailed assessments of the mental health of individuals involved in criminal cases impact the choices made by the courts. Expert evidence on patterns and reasons for criminal behaviour allows for a thorough knowledge of the crime. Furthermore, forensic psychologists assess possible hazards in suspects to assist courts in determining their sanity and accountability. They help guide the legal system through the murky waters of social psychological concerns. When seen through the lens of the law, these experts deepen our comprehension of criminal psychology and conduct.

DISCOVERING THE MYSTERIES OF THE CYBER WORLD: DIGITAL FORENSICS

Evidence presented digitally tells its narrative in this day and age. Therefore, digital forensics is an important tool for detectives. Computers, cell phones, and other digital devices are all part of this field's purview as investigators seek proof of cybercrimes including fraud. Knobs in digital white laboratories of

contemporary forensic scene, following electronic fingerprints as they snake their way through an enigmatic realm of raw data and algorithms. When it comes to investigating cybercrimes like hacking or financial fraud, experts in digital forensics need to be able to decipher the ever-changing string of zeros and ones that control the online world. Even though technology is bringing new kinds of courtroom dramas to a head, digital forensics is there to keep its duties in check. It takes guts to trace digital trails, keep evidence safe, and uncover the truth in a world where incidents of technological theft are always evolving. Different branches of forensic science, each with its own set of tools and techniques, contribute to filling in the gaps. The identification of criminals and the strengthening of the evidential foundation necessary to achieve justice and fairness in criminal proceedings are both aided by the integration of different forensic methodologies. The intersection of traditional and modern methods is a driving force in both fields, and the way they complement one another highlights the unending development of forensic science (McCartney, 2013).

WHETHER OR NOT FORENSIC EVIDENCE IS RELIABLE

Although forensic evidence has played a major role in solving several cases, it is nevertheless subject to doubt and criticism due to concerns over its credibility. With the knowledge that we can do little miracles but also encounter obstacles, this part delves into the intricate aspects that determine a forensic inquiry. A major contributor to unreliability is the fact that human mistake is always has a possibility. The potential for human error exists across the whole data lifecycle, from collection to processing and interpretation.

The credibility of forensic conclusions might be impacted by data misinterpretation, biased assumptions, or even plain amnesia. Some studies (such as pattern matching in fingerprinting) may vary from one expert to another due to the subjective character of forensic science, which is a combination of art and science. The credibility of forensic evidence is jeopardised by contamination, another major danger. At the crime scene, when collecting evidence, or even in the forensic lab, if one source is taken and inadvertently contaminates another, the quality of the analysis will suffer. Contamination poses the biggest threat to cases using trace evidence because even a small amount can have a significant impact, such as fibers or DNA (Hussain, Khan, Chandio, and Oad, 2023).

The fundamental limitations of some forensic methods also need to be acknowledged. The underlying shortcomings of certain forensic methods are an additional consideration. First of all, it's unfair to the innocent people. There is a wide range of forensic outcomes because of regional disparities in factors like courtroom artistry, courtroom experience, and similar traits. These difficulties provide the groundwork for the claim that quality control is fundamental to any

forensic science system. Throughout the forensic process, from evidence collection to analysis and reporting, quality assurance must be applied to minimize the possibility of mistakes. Forensic scientists are required to undergo regular competency testing, and standardized machine processes ensure the general trustworthiness of forensic evidence. In cases involving improper collection or preservation techniques, the trustworthiness of forensic evidence in Pakistan has been called into question. Notably, the forensic evidence in *Mumtaz Ali v. The State* (PLD 2016 SC 261) was dismissed by the Supreme Court because it did not adhere to regular operating procedures. This case emphasizes the need to follow established criteria. Also, forensic evidence in Pakistani courts is still not always accepted or believed because there aren't enough qualified experts or licensed forensic labs.

Forensic analysis will become more reliable with the support of innovations and ongoing research in this field. Forensic science must adapt its methods and stay up with technological changes if it is to continue meeting the ever-increasing demands for dependability and precision. The limits of what forensic evidence can do in the quest for justice are pushed beyond imagined capabilities by a research-based enhancement. While recognizing forensic evidence's transformative power, it is vital to also acknowledge the problems it confronts in terms of dependability. It is essential to comprehend the elements involved to the best of our ability. The goal of forensic researchers is to counteract these variables. The objective is to make forensic analyses more trustworthy and accurate. The criminal justice system benefits from this because forensic evidence is more reliable in its quest for truth (Murphy, 2007).

ACCEPTANCE IN A COURT OF LAW

Is it appropriate for the court to accept forensic evidence? This question is of the utmost importance. To what extent can scientific findings impact and bolster criminal investigations is at issue here. This essay will take a close look at the convoluted process of judicially admitting forensic evidence. In addition to reviewing the famous Frye and Daubert standards, it takes a look at current trends, disputes, and challenges in the area, including the Daubert-edit test. The use of generally accepted and trustworthy scientific methods was the goal of this widespread acceptance concept. For scientific evidence to be admissible in court, it had to be authorized by other scientists in the field. For a long time, the Frye Standard which served as a basis for more than just that—came under fire for limiting the adoption of novel, albeit scientifically sound, approaches (Khan, A., Khan, A. S., and Khan, I., 2022). The Pakistan Evidence Act, of 1984 grants judges authority over the admissibility of forensic evidence in Pakistani courts. The Supreme Court ruled in *Muhammad Bashir v. The State* (PLD 1997 SC 408)

that to gain a conviction, forensic evidence like ballistics reports and fingerprint analysis have to be supported by other pieces of evidence. The court reiterated that for evidence to be admissible, expert testimony must be presented in accordance with established international forensic standards.

Both the law and scientific progress are at play in the use of forensic evidence in court. A fine-tuning of judgment is required to navigate the complex landscape, issues, and conflicts surrounding the use of expert testimony. Recent legislative developments, historic cases, and the current state of admissibility standards in the law all point to a determination to maintain justice while permitting the use of scientific advancements in court (Johnson, D., Peterson, J., Sommers, I., & Baskin, 2012).

CONSIDERATIONS OF ETHICS

An in-depth understanding of privacy, permission, and the responsible application of technology is required when addressing the ethical aspects of forensic evidence. In this part, we will delve into the ethical considerations that come with forensic evidence collection and analysis, as well as the delicate balancing act that is necessary to protect both individual rights and the concepts of justice. In addition, it examines the forensic professionals' ethical responsibilities to carry out investigations without prejudice. Ethical considerations concerning forensic evidence are linked to constitutional rights under Article 14 of the Constitution of Pakistan 1973, which protects citizens' dignity and privacy. Forensic investigations, especially those involving personal data like DNA and digital footprints, must balance the need for justice with the protection of individuals' privacy. In the case of *Salman Taseer v. The State* (PLD 2012 SC 66), the Supreme Court underscored the importance of consent in obtaining DNA evidence and the potential for abuse if privacy safeguards are not observed.

A CONFIDENTIAL AND INFORMED PERMISSION

The right to privacy is a major ethical consideration in the context of forensic evidence. Forensic investigations frequently probe into personally identifiable information, such as DNA fingerprints and digital footprints. It is critical to pursue justice while still protecting residents' privacy. Respecting the rights and autonomy of those being studied is essential, and this is not limited to handling delicate biological samples or intrusive internet searches (Wiltshire, 2016).

CONTEMPORARY CRIMINAL INVESTIGATIONS AND THE IMPORTANCE OF FORENSIC EVIDENCE

Technology and the Risk of Abuse Ethical concerns, such as the potential for abuse, arise from the fast development of forensic technologies. New technologies have both positive and negative aspects; although they are essential for crime investigation, they pose risks of overburdening law enforcement or causing unforeseen effects. New technologies such as facial recognition software, genetic genealogy databases, and advanced monitoring tools are becoming more and more commonplace, and it is important to evaluate their potential ethical consequences. Ensuring that technology advancements are regulated appropriately and managed in a morally good manner is extremely important to prevent unjustified abuses of individual liberty.

PERSONAL FREEDOMS AND FAIR TREATMENT

One of the most important aspects of ethical forensic techniques is ensuring that the delicate balance between justice and individual rights is upheld. Ethical issues follow from the initial gathering of evidence to its subsequent analysis and presentation in court. Forensic specialists have an ethical obligation to deliver their findings honestly and impartially to ensure that justice is served fairly and transparently while respecting the rights of victims and suspects. Miscarriages of justice can be avoided by being open and honest about the limitations of forensic evidence and discussing uncertainty.

THE DUTY OF FORENSIC EXPERTS TO ACT ETHICALLY

When it comes to the criminal court system, forensic experts are considered exceptional. Their employment responsibilities are expanded as a result. The integrity, objectivity, and fairness of the forensic inquiry are crucial to maintaining public trust in it. To guarantee the reliability of the forensic procedure, it is critical to adhere to three principles: honesty, impartiality, and openness. Forensic disciplines foster an ethical mindset through ethical education, continuous education, and adherence to professional norms. Forensic evidence cannot be examined in a legal or ethical vacuum, given the presence of these dilemmas. Finding a middle ground between seeking justice and protecting individual rights is crucial in this regard. Efforts to develop new ethical paradigms for forensic evidence technologies will likewise proceed at a rapid rate. There can be no just legal system apart from ethical principles (Nickell, J., & Fischer, J. F. 2014).

INFLUENCE ON CRIMINAL COURT RULES

A more open and responsible judicial system, faster case settlement, and fewer false convictions are all results of the revolutionary age that forensic evidence has brought to the criminal justice system. In this part, we'll look at how forensic evidence has changed the criminal justice system in many ways, including how it helps with cold cases, prevents unjust convictions, and deals with the possibilities and threats given by new technologies.

CLOSE OF UNSOLVED CASES

When forensic expertise is used, long-dormant investigations that have failed to resolve cold cases become a shining example. Recently improved precision tools, such as DNA analysis and fingerprinting, have breathed new life into cases like this, offering investigators a chance for a new beginning in their unresolved crime problem. It is cause for gratitude that, on rare occasions, the capacity to test samples of different types of material or to link previously unrelated evidence has resulted in some remarkable discoveries. That has restored victims' rights and provided closure to their families. While everything else fails, forensic science can help us find answers by breaking a path through the ropes that bind reality.

REDUCING THE NUMBER OF FALSE CONVICTIONS

The tragic reversal of a wrongfully decided verdict can be avoided by powerful forensic evidence. Before anything else, forensic procedures lessen the need to depend solely on indirect evidence or witness testimony by offering scientific reasons for the identification of the perpetrators and tying them to crime sites. Among the scientifically uneducated, because DNA evidence has been crucial in the acquittal of many erroneous convicts. An example of justice in action that upholds the values of equity and fairness is the use of forensic evidence, which serves to both, identify and apprehend those responsible for wrongdoing.

AN OPEN AND RELIABLE JUSTICE SYSTEM

The integration of forensic evidence enhances the openness and responsibility of the judicial system. Forensic procedures have increased public trust in the justice system by providing more solid evidence that is both objective and reliable. Forensic science also benefits from standards-based quality control

laws and tried-and-true scientific procedures. More than just reassuring the public, such openness demonstrates the integrity and fairness of the judicial system.

POSSIBILITIES AND DIFFICULTIES PRESENTED BY TECHNOLOGICAL PROGRESS

Technological progress has opened up new vistas for forensic science but that has also brought new challenges and opportunities. To keep one step ahead of hackers, one must constantly adapt to the ever-increasing complexity of digital forensics. To make the most of technical resources, it is necessary to find a middle ground between being innovative and being ethical. Plus, it's important to constantly assess and validate potential limits of forensic procedures, as well as ensure their continuous dependability, because relying on them raises questions. Forensic evidence has far-reaching and dramatic consequences for the criminal court system. Forensic science has developed into a powerful tool for justice in the legal system, useful for anything from resolving long-lost cases to protecting innocent men from false accusations. The requirement for an adaptable and moral strategy is ever-growing in response to the ever-changing nature of technology and the opportunities and threats it poses. This will keep forensic evidence at the center of the criminal justice system's quest for truth, accountability, and justice (Lynch 2013).

SCENARIO IN PAKISTAN

The forensic evidence framework in Pakistan faces substantial challenges, primarily rooted in the lack of robust infrastructure, inadequate training, and legal ambiguities that hinder the effective use of forensic science in criminal investigations. Despite advancements in forensic technologies, including DNA analysis and digital forensics, their integration into the legal system remains limited and inconsistent. The legal system's reliance on traditional forms of evidence over scientific evidence can lead to prolonged case resolutions and the risk of wrongful convictions or acquittals due to misinterpretation of forensic evidence. The absence of a comprehensive regulatory structure for forensic laboratories and limited training among law enforcement officials exacerbate these issues, making it difficult to establish an effective forensic culture within Pakistan's judicial framework.

In Pakistan, forensic evidence is governed by laws such as the Pakistan Penal Code (PPC) and the Qanoon-e-Shahadat Order (QSO) 1984. Article 164 of the QSO gives courts discretionary power to admit evidence obtained via modern devices. While this provision allows for flexibility, it lacks detailed guidelines on

admissibility, resulting in inconsistent application in the courts. For instance, courts have often disregarded forensic evidence due to procedural flaws, as demonstrated in cases where the chain of custody is inadequately maintained or evidence is mishandled. Additionally, the criminal justice system lacks proper protocols to ensure the timely and systematic collection of evidence, leading to issues such as contamination and evidence degradation, which compromise the reliability of forensic evidence in trials.

To address these challenges, Pakistan's forensic framework requires legal reforms and procedural enhancements. Some key steps include establishing an independent forensic regulatory authority to standardize and monitor forensic practices across the country. This authority could oversee the accreditation of forensic laboratories, ensuring compliance with international standards for evidence collection, handling, and analysis. Furthermore, amending Article 164 of the QSO to include explicit guidelines on admissibility, collection procedures, and the maintenance of evidence chains would strengthen the role of forensic science in the judicial process.

Additional amendments to the Pakistan Penal Code could create provisions for mandatory forensic evidence in serious criminal cases, such as murder and sexual assault, particularly for DNA evidence. Introducing a section that mandates proper evidence handling and clear repercussions for mishandling evidence could improve accountability among law enforcement and forensic personnel. Furthermore, incorporating forensic evidence training modules in law enforcement and judicial training programs would enhance understanding and effective utilization of forensic science in criminal investigations.

In conclusion, implementing these legal reforms and enhancing procedural safeguards are crucial to establishing a reliable forensic evidence framework in Pakistan. Such steps would not only bolster the credibility of forensic evidence but also ensure that the pursuit of justice is based on scientifically sound, reliable, and objective findings.

CONCLUSION

Forensic evidence has undergone a significant metamorphosis around the scientific, legal, and ethical terrains since the rise of contemporary criminal justice. When it comes to instances of unfairness, it has made a huge difference. Our investigations have led us to the conclusion that forensic evidence is a powerful system prop that shapes our understanding of justice and directs our quest for the truth. In contrast to fingerprinting, which has been around for a long time, microarray analysis of genetic data is a relatively new phenomenon. The trajectory analysis is where ballistics shine, whereas digital forensics delves deep into computers and other electronic devices to uncover their hidden secrets. When

it comes to solving crimes, the several forensic subfields each play an important but distinct role. The evolution of forensic science from its earliest days to its current level demonstrates a never-ending pursuit of precision and dependability in the pursuit of justice.

However, concerns over the credibility of forensic science have increased in tandem with its advancements and development. Constant attention and quality control are required due to reliability considerations such as the likelihood of human mistakes, contamination, and specific limitations in methodology, among others. Incorporating a method of presenting forensic evidence in court that gives everything significance. There needs to be a balance if justice is to be served, and ethical issues have brought attention to the proper use of forensic evidence. As technology progresses, the forensic community must exercise caution to protect individuals' privacy, get their informed permission, and avoid any potential exploitation. If forensic evidence can alter the criminal justice system's practices, it will have far-reaching and profound philosophical consequences. Forensic science has become an important tool in identifying and resolving cold cases as well as in preventing wrongful convictions. It provides much-needed openness and ensures that the justice system is held to account. The significance of steadfast dedication to ethical conduct, scientific validation, and adaptation to new complications is heightened by the fact that technological innovation presents both possibilities and problems, mirroring the dynamic nature of forensic research. To put it simply, in today's criminal justice system, forensic evidence is not seen as an objective bystander but rather as an active participant who guides investigators through complex crime scenes and helps to establish a clear and just legal system. Even though science, law, and ethics are always interacting, forensic evidence has always had and always will have a significant impact on how justice is defined.

The document underscores the transformative impact of forensic evidence on criminal investigations globally and highlights its increasing relevance within Pakistan's justice system. Forensic evidence, especially in DNA analysis, fingerprinting, and digital forensics, has brought a scientific foundation to investigations, enhancing the accuracy of criminal identification and reducing wrongful convictions. However, in Pakistan, significant challenges remain. These include inconsistent evidence-collection standards, limited technological infrastructure, and the absence of sufficient training for law enforcement.

Legal reforms are necessary to enhance the collection and reliability of forensic evidence. Initially, Pakistan must implement rigorous processes for the collection, preservation, and management of the chain of safekeeping for evidence. Secondly, extensive training programs for law enforcement and forensic professionals are essential for guaranteeing procedural precision and reducing errors. Revising the Qanun-e-Shahadat Order to delineate admissibility criteria

and implement quality standards would enhance uniformity in the assessment of forensic evidence across cases.

Moreover, the establishment of a centralized forensic authority and the augmentation of investments in laboratory facilities will enhance effective forensic processes. Revising legislation to require consistent protocols and independent supervision of forensic practices could substantially increase public and judicial trust in forensic evidence, hence improving justice results in Pakistan.

Considering these facts, it is evident that an individual who perpetrates a crime cannot evade consequences. The heavens will demand retribution if he evades consequence.

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