

THE CRISIS OF FORENSIC RELIABILITY IN PAKISTAN: AN ANALYSIS OF WEAK CHAIN-OF-CUSTODY PRACTICES AND THEIR IMPACT ON CRIMINAL CONVICTIONS

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Abstract

Forensic evidence is an essential part of modern criminal justice systems, which serve as a key junction through which empirical truth in the scientific domain can be reconciled with formal legal adjudication. In Pakistan, on the other hand, reliability of the forensic evidence is seriously compromised by a continuing weakness in chain-of-custody routes. The given paper systematically examines the impact which institutional fragmentation, lack of standardization of procedures, inadequate training, and poor documentation have on the loss of forensic integrity and consequently, a negative impact of conviction outcomes. Through qualitative analytic approach methodology that should be coupled with comparative legal and policy analysis, the study measures the present-day forensic practices against international standards like ISO/IEC 17025. The results point to the fact that the impact of chain-of-custody failures is a regular polluting of evidence, breeding judicial distrust, contributing to acquittals, and undermining the trust that people have in the criminal justice system. The paper argues that only evolution of technology cannot address these problems without accompanied legal reforms, capacity development, and cultural change towards the direction of evidence-based justice. Based on this, it proposes an inclusive policy framework of focusing on the use of standardized operating procedures, digital evidence-tracking systems, specific judicial training, and independent judicial oversight in the form of forensic experts. Chain-of-custody procedures need to be reinforced to facilitate fair convictions, protection of due process rights and credibility to the criminal justice system in Pakistan.

INTRODUCTION

Forensic science occupies a central position in contemporary criminal justice systems by providing objective, scientific assistance in determining guilt or innocence. Its evidentiary value, however, depends not merely on laboratory analysis but on the integrity of the chain of custody—the continuous, documented, and

verifiable process through which evidence is collected, preserved, transferred, analyzed, and presented before the court. Any breach in this chain compromises the authenticity of evidence and renders forensic findings legally vulnerable. In Pakistan, despite the establishment of specialized forensic institutions such as the Punjab

Forensic Science Agency and provincial DNA laboratories, the criminal justice system continues to suffer from a crisis of forensic reliability. Courts frequently encounter evidence that is poorly preserved, inadequately documented, or susceptible to tampering. As a result, forensic material is often excluded or accorded limited probative value, particularly in serious criminal cases involving murder, terrorism, and sexual violence.

1.1 Problem Statement

The systemic issue that is explored in the present study is that the chain-of-custody practices in the Pakistani criminal justice system are weak. The mishandling of evidence at crime scenes and during transfer is common, and such evidence may be kept in unsecured conditions and represented in courts incompletely with a record of custody. These shortcomings result in contamination, evidence loss, judicial distrust and unreliable conviction results. The lack of a cohesive national forensic policy, the ability to track digital evidence, and the application of the custody standard that can be legally enforced do not contribute to solving this crisis, which violates the right to fair trial and erodes societal trust.

1.2 Aims and Objectives of the Study

The primary aim of this research is to examine the impact of weak chain-of-custody practices on forensic reliability and criminal convictions in Pakistan.

The specific objectives are to:

1. Analyze institutional, procedural, and legal weaknesses affecting chain-of-custody practices in Pakistan.
2. Examine the relationship between custody failures and unreliable conviction outcomes.
3. Compare Pakistan's forensic practices with international standards and best practices.
4. Identify gaps in existing legal and policy frameworks governing forensic evidence.
5. Propose practical, policy-oriented reforms to strengthen forensic reliability and evidentiary integrity.

1.3 Contribution of the Paper

The following aspects are significant contributions of this paper. First, it establishes chain-of-custody failure as the focal point of forensic unreliability in Pakistan as opposed to portraying the forensic weaknesses as a uniform issue. Second, it combines the legal analysis with the forensic governance and policy analysis, and provides the multidisciplinary approach in accordance with the quality of the Policy Research Journal. Third, it suggests a reform-based system of focus on digital records, uniformity of protocol and institutional responsibility in order to increase conviction rate and judicial trust.

1.4 Structure of the Paper

The remainder of this paper is organized as follows. **Section 2** reviews the relevant literature on forensic evidence and chain-of-custody practices, identifying key themes and research gaps. **Section 3** outlines the research methodology and analytical framework adopted in the study. **Section 4** presents a comparative analysis of international forensic practices to contextualize Pakistan's challenges. **Section 5** proposes a policy-oriented reform framework for strengthening chain-of-custody mechanisms. **Section 6** discusses the findings in light of institutional and governance constraints. Finally, **Section 7** concludes the paper and highlights directions for future research.

2. Literature Review

The reliability of forensic evidence has been widely examined in legal and criminological scholarship, with particular emphasis on the chain of custody as a prerequisite for evidentiary admissibility and probative value. The chain of custody refers to the documented and uninterrupted control of evidence from the crime scene to its presentation in court, ensuring that the material remains authentic, uncontaminated, and legally verifiable.

2.1 Conceptual Understanding of Chain of Custody

International literature conceptualizes chain of custody as both a **procedural safeguard** and an **institutional accountability mechanism**. James

and Nordby (2020) describe it as the backbone of forensic credibility, without which scientific findings lose legal significance. Houck and Siegel (2019) further argue that chain-of-custody integrity is not limited to documentation but extends to trained personnel, secure storage, standardized handling procedures, and oversight mechanisms. Scholars emphasize that even minor lapses—such as missing timestamps, improper sealing, or undocumented transfers—can invalidate forensic evidence during judicial scrutiny. Consequently, courts in many jurisdictions treat chain-of-custody compliance as a threshold requirement for admissibility.

2.2 Forensic Evidence and Chain-of-Custody Practices in Pakistan

In the Pakistani context, existing studies consistently highlight deficiencies in forensic handling and evidence management. Ali and Malik (2023) identify lack of standardized procedures and insufficient forensic training of police officers as major contributors to evidentiary weaknesses. Rizwan and Mehdi (2024) observe that although forensic laboratories have expanded in recent years, their effectiveness is undermined by weak coordination with law enforcement agencies and prosecutors.

Empirical observations indicate that evidence is often collected by untrained personnel, transported without proper packaging, and stored

in facilities lacking basic preservation requirements. Documentation remains largely manual and fragmented, increasing the risk of loss, tampering, and judicial rejection.

2.3 International Perspectives and Best Practices

Comparative literature underscores the importance of **accreditation standards, digital documentation, and independent oversight** in maintaining forensic reliability. Jurisdictions such as the United Kingdom and the United States have institutionalized national forensic regulators, digital evidence-tracking systems, and mandatory laboratory accreditation under ISO/IEC 17025 (UNODC, 2023).

These systems ensure transparency, traceability, and accountability at every stage of evidence handling, significantly enhancing conviction accuracy and judicial confidence.

2.4 Research Gap and Comparative Positioning

Despite growing scholarship on forensic challenges in Pakistan, most studies address forensic unreliability in broad terms. There is limited focused analysis identifying **chain-of-custody failure as the principal structural cause** of unreliable convictions. Moreover, policy-oriented solutions remain underdeveloped.

Table 1: Comparison of Existing Literature and the Present Study

Dimension	Existing Studies	Present Study
Core Focus	General forensic challenges	Chain-of-custody as central failure
Analytical Depth	Descriptive	Systemic and causal analysis
Methodology	Doctrinal / narrative	Qualitative analytical & comparative
Policy Orientation	Limited	Explicit reform framework
International Benchmarking	Partial	Systematic and standards-based
Contribution	Problem identification	Solution-driven policy model

3. Research Methodology

This study employs a **qualitative, analytical, and policy-oriented research methodology** to examine the crisis of forensic reliability in Pakistan, with

particular emphasis on weaknesses in chain-of-custody practices and their impact on criminal convictions. The methodology is designed to analyze institutional structures, legal frameworks, procedural practices, and governance

mechanisms rather than focusing solely on laboratory-based forensic techniques.

Given that chain-of-custody failure is primarily a **systemic and governance problem**, a qualitative approach is most appropriate for capturing procedural lapses, institutional behavior, and policy deficiencies that directly influence evidentiary integrity and judicial outcomes.

3.1 Research Paradigm and Approach

The research is grounded in a **socio-legal and institutional analysis paradigm**, integrating legal doctrinal analysis with forensic governance and public policy evaluation. This approach enables a comprehensive assessment of how legal rules, institutional practices, and administrative systems interact to shape forensic reliability.

A **comparative analytical approach** is also adopted to benchmark Pakistan's chain-of-custody practices against internationally recognized forensic systems. This comparative lens assists in identifying structural gaps and feasible reform pathways aligned with global best practices.

3.2 Research Design

A **descriptive-analytical research design** has been employed. This design allows the study to:

- Describe existing chain-of-custody practices in Pakistan.
- Analyze institutional and procedural deficiencies.
- Assess their consequences for conviction reliability.
- Develop policy-oriented reform recommendations.

The design supports systematic integration of legal texts, judicial decisions, institutional reports, and international forensic standards.

3.3 Data Sources and Data Collection

This research relies on **secondary qualitative data**, ensuring methodological rigor and reliability.

3.3.1 Legal and Judicial Sources

- Judicial decisions concerning forensic evidence admissibility under the **Qanun-e-Shahadat Order, 1984**.

- Cases where evidence was excluded or weakened due to chain-of-custody defects.
- Judicial commentaries and training materials related to forensic evidence.

3.3.2 Institutional and Policy Sources

- Reports from the National Forensic Science Agency, Punjab Forensic Science Agency, and provincial forensic laboratories.
- Policy documents issued by international organizations such as UNODC and UNESCO.
- Accreditation and forensic quality standards, including ISO/IEC 17025.

3.3.3 Academic Literature

- Peer-reviewed journal articles published between 2019 and 2024.
- Comparative studies on forensic governance and criminal justice reform.

3.4 Analytical Framework

To ensure systematic analysis, collected data were examined across **five interrelated analytical dimensions**:

1. Institutional capacity and inter-agency coordination.
2. Legal and procedural compliance.
3. Documentation and evidence management mechanisms.
4. Cultural and ethical practices within law enforcement.
5. Policy and governance alignment.

This framework allows the study to trace how failures at each stage of the chain of custody collectively undermine forensic reliability and conviction outcomes.

3.5 Research Methodology Workflow

This section explains the logical and sequential structure of the research process adopted in the study. The research methodology workflow is designed to ensure transparency, coherence, and systematic progression from problem identification to policy-oriented outcomes. Given the qualitative and analytical nature of the study,

the workflow serves as a roadmap illustrating how diverse data sources, analytical stages, and comparative evaluations are integrated into a unified methodological framework.

The workflow begins with identification of the core research problem—namely, the crisis of forensic reliability caused by weak chain-of-custody practices in Pakistan. This is followed by a comprehensive review of relevant legal, forensic, and policy literature to establish conceptual foundations and identify research gaps. Subsequently, qualitative data are collected from judicial decisions, institutional reports, and academic sources. These data are then categorized into distinct analytical dimensions to facilitate

structured examination. Comparative analysis with international forensic standards allows benchmarking of national practices, after which the findings are evaluated in terms of their impact on conviction reliability and judicial confidence. The workflow culminates in the formulation of a policy-oriented reform framework aimed at strengthening chain-of-custody mechanisms and forensic governance.

This structured workflow ensures methodological rigor by maintaining a clear linkage between research objectives, analytical processes, and policy recommendations.

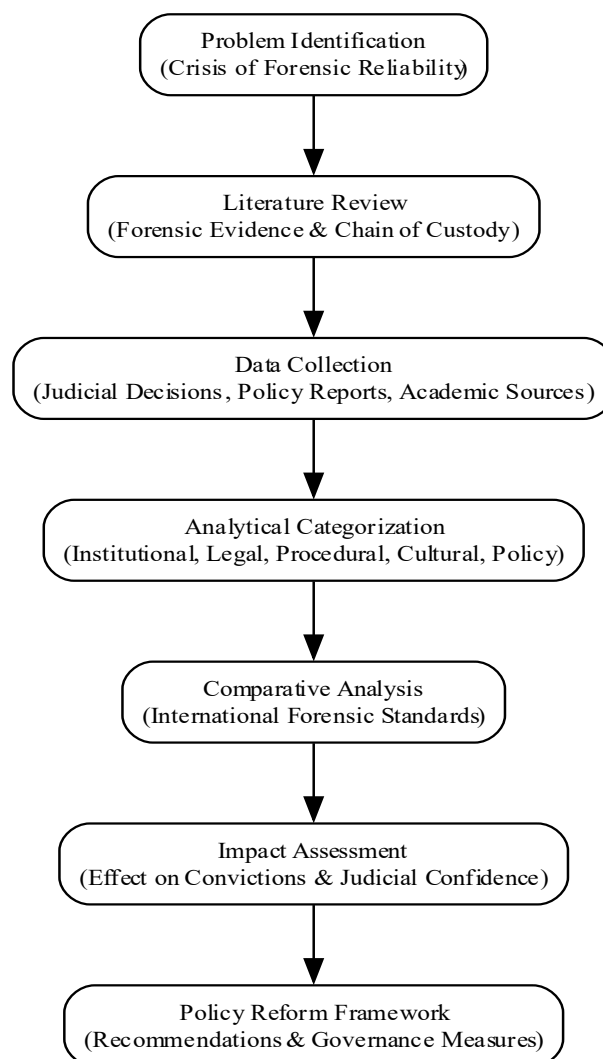


Figure 1: Research Methodology Workflow.

Figure 1 illustrates the sequential workflow adopted in this study. The research begins with identification of the forensic reliability crisis, followed by a structured review of relevant literature. Qualitative data are then collected from legal, institutional, and academic sources. These data are categorized into analytical dimensions, benchmarked against international standards, and evaluated for their impact on conviction outcomes. The process culminates in the development of a policy-oriented reform framework.

3.6 Analytical Framework for Chain-of-Custody Assessment

The analytical framework presented in this section provides the conceptual foundation for evaluating weaknesses in chain-of-custody practices. Rather than treating forensic failure as a singular technical issue, the framework conceptualizes chain-of-custody integrity as a multidimensional phenomenon influenced by legal, institutional, procedural, cultural, and governance-related factors.

This framework allows the study to systematically examine how failures at different stages of evidence handling—ranging from crime scene management to courtroom presentation—collectively undermine forensic reliability. Institutional capacity and coordination are assessed to understand inter-agency relationships and accountability structures. Legal and procedural compliance is examined to evaluate the adequacy of statutory guidance and evidentiary rules. Documentation and evidence management mechanisms are analyzed to assess traceability, transparency, and auditability. Cultural and ethical practices are explored to identify resistance to forensic modernization and reliance on non-scientific investigative methods. Finally, policy and governance alignment is examined to determine consistency with international standards and best practices.

By applying this analytical framework, the study moves beyond descriptive observations and offers a structured explanation of how systemic deficiencies converge to weaken evidentiary integrity and conviction outcomes.

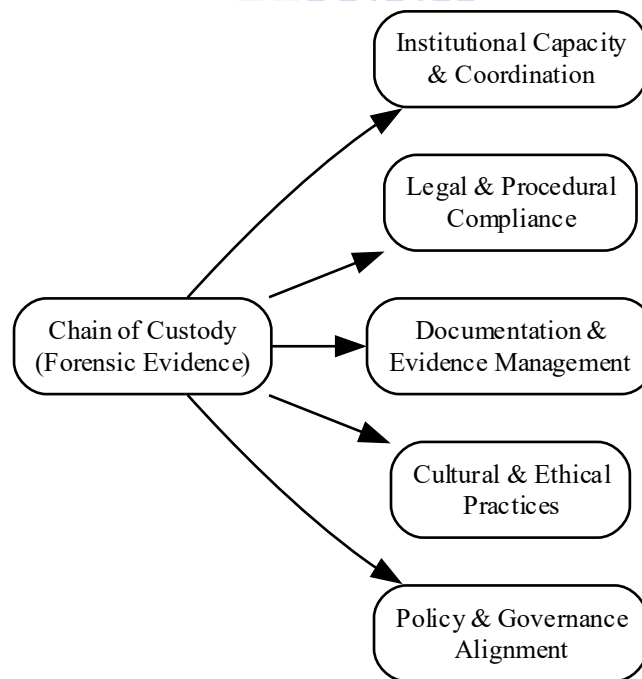


Figure 2: Analytical Framework for Chain-of-Custody Evaluation.

Figure 2 presents the analytical framework used to assess chain-of-custody weaknesses. The chain of custody is treated as the central analytical unit and examined through five interconnected dimensions. This framework enables the study to move beyond technical shortcomings and evaluate governance, legal, and cultural factors that compromise forensic integrity.

3.7 Comparative Benchmarking Framework

The comparative benchmarking framework is employed to contextualize Pakistan's chain-of-custody practices within a broader international perspective. This section explains the rationale for selecting comparative jurisdictions and the indicators used to assess forensic governance models. Comparative analysis is essential in policy-oriented research, as it enables identification of structural gaps and realistic reform pathways rather than abstract ideal standards.

The framework benchmarks Pakistan's forensic system against selected jurisdictions with established forensic governance structures, focusing on accreditation mechanisms, digital evidence-tracking systems, independent oversight bodies, and legal enforceability of custody protocols. These jurisdictions serve as reference models demonstrating how standardized procedures and accountability mechanisms enhance forensic reliability and judicial confidence.

The purpose of this comparative framework is not to replicate foreign systems mechanically but to extract transferable principles suitable for Pakistan's legal and institutional context. Through systematic comparison, the study identifies deficiencies in national practices and informs the development of a reform framework that aligns international best practices with domestic realities.

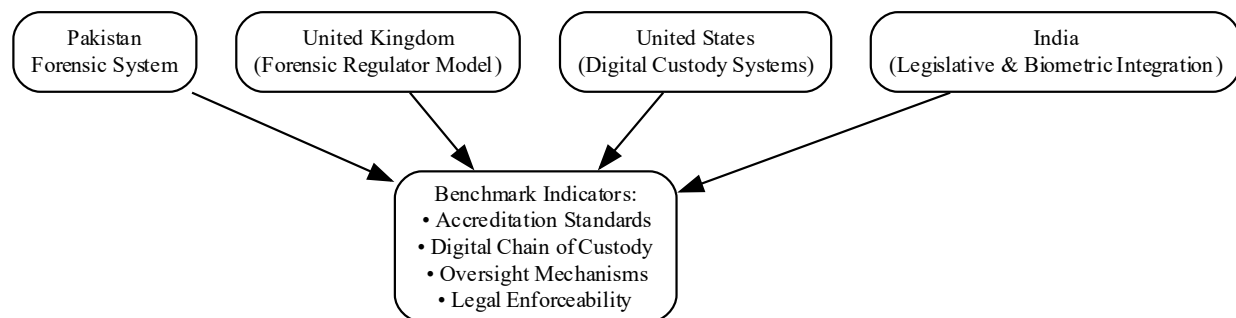


Figure 3: International Comparative Benchmarking Framework.

Figure 3 illustrates the comparative benchmarking framework applied in this study. Pakistan's forensic system is evaluated alongside selected international jurisdictions using clearly defined indicators. This comparison facilitates identification of institutional and legal gaps and informs the formulation of realistic, policy-relevant reform recommendations.

3.8 Methodological Rigor and Limitations

The qualitative methodology ensures analytical depth, contextual understanding, and policy relevance. However, the study does not employ quantitative conviction data due to the absence of standardized forensic performance metrics in

Pakistan. Future empirical studies may complement this framework with data-driven assessments.

3.9 Policy Reform Implementation Model

The Policy Reform Implementation Model is introduced to translate the analytical findings of this study into a structured and actionable reform pathway. While previous sections identify institutional, legal, and procedural weaknesses in chain-of-custody practices, this model explains **how reform can be systematically operationalized** within Pakistan's criminal justice system. The model conceptualizes forensic reform as a multi-stage governance process that integrates policy formulation, legal enforcement, institutional

capacity building, technological modernization, and judicial engagement.

This model is grounded in the assumption that isolated interventions—such as laboratory upgrades or training programs—are insufficient to restore forensic reliability unless they are embedded within a coherent policy and

accountability framework. Accordingly, the model adopts a sequential yet interdependent approach, ensuring that reforms at each stage reinforce one another and contribute to sustainable improvement in evidentiary integrity and conviction accuracy.

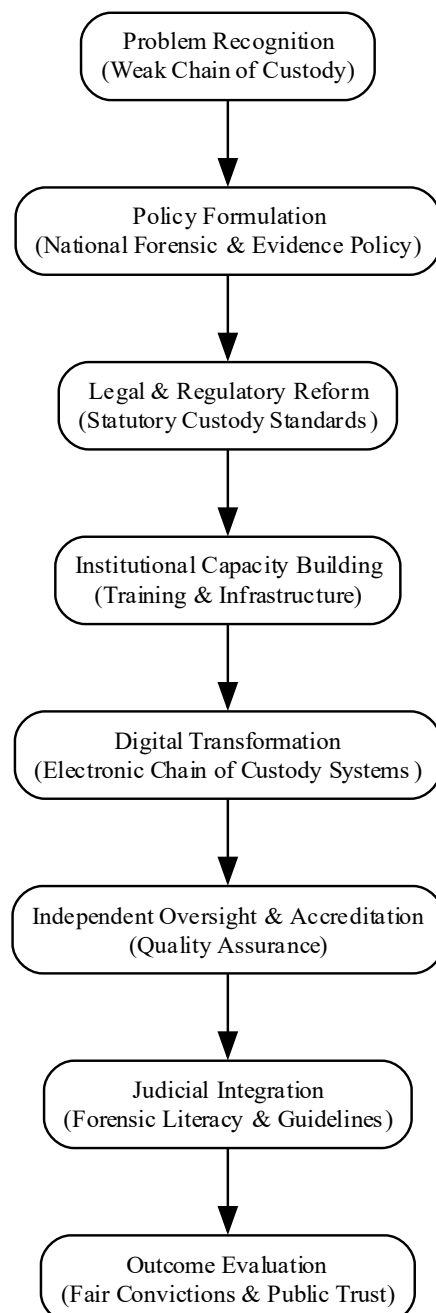


Figure 4: Policy Reform Implementation Model for Strengthening Chain-of-Custody Practices.

Figure 4 illustrates the proposed **Policy Reform Implementation Model** aimed at strengthening chain-of-custody mechanisms and improving forensic reliability in Pakistan. The model begins with formal recognition of weak chain-of-custody practices as a systemic problem affecting criminal convictions and judicial credibility.

The second stage focuses on policy formulation, advocating the development of a comprehensive National Forensic Science and Evidence Management Policy to establish uniform standards across provinces. This policy must then be reinforced through legal and regulatory reforms that explicitly define custody obligations, documentation requirements, and penalties for violations.

Subsequent stages emphasize institutional capacity building, including specialized training for law enforcement officers, forensic personnel, and prosecutors, alongside infrastructure modernization. Digital transformation is positioned as a pivotal reform component, enabling electronic chain-of-custody systems that ensure real-time tracking, transparency, and auditability of evidence.

Independent oversight and accreditation mechanisms are incorporated to maintain forensic integrity and reduce political or institutional interference. The model further integrates judicial reforms by enhancing forensic literacy among judges and establishing guidelines for evaluating chain-of-custody compliance.

The final stage of the model links successful reform implementation to measurable outcomes, including fair and reliable convictions, reduced evidentiary disputes, and restoration of public confidence in the criminal justice system.

4. Comparative Analysis of International Forensic Practices

This section situates Pakistan's forensic challenges within a comparative international context to demonstrate how governance structures, legal enforceability, and evidence-management systems influence forensic reliability and conviction outcomes. Comparative analysis is essential in policy-oriented research to distinguish structural deficiencies from contextual constraints and to identify reform models adaptable to domestic realities.

In the **United Kingdom**, forensic reliability is maintained through mandatory laboratory accreditation and oversight by an independent Forensic Science Regulator. Digital chain-of-custody systems ensure traceability and accountability at every stage of evidence handling. Courts place high evidentiary confidence in forensic reports due to strict compliance with ISO/IEC 17025 standards.

The **United States** employs integrated electronic evidence-tracking systems and centralized forensic databases. Time-stamped custody logs, specialized forensic units, and continuous professional training contribute to strong institutional credibility and judicial trust.

In **India**, legislative reforms and national-level forensic coordination have strengthened biometric evidence handling and inter-agency cooperation. Standardized operating procedures and statutory authority enhance accountability and consistency.

By contrast, Pakistan's forensic system remains fragmented. Evidence handling is largely manual, oversight mechanisms are weak, accreditation is inconsistent, and legal enforceability of chain-of-custody standards is limited. These deficiencies explain recurring judicial skepticism toward forensic evidence and unreliable conviction outcomes.

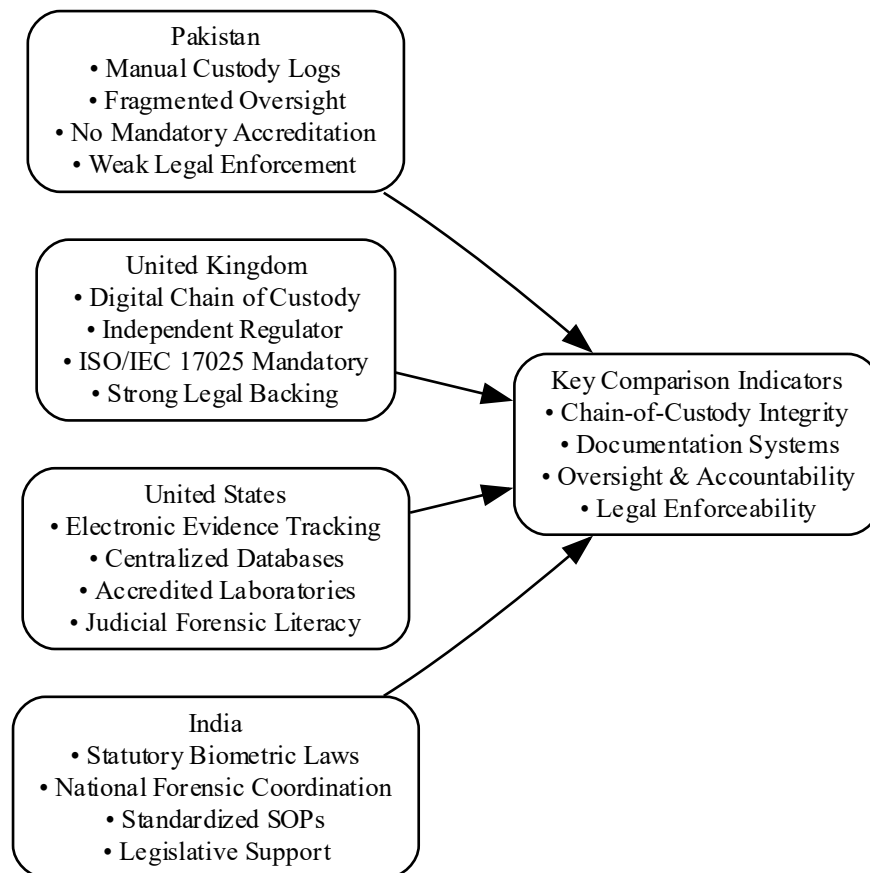


Figure 5: Comparative Forensic Governance and Chain-of-Custody Model.

Figure 5 illustrates comparative forensic governance structures across selected jurisdictions using core indicators of chain-of-custody integrity, documentation mechanisms, oversight, and legal enforceability. The model highlights that jurisdictions with independent regulators, digital custody systems, and statutory accreditation demonstrate stronger forensic reliability and judicial confidence. Pakistan's reliance on manual documentation and fragmented oversight explains persistent evidentiary vulnerability and conviction inconsistency.

5. Policy-Oriented Reform Framework for Strengthening Chain-of-Custody Practices

Building on the comparative analysis and methodological findings, this section proposes a policy-oriented reform framework aimed at

strengthening chain-of-custody mechanisms in Pakistan. The framework emphasizes that forensic reliability cannot be restored through isolated interventions but requires coordinated legal, institutional, and technological reform.

Core elements of the framework include formulation of a **National Forensic Science and Evidence Management Policy**, enforcement of standardized operating procedures, digital transformation of custody systems, institutional capacity building, and establishment of independent oversight mechanisms. These reforms are designed to align forensic practices with international standards while remaining sensitive to Pakistan's legal and administrative structure.

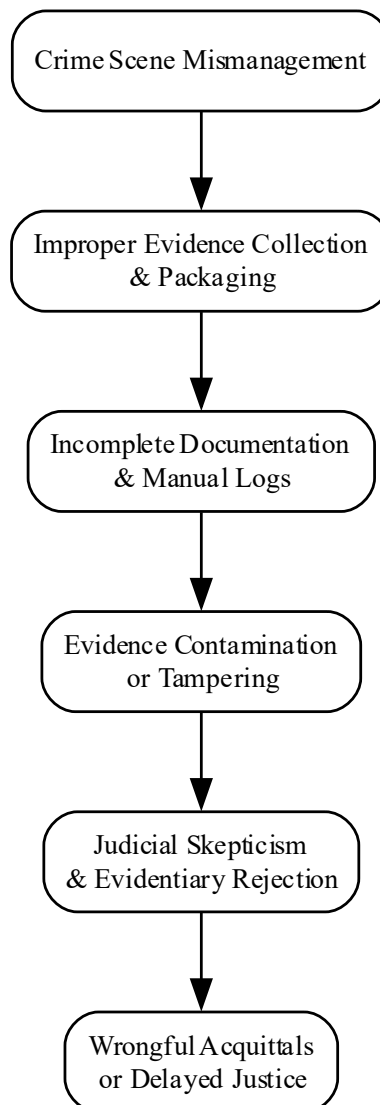


Figure 6: Chain-of-Custody Failure Impact Pathway.

Figure 6 demonstrates the causal pathway through which chain-of-custody failures translate into unreliable judicial outcomes. Procedural lapses at early stages of evidence handling propagate through the criminal process, ultimately resulting in evidentiary exclusion, wrongful acquittals, or delayed justice. The figure reinforces the study's argument that forensic unreliability is cumulative and systemic rather than incidental.

6. Discussion

The findings of this study confirm that forensic unreliability in Pakistan is fundamentally a **governance and procedural failure**, not a technological limitation. Weak chain-of-custody practices—characterized by manual documentation, lack of standardized protocols, inadequate training, and poor institutional coordination—consistently undermine evidentiary integrity.

Although forensic laboratories have expanded, their effectiveness remains constrained by the absence of enforceable custody standards and

inter-agency integration. Judicial skepticism toward forensic evidence reflects legitimate concerns regarding procedural compliance rather than resistance to scientific methods.

The persistence of confession-based investigative culture further marginalizes forensic evidence. Without accountability mechanisms and cultural transformation toward evidence-based investigation, technological investments alone will not restore public trust or conviction reliability.

6.1 Policy Recommendations

Based on the findings and comparative analysis, the following recommendations are proposed:

1. **Adopt a National Forensic Science and Evidence Management Policy** aligned with ISO/IEC 17025.
2. **Legally codify chain-of-custody requirements** within evidentiary and procedural laws.
3. **Mandate standardized SOPs** for all evidence-handling agencies.
4. **Digitalize chain-of-custody systems** with real-time tracking and audit trails.
5. **Strengthen institutional capacity** through specialized forensic training for police, prosecutors, and judges.
6. **Establish an independent forensic oversight authority** for accreditation and compliance.
7. **Promote evidence-based investigative culture** through accountability and ethical enforcement mechanisms.

7. Conclusion and Future Research

The paper has found that the lack of chain-of-custody in Pakistan is the root cause of the crisis of forensic reliability as it negatively affects the evidentiary integrity and accuracy of conviction. Poor documentation, institutional fragmentation, lack of enforceable standards and insufficient judicial forensic literacy all contribute to the demise of the criminal justice process. The results support the main hypothesis of the abstract: if they do not have strong systems of custody, interventions or measures to make the law enforceable, and a system of institutional responsibility, justice cannot be established solely

by the power of forensic technology. Chain-of-custody systems should be reinforced with standardized procedures, digitalization, and policy change to be able to secure equitable convictions and to make citizens trust Pakistan in how justice is administered.

Future Research Directions: Future studies must be able to evaluate, empirically, how digital chain-of-custody systems affect the conviction and judicial efficiency. Dependability tests can also be improved with the help of quantitative forensic performance indicators and AI-aided evidence validation tools. Sustainable reform will be on interdisciplinary collaboration among the law enforcement agencies, academic institutions and international bodies of forensic research.

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