# Forensic Science and Wrongful Convictions in Canada: Errors, Challenges and Reforms

Ancy Maria Herbert

J0512422

Post-Baccalaureate Diploma in Law Enforcement Studies, Justice Institute of British Columbia

## Author Note

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**Abstract**

Forensic science plays a very significant role in criminal case investigation, but lately, errors in forensic methods and judicial misconceptions have significantly contributed to miscarriages of justice in Canada. The following paper examines how poorly constructed forensic methods, cognitive limitations, and the misuse of forensic data undermine the stability of the judiciary. Despite technological progress, institutional fault rests with poorly validated forensic procedures, lack of standardized regulation, and poor forensic literacy among judges and court staff. Based on the analysis of case studies, peer-reviewed journals, and legal reports, this research identifies major flaws in forensic practice including misinterpretation of forensic probability, expert bias, and inconsistent forensic standards across jurisdictions. The study discovers that forensic evidence is at times considered to be unfailing, leading to over-dependence on unsound forensic practices such as bite mark analysis and microscopic hair comparison. In response to these problems, this study recommends the establishment of a national registry of wrongful convictions, enacting stricter verification processes for forensic techniques, mandating forensic science training for legal professionals, and enhancing independent observation of forensic practice. Ensuring equal access to forensic expertise for defense and enhancing forensic admissibility criteria in courtrooms are also essential steps toward reform. Strengthening the connection between forensic science and legal accountability through interdisciplinary collaboration and policy change will enhance the validity of forensic evidence, minimize forensic errors, and prevent future wrongful convictions in Canada.

*Keywords:* Wrongful convictions, forensic errors, legal misinterpretation, forensic oversight, cognitive bias, expert testimony, forensic reliability, criminal justice reform

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# Forensic Science and Wrongful Convictions in Canada: Errors, Challenges and Reforms

Forensic science plays a crucial role in criminal investigations by providing scientific examinations that help convict or acquit suspects. However, despite advancements, challenges remain in the reliability and interpretation of forensic evidence, particularly concerning wrongful convictions (Savage, 2023). In Canada, cases of wrongful convictions due to flawed forensic examinations highlight systemic weaknesses in forensic methods and their application within the criminal justice system (CJS). Uncertainty regarding the credibility of forensic techniques, as well as the misapplication of findings by legal professionals, has contributed to miscarriages of justice (Cunliffe & Edmond, 2021). While technological advancements have strengthened forensic science, inconsistent application within the CJS continues to pose risks to innocent individuals (Pollanen, 2014). To ensure justice and maintain the integrity of Canada's CJS, it is essential to critically assess forensic methods, standardize their application, and implement safeguards that prevent wrongful convictions.

## Problem Statement

Some well-known Canadian wrongful convictions of Donald Marshall Jr., Guy Paul Morin, and David Milgaard expose inherent flaws in forensic science practice (Mason, 2020). The primary areas of concern are over-reliance on unvalidated forensic methods, expert bias, and abusive use of forensic evidence by legal professionals (Public Prosecution Service of Canada [PPSC], 2019; Cunliffe & Edmond, 2021). In some cases, forensic evidence presented in court was later discredited due to methodological defects or misrepresentation, leading to grave miscarriages of justice. Problems also exist with the lack of scientific control, inadequate training of lawyers and judges in evaluating forensic evidence, and the absence of clearly defined standards of admissibility (Garrett & Neufeld, 2009). These problems emphasize the need for

reforms to improve forensic practice, improve legal literacy in scientific evidence, and prevent the use of questionable forensic practices.

**Purpose of the Study**

This study aims to determine common forensic analysis errors resulting in wrongful convictions in Canada and how recent advances counter such obstacles. The study will also discuss potential forensic and legal reforms to ensure forensic practice is more dependable in Canada's justice system. Specifically, it will address issues like cognitive bias, lack of standardized forensic procedures, and the challenges legal professionals face when evaluating scientific evidence (Morgan, 2023a; Cunliffe & Edmond, 2021). The study will consider the impact of flawed forensic methods such as bite mark analysis and microscopic hair comparison (Pollanen, 2014), and it will propose recommendations for stricter forensic reliability standards, improved legal education, and greater accountability for forensic experts. Based on a critical review of peer-reviewed literature, government documents, forensic examinations, and case studies of wrongful convictions, this study will provide evidence-based solutions to enhance forensic science standards and legal regulation.

**Research Question**

This study strives to answer the questions: How can forensic analysis errors and legal misinterpretations cause wrongful convictions in Canada, and what reform would enhance the reliability of forensic evidence? These questions are important because forensic science is considered untouchable throughout legal proceedings. However, in the case of wrongful convictions, it exhibits the disastrous consequences of forensic errors. Misinterpretation by legal professionals, cognitive bias, and low standards of admissibility lead to miscarriages of justice (Morgan, 2023a; Savage, 2023). The current study will examine forensic and legal breakdowns

to provide recommendations for reform that enhance forensic accuracy and reduce wrongful convictions.

### Main Argument and Expectations

Forensic errors and legal misinterpretations have significantly contributed to wrongful convictions in Canada. Defective forensic practices, biased experts, and misinterpreted evidence have led to flawed convictions, compounded by the limited ability of legal professionals to critically analyze forensic science (Morgan, 2023a; Savage, 2023). The main argument of this research is that significant reforms are needed to improve the reliability of forensic evidence and ensure its accurate application in the legal system. It is expected that addressing issues like cognitive bias, lack of standardized forensic procedures, and inadequate legal evaluation of scientific evidence will help reduce wrongful convictions. This paper argues for stricter forensic reliability standards, improved legal education on scientific evidence, and greater accountability for forensic experts in the Canadian justice system.

## Literature Review

A review of the literature revealed some common themes regarding the role of forensic science in wrongful convictions. These include the accuracy and limitations of forensic techniques, the challenges in interpreting forensic evidence, the influence of cognitive biases, and the shortcomings in forensic governance and regulation. These themes are discussed across multiple sources by Garrett and Neufeld (2009), Rajapakse (2024), Scherr and Dror (2021), and Roach (2009). The ongoing controversy highlights a significant dispute over whether forensic science itself is directly responsible for wrongful convictions, as well as the necessity of legal and scientific reforms. Although technological advances in forensic techniques have certainly improved the accuracy of investigations, institutional flaws persist. These flaws indicate a need

for continuous research, standardization, and policy reforms to enhance the credibility of forensic evidence and prevent miscarriages of justice. Addressing these issues will be crucial in ensuring that forensic science can truly fulfill its role in achieving justice.

**Reliability and Limitations of Forensic Methods**

Forensic science has experienced tremendous advancements, particularly with the invention of DNA analysis. This technique has played a central role in exonerating individuals wrongly convicted of crimes (Garrett & Neufeld, 2009). However, as DNA technology has evolved, it has also revealed the limitations of older forensic methods, such as hair microscopy and bite mark comparisons, which have been linked to numerous wrongful convictions (Morgan, 2023b). These methods were initially adopted by the CJS under the assumption of their scientific validity. Yet, over time, flaws in these techniques became apparent, leading to their eventual discredit. Hair microscopy, for instance, was once a fundamental method used to connect suspects to crime scenes. It was later found to be unreliable, contributing to many wrongful convictions before being phased out (Morgan, 2023b). This highlights the importance of ongoing scrutiny and improvement of forensic methods to uphold justice.

Additionally. DNA offers significant improvements; however, this method is not without limitations. DNA evidence, while often considered the most reliable form of forensic evidence, can be subject to misinterpretation, particularly in cases involving degraded, mixed, or trace samples. A notable example is the *R v Grant* case, where the interpretation of DNA evidence was contested due to the poor quality of the sample, highlighting that even DNA evidence can be open to misinterpretation (Frederiksen, 2011). This issue underscores a broader challenge in forensic science: while some techniques, such as DNA analysis, have been scientifically validated, many others still lack empirical backing and standardized validation.

Moreover, despite the advancements in technology, many forensic specialties continue to face issues related to reproducibility and consistency. The failure to implement standardized operating procedures and validation protocols across forensic laboratories contributes to these challenges. As a result, ensuring the reliability of forensic evidence remains difficult (Giannelli, 2007). Although molecular techniques like DNA analysis have significantly improved forensic reliability, many specialties still lack the scientific rigor necessary to minimize error. This lack of rigor increases the potential for inconsistencies in forensic findings. Consequently, the risk of wrongful convictions remains a significant concern.

**Misinterpretation of Forensic Evidence and Cognitive Bias**

One of the central issues in wrongful convictions is the misinterpretation of forensic evidence, often worsened by cognitive bias. Rajapakse (2024) emphasizes that legal professionals, including judges, prosecutors, and defense attorneys, often lack the specialized scientific knowledge required to critically evaluate forensic testimony. This knowledge gap can lead to misapplications of forensic evidence, particularly when presented with vague or overly presumptive language. Terms like consistent with or matches are commonly used by forensic experts, but they can result in jurors overestimating the confidence level in the evidence, potentially leading to wrongful convictions (LaPorte, 2018). Addressing these issues requires greater scientific literacy among legal professionals and stricter guidelines for the presentation of forensic evidence to prevent misinterpretations that could lead to wrongful convictions. In addressing these challenges, Rajapakse (2024) proposed a novel framework called the Egg Analogy. This framework categorizes forensic evidence into layers of reliability, helping judges and attorneys differentiate scientifically validated methods from those that are less credible or

unproven. The analogy provides a structured way to understand the varying degrees of certainty that forensic evidence can present, thereby assisting in its proper application in court.

Cognitive bias plays a significant role in the misinterpretation of forensic evidence. Forensic experts, like all practitioners, are susceptible to biases that influence their judgments. Scherr and Dror (2021) discuss how experts may unconsciously align their conclusions with law enforcement expectations, leading to confirmation bias and compromised forensic outcomes. Additionally, the problem of contextual bias further complicates forensic evidence interpretation. Experts may be influenced by case-related information, such as details of the investigation, which they would otherwise be insulated from, resulting in misleading conclusions. Garrett and Neufeld (2009) also highlight how contextual factors, such as pressure from law enforcement or the nature of the investigation, can lead to biased forensic conclusions, thereby increasing the risk of wrongful convictions. These biases can distort the interpretation of forensic findings and contribute to miscarriages of justice.

The adversarial nature of the legal system also worsens this issue. Both the prosecution and defense attorneys may seek to frame forensic outcomes in ways that benefit their clients. This can lead to selective interpretation or even evidence manipulation. The case of Guy Paul Morin, whose wrongful conviction was influenced by misinterpreted fiber testing, demonstrates this problem (Savage, 2023). This stresses the need for increased scrutiny of forensic evidence within the courtroom, ensuring that legal professionals are adequately trained to understand and interpret forensic data accurately.

**Systemic Failures of Forensic Governance**

A significant contributor to wrongful convictions is the lack of regulatory oversight in forensic science. Canada's decentralized forensic system means there is no national standard for

accrediting forensic labs. This leads to varying levels of forensic quality across provinces. As Roach (2009) points out, this lack of a unified regulatory body means forensic practices differ from province to province, making it difficult to ensure uniform standards for accuracy and reliability. This decentralization also limits accountability, which is problematic given the potential for errors in forensic analysis.

The lack of oversight is particularly concerning in jurisdictions where forensic analysts work closely with law enforcement agencies. This raises concerns about bias and conflicts of interest. For instance, the Motherisk drug-testing scandal highlights how flawed forensic testing led to improper convictions. This case further emphasizes the need for independent forensic laboratories. It also highlights the importance of robust regulatory systems (Roach, 2009; Morgan, 2023b). Without effective oversight, forensic science risks becoming a tool used to secure convictions, rather than an impartial process for truth-seeking.

**Legal Reforms to Improve Forensic Reliability**

To enhance the reliability of forensic evidence, it is crucial to ensure that only scientifically validated methods are admitted in court. The Daubert standard serves as a guide for assessing the admissibility of forensic evidence. However, its application has been controversial. Some argue that the Daubert standard is too rigid. They suggest it may exclude forensic practices that have not been extensively tested but could still be valuable in criminal investigations (MacFarlane, 2014). This raises important questions about balancing scientific rigor with the practical needs of the legal system.

Another key issue is the use of vague language in forensic reports, such as might have been involved. These terms, while technically accurate, often give jurors the impression that the forensic evidence is more conclusive than it is (LaPorte, 2018). This misrepresentation can lead

to wrongful convictions. Such misleading interpretations can significantly impact case outcomes. Although these concerns will be revisited in later sections regarding judicial reform, they highlight an important challenge in presenting forensic evidence. Ensuring clarity and equity in forensic testimony is essential for sound legal decision-making.

**Divergent Views and Debates**

Experts disagree on the primary causes of wrongful convictions in forensic science and the best solutions. Some argue that the issue lies mainly with the forensic techniques themselves, calling for stricter controls, standardized procedures, and more scientific validation (Giannelli, 2007; Roach, 2009). These researchers contend that methods such as bite mark comparison and hair analysis are scientifically unreliable and could lead to wrongful convictions if misused. Others, however, focus on the misuse of forensic science by the judiciary. Rajapakse (2024) suggests that the problem is less about the techniques and more about the lack of critical review of forensic data by legal professionals. The manipulation of forensic evidence can warp legal decisions, highlighting the need for better education and training for legal professionals in forensic science.

The application of the Daubert standard to filter forensic evidence is another contentious issue. While some, like MacFarlane (2014), believe that the Daubert standard ensures only scientifically valid methods reach the courtroom, others argue that this standard could exclude useful forensic approaches that have not been thoroughly tested but could be pivotal in solving cases. The challenge is to balance scientific integrity with the practical demands of the courtroom. Lastly, there are divergent opinions regarding the need for centralized forensic oversight. Some experts advocate for a unified national regulatory body to standardize and oversee forensic practices (Roach, 2009; Hamer & Edmond, 2019), while others argue that

reform should focus on improving procedural aspects of the legal system, such as enhancing judicial training to improve the interpretation of forensic evidence (Savage, 2023).

### Gaps in Current Literature

Despite extensive research on forensic errors and miscarriages of justice, there remain significant gaps in the literature, particularly in the Canadian context. Much of the existing research is based on U.S. case studies, which may not be fully applicable to the Canadian system (MacFarlane, 2014). Furthermore, many high-profile cases of wrongful convictions receive considerable media attention. However, empirical research on forensic science practices in Canada is limited. More data is needed to assess the role of forensic science in routine legal processes and identify systemic issues that contribute to wrongful convictions.

Additionally, emerging fields such as digital forensic science and probabilistic genotyping have not been extensively studied, despite their growing importance in modern criminal investigations (Frederiksen, 2011). These disciplines introduce new challenges related to reliability and admissibility, yet they remain underexplored in the literature. There is also limited research on the effectiveness of forensic education, despite its emphasis in theoretical literature. Furthermore, Canada lacks a comprehensive database of wrongful convictions, which makes it difficult to identify patterns and implement targeted reforms (Schuller et al., 2021). Addressing these gaps is critical to ensuring that forensic science remains a reliable and effective tool in securing justice.

## Methodology

This research adopts pragmatism as an overall worldview, dealing with resolving or issuing an improvement on one real-world problem at hand, wrongful convictions in Canada, through increased forensic science and legal reforms. Pragmatism emphasizes practical solutions,

integrating scientific and legal perspectives to develop evidence-based recommendations (Kaushik & Walsh, 2019). Within this framework, the paper identifies problems in current practices in the field of forensic and legal practice and seeks to obtain recommendations that would improve justice outcomes. The goal is not to prove absolute truths in forensic science, but rather to develop actionable solutions, for example, improved forensic methodologies and judicial training, as well as policy changes. To achieve these objectives, a secondary research design is employed.

A secondary research design allows case analyses, academic literature, and forensic science reports to be reviewed on a broad scale and to provide context and supporting evidence in the wrongful convictions caused related to forensic errors in Canada. The main resources utilized included the Justice Institute of British Columbia (JIBC) Library (EBSCO Database) and Google Scholar. The advantage of the JIBC Library was its advanced filtering capabilities, to allow users to make searches by geography, publisher, language, and source type. This leaves no room for doubt in terms of academic consistency. Google Scholar complemented this by using its cited-by feature to find other relevant sources not available through JIBC. These methods provide a holistic approach to ensure that there is a complete understanding of the literature.

**Inclusion/Exclusion Criteria**

A systematic search process was implemented to refine the scope of the study. The first search involved broad keywords including forensic errors, wrongful convictions, and misinterpretation of law in Canada. Table A1 outlines the initial keywords used. A refined search was thereafter conducted after involving both the inclusion and exclusion criteria to ensure not just relevance but also reliability. This is outlined in Table A2. The study examines forensic science practices, wrongful convictions, and legal misinterpretations in the Canadian legal

system. Inclusion criteria include literature published after 2000, peer-reviewed journals, case studies, and legal inquiries addressing errors in forensic science and legal reforms. Articles published before 2000 are excluded except for pivotal wrongful conviction cases like Guy Paul Morin, and David Milgaard, which were catalysts for changes in forensic science, concerning DNA testing. Eyewitness misidentification, false confessions, non-peer-reviewed articles, and unrelated legal reforms are excluded, focusing on forensic errors, legal misinterpretations, and reforms to prevent wrongful convictions.

**Initial Article Assessment and Selection**

Following the refined search process, relevant articles were systematically selected by first reviewing titles and abstracts. The selection criteria focused on studies addressing forensic science in wrongful convictions, forensic errors, and potential reforms. Sixteen articles were chosen for abstract reviews to assess relevance. Several works highlight issues with unvalidated forensic methods contributing to wrongful convictions. These include flawed analysis by Cunliffe and Edmond (2021), fingerprint and bite mark analysis by Olaborede and Meintjes-Van der Walt (2020), and underfunding and misuse as per Pollanen (2014).

To ensure a comprehensive analysis, the final selection included studies covering key themes in forensic reliability and legal oversight. Research by Eastwood and Caldwell (2015) examines misleading forensic testimony, while Scherr and Dror (2021) explore cognitive bias among forensic experts. The need for better regulation is argued by Hamer and Edmond (2019), whereas Schuller et al. (2020) focus on national oversight and database implementation. Morgan (2023a) categorizes forensic errors and emphasizes judicial scrutiny. Additionally, government reports such as Innocence at Stake (PPSC, 2019) address misidentification and false confessions. Judicial training and scrutiny are covered by Rajapakse (2024) and Roach (2009), while Savage

(2023) discusses the Daubert standard. Validation and oversight concerns are presented by Frederiksen (2011) and MacFarlane (2014). Finally, DNA testing and exonerations are analyzed by Garrett and Neufeld (2009) and LaPorte (2018). By incorporating these sources, the study ensures a well-rounded examination of forensic science challenges and judicial review improvements aimed at preventing wrongful convictions in Canada.

**Final Article Evaluation and Selection**

To ensure reliability, accuracy, and validity, articles were assessed based on their relevance to the study's focus. The quality of analysis and the expertise of the authors were also considered. The selection process prioritized peer-reviewed publications. It also focused on research conducted by experts in forensic science, law, and criminal justice. In total, nine articles were chosen for full review, as they provided critical insights into flawed forensic methods, DNA testing, and regulatory oversight. The evaluation considered not only the findings presented in each study but also the strength of their methodologies, the transparency of data interpretation, and the consistency of their conclusions with broader forensic research.

In addition to methodological rigor, the credibility of the sources was carefully examined to minimize the influence of potential biases. Forensic science literature can sometimes be shaped by institutional priorities, funding sources, or legal perspectives, which may impact the framing of research conclusions. To address this concern, the selected studies were cross-referenced with other high-quality sources to ensure that claims were well-supported by empirical evidence. Furthermore, studies that provided historical context, comparative analyses, or recommendations for policy reform were given consideration, as they offered a more comprehensive view of the challenges facing forensic science. By applying these rigorous selection criteria, this research establishes a strong and balanced foundation for analyzing the

role of forensic evidence in wrongful convictions and identifying potential improvements in forensic practices and judicial oversight.

### Ethical Considerations

Ethical considerations are crucial in ensuring objective data analysis. This is especially important when considering the impact of wrongful convictions on individuals and communities. The research will ensure proper attribution to original researchers and avoid selective reporting. The study will remain relevant to current forensic science practice and the Canadian legal framework. Given that wrongful convictions deeply affect individuals, families, and public confidence in the justice system, the study takes care to present findings respectfully. Selective reporting is avoided to maintain research integrity, thus ensuring the study's ethical thoroughness.

## Results

The findings of the study provide an extensive understanding of how faulty forensics and misconstrued legal matters contribute to wrongful convictions in Canada. The results present extensive research that brings to the forefront some of the major themes. Appendix B gives an overview of these major themes.

### Flawed Forensic Methods

Misstatements in forensic reports, where experts overstate the certainty of their conclusions, are identified as a significant issue. These misstatements greatly mislead courts and juries into thinking that forensic evidence is some kind of infallible evidence. It does not, however, talk about the limitations and uncertainties that all forensic types entail. These refer to subjective forensic analysis methods such as the much-publicized bite mark analysis or microscopic hair comparison, where the conclusions can be exceedingly shaky (Morgan, 2023a;

Garrett & Neufeld, 2009; LaPorte, 2018). Once again, a good example is manipulation by fingerprint evidence which can be used to convict people wrongly. In such cases, the manipulation usually results from wrong identifications or misclassifications for which subsequent DNA evidence has exonerated (Rajapakse, 2024; Roach, 2009; Hamer & Edmond, 2019). Addressing these issues is crucial for improving the accuracy and reliability of forensic evidence in the criminal justice system.

**Misinterpretation of Forensic Evidence**

The overconfidence displayed in expert testimonies, often the result of pressure from law enforcement agencies to present compelling evidence, has also been highlighted as a factor that contributes to the wrongful use of forensic evidence. Exaggerated presentations of the conclusiveness of expert opinion sometimes reinforce the perception that forensic science can deliver irrefutable proof of guilt (Savage, 2023; Frederiksen, 2011). Moreover, problems in evidence handling and reporting, such as failure to maintain an appropriate chain of custody, contamination of forensic evidence, and selective reporting of evidence, all contribute significantly to wrongful convictions (MacFarlane, 2014; Schuller et al., 2021). These deficiencies expose systemic flaws within the forensic and judicial systems, highlighting that forensic blunders are not solely the result of flawed methodologies or cognitive bias but also stem from inadequate regulatory oversight (Morgan, 2023b). This broader perspective challenges the assumption that forensic errors arise only from individual mistakes rather than deeper structural issues within the system.

**Cognitive Bias in Forensic Analysis**

Legal professionals often lack adequate scientific literacy. They frequently misinterpret forensic evidence due to cognitive biases and statistical misinterpretations (Rajapakse, 2024).

One clear example is the prosecutor's fallacy. In this, forensic evidence is incorrectly presented as definitive proof of guilt, even when the probability of a match is overstated (Cunliffe & Edmond, 2021). This misrepresentation of forensic certainty has contributed to wrongful convictions across generations, particularly in cases where prosecution arguments relied too heavily on inconclusive forensic evidence (Cunliffe & Edmond, 2021; Rajapakse, 2024). These issues highlight the urgent need for improved scientific education for legal professionals. There is also a need for more rigorous standards for presenting forensic evidence in court.

The adversarial nature of the legal system also intensifies these problems. Forensic evidence is often selectively presented to support the prosecution's narrative. Instead of being evaluated impartially and objectively, the evidence is used to favor one side (Hamer & Edmond, 2019). In the same vein, Scherr and Dror (2021) revealed that cognitive biases in forensic testimonies are largely responsible for wrongful convictions. Forensic analysts may unknowingly align their findings with the theory of the case proposed by law enforcement. This creates tunnel vision and leads to biased conclusions. As a result, judges and jurors tend to accept expert testimony as definitive, despite their often inadequate understanding of the underlying scientific principles. This makes forensic evidence interpretation inherently probabilistic.

Misinterpretation of forensic evidence as conclusive proof rather than probabilistic generates wrongful convictions. These convictions are based on flawed scientific assumptions (Eastwood & Caldwell, 2015; PPSC, 2023). One such novel framework dealing with this issue is the Egg Analogy proposed by Rajapakse (2024). This analogy categorizes forensic evidence into layers of reliability. It helps judges and attorneys distinguish scientifically validated methods from less credible or unproven ones. By introducing this framework, the goal is to prevent the

misinterpretation of forensic evidence as definitive proof of guilt. This method allows for a more detailed and accurate evaluation of forensic evidence.

**Lack of Regulatory Oversight**

Perhaps the most pressing hurdle to achieving the reliability of forensic evidence in Canada remains the absence of a cohesive and national forensic regulation framework. Because of the decentralized nature of forensic services in Canada, there are differences in how techniques are applied and quality standards, and the monitoring of provinces all amounts to substandard reliability of forensic evidence used by the courts (Pollanen, 2014; Roach, 2009; Savage, 2023). Canada lacks such a body, unlike the United Kingdom (UK) and the United States (US), where centralized forensic regulatory bodies impose standards and do regular evaluations. Such a lack of a centralized body permits the use of discredited forensic techniques in legal proceedings. Methods like bite mark analysis, microscopic hair comparison, and voice spectrography that have been discredited scientifically, still find their way into the legal arena, eventually leading to possible wrongful convictions (Hamer and Edmond, 2019; Morgan, 2023a; Olaborede & Meintjes-Van der Walt, 2020). The entry of DNA tests brought these fallibility issues to the front, signaling an urgent need for stricter validation protocols before admitting the forensic technique in court.

**Limited Forensic Literacy Among Legal Professionals**

The justice system continues to apply forensic techniques that may become discredited as new scientific methods emerge. As forensic science evolves, it becomes apparent that some previously accepted methods may no longer meet the rigorous standards of reliability required for accurate criminal investigations. Convictions based on such obsolete techniques would need to be revisited in light of prevailing scientific knowledge to ensure that miscarriages of justice

are corrected. For example, forensic hair comparison once considered a reliable method for linking a suspect to a crime scene, was later found to be highly prone to error and misinterpretation, leading to numerous wrongful convictions (MacFarlane, 2014). Similarly, flawed forensic pathology, which was once deemed authoritative, has been discredited over time for its lack of scientific rigor and contributed to the wrongful conviction of innocent individuals (Taylor-Baer & Anderson, 2023). The Goudge Inquiry, for instance, highlighted that forensic pathologists often struggled to quantify the level of certainty in their opinions regarding the cause of death, which has contributed to wrongful convictions (Roach, 2009). These cases illustrate how the justice system's reliance on outdated forensic techniques can perpetuate errors, especially when these methods are not properly re-evaluated against modern scientific advancements. As such, forensic evidence must be constantly assessed and updated to reflect the latest research, ensuring that it serves as a tool for justice rather than a source of potential harm.

Relying solely on forensic evidence without any corroborative information has been widely criticized as a dangerous and flawed practice, particularly given that error rates for certain forensic disciplines, such as pattern matching, are already well-documented (National Institute of Justice [NIJ], 2023; Olaborede & Meintjes-Van der Walt, 2020). Additionally, forensic experts may be susceptible to collaborative bias, interpreting their findings as more conclusive or exonerative than they truly are. This further contributes to the risk of wrongful convictions (MacFarlane, 2014; Scherr & Dror, 2021). It also highlights that systemic biases and professional cultures within forensic science also play a crucial role in perpetuating the acceptance of unreliable forensic evidence in criminal trials. These issues, alongside challenges related to the technical reliability of forensic methods, showcase the need for a more cautious and evidence-based approach to the use of forensic evidence in legal proceedings.

**Reforms to Enhance Forensic Evidence Reliability**

To address these systemic issues, a comprehensive reform approach is necessary. First and foremost, there needs to be an increased validation and regulation of forensic methods to enhance their credibility. Rigorous empirical validation of forensic fields, so that they are thoroughly tested scientifically before being admitted as evidence in court, would be a step in making sure forensic practice meets similar standards of scrutiny as applied to DNA testing (Garrett & Neufeld, 2009; Frederiksen, 2011**).** To ensure the consistent application of these standards, an independent oversight body should be established. The establishment of such a body would enable forensic methodology to be standardized across Canada, investigate errors in forensic practice, and prevent forensic misconduct (Morgan, 2023b; Pollanen, 2014; Roach, 2009). It would also help restore public trust in the forensic science system.

In addition, legal professionals would benefit from education and training in forensic science. With the necessary knowledge, judges and lawyers would be better equipped to understand the complexities of forensic evidence. This includes understanding statistical reasoning and the role of probability in forensic analysis. By gaining a deeper understanding, they would be able to more thoroughly evaluate forensic findings and avoid misinterpretations stemming from uncertain conclusions. Such training would enable legal professionals to critically assess forensic evidence and ensure its proper application in the courtroom (LaPorte, 2018; Rajapakse, 2024). Ensuring equal access to forensic expertise is also critical to reforming wrongful convictions.

Due to financial and systemic limitations, defense challenges to forensic evidence are often weakened, making it difficult to counter prosecutorial claims effectively. This lack of access to independent forensic expertise increases the risk of wrongful convictions by allowing

prosecution-driven forensic evidence to go unchecked (Eastwood & Caldwell, 2015). The disparity in resources between the defense and prosecution highlights a significant issue within the justice system. To correct this imbalance, mandatory funding for expert witnesses in criminal trials should be introduced (PPSC, 2023). This ensures that both the defense and prosecution have equal access to independent forensic expertise.

This reform should also include standards that are innovated regarding forensic testimony. Forensic experts should be able to include guidelines in their reports on error rates and any methodological limitations as they present forensic evidence with appropriate caution and scientific rigor (Garrett & Neufeld, 2009; Savage, 2023). Scherr and Dror (2021) and Morgan (20232a) suggested introducing blind forensic testing to account for the cognitive bias involved in forensic conclusions and diminish wrongful convictions on biased forensic grounds. In this way, forensic analysts would know neither the theories of law enforcement nor the identities of the suspects. This approach would help ensure that forensic conclusions are based solely on empirical evidence rather than external influences, ultimately enhancing the objectivity and reliability of forensic testimony in court.

## Discussion

The research conducted on forensic errors and legal misinterpretations contributing to wrongful convictions in Canada offers valuable insights. However, it is not without its strengths and weaknesses. One of the primary strengths of this research lies in its reliance on a comprehensive secondary research methodology. By utilizing a wide range of peer-reviewed journal articles, legal reports, and case studies, the study effectively highlights systemic issues within forensic science and the legal system. For example, the inclusion of high-profile wrongful

conviction cases and legislative reviews provides a sufficiently rounded view to facilitate an analysis of the real-life implications of these issues.

Another major strength is the assessment of cognitive biases in forensic science and law. In assessing these interrelationships, this study successfully integrates psychological insights with forensic analysis. It sheds light on how forensic experts, legal professionals, and jurors may unknowingly contribute to wrongful convictions through confirmation bias and misinterpretation of probabilistic forensic evidence (Scherr & Dror, 2021). Hamer and Edmond (2019) support this view by showing that the combative nature of legal processes often elicits forensic experts to adapt their testimony in favor of the prosecution's narrative, thus deviating from scientific objectivity. Overall, the credibility associated with such findings is amplified by this interdisciplinary approach.

The fact that actual courtroom cases, such as the Guy Paul Morin case and the Motherisk drug testing scandal, are blended with theoretical discussions in this context further strengthens the discipline. Concrete instances of how forensic errors and legal misinterpretations occur in real courtroom settings are provided (Morgan, 2023b; Savage, 2023). These instances demonstrate the significant consequences of such errors in legal proceedings. Notably, the forensic pathology failures outlined in the Goudge Inquiry (Roach, 2009) investigated wrongful convictions. The inquiry examined cases resulting from improper expert testimony in Ontario. These cases further stress the critical need for reform in forensic science practices and illustrate the effects of wrongful forensic practices.

Despite its strengths, the study has certain limitations. One such limitation is its reliance on secondary data. While secondary research provides a comprehensive understanding of forensic errors and legal misinterpretations, it does not offer firsthand empirical data, such as

qualitative interviews with forensic experts and legal professionals. Such data would provide deeper insights into the practical issues discussed (Rajapakse, 2024). Additionally, forensic analysts and researchers have found that forensic science is often perceived as more exonerating than it truly is, which can introduce bias within the forensic community. This misconception can distort forensic testimony and contribute to wrongful convictions (Scherr & Dror, 2021). While secondary data offers valuable analysis, integrating firsthand accounts would enhance the study by providing a more holistic view of the challenges facing forensic science today.

A second weakness of the study is the heavy reliance on U.S.-based forensic literature. While the research includes some focus on Canada, most forensic studies and wrongful conviction investigations draw from U.S. legal cases and research institutions (MacFarlane, 2014). While these sources offer valuable insights, they may not adequately address the unique aspects of the Canadian legal and forensic landscape. This reliance on international literature introduces a potential gap in addressing forensic errors and legal misinterpretations specific to Canadian jurisdictions. Furthermore, as noted by Roach (2013) and Schuller et al. (2021), Canada lacks a centralized forensic science regulatory body, which leads to disjointed wrongful conviction research across provinces and independent inquiries.

Another gap in the study is the limited coverage of forthcoming forensic technologies and their relevance to current investigations. While this study does not delve deeply into emerging fields like probabilistic genotyping and digital forensics (Frederiksen, 2011), these technologies are worth noting for their potential impact on reducing wrongful convictions. For example, Morgan (2023a) mentions that advanced forensic methods, including AI-driven forensic analysis and high-resolution DNA testing, could significantly mitigate wrongful convictions. However, these methods are still in the early stages and require thorough validation and precise

implementation before being widely adopted in the legal system. As these technologies continue to evolve, they could offer crucial tools for ensuring greater accuracy in forensic investigations, provided they are subjected to rigorous testing and legal scrutiny. Thus, while not a central focus of this study, the potential of these technologies warrants future research to assess their impact on the justice system.

**Limitations of the Research**

While the research methodology included rigorous inclusion and exclusion criteria, some challenges arose in selecting relevant sources. One such limitation is having few Canadian wrongful conviction data. Unlike the U.S., Canada does not maintain a centralized database for wrongful convictions, which would allow researchers to examine patterns and trends in forensic errors and legal misinterpretations systematically (Schuller et al., 2021). Although peer-reviewed journals and government reports were preferred for their credibility, the field of forensic science is continually evolving, with ongoing debates and emerging research. This makes it possible to speculate that many of the studies included in this research might become outdated as forensic methodologies advance, hence stressing the need for airtight updates of the forensic system.

Additionally, the research was conducted within a limited 3-month period, restricting the depth of analysis. This limitation affected the ability to incorporate broader datasets or emerging studies. With more time, a more focused examination of particular forensic specialties such as fingerprinting, forensic pathology, and bite-mark analysis might have strengthened this study. Future work could benefit from investigating which forensic techniques in particular give rise to errors that lead to wrongful convictions. The works of LaPorte (2018) stress that forensic methods are often not uniformly reliable between disciplines. This introduces variability that

could impact the accuracy of forensic evidence in court, an element of inconsistency into the treatment of forensic evidence.

## Recommendations

To enhance the reliability of forensic evidence and prevent wrongful convictions, a series of systemic reforms must be implemented in Canada. These reforms should address gaps in forensic data collection, the impact of emerging technologies, interdisciplinary collaboration, legal education, and equitable access to forensic expertise. This section outlines key areas for improvement and proposes concrete measures to strengthen forensic science within the justice system.

One critical reform is the establishment of a national wrongful conviction data bank, which would enable researchers to track trends, identify recurrent forensic errors, and make specific policy recommendations based on empirical knowledge (Roach, 2009). In Canada, the lack of systemic tracking of wrongful convictions limits the ability to implement policy changes based on empirical data. By creating a central warehouse for forensic malpractice and wrongful conviction cases, attorneys and forensic scientists could more easily identify recurrent issues and ensure that corrective measures are taken. This would facilitate better data-driven decisions in addressing forensic errors. Moreover, more work should be done to encourage Canadian forensic error studies, particularly those that focus on unsourced findings from the U.S., to provide a more comprehensive and localized understanding of forensic malpractices.

Another area in need of reform is the integration of emerging technologies in forensic science. While DNA testing has proven to be an invaluable tool, technologies like probabilistic genotyping, digital forensics, and artificial intelligence-driven forensic analysis raise questions about their reliability and applicability (MacFarlane, 2014; Morgan, 2023a). Research should be

conducted to evaluate the reliability of these methods, establish best practices for their use in legal proceedings, and set clear guidelines for their legal admissibility. This will help prevent courts from prematurely adopting unvalidated techniques. Additionally, forensic validation studies should focus on real-life scenarios, ensuring that new methods are reliable across various crime scenes and laboratory conditions.

To better understand how forensic errors occur and how they are interpreted in the legal system, qualitative research involving interviews and surveys with forensic analysts, legal practitioners, and exonerees should be prioritized. This approach would provide deeper insights into the practical challenges faced by forensic experts and the impact of systemic biases on judicial decision-making (Rajapakse, 2024). Furthermore, longitudinal studies tracking the success of forensic reforms could help assess whether changes in policies lead to measurable improvements in forensic reliability. Comparative research across different jurisdictions could shed light on best practices for avoiding forensic misinterpretations in the courtroom.

Interdisciplinary collaboration is crucial for addressing wrongful convictions. Forensic science, legal scholarship, psychology, and policymaking must work together to develop comprehensive solutions. These solutions should span legal reforms, scientific advancements, and psychological insights (Scherr & Dror, 2021). Increased judicial education in forensic science, as advocated by Eastwood and Caldwell (2015), is essential. This education is necessary to ensure the proper interpretation of forensic evidence. Additionally, training in Bayesian statistics should be incorporated into legal education to enhance the understanding of probabilistic forensic evidence.

Several essential reforms must be made to improve the validity of forensic evidence in Canada. One key measure is ensuring that forensic science methodologies, laboratory

accreditation, and expert witness attestations are standardized nationally (Hamer & Edmond, 2019). Additionally, forensic evidence should be scientifically validated beyond a reasonable doubt before being accepted in legal proceedings, similar to the Daubert standard used in the USA (Savage, 2023). Forensic disciplines with high error rates, such as bite mark analysis and microscopic hair comparison, should be inadmissible in court until modern scientific methods can validate their reliability.

The training and education of legal professionals must also be improved. Mandatory forensic science training for judges, lawyers, and law enforcement would enhance their understanding of forensic methodologies and statistical probabilities (LaPorte, 2018). The creation of forensic evidence review panels within the court system could further ensure that forensic findings are accurately assessed during criminal trials (Eastwood & Caldwell, 2015). Increased funding for forensic research and training initiatives would help bridge the gap between scientific advancements and their application in the courtroom. This investment is crucial for improving the overall quality of forensic evidence used in legal proceedings. By improving training and review processes, the justice system can prevent wrongful convictions and promote more accurate legal outcomes.

Ensuring equal access to forensic expertise is a vital reform to prevent wrongful convictions. Defense counsel must have access to independent forensic experts, enabling them to challenge prosecution evidence effectively. Government-funded forensic expert consultations should be made available to ensure that both sides of the legal system have equal access to forensic testimony (PPSC, 2023). This would help level the playing field and prevent the misuse of forensic evidence. By implementing these reforms, Canada can improve the reliability of

forensic evidence. These changes would significantly reduce the occurrence of wrongful convictions and strengthen the fairness of the legal system.

## Conclusion

In summary, this research highlights the critical role of forensic science in wrongful convictions in Canada. It exposes significant flaws in forensic methodologies, legal interpretations, and systemic oversight. Despite technological advancements, wrongful convictions persist due to unreliable forensic techniques. Cognitive biases and misinterpretations of probabilistic evidence by legal professionals also play a major role. Additionally, the absence of a forensic regulatory body allows scientifically inferior evidence to cloud the integrity of justice. Furthermore, the limited knowledge of forensic matters among judges, attorneys, and jury members leads to the overstatement of forensic evidence certainty, making it harder to accurately assess evidence in the courtroom.

Resolving these problems will require a multifaceted approach. First, a national wrongful conviction database should be established to track cases and identify trends. Additionally, a better process for validating forensic practices needs to be developed. This will allow the legal community to adequately assess forensic evidence during criminal trials. More effective regulations concerning forensic science should include an independent forensic review panel. Standardized admissibility criteria and equal access to forensic expert testimony for the defense are also necessary steps to improve fairness in the justice system.

The preservation of forensic integrity is paramount for preventing miscarriages of justice. With these changes, Canada may redeem forensic evidence as justice, rather than a vehicle of wrongful conviction. A system with a strong regulatory framework, scientific advancement, and legal education will create a more credible criminal justice system. This will reduce wrongful

convictions and promote public trust in forensic science. By ensuring proper training and oversight, Canada can foster a more just and fair legal system. Ultimately, these reforms will contribute to greater public confidence in the justice process and its outcomes.

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## Appendix A

## Search Methodology

**Table 1**

*Initial Keyword Search and Hits*

| Database | Search Term(s) | # of results |
|---|---|---|
| Google Scholar | Wrongful Convictions and Forensic Science in Canada | 24700 |
| Google Scholar | Forensic Science and Miscarriages of Justice in Canada | 18500 |
| JIBC Library (EBSCO) | Wrongful Convictions AND Forensics | 945 |
| JIBC Library (EBSCO) | Miscarriage of Justice AND Forensics | 503 |
| JIBC Library (EBSCO) | Forensics AND Reliability AND Canda | 489 |

*Note.* This table demonstrates the initial search process conducted to obtain articles for the research paper. It includes broad search terms that returned a large number of results.

**Table 2**

*Secondary Keyword Search and Hits*

| Database | Search Term(s) | # of results | Reason for Revision |
|---|---|---|---|
| Google Scholar | Wrongful Convictions and Forensic Science in Canada | 19700 | Added date range filter (2000-2024) |
| Google Scholar | Forensic Science and Miscarriages of Justice in Canada | 17200 | Added date range filter (2000-2024) |
| JIBC Library (EBSCO) | Wrongful Convictions AND Forensics AND Canada | 86 | Added ‘Canada’ to narrow the scope |

| | | | |
|---|---|---|---|
| JIBC Library (EBSCO) | Miscarriages of Justice AND Forensics AND Canada | 56 | Replaced ‘wrongful convictions’ with ‘miscarriages of justice’ |
| JIBC Library (EBSCO) | Miscarriages of Justice AND Forensics AND Canada | 16 | Filtered by date range (2000-2024) and peer-reviewed journals |
| JIBC Library (EBSCO) | Wrongful Convictions AND Forensics AND Canada | 82 | Filtered by date range (2000-2024) |
| JIBC Library (EBSCO) | Wrongful Convictions AND Forensics AND Canada | 30 | Filtered by peer-reviewed journals |
| JIBC Library (EBSCO) | Wrongful Convictions AND Forensics AND Canada AND Reliability | 3 | Added the keyword ‘Reliability’ |
| JIBC Library (EBSCO) | Miscarriage of Justice AND Forensics AND Canada AND Reliability | 2 | Replaced ‘wrongful convictions’ with ‘Miscarriage of Justice’ |

*Note.* This table shows the narrowing process through various stages. Initially, broader terms yielded large results, which were progressively refined by adding filters for location (Canada), date range (2000-2024), and peer-reviewed sources to focus on the most relevant articles for the research.

# Appendix B

## Overview of Major Themes

**Figure 1**

*Forensic Errors Leading to Wrongful Convictions in Canada*


*Note.* The diagram highlights key forensic errors leading to wrongful convictions in Canada. It includes flawed forensic methods, misinterpretation of evidence, cognitive biases, weak regulatory oversight, and limited forensic literacy among legal professionals. These cover issues such as discredited techniques, overstated certainty, inconsistent forensic standards, lack of scientific training etc., all of which contribute to increasing the risk of wrongful convictions. The figure was created by using Canva software.