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Wrongful convictions have long been a source of contention in criminal justice systems worldwide. Due to the devastating impact on the convict, exonerees, victims, and communities, erroneous convictions have been dubbed a criminal justice system tragedy (Yadav, 2017). Exonerees, original crime victims, and their families may experience lifelong consequences of erroneous convictions. Additionally, they may have long-term negative implications for witnesses, investigators, attorneys, judges, and other criminal justice professionals who assisted in false convictions. Numerous reasons have been implicated in wrongful convictions, with forensic science playing a critical part (Bonventre, 2021). Due to the fact that many convictions are preceded by complicated scientific investigations involving a number of interconnected variables, the authenticity of these scientific techniques ultimately affects the impartiality and credibility of the convictions gained. The majority of juror judgments in instances involving these complicated forensic scientific investigations rely heavily on their results to corroborate other relevant pieces of evidence and arrive at science-based legal conclusions (Yadav, 2017). As a result, any error in these scientific methodologies jeopardizes all subsequent stages, perhaps resulting in false convictions. Because forensic science is predicated on preset guidelines, any deviation from these guidelines instantly invalidates the entire process, resulting in systemic inequality and false convictions (Bonventre, 2021). As a result of these inherent methodological shortcomings, forensic science is heavily reliant on human interpretation.

It must be recognized, however, that forensic science continues to be the most revolutionary component of criminal investigations. Criminal investigators have resolved complicated cases that would have remained unsolved without forensic examination of crime scene evidence (Cole & Duster, 2016). A well-known example is the use of D.N.A. and other molecular methods for criminal mapping, which allows for the reliable identification of offenders from a large pool of suspects. Despite these significant advancements in criminal justice, forensic science has been involved in a number of false cases. Several of these are motivated by human nature, which is marked by error, carelessness, ineptitude, and a disregard for ethical rules of conduct (Yadav, 2017). Due to the criminal justice community's conception of forensic science as a defective discipline, several measures and endeavors have been undertaken to reform forensic sciences to conform to the demands of criminal justice systems. This widespread view of forensic science as junk science may be inaccurate, given not all facets of the profession have been shown to be incorrect (Yadav, 2017). Certain subfields have resulted in ground-breaking solutions to challenging issues. Rather than that, the errors in forensic science have been limited to certain forensic specializations.

When the focus is incorrectly placed on a whole discipline, reforms may be ineffective in achieving desired improvements, and the discipline's misunderstandings linger. Even within a forensic scientific specialization, a variety of analytical procedures may be used to determine the authenticity of a criminal case, each with a variable degree of precision and dependability (Olaborede & Meintjes-Van der Walt, 2020). Forensic science misinterpretations are frequently limited to a particular approach (Yadav, 2017). Hair examination is one of the most culpable aspects of forensic science for wrongful convictions resulting from exaggerations and reliance on flawed scientific protocols. Hair microscopy, in particular, had resulted in false convictions, particularly during the late twentieth century, when it was seen as a vital tool in forensic

investigations (Cole & Duster, 2016). These results caused the F.B.I. to recently acknowledge the fallibility of hair analysis in obtaining correct convictions.

Due to faults and exaggerations in pre-2000 hair investigations, many Americans have been sentenced to prison terms, including life sentences, for crimes they did not commit (Cole & Duster, 2016). Regardless of the criteria used at the time, hair inspections remain junk science as a result of their participation in the erroneous convictions of thousands of innocent Americans. If it were an actual science, its validity and dependability in convicting the proper culprits and enforcing the law would have stayed remarkably stable over the last two decades.

Hair examination was common in criminal forensic investigations during the 1970s and 1990s. Despite their lack of scientific integrity, most investigations produced exaggerated results that inappropriately affected juror decisions. One of the most egregious examples of such exaggerations was the affirmation of a 'match' between the suspect and evidence hair. Investigators frequently testified before juries in these circumstances, verifying that the evidence was identical to the suspect's hair (Cole & Duster, 2016). This interpretation of the hair analysis results was based on the techniques and standards for hair microscopy used at the time, which were flawed. The similarity was seen as proof of a match between the suspect and the submitted evidence under these standards. While the resemblance is frequently an accurate confirmation of an occurrence, it is insufficient to serve as a decisive foundation for criminal justice decision-making. Decisions in criminal justice should be founded on substantial, if not absolute, evidence (Olaborede & Meintjes-Van der Walt, 2020). While resemblance may imply affirmative verification of the evidence, it does not constitute conclusive identification and cannot be replaced for it (Cole, & Duster, 2016). In other words, similarity does not always mean identical, and only conclusively identical evidence should be used to establish criminal guilt. Thus, uncertainty in the analytical interpretation of hair microscopy data is a significant fault that renders microscopic hair inspection a trash science incapable of solving criminal justice matters objectively and conclusively.

Additionally, uncertainties in interpreting hair microscopy data come from and create opportunities for additional errors such as court malpractice and forensic investigator misconduct. Ambiguity fosters the growth of subjectivity and unethical acts (Yadav, 2017). When forensic arguments are confusing, court authorities may read them incorrectly, whether intentionally or unintentionally. As previously noted, criminal investigations contain a plethora of variables that interact to impact the investigator and the direction of the inquiry. As a result, investigations seldom rely on a single tool or methodology for suspect identification (Olaborede & Meintjes-Van der Walt, 2020). Hair microscopic analysis follows this forensic investigative pattern, in which hair analysis is supported by other procedures such as eyewitness identifications. The majority of these extra methods of identification are frequently subjective and therefore inaccurate. Despite these shortcomings, hair analyses have been used in conjunction with – albeit flawed – eyewitness identifications to corroborate the identity of suspects.

Among the several elements impacting suspect identification, a significant error committed by forensic investigators is their failure to approach hair analysis in the context of the crime. The forensic scientists were primarily (erroneously) guided by the belief that hair analysis was an empirical science capable of correctly correlating other aspects in an investigation to identify culprits (Olaborede & Meintjes-Van der Walt, 2020). Most of the time, the testimony

was not entirely translated or comprehended. The forensic investigators did not elaborate their findings and testimony sufficiently to minimize uncertainties, such as the misreading of 'similar' as 'conclusively identical' when matching suspects with hair evidence. Due to the resulting subjectivity and ambiguity in interpreting the evidence value of hair tests, it became difficult (if not impossible) to ascertain the effects of hair examinations on jury judgments (Cole, & Duster, 2016). This contributes to the errors in hair examination and results in wrongful convictions. As a result, such F.B.I. reports and testimony that cannot be independently confirmed should be revoked and erroneous convictions reversed.

By preventing professionals from determining any individual as the sole source of hair at a crime scene, the field rules governing hair investigations aimed to drastically limit forensic investigators from making confirming statements about suspect identity. However, due to the vagueness of the field vocabulary, violations of these requirements occur, resulting in the inaccuracy of such conclusions. The majority of hair analysis's discipline-specific language, such as 'similar', 'identification', and 'match', lacked unambiguous meaning; they might have either strong or weak connotations (Cole, & Duster, 2016). An expert was only required to testify that the hair shared class features, implying a possible connection to the suspect's hair. These results suggested that the defendant's hair was most likely his. Furthermore, the expert was compelled to recognize that hair found at the crime scene may have come from a source other than the suspect.

While the field standards in hair examination sought to make hair analyses a reference for further investigations rather than a point of conclusive decision-making, there were minimal safeguards against experts overstating their findings. In their testimonies, many F.B.I. hair analysis experts made statements tantamount to confirming a match rather than suggesting the likelihood of a match. According to the recent joint audit report by the F.B.I., D.O.J., and the Innocence Project, among other agencies, these microscopic hair investigation experts inflated their conclusions beyond the reporting standards, hence attracting wrongful convictions (Cates et al., 2015). One worry about this type of evidence is that it might lead to fields making overly strong, scientifically unsubstantiated assertions such as individualization or suspect matching. In addition, such evidence can lead to examiners going above field standards and testifying to stronger conclusions than the field can justify. Therefore, hair analysis was unreliable, and the resulting reports or testimonies should be retracted.

The incidence of error in the hair examination reports by the F.B.I. was too high for the technique to be a reliable source of inference for criminal justice decisions. The laboratory reports and court testimonies made by the F.B.I. regarding hair examinations before 2000 were fundamentally flawed and inaccurate. According to the joint report, more than 90% of the laboratory reports and court testimonies arising from hair examinations contained erroneous statements propagated by the F.B.I. investigators (Cates et al., 2015). Out of the 28 F.B.I. agents whose statements were analyzed during the joint inquiry, only two agents made accurate statements in their laboratory reports and court testimonies (Cates et al., 2015). These findings show that F.B.I. microscopic hair analysts made a widespread, systematic error by drastically misrepresenting the value of their data while testifying under oath. This amounts to investigator misconduct guided by a flawed scientific methodology to further the interests of the prosecution, whose case the F.B.I. experts advance in the court of law.

The report manifests the gross injustice meted out on suspects by a federal agency that ought to uphold justice and fairness and protect the public from crime and insecurity.

According to the F.B.I.:

> The government identified nearly 3,000 cases where F.B.I. examiners may have submitted reports or testified in trials using microscopic hair analysis. As of March 2015, the F.B.I. had reviewed approximately 500 cases. The majority of these cases were trials, and the transcript of examiner testimony was reviewed. Some of these cases ended in guilty pleas, limiting the review to the original lab report. In the 268 cases where examiners provided testimony to inculpate a defendant at trial, erroneous statements were made in 257 (96 percent) of the cases. Defendants in at least 35 of these cases received the death penalty, and errors were identified in 33 (94 percent) of those cases. Nine of these defendants have already been executed, and five died of other causes while on death row. The states with capital cases included Arizona, California, Florida, Indiana, Missouri, Ohio, Oklahoma, Pennsylvania, Tennessee, and Texas. It should be noted that this is an ongoing process and that the numbers referenced above will change. (Cates et al., 2015, para. 6)

The shortcomings in using hair microscopy for forensic purposes in criminal investigations were a significant cause of the scientific community's shift away from the value of hair tests for criminal convictions. Science is a dynamic field of study. Due to the advancement of D.N.A. technology and the occurrence of discrepancies in hair examinations, the scientific community validated the hair microscopic tests' high unreliability (Cole, & Duster, 2016). The scientific community's shift in perception may be interpreted as a late reaction to remedy past injustices. However, empirical research and its application to criminal justice are dynamic and changing fields of study. With the evolution of D.N.A. and molecular identification technologies, which are more precise and have greater throughput than hair microscopy and serology, it was necessary to examine and update previously utilized methodologies. As a result of these improvements and the limits of hair analysis for confirmatory testimony, D.N.A. technology has arisen as a very accurate technique for establishing a suspect's identity. Hair microscopy may be employed to ascertain the resemblance and common origin of the hair before D.N.A. mapping is used to authenticate the identification of hair acquired from the crime scene.

The erroneous laboratory reports and court testimonies from hair analyses led to many Americans' wrongful convictions, some of whom have been executed or died from various causes during incarceration due to those errors. There is a need to serve justice for these imprisoned Americans and their families. The first step towards such justice for wrongfully imprisoned individuals is for the F.B.I. to conduct a thorough review of all cases that involved hair analysis leading to incarceration. This helps uncover all the cases and embark on a path for justice for the victims. Next, the F.B.I. should retract all its reports and testimonies in hair examination cases to enable new trials of the victims based on empirical forensic scientific methods like mitochondrial D.N.A. analysis (Cates et al., 2015). Since the incarceration of these convicts is based on flawed science and investigator errors, the federal government should take full responsibility and compensate these wrongfully convicted prisoners for the injustice meted against them through the misdoings of the F.B.I. The victims should thus be unconditionally released when their innocence is confirmed after rigorous retrials. Upon their release, these convicts are bound to face the same social and economic difficulties of reintegration faced by other ex-convicts. Thus, the federal government should completely ease these individuals' reintegration into society by providing the necessary social, economic, and legal help.

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