A SAFETY DOCTRINE FOR THE CRIMINAL JUSTICE SYSTEM

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INTRODUCTION

Imagine an airline that markets its flights as follows:

Our airplanes are exceptionally comfortable, with lots of space between the passenger seats. Our food is gourmet, and our crew completely professional and polite. We show newly-released movies and even offer massages to passengers during the flight. Our prices are modest; our crashes rare (only 1%).

Would anyone buy a ticket with this airline given its crash rate of one out of one hundred flights? Of course not. But as we will show in this Article, although conviction of the innocent is at a far more prevalent rate than one percent of those accused, criminal law, unlike other risk-creating fields, currently lacks any form of a modern safety doctrine.

The Innocence Project, which has exposed thus far 288 wrongful convictions through DNA comparison testing,1 and recent studies show that conviction of the innocent is not an uncommon phenomenon.2 This Article looks at ways to reduce the rate of false convictions.

In our view, the legal system is a safety-critical system.3 Since it deals with matters of life and death, any error in the system is likely to cause grave harm to both the individual and society.4 We maintain that a false conviction is an accident just like a fighter airplane crash. As we will show,

1. See Know the Cases, INNOCENCE PROJECT, http://www.innocenceproject.org/know/Browse-Profiles.php (last visited Oct. 7, 2011). It should be noted that the fact that the results of DNA testing could lead to an overturning of a conviction does not mean that they necessarily do. The results in fact usually lead to a reopening of the investigation of the incident. Convictions are overturned when, for instance, the defendant emerges as innocent in the renewed investigation, or when the true perpetrator is revealed, or errors are exposed in the gathering of the evidence that led to the conviction. DNA test results alone are not always sufficient to acquit. For discussion of an example of a case in which, despite the DNA test results indicating the defendant’s innocence, he was not acquitted, see Boaz Sangero & Mordechai Halpert, Proposal to Reverse the View of a Confession: From Key Evidence Requiring Corroboration to Corroboration for Key Evidence, 44 U. MICH. J.L. REFORM 511 (2011) [hereinafter Sangero & Halpert, Proposal to Reverse].


4. “Life and death”—given the existence of the death penalty in some states.
this analogy is not only metaphorical, in the sense of the economic cost they both entail, but quite literal. Care and safety in law do not merely raise the beyond-reasonable-doubt threshold in that the number of acquittals increases at the expense of the number of convictions; rather, care is an investment in reasonable safety measures whose cost is less than their expected harm since the number of false acquittals and the number of false convictions will be reduced. Indeed, in tort law, the Hand formula stipulates that a tortfeasor’s behavior is wrongful when the expected harm, given the probability of its occurrence, is greater than the cost of preventing it. It is our claim that this approach should be implemented in criminal law as well, which, to the best of our knowledge, completely lacks any elements of the modern notion of safety.

The path to safety in criminal law begins with scientific evidence. The needs of safety in the field of scientific evidence are comparable to its application in certain engineering fields, such as medical devices where safety measures are significantly developed and implemented. Indeed, the medical devices field offers proven, FDA-regulated safety solutions that could be applied to the context of scientific evidence, such as DNA testing. Yet in criminal law, there are no such precautionary measures, even, as we will see, with regard to non-scientific evidence, such as eyewitness testimony and confession.

Why have safety measures yet to be implemented in criminal law? Our answer is related to the fact that it is usually impossible to know that a wrongful conviction has occurred. This has led to a false sense of optimism that wrongful convictions are very rare. Thus, although there could conceivably be a very high rate of wrongful conviction, policymakers and the public are convinced that the system is almost perfect and see no need to invest any effort or resources in safety measures.

This issue is so fundamental in criminal law that we ascribe it the status of principle, what we term the “Hidden Accident Principle” in the criminal justice system. Any safety theory in criminal law must be based on this principle. Failure to understand and internalize it will only perpetuate the belief that the rate of accidents in the criminal justice system is negligible and that there is thus no need for safety measures in criminal law.

This Article proceeds as follows: In Part I, we briefly describe safety in the aviation, engineering, and medical devices fields. In Part II, we ex-

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5. See infra Section II.B.
7. Halpert & Sangero, From a Plane Crash, supra note 3, at 72-74; see also infra Section II.C.
plain why implementing safety in criminal law is necessary both morally and economically. We also show that existing simple safety measures currently being applied in other fields are not even considered in the criminal justice context. In Part III, we propose general principles for safety in the criminal justice system. We first offer a definition of safety, elaborate on the Hidden Accident Principle, and then assess the risk of false conviction. Risk assessment is an important component of any safety theory. We propose taking seriously the expected risk of the beyond-reasonable-doubt standard of proof as constituting a fundamental risk of false conviction and abandoning the erroneous belief that the system is close to perfection.

We further suggest augmenting the reasonable doubt standard with a safety component that will prevent anomalies by looking to other fields in which safety is crucial. Accordingly, conviction in a criminal trial would be possible only where: (1) guilt has been proven beyond a reasonable doubt; and (additionally) (2) all reasonable measures have been taken to ensure that false conviction does not occur. Moreover, we recommend specific, relatively easily-implemented solutions for several of the problems raised over the course of the discussion in the Article. In the Conclusion, however, we explain why specific solutions are not a sufficient response to the general problem of wrongful convictions and call for the development of a comprehensive safety theory for criminal law.

I. SAFETY IN AVIATION, ENGINEERING, AND MEDICAL DEVICES

The United States Air Force System Safety Handbook defines “safety” as follows: “Freedom from those conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment.” Until the end of World War II, the approach to safety in aeronautics was “Fly-Fix-Fly:” an airplane would fly until an accident occurred, at which point, the reasons for the accident would be investigated, and the defects repaired. The airplane would then continue to fly. Sometimes, the lessons learned from a particular incident would be incorporated into the engineering rules and regulations for the specific aircraft. The aircraft would be operated accordingly until the next accident, when the process would be repeated. This approach is based on learning through past experience to repair defects so that the same problems will not resurface. However, such a safety system cannot protect against other, unknown


10. HAROLD E. ROLAND & BRIAN MORTIARTY, SYSTEM SAFETY ENGINEERING AND MANAGEMENT 8-9 (1990); Halpert & Sangero, From a Plane Crash, supra note 3, at 71.

11. Halpert & Sangero, From a Plane Crash, supra note 3, at 71.
defects in an airplane that might cause mishaps of a different kind in the future. But with the rapid development of technology and increasing cost of airplanes, it became clear that this approach was inadequate. The cost of learning from experience was too expensive. Thus, more than half a century ago, there was a shift in approach, and the modern science of safety was born.

The following is one of the guiding principles in aviation safety developed by William Stieglitz more than sixty years ago:

“Safety must be designed and built into airplanes, just as are performance, stability, and structural integrity. A safety group must be just as important a part of a manufacturer’s organization as a stress, aerodynamics, or a weights group.”

A second principle stated:

“The evaluation of safety work in positive terms is extremely difficult. When an accident does not occur, it is impossible to prove that some particular design feature prevented it.”

The primary goal in the field of safety therefore became preventing accidents before they occur, without incurring the high costs of learning through experience: a “first-time safe” approach. Accordingly, the Fly-Fix-Fly method was replaced by the “Identify-Analyze-Control” approach. Under the latter, future threats are systematically identified, the probability of their occurrence analyzed, and their risk neutralized. From this perspective, safety must be built into the product for its entire lifetime, from its inception until the consumer ceases to use it.

Today, it is deemed essential that all devices in critical systems be developed using safety methods that prevent, to the greatest extent possible, any defects from being built into the device. The state supervises manufacturers of critical systems so as to ensure that they are developing their products by employing appropriate safety practices. Regulatory agencies established for this purpose include the Federal Aviation Administration (FAA) and the Food and Drug Administration (FDA).

12. Id.
13. Id.
14. Id. at 72.
15. Roland & Moriarty, supra note 10, at 10; USAF Handbook, supra note 9, at 3.
16. USAF Handbook, supra note 9, at 3.
18. USAF Handbook, supra note 9, at 3.
The underlying principle in safety engineering is that a product’s safety is not necessarily guaranteed by testing the performance of the finished product alone, i.e., treating the product like a “black box” where only the output and not what goes on inside is of interest. Rather, the manufacturer is obligated to prove that its product is safe, by implementing accepted safety measures, such as safety development systems. Similarly, in software development, it is not sufficient to test only the completed software or performance of the end product to determine its safety; instead, from the outset, the software must be written in a way that prevents the inclusion of defects and allows for it to be tested for safety.

The FDA’s premarket approval of medical devices has been recognized by the Supreme Court as “a rigorous process.” The 1990 Safe Medical Devices Act (“SMDA”) granted the FDA explicit authority to include in its standards for good manufacturing practices (GMP) for medical devices the pre-production condition of “design validation controls.” Furthermore, the Act authorized the Agency to require manufacturers to provide data on the sensitivity of their testing, its specificity, and its positive and negative predictive values. The Supreme Court considers the FDA premarket approval

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20. The FDA’s explicit policy on the issue is as follows: 
[The] FDA believes that because of the complexity of many components used in medical devices, their adequacy cannot always be assured through inspection and testing at the finished device manufacturer. This is especially true of software and software-related components, such as microprocessors and microcircuits. Quality must be designed and built into components through the application of proper quality systems.


24. Sensitivity = [1- false negative rate]. For example, if the false negative (the percentage of those for whom the medical test shows erroneously that they are healthy when they are in fact sick) is 1%, then the test’s sensitivity is 99%. See Anthony K. Akobeng, Understanding Diagnostic Tests 1: Sensitivity, Specificity and Predictive Values, 96 Acta Paediatrica 338, 339 (2007).

25. Specificity = [1- false positive rate]. For instance, if the false positive (the percentage of those for whom the medical test shows erroneously that they are sick when they are in fact healthy) is 1%, then the specificity of the test is 99%. See Akobeng, supra note 24, at 339.

26. The positive predictive value (PPV) of a test is defined as:
proval so exacting that it released a manufacturer from liability for negligence because it had received this approval.\textsuperscript{27} In other words, from the perspective of the Court, FDA approval signifies that the device is safe (and effective).

The scope of this Article does not allow an exhaustive consideration of every safety standard set by the FDA and similar safety oversight authorities. For the purposes of the discussion, it will suffice to give only the example of Medical Device Reporting (MDR) requirement.\textsuperscript{28} As noted, in prevailing safety theory, great weight is placed not on experience but on preventing defects and problems before they occur. Consequently, there is a duty to report not only accidents but also “incidents,”\textsuperscript{29} defined as situations in which there is the potential for harm to be caused and only by mere coincidence was this averted.\textsuperscript{30} There is important recognition of the fact that “near-miss conditions, if not corrected, most likely develop into accidents.”\textsuperscript{31} Therefore, incident investigation is a critical element of safety. The FDA routinely releases what are known as “medical device safety alerts” based on the MDR requirement,\textsuperscript{32} at times even ordering a recall of the particular product.\textsuperscript{33}

In contrast, in criminal law, incidents are not investigated at all, and as we will show, even accidents are not always investigated. Ironically, incidents, such as cases in which we suspect X, almost convict him, and then find out he is innocent, are regarded as the success of the criminal justice

\[ PPV = \frac{\text{Number of True Positive}}{\text{Number of True Positive} + \text{Number of False Positive}}. \]

The negative predictive value (NPV) of a test is defined as:

\[ NPV = \frac{\text{Number of True Negative}}{\text{Number of True Negative} + \text{Number of False Negative}}. \]


30. \textit{Id}.

31. \textit{Stephans, supra note 17, at 23.}

32. “Medical device safety alert: issued in situations where a medical device may present an unreasonable risk of substantial harm. In some cases, these situations also are considered recalls,” \textit{Background and Definitions}, FOOD AND DRUG ADMIN., http://www.fda.gov/Safety/Recalls/ucm165456.htm (last modified June 24, 2009).

33. “Recalls are actions taken by a firm to remove a product from the market. Recalls may be conducted on a firm’s own initiative, by FDA request, or by FDA order under statutory authority.” \textit{Id}.
In aviation, in contrast, if two planes had almost crashed, this luck would be deemed absolutely inadequate, and the incident would be investigated thoroughly.

II. THE NEED FOR SAFETY IN THE CRIMINAL JUSTICE SYSTEM

A. A Proposed Definition

In criminal law, the counterpart to an accident such as a plane crash is false conviction. Before proceeding to discussing safety in criminal law, the concept itself requires definition in this specific context. In its intuitive sense, safety can be conceived of in criminal law as precaution-tasking against false conviction by raising the evidentiary standard for conviction. In light of this definition, there will probably be those who would oppose introducing new safety mechanisms into the criminal justice system. Indeed, finding the optimal balance between false acquittals and false convictions is a problem that is innate to criminal law. On the one hand, as a social value judgment, we are more concerned about false convictions than false acquittals, to the point that we would rather see many (ten?, one hundred?) guilty persons acquitted than one innocent person convicted. Yet on the other hand, we would not want to abandon the criminal justice system altogether by acquitting all defendants in order to reduce false convictions to zero. Presumably, safety means increasing the number of offenders who are acquitted. We will show below that this is not necessarily so.

One possibility for defining safety in criminal justice could be a variation of the U.S. Air Force’s definition of safety:

Safety in criminal law—Freedom from those conditions that can cause false conviction.

Clearly, absolute safety cannot be attained without undermining criminal law’s fundamental objectives. However, resources can, and must, be invested in safety in order to reduce the rate of error.

Another way to define safety in the criminal justice system is on the basis of the safety measures that should be implemented.
Safety is the state in which the risk of harm to innocent people is lessened through a continuous process of hazards identification and risk management, without hindering criminal law’s fundamental objectives.

In line with Packer’s two-model paradigm of the criminal process—crime control versus due process—people tend to conceive of the process as a zero-sum-game: greater due process and fewer wrongful convictions come at the cost of less crime control and more wrongful acquittals. However, integrating safety into the criminal justice system could, in fact, be a win-win situation. Resources should be allocated to the systematic assessment of threats, identification of risks, and implementation of safety measures that reduce the rate of both false conviction and false acquittal. It is important to understand in this context that there is no contradiction in terms here: as safety increases (for instance, by improving the reliability of certain types of evidence), we are in fact killing two birds with one stone, in reducing the grave danger of convicting the innocent while increasing efficiency in convicting the truly guilty.

B. A Moral Duty

There is no greater injustice than the conviction of an innocent person. The fundamental damage is borne by the person convicted: the very fact of conviction, the accompanying stigma, and the punishment, which could be anything from monetary fine, to deprivation of liberty, to imprisonment. Indeed, in jurisdictions with the death penalty, wrongful conviction could even render the most drastic outcome: loss of life.

Only recently have researchers begun to examine the psychological damage inflicted on a person who is falsely convicted. Some studies have applied methodology and models from the fields of psychology and psychiatry. One study of eighteen released convicts who had been wrongfully convicted revealed changes in their personalities; they exhibited symptoms of Post-Traumatic Stress Disorder, with other depressive disorders also common among them. The former convicts reported psychological difficulties and trouble with social adjustment, particularly in the context of intimate relationships.

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40. See infra Section II.C (demonstrating that investing money in the safety of criminal law can be a win-win situation not only morally, but also economically).
41. This is especially true if we did not invest enough in preventing false conviction or did not do what we ought to have done to prevent it.
42. Adrian T. Grounds, Understanding the Effects of Wrongful Imprisonment, 32 CRIME & JUST. 1 (2005).
43. Id. at 2-3.
44. Id. at 1-2.
45. Id. at 2.
The details of the individual cases are illustrative of the trauma and injury to the wrongfully convicted. For example, James Bain was convicted in 1974 for the kidnapping and rape of a nine-year-old girl and was sentenced to life imprisonment. At the time of his arrest, he was nineteen years old. In December 2009, thirty-five years after his conviction, he was acquitted on all counts and released. He had spent, and wasted, almost his entire adult life behind bars for crimes he had not committed. Another falsely convicted individual, William Jackson, was stabbed and repeatedly assaulted during his five years of incarceration. Michael Evans and Paul Terry were both seventeen years old when they were arrested for raping and murdering a nine-year-old girl; they were both convicted and sentenced to 200 to 400 years' imprisonment. In 2003, however, the two men were acquitted and released, after having served twenty-seven years in prison. The court ruling in Michael Evans' suit against the state stated, despite rejecting his claim, that “what happened to Mr. Evans—his wrongful conviction and imprisonment for a substantial portion of his life—was a tragedy of epic proportions.”

We maintain that any false conviction that results in incarceration is a tragedy of epic proportions. In addition to the harm caused to the individual, there is the harm, both direct and indirect, to the families and friends of the wrongfully convicted. Moreover, wrongful conviction is significantly harmful to society as a whole, for the actual criminal continues to roam free and perhaps commit more crimes.

One of the central justifications for the state’s failure to invest all available resources in safety in other contexts, such as in improving the roads infrastructure, is that there is not enough money for it to optimally

47. Phillips, supra note 46.
48. Id.
51. Evans v. Katalinic, 445 F.3d 953, 955 (7th Cir. 2006).
52. Michael Evans and Paul Terry, supra note 50.
53. Evans v. City of Chicago, 513 F.3d 735, 747 (7th Cir. 2008).
54. Limone v. United States, 579 F.3d 79, 102 (1st Cir. 2009); see also text accompanying infra note 65.
55. For example, in the case of James Bain, see supra note 46, the true criminal has yet to be found. Know the Cases: James Bain, INNOCENCE PROJECT, http://www.innocenceproject.org/Content/James_Bain.php (last visited Oct. 7, 2011).
A Safety Doctrine for the Criminal Justice System

achieve all of its objectives, such as security, education, and health. This argument, however, does not hold in the context of the criminal justice system. Firstly, in other contexts, such as motor traffic, the risk of accidents is apparent, and the state tries to reduce that risk by setting mandatory safety standards. In the case of false convictions, however, it is in fact the state itself that creates the risk: by setting the offenses in law; by focusing on one specific suspect; by bringing people to trial; by using problematic evidence and inaccurate equipment to prove guilt; and by convicting and imposing harsh penalties. An accepted principle in both torts and criminal law is that the creator of a dangerous situation is duty-bound to eliminate or reduce the risk of harm deriving from that situation.56 The “state-created danger doctrine” has a similar logic, imposing duties on the state when its actions create a risk.57 Thus, not only does the state have a moral duty to incorporate safety into the criminal justice system, even if this would entail resources, but it also bears a legal obligation to do so.

Secondly, under the social contract theory, the state was established to protect the rights of society’s members and certainly not to cause them harm.58 The conviction of an innocent person is the greatest injustice that a state can inflict on its citizens. Consequently, in the context of criminal justice, the state, as the creator of the risk, has an enhanced moral duty (as compared to its duty in the area of road infrastructure, for instance) to employ measures to reduce the risk.59

Thirdly and quite unfortunately, apart from the theoretical declaration that guilt should be proven beyond a reasonable doubt, no genuine effort is actually made to reduce the significant risk of wrongful conviction: the concept of modern safety is completely foreign to criminal law.60 As we will show below,61 even the most basic and easily performed measures for reducing that risk are not implemented.

Fourthly, in the context of criminal law, there is a particularly simple and straightforward solution to the problem of funding safety: the extent to which the law is enforced is determined by the budget allocated for law

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60. See infra Section II.D (regarding simple safety measures, many of which are currently employed in other fields but none of which are used in the field of scientific evidence). To the best of our knowledge, there appears to be no book or article that includes any discussion of safety in criminal law, the only exception being the article From a Plane Crash to the Conviction of an Innocent Person, which proposes introducing “safety-critical systems” into criminal law. Halpert & Sanguero, From a Plane Crash, supra note 3.
61. See infra Section II.D.
enforcement, and the extent of the safety precautions that will be implemented should be included in that budget. In other words, based on the (not inevitable) assumption of a fixed budget, it is possible to implement safety by making do with slightly fewer criminal proceedings. The goal is not maximum enforcement, which severely impairs our freedom and makes life insufferable. In fact, many already believe, as do we, that the system suffers from over-criminalization.62

Finally, we will explain below that the investment in safety has proven to be beneficial in other fields, even under narrow economic analysis devoid of any moral considerations.

C. Economic Justification

In the context of fighter planes, safety is justified by cost-benefit analysis. Simply put, it would be too expensive not to implement safety. For example, the total cost of the safety program in the development of the F-14 planes was $5 million, divided over ten years.63 Since the cost of building one F-14 at the time was $15 million, this investment in safety was economically justified even if it prevented only a single plane from crashing.64

The economic cost of errors in the criminal justice system is no less considerable and is also quantifiable. In recent years, several plaintiffs have been awarded large sums in damages. In Limone, for example, the appellate court upheld the decision to award $101,750,000 in compensation to four falsely convicted men and their immediate families.65 This amounted to $1 million for each year in prison.66 It can be inferred from this judgment that the incorrect “solving” of one crime that leads to the false conviction of a number of individuals can generate economic harm of over $100 million, similar to the cost of a sophisticated twenty-first-century fighter plane. In other cases, even more damages have been awarded per year in prison. Juan Johnson, for example, received $21 million in compensation for eleven

63. Halpert & Sangero, From a Plane Crash, supra note 3, at 89.
64. Id.
65. Limone v. United States, 579 F.3d 79, 102 (1st Cir. 2009).
66. Id. at 105-07.
years of false imprisonment,\textsuperscript{67} amounting to nearly $2 million for each year of incarceration.

Consequently, even if only one false conviction could be successfully avoided through safety measures, it would be economically worthwhile to invest even millions of dollars to do so. As shown further on, false conviction is not merely a matter of isolated instances, its rate is surprisingly high.\textsuperscript{68}

Some may claim that less economic harm is caused to society than what we described above, since the majority of false convictions are never uncovered and society is therefore not required to compensate for the harm. This reasoning should be rejected. Economic harm is clearly created, but its cost is actually, and unjustifiably, borne by the falsely convicted. The state makes them shoulder the burden of this grave harm, while refraining from implementing any precautionary measures to prevent its occurrence.

D. Examples of Absence of Safety

1. Lack of Safety in Scientific Evidence

The risks inherent to scientific evidence are very similar to those entailed in medical diagnostic tests. As with any form of medical testing, there is always a likelihood of error with scientific evidence. However, while manufacturers of medical devices are fully regulated by the FDA, no such supervision exists vis-à-vis manufacturers of scientific evidence equipment.\textsuperscript{69} Thus, manufacturers of DNA testing equipment, for example, are not regulated,\textsuperscript{70} despite the many risks involved.\textsuperscript{71} In particular, there is no reporting duty, which is accepted practice in the medical devices industry and automobile industry. This lack of safety mechanisms leads to anomalies.


\textsuperscript{68} See infra Section III.B.

\textsuperscript{69} U.S. federal law and FDA regulations distinguish among three classes of medical devices intended for human use, in accordance with the level of risk posed to the public and the required degree of control: Class I, Class II, and Class III devices. Halpert & Sangero, From a Plane Crash, supra note 3, at 73. Although Class III devices are subject to the strictest control system because they pose a significant risk to human life, even Class I devices—such as elastic bandages, supra—must meet strict quality assurance requirements. Id.

\textsuperscript{70} Id. at 74.

\textsuperscript{71} Eric Sobel et al., Detection and Integration of Genotyping Errors in Statistical Genetics, 70 AM. J. HUM. GENETICS 496, 496 (2002); François Pompanon et al., Genotyping Errors: Causes, Consequences and Solutions, 6 NATURE REV. GENETICS 847, 852-53 (2005); William C. Thompson, Tarnish on the ‘Gold Standard’: Understanding Recent Problems in Forensic DNA Testing, CHAMPION, Jan.-Feb. 2006, at 10, 14.
One example can be found in the user manual of Applied Biosystems, a company that manufactures DNA testing kits. The manual includes the following statement in bold: "For Research, Forensic and Paternity Use Only. Not for use in diagnostic procedures." Thus, while a single piece of evidence is adequate basis for sentencing someone to extended jail time, life imprisonment, or even execution, it is insufficient for medical diagnosis.

Applied Biosystems also included a disclaimer in its GeneMapper software user manual that the company bears no liability for errors appearing in the booklet describing the software and the manner in which it should be used. The manual even contains a clarification that it takes no responsibility for any damage caused as a result of using the software and does not guarantee that the software is error-free. Thus, rather than providing declarations and proof that the software and its accompanying documentation are safe, as required by the FDA for medical devices, the manufacturer of a DNA testing kit that is used in criminal proceedings can declare the opposite. Not surprisingly, problems with Applied Biosystems software have arisen.

In fact, large-scale accidents and incidents are not a rarity in DNA testing. For example, researchers uncovered widespread contamination at the British Forensic Service, where it emerged that the DNA of twenty employees of the microfuge tubes manufacturer had contaminated the DNA evidence in various cases. The researchers further reported that “contamination by police personnel has been detected at approximately 10% of scenes.” This illustrates how DNA is still governed by the outdated Fly-Fix-Fly approach. The preventative measures that were implemented following the discovery of contamination were all connected to flaws discov-

73. Daryl Mack was convicted of murder based solely on DNA evidence collected during a scan of a pool of genetic profiles and subsequently sentenced to death. Halpert & Sangero, From a Plane Crash, supra note 3, at 83. He was executed on April 26, 2006. Id.
75. Id. at I-3.
78. Id. at 176.
ered in the past and not to future possible mishaps.\textsuperscript{79} Indeed, these measures did not prevent other instances of large-scale contamination caused by unidentified sources. Thus, in 2008, the German police appealed to the public, offering 100,000 Euros for information leading to the arrest of the serial killer known as “the Phantom of Heilbronn.”\textsuperscript{80} Traces of the killer’s DNA had been discovered at approximately forty crime scenes in Germany, Austria, and France, six of them cases of murder.\textsuperscript{81} In 2009, the mystery was solved: there was no serial killer.\textsuperscript{82} Rather, the DNA found at the crime scenes belonged to an innocent female worker at the factory in Bavaria that produces the cotton swabs used in the DNA collection, and they had been contaminated by her DNA.\textsuperscript{83}

Optimists will continue to claim that, at worst, such instances of contamination result in the actual perpetrator remaining at large, but not the incrimination of an innocent person. However, from a safety perspective, this is flawed. Firstly, safety in DNA testing may achieve reduction of undesirable “false negatives,” which allow the actual perpetrator to be free to commit additional crimes. Secondly, safety in DNA would also reduce the risk of false positives that derives from the relatively easy and undetected contamination of samples. One of the central dangers is “cross-contamination,” where the genetic matter of an innocent suspect (or someone who becomes a suspect after the DNA test) contaminates the DNA sample taken from a crime scene, and the suspect mistakenly appears to be the perpetrator.\textsuperscript{84}

Some examples where cross-contamination led to false convictions include the Jaidyn Leskie murder investigation,\textsuperscript{85} the Russell John Gesah

\textsuperscript{79} Id.
\textsuperscript{81} Moore, supra note 80; Kaye, supra note 80; "DNA Bungle" Haunts German Police, supra note 80.
\textsuperscript{82} "DNA Bungle" Haunts German Police, supra note 80.
\textsuperscript{83} Moore, supra note 80; Reward for "Phantom Killer" Reaches Record €300,000, supra note 80; Kaye, supra note 80; "DNA Bungle" Haunts German Police, supra note 80.
\textsuperscript{84} Thompson, supra note 71, at 10-12.
\textsuperscript{85} In this case, DNA samples of a young “mentally challenged” girl (hereinafter “P”) matched the samples taken from the Leskie murder scene. Inquest into the Death of Jaidyn Raymond Leskie, Coroners Case Number: 007/98 64-85, available at http://www.bioforensics.com/conference09/Workshop/Leskie_decision.pdf. The coroner’s inquiry revealed that around the same period in which the blood stains from the murder had been tested, a sex crime committed against P had been investigated in the same laboratory. Id. at 67-70. Although the lab personnel claimed contamination to be improbable, the coroner’s final conclusion was that the DNA sample in the Leskie case had been contaminated
and the Farah Jama case—where it even led to a false conviction.87 Cases of cross-contamination have arisen in the United States as well. For example, in 2004, a DNA sample taken in the 1968 Jane Durrua murder investigation was found to match the DNA of convicted sex criminal Jerry Bellamy.88 In retrospect, it emerged that Bellamy’s sample and the sample from the Durrua case had been processed in the same laboratory at the same time, giving rise to serious suspicions of contamination.89 As a result, the prosecutor dropped the charges against Bellamy.90 In 2008, testing of the samples in other laboratories produced a different result, leading to charges being filed against another person, Robert Zarinsky, for the same murder.91

Unfortunately, not all errors are discovered. In another case, DNA from John Ruelas and Gary Lieterman were found to match samples taken from a 1969 murder crime scene.92 However, Ruelas was four years old at the time of the murder and was thus clearly not the murderer. Despite the

with P’s DNA. Id. at 70-72, 85. While he could not point to the exact manner in which the contamination had occurred, the coroner did note that additional cases of contamination had been uncovered at the same laboratory, whose precise sources had not been determined. Id. at 85.

86. In 2008, murder charges against Russell John Gesah based on DNA test results were dropped. It emerged that his DNA sample and a sample from the crime scene had been processed at the same time and at the same laboratory, raising suspicions of cross-contamination. Media Release, Victoria Police, DNA Review Finalized (Sept. 24, 2008), http://www.police.vic.gov.au/content.asp?Document_ID=17223.

87. Farah Jama was convicted and sentenced to six years’ imprisonment. FRANK H. R. VINCENT, REPORT: INQUIRY INTO THE CIRCUMSTANCES THAT LED TO THE CONVICTION OF MR. FARAH ABDULKADIR JAMA (2010). He served approximately a year and a half until 2009, when the prosecutor informed the court that the DNA sample had apparently been contaminated. Id. The court overturned his conviction, and he was released from prison. Id. For a summary of this document, see http://guides.sl.nsw.gov.au/content.php?pid=242811&sid =2147036.


90. Id.


92. Thompson, supra note 71, at 14.
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lack of any logical reasonable explanation for the match between the murderer’s DNA and Ruelas’ DNA and even though it emerged that the samples taken from the victim and two suspects had been processed in the same laboratory at the same time, Lieterman was convicted of the murder. Moreover, it should be noted, under the Hidden Accident Principle, had the innocent suspect Ruelas been an adult and not a child at the time of the murder, he would probably have been convicted and the probable cross-contamination never discovered.

Mishaps with DNA testing are often reported in the media. The information provided, however, is not always accurate. Yet since no reporting duty exists, nor any duty to investigate incidents or even accidents, the media is often the sole source of information. Thus, not only is there no safety approach aimed at preventing accidents from occurring, but no consistent attempt is made to learn from experience. Indeed, not even the Fly-Fix-Fly method is systematically implemented in criminal law.

Another example of the lack of safety in scientific evidence in criminal law is Chun, a New Jersey case that revolved around a breath alcohol testing device for drivers manufactured by Draeger. The experts for the defense testified in court that the software would not have met the standards of any regulatory body, such as the FDA, FAA, or U.S. Department of Defense. A programmer employed by the manufacturer testified that he did not know of any basic standards for software development and had instead relied on personal experience. The same programmer had apparently single-handedly caused an unnecessary defect in the software. It was also discovered that there was no quality assurance supervisor or anyone who performed that function with respect to software development at Draeger. Nonetheless, the court ruled that standards for software development are a matter of style and theory and not necessary for guaranteeing the safety and reliability of any given device. The court was in fact implementing the Fly-Fix-Fly approach: having found a defect in the software, it ordered its repair and approved the continued use of the device (until the emergence of the next defect).

93. Id.
95. Halpert & Sangero, From a Plane Crash, supra note 3, at 78-82.
96. Id. at 82.
98. Chun, 943 A.2d at 160.
99. Halpert & Sangero, From a Plane Crash, supra note 3, at 78-82.
The 2009 National Academy of Science Report exposed basic problems with all forms of scientific evidence. Indeed, for many years, supervision of laboratories was atrocious. The Houston Police Department Crime Laboratory, for example, has been described as follows:

The complete lack of outside scrutiny of the Crime Lab’s operations, procedures, and reporting of results allowed serious deficiencies, particularly in the DNA/Serology Section, to become so egregious that analysts in the Lab simply had no perspective on how bad their practices were.

There is no justification for such a total disregard for safety in the criminal law context. When conducted, laboratory proficiency testing has revealed a significant error rate. In fact, erroneous forensic testimony has been found to constitute the second most significant factor in false convictions. Thus, mere awareness of the error rate in labs, as has been proposed in the literature, is not sufficient for ensuring safety. Rather, instituting safety measures is crucial for reducing the incidence of error. Furthermore, certain types of evidence, such as microscopic comparisons of hair, which are deserving of the title “junk science,” unfortunately continue to be held admissible by some of the courts.

2. Disregard of Organizational Theories

False convictions can also be analyzed through the prism of organizational theories. The criminal justice system features a significant amount

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103. Saks & Koehler, supra note 2, at 892.

104. Id.

105. Halpert & Sangero, From a Plane Crash, supra note 3, at 86-88.


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of built-in redundancy,¹⁰⁸ which is presented as a sort of back-up safety mechanism. There is the expectation that where one function in the system fails (such as false lineup identification), other units’ functions will compensate (the forensics laboratory; the prosecution, which supervises the police; the defendant’s lawyer, who knows how to present or uncover errors; or the judges and the juries, which consider the facts of the case, and the appellate courts). Yet, as the famous Josiah Sutton case demonstrates, these various parts of the system are in fact intertwined and impact one another.¹⁰⁹ Accordingly, the risk of all the parts collapsing at once is greater than what might be expected.

Studies of fingerprint experts have shown how external information can shape their determinations.¹¹⁰ Exemplifying this is the case of the investigation of a terrorist attack in Madrid.¹¹¹ Over the course of the investigation, an American lawyer named Brandon Mayfield became the main suspect after an automatic fingerprint identification system pointed to a similarity between the fingerprints taken from the crime scene and Mayfield’s fingerprints, which were in the computer’s database.¹¹² The information given to the fingerprints experts, namely, that Mayfield was a Muslim married to an Egyptian and had, in the past, represented a terrorist in legal proceedings, emerged as having influenced the possibility of detecting an error when doubts first arose regarding the match between his fingerprints and the prints from the crime scene.¹¹³

Non-scientific evidence has also been shown to be susceptible to bias. A control study showed how a significant percentage of eyewitnesses changed their minds about the suspect they identified in a police lineup after having been provided with information from the investigation, such as the fact that one of the lineup participants had confessed during interrogation.¹¹⁴

108. Id. at 1032 n.32 and accompanying text.
109. See Know the Cases: Josiah Sutton, INNOCENCE PROJECT, http://www.innocenceproject.org/Content/Josiah_Sutton.php (last visited Nov. 21, 2011); Thompson, supra note 107, at 1032.
112. Id.
113. Id. at 178.
114. Lisa E. Hasel & Saul M. Kassin, On the Presumption of Evidentiary Independence: Can Confessions Corrupt Eyewitness Identifications?, 20 PSYCHOL. SCI. 122 (2009). Thus, Michael Evans was convicted of the murder and rape of a young girl. Evans v. City of Chicago, No. 04 C 3570, 2006 U.S. Dist. LEXIS 9831, at *20 (N.D Ill. Jan. 6, 2006). His conviction was based solely on questionable eyewitness identification. Id. at *14-16. Twenty-seven years later, he was released from prison when a DNA test proved that he was not the rapist. Id. at *20-21. The witness had not been certain in identifying him as the rapist, and
Thus, criminal law seems to lack a safety policy aimed at ensuring autonomy of the various pieces of evidence.

3. Lack of a Serious Attempt to Reduce Government Misconduct

A central source of false conviction is misconduct on the part of police investigators, lab technicians, or prosecutors. Misconduct includes any of the following: deliberate suggestiveness in identification procedures; withholding of evidence from the defense; deliberate mishandling, mistreatment, or destruction of evidence; coercion of false confessions; deliberate contamination of confessions; and reliance on unreliable government informants or snitches. The number of documented cases of prosecutorial misconduct has tripled over the last two decades.

We propose distinguishing between two types of criminal behavior by the police. The first type is corruption on the part of police investigators, as in the well-known Rampart and Tulia scandals, where the police know that the suspect is not guilty but seek to incriminate her. The second type of criminal conduct arises when police investigators are truly convinced that the suspect is guilty but are concerned that the court will not convict her. Investigators thus take matters into their own hands, either concealing evidence that would prove the suspect’s innocence or “enhancing” or even fabricating incriminating evidence. This second type of criminal behavior is more dangerous, as it is apparently more prevalent. A distorted perception of their role—supposedly to ensure conviction—is certainly likely to be the cause of this behavior among police investigators and even prosecutors.

had been told that he had confessed during interrogation; this information had bolstered her confidence in her identification. Id. at *15; see also supra notes 50-53 and accompanying text.


118. Samuel R. Gross et al., Exonerations in the United States, 1989 Through 2003, 95 J. CRIM. L. & CRIMINOLOGY 523, 534-36 (2005). In the LAPD Rampart scandal, a corrupt police officer who was awaiting trial for dealing in cocaine revealed how he and his colleagues in the unit had incriminated defendants by fabricating evidence, false testimony, and more. Id. At least one-hundred defendants were incriminated and convicted in this way, with most pleading guilty to the charges against them. Id.

119. In the Tulia scandal, thirty-nine defendants were brought to trial for drug offenses as a result of a single piece of false testimony given by an undercover police detective. Id. at 534. Most of the defendants pleaded guilty and were convicted. Id. 534-36
contend with this phenomenon, it is vital to acknowledge its existence and to deem such conduct criminal, because it misleads the court in exercising its discretion.

The case of John Kelly illustrates how even negligent behavior that does not amount to misconduct should not be tolerated. Kelly "spent a year in jail awaiting trial on charges that were eventually dropped." Already at the outset of his trial, when the evidence against him was handed over to the public defender, two fundamental flaws in the prosecution’s case became clear. First, Kelly did not fit the description of the drug dealer provided by the investigating detective. Second, the rock-like substance found in the apartment was determined not to be a drug in a lab test conducted a week after Kelly’s arrest. Consequently, Kelly was released, and the charges against him were dropped.

In the civil suit brought by Kelly, the court determined that the forensic report stating that the substance was not a drug was delivered to one of the detectives one day after the substance had been sent for lab testing and approximately one week after Kelly’s arrest, whereas the prosecutor received the report months after the arrest. The court did not discuss the prosecutor’s liability, despite the fact that nearly a year had passed between the receipt of the test results and Kelly’s release. Under federal law, prosecutors enjoy absolute immunity from claims of misconduct in performing their job. With regard to the detectives in the Kelly case, however, the court held that they had qualified immunity. One of the detectives, Julie Gibson, knew about the forensics report but did not inform the prosecutor about it. In fact, she failed to mention the report even in her court testimony in an arrest proceeding a month after Kelly’s first arrest, while he was still incarcerated.

In Kelly’s claim against the state, the court ruled as follows regarding Gibson:

Although Gibson did receive the exculpatory report, she did not, on the facts of this case, have a clearly established duty to bring that report to the attention of the prosecutor or the state court. . . .

120. Kelly v. Curtis, 21 F.3d 1544, 1546 (11th Cir. 1994) (this was the civil suit brought by Kelly in this matter, in which the details of the case were clarified).
121. Id. at 1547.
122. Id. at 1547-48.
123. Id. at 1548.
124. Id. at 1549.
125. Id. at 1549.
127. Kelly, 21 F.3d at 1550-52.
128. Id. at 1548 & n.3.
129. Id. at 1548.
The same is true of any failure of an officer to inform defense counsel or the court of exculpatory evidence: the officer has no such duty where she has reason to believe that the prosecutor is aware of that evidence. The Constitution places the duty to disclose known exculpatory evidence upon prosecutors.130

Kelly’s case implies that not only is the law enforcement system negligent and perhaps even aware of the potential of an innocent person going to prison, but that it regards the policy facilitating this as appropriate.131 There is absolutely no justification for incarcerating someone for a year when from the outset the evidence clearly mandates his release. In the civil suit, the court in fact explicitly took an anti-redundancy approach, for it espoused leaving the decision in the hands of one person, namely, the prosecutor. It does not encourage actors within the law enforcement system to rectify the mistakes of other actors. It is not surprising, then, that in many cases, exculpatory evidence has been kept from the defense. Indeed, this is a significant risk factor that materializes in many cases of false conviction.132

III. TOWARD SAFETY IN THE CRIMINAL JUSTICE SYSTEM

Having demonstrated that there is no modern safety approach in the criminal justice system, we will now proceed to present a number of principles that can serve as the foundation for a core safety theory for the criminal justice system.

A. The Hidden Accident Principle

Why is the criminal justice system negligent in comparison to the aviation, engineering, and medical fields? In the latter three, the occurrence of an accident is both observed and observable. A defect in an airplane will cause its apparent crash; a defect in a bridge will cause its apparent collapse. An erroneous diagnosis of appendicitis will be discovered when surgery reveals that the appendix is not infected.133 The fact that accidents and their ensuing damage are discernible led, as early as the 1940s, to the development and implementation of a science of modern safety in order to reduce defects in products and their resulting damage.134

130. Id. at 1552.
134. Halpert & Sangero, From a Plane Crash, supra note 3, at 71-74. In the 1980s, product liability litigation and other factors served as added incentive to manufacture safe products in additional fields. See STEPHANS, supra note 17, at 6.
Assuming that false convictions are accidents, they are of the type that is never detected. There is no “gold standard” for determining whether a conviction was incorrect. Indeed, if one were to exist, it would already be applied at trial. When people who have been convicted of a crime proclaim their innocence, this is met with complete skepticism in light of the court’s guilty verdict.

This inability to detect wrongful conviction is a highly significant feature of criminal law, which we call the “Hidden Accident Principle.” This principle can be formulated as follows:

The criminal justice system is characterized by accidents (false convictions) that typically remain undetected. The inability to detect these accidents translates into optimism on the part of policymakers that false convictions only occur at a negligible rate.

In a reality in which false convictions go undetected, the criminal justice system in fact receives no feedback. As in the case of the Houston Crime Lab, the lack of external review means that the laboratory technicians have no notion of how deficient their practices are. Under the Hidden Accident Principle, effective feedback for the criminal justice system, even in theory, is implausible. The system does not know how poor its operation and safety practices are. The only way for it to grasp this is through comparison with other fields in which mishaps are liable to cause serious damage.

In a historical window of opportunity, post-conviction DNA testing emerged as a gold standard for verifying a certain class of convictions. The results of some of these tests have led to the reopening of cases; thus far, for example, more than 270 convicted prisoners have been exonerated and released through the Innocence Project. Notably, 270 cases of false convictions are considerably less than what the Supreme Court has indicated it is willing to “sacrifice.” Moreover, this number is certainly far lower than the other, much higher estimates that will be discussed below. Regardless, the uncovering of the false convictions in the framework of the Innocence Project’s work shocked not just the public at large, but also jurists. The reason for this was the disclosure in the media of the names of some of those falsely convicted, their faces, and the great suffering they experienced.

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135. Samuel R. Gross, Convicting the Innocent, 4 Ann Rev. L. Soc. Sci. 173, 175 (2008) (“False convictions are not merely unobserved, but in most cases are also unobservable. The problem is not simply that we do not know for sure whether a particular prisoner is innocent. We also may not know for sure whether he is HIV positive, but we can test him, or the prison population as a whole, or a random sample. There is no general test for the accuracy of criminal convictions. If there were, we would use it at trial.”).
136. See sources cited in supra note 2.
138. See infra Section III.B.
se details have quite a different impact than abstract, sterile awareness of the fact that there are people who are falsely convicted.\textsuperscript{139}

The Hidden Accident Principle demonstrates the almost complete ineffectiveness of the Fly-Fix-Fly safety method in criminal law, principally because it is extremely difficult to learn from the experience of past accidents when they are a hidden phenomenon. Below we proceed to the next stage of developing a safety theory for criminal law: a general assessment of the risks inherent to the criminal justice system.

B. Assessment of Risks Regarding the False Conviction Rate

Risk assessment is an integral part of the science of safety. Courts have always been optimistic regarding the possibility of false conviction. In fact, for many years, a great number of jurists believed false conviction to be almost impossible, with Justice Learned Hand’s oft-quoted description of the phenomenon as an “unreal dream”\textsuperscript{140} reflective of this stance.

In \textit{Kansas v. Marsh}, Justice Scalia revealed a similar approach to the possibility of false conviction.\textsuperscript{141} He quoted a prosecutor who claimed in a newspaper article that the rate of false convictions at worst stands at only 0.027%:

“[L]et’s give the professor the benefit of the doubt: let’s assume that he understated the number of innocents by roughly a factor of 10, that instead of 340 there were 4,000 people in prison who weren’t involved in the crime in any way. During that same 15 years, there were more than 15 million felony convictions across the country. That would make the error rate .027 percent—or, to put it another way, a success rate of 99.973 percent.”\textsuperscript{142}

Such estimations, however, contradict accepted practice. In American law, Blackstone’s 1:10 ratio is commonly adopted, whereby guilt must be proven at a level of 90.91% (10/11).\textsuperscript{143} This formula is based on his famous declaration that it is “better that ten guilty persons escape, than that one innocent suffer.”\textsuperscript{144} Indeed, in a survey of 171 judges, the most common choice (56 participants) was a 90% proof threshold.\textsuperscript{145} The average choice

\begin{itemize}
  \item \textsuperscript{139} Gross, \textit{supra} note 135, at 174.
  \item \textsuperscript{140} United States v. Garsson, 291 F. 646, 649 (1923).
  \item \textsuperscript{141} 548 U.S. at 196-98 (Scalia, J., concurring).
  \item \textsuperscript{142} \textit{Id.} at 197-98 (quoting Joshua Marquis, \textit{The Innocent and the Shammed}, N.Y. \textit{TIMES}, Jan. 26, 2006, at A23).
  \item \textsuperscript{143} Volokh, \textit{supra} note 36, at 174.
  \item \textsuperscript{144} \textit{Id.}
  \item \textsuperscript{145} See C.M.A. McCauliff, \textit{Burdens of Proof: Degrees of Belief, Quanta of Evidence, or Constitutional Guarantees?}, 35 VAND. L. REV. 1293, 1324-27 (1982).
\end{itemize}
was 90.3%, and the median 90%. If we assume Blackstone’s theoretical ratio to be the actual average ratio, as it emerges from the survey, the results diverge significantly from the optimistic expectations regarding conviction reliability. In 2008, there were 2,310,984 inmates in U.S. prisons. Assume that the distribution of the probability of guilt for each of the inmates is uniform, ranging from a minimum threshold level of 90.91% to a maximum of 100%; in other words, there is a uniform number of cases for each level of probability of guilt. The average true conviction rate is then 95.455%, which is the median between the 90.91% threshold level and 100% ceiling. But according to this, 4.545% of the 2,310,984 inmates, which amounts to 105,034, are in fact innocent! This demonstrates the significant logical inconsistency in setting the beyond-reasonable-doubt threshold at the 1:10 ratio, which predicts 105,034 innocent inmates and the optimistic belief that over a period of fifteen years “only” 4,000 false convictions occurred and that the legal process is safe, with only a negligible rate of error.

Some may dispute our calculations, asserting that this does not take into account the fact that the majority of convictions are based on plea bargains, and that the error rate of plea bargains is significantly lower than the error rate of trials. In our view, however, these assumptions are erroneous and indifferent to safety. It is not plausible that plea bargains somehow

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146. See id. For an overview of additional surveys with similar results, see Lawrence M. Solan, Refocusing the Burden of Proof in Criminal Cases: Some Doubt About Reasonable Doubt, 78 TEX. L. REV. 105, 125-29 (1999).

147. This is doubtful, as there are many cases in which defendants are convicted based on a single piece of evidence, such as line-up identification or a confession, or a single item of scientific evidence—sometimes supplemented by a weak piece of evidence. In such cases, the fallacy of the transposed conditional (or false positive fallacy) is likely to arise, and the probability of guilt is much lower than it seems. See Sangero & Halpert, Why a Conviction Should Not Be Based on a Single Piece of Evidence, supra note 2; Sangero & Halpert, Proposal to Reverse, supra note 1. Furthermore, a judge’s estimate of 90% certainty of guilt is, of course, subjective, and it is quite possible that, objectively, guilt has been proven to a much lesser extent.


149. For a similar assumption, see David Hamer, Probabilistic Standards of Proof, Their Complements, and the Errors that are Expected to Flow from Them, 1 U. NEW ENG. L.J. 71, 90 (2004).

150. See the details of this calculation in Sangero & Halpert, Proposal to Reverse, supra note 1, at 545-46.

151. For a non-uniform distribution of guilt assumptions, see Hamer, supra note 149, at 87-96; see also Sangero & Halpert, Proposal to Reverse, supra note 1, 543-48.

“magically” increase the accuracy of the system. On the contrary, a safety approach must assume a far riskier situation in plea bargains, where there is no 90% probative threshold. Indeed, it is sufficient that the defendant confessed in order to conceive of the case as closed. Ironically, an accepted justification for the prosecution to offer a plea bargain is that the evidence is not strong enough to convict at trial. The reality is that false convictions also occur when defendants confess as part of a plea bargain. For example, in some cases of widespread police corruption, where many innocent suspects were brought to trial, as in the LAPD Rampart scandal and the Tulia scandal, the majority pleaded guilty.

Substantial empirical support for our assessment can be found in a recently published study by Risinger using empirical data from the Innocence Project. The analysis of the data revealed a 3.3% minimum rate of factually wrongful convictions in the 1980s for capital rape-murder. To calculate the minimum false conviction rate, Risinger used the following formula: the numerator was the known number of false convictions within a reference group with similar characteristics and the denominator was the total number of convictions within the same reference group. Seeking a reliably-sized reference group, Risinger chose a group of false convictions that were exposed by the Innocence Project in capital rape-murder cases between the years 1982 and 1989 where DNA samples had survived. Eleven such cases were found in the Innocence Project database. Risinger (carefully) excluded 5% of the cases based on the possibility that some had been guilty despite the exonerating results of the DNA testing, leaving 10.5 relevant cases. During the relevant period, there were 479 convictions in cases of capital rape-murder in the U.S. It emerged from the Innocence Project data that in one-third of the cases, no DNA samples had been preserved. Thus, it could be expected that of the 479 convictions, there was potential for DNA testing in only two-thirds of the cases (319 cases). This yielded a 10.5/319=3.33% minimum rate of false conviction, for it was not at all

154. Supra note 118.
155. Supra note 119.
157. Id. at 780.
158. Id. at 768.
159. Id. at 774-78.
160. Id. at 773-74.
161. Id. at 774.
162. Id. at 778.
163. Id.
164. Id.
165. Id.
clear whether all 319 had requested post-conviction DNA testing.\textsuperscript{166} Risinger assumed that at least half of those convicted would have requested a DNA test, since this would be their last chance for exoneration.\textsuperscript{167} This assumption yielded a 6.4\% upper boundary.\textsuperscript{168} However, because of the lack of accurate information, he chose a \textit{“fair threshold”} of 5\%.\textsuperscript{169} While the calculation of the lower boundary was well supported, the calculation of the upper boundary and fair threshold was only an estimate and could be higher.\textsuperscript{170} Risinger’s (empirical) results correspond closely to our calculations (5\%), which we based on a 90\% conviction threshold.

For the purposes of this discussion, we will assume a 5\% false conviction threshold for all criminal offenses and not just capital rape-murder, for the following reasons: (1) This rate is the product of Risinger’s calculations based on empirical data. (2) Our calculations, based on the accepted criminal conviction threshold in the United States (Blackstone’s ratio), yield a similar result. (3) We maintain that a safety approach must take into account the possibility that in cases of offenses that are less grave than rape-murder, the courts are less cautious and the rate of false conviction is even higher.

It is important to note that we do not claim the false conviction rate to be exactly 5\%. Indeed, it could be lower, and it could be higher. It is also possible that there are different rates for different offenses.\textsuperscript{171} What we seek to show, rather, is that the false conviction rate is \textit{not insignificant}. Thus, a safety approach should not optimistically presume a low rate of false conviction, but instead assume matters to be much bleaker.

How, then, can we explain the Supreme Court’s willingness to accept that there were only 4000 false convictions out of the 15 million felony convictions handed down over a fifteen-year period (a 0.027\% false conviction rate)? Under the Hidden Accident Principle, since the majority of false convictions are undetectable, policymakers and judges continue to assume the system to be almost error-free, despite the possibly huge rate of false convictions.

C. The Adaptation of “Reasonable Doubt” Standard to the Safety Doctrine

For years, beyond a reasonable doubt has been the accepted standard of proof in U.S. criminal law.\textsuperscript{172} This standard of proof is applied in many

\textsuperscript{166} Id.
\textsuperscript{167} Id. at 779.
\textsuperscript{168} Id.
\textsuperscript{169} Id. at 779-80.
\textsuperscript{170} Id.
\textsuperscript{171} Gross, supra note 135, at 178.
\textsuperscript{172} \textit{In re} Winship, 397 U.S. 358, 361 (1970).
other legal systems as well. The reasonable doubt standard has been the subject of much discussion in both the case-law and literature. On the one hand, it supposedly ensures a high level of certainty in conviction. On the other hand, “‘[b]eyond a reasonable doubt’ does not mean beyond any doubt,” for otherwise, we could never convict even the guilty, as imaginary and baseless doubts always exist. Thus, there is no absolute certainty in conviction: “the beyond a reasonable doubt standard is itself probabilistic.”

In practice, when the law allows a defendant to be convicted based on the lineup identification of only one eyewitness or on the defendant’s confession, there is hardly a high level of certainty to the conviction. We therefore propose the following adjustment of the standard of proof:

Conviction in a criminal trial will be possible only where: (1) guilt has been proven beyond a reasonable doubt; and (additionally) (2) all reasonable measures have been taken to ensure that false conviction does not occur.

The first requirement will create a certain level of certainty in convictions, in line with current practice. Although high, this would be far from absolute certainty. The second requirement is thus intended to ensure the necessary safety in criminal convictions. In other words, applying one, fixed probability threshold for conviction in each and every case (such as 90%, which is accepted practice in American courts) is not adequate. If, in a given case, the evidence points to guilt beyond a reasonable doubt but there are reasonable measures available to bolster certainty, they must be pursued.

Anomalies arise if the second requirement is disregarded, something that can be illustrated in the context of other safety critical systems. For

177. Sangero & Halpert, Proposal to Reverse, supra note 1; Sangero & Halpert, Why a Conviction Should Not Be Based on a Single Piece of Evidence, supra note 2; see also supra note 147.
178. See supra notes 145-46 and accompanying text.
179. Even a requirement to prove guilt at a level of 99% (if this is the understanding of the level of probability required by “beyond a reasonable doubt”) should not be considered adequate in itself, given that on a large scale, this probability level will still lead to a large number of errors (0.5%).
180. See infra text accompanying notes 182-83 for the example of Stephan Cowans.
example, if the reasonable doubt standard were to be implemented in the field of fighter planes (at 90%, 99%), as soon as the accident rate were to reach 1% per flight, it would be determined that the planes are safe to fly. However, in the 1950s, a 100-times-lower accident rate—0.01% of all flights—was found to be too costly even given the lower cost of the airplanes in that period. Thus, the industry began to employ safety methods to reduce the incidence of accidents. We see, then, that in other fields implementing the beyond-reasonable-doubt standard would lead to an unacceptable outcome. We maintain that it is the Hidden Accident Principle of criminal law that enables the justice system to settle for the uniform beyond-reasonable-doubt level of certainty, without any attempt to improve the system so as to reduce the number of accidents—i.e., false convictions. Indeed, is it conceivable that the Air Force would be content with a 1% crash rate and not attempt to minimize this?

The following example can illustrate another anomaly. Assume that substantial evidence has been brought against a defendant in a murder trial, such as fingerprint match and lineup identification. This evidence (or even each piece of evidence on its own) is certainly sufficient to convict the defendant beyond a reasonable doubt as it is currently interpreted. In the case of Stephen Cowans, for instance, evidence of this very kind was sufficient to convict him. But assume also that a DNA sample was taken from the crime scene that can be tested. Without the proposed requirement to exhaust all possible means to increase safety in convictions and not to rely solely on proof beyond a reasonable doubt, there would be no imperative to conduct DNA testing because the existing evidence would be sufficient for conviction. Yet Cowans’ conviction was overturned, after having served six years in prison, based on post-conviction DNA testing and a reopening of the investigation in the wake of the test results. Accordingly, cumulative evidence (fingerprints and lineup identification) should be sufficient to convict beyond reasonable doubt only when there is no DNA sample available for testing. The reason for this is that conviction beyond a reasonable doubt does not amount to absolute certainty of guilt. Our proposed safety condition would require the examination of all reasonable potential evidence.

It is important to note that, in our view, the mere failure to examine any potentially exculpating evidence creates reasonable doubt and mandates acquittal. Any doubt as to guilt must work in favor of the defendant. But

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181. USAF HANDBOOK, supra note 9, at 2.
183. Id.
how can a given set of evidence be sufficient for conviction in one case but insufficient in another simply because there is reasonable potential for additional evidence in the latter? The explanation, in our opinion, lies in an understanding of the need for safety in the criminal justice system.

D. Some Specific Safety Solutions

In this section, we will suggest seven safety measures that arise as possibilities from the discussion in this Article. It is not our intention to present here a safety theory for the criminal justice system, but rather only to demonstrate that there are many measures that are both feasible and necessary for ensuring safety in the system. First, we recommend introducing a regulatory regime similar to the premarket approval required for medical devices that will be imposed on manufacturers of devices producing scientific evidence, such as DNA kits, drug-testing kits, breathalyzers, and carspeed testing devices. This regulation would include a reporting requirement for both accidents and incidents involving accuracy, as is the case with medical devices. This would supplement existing safety recommendations relating to the accreditation of laboratories, such as those set forth in the Nation Academy of Science’s 2009 report. Regulation would also be set for any device employed in criminal procedures, for example, audio and video recording devices used in investigations, so as to ensure that recordings capture crucial moments and expose the truth. Given that these are standard measures in other fields, set in law, they could be easily implemented in criminal law as well.

Second, the protocols for police lineups suggested in the professional literature must be adopted, including video documentation of the procedure. Third, all interrogations should be videotaped to eliminate the secrecy shrouding them. Fourth, an operative conclusion deriving from organizational theories is that evidentiary autonomy must be sought in criminal law to the greatest extent possible. In the context of scientific evidence, for example, sequential unmasking protocols are necessary for ensuring that certain details regarding a case and its investigation are withheld from lab technicians working

185. See STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD, supra note 100.
on case-related evidence, such as the fact that the victim identified the sus-
pect.

Fifth, safety must be implemented throughout the entire duration of
the criminal procedure, including the investigation and trial stages and
following conviction. Because conviction does not require absolute certainty
of guilt, post-conviction DNA testing must be granted to anyone requesting

Sixth, safety considerations and the need to prevent a high false con-
viction rate mandate a legal rule prohibiting convictions based on a single
piece of evidence. As we have shown elsewhere,\footnote{Sangero & Halpert, Why a Conviction Should Not Be Based on a Single Piece of Evidence, supra note 2.} not only is classic evidence such as confessions\footnote{See Sangero & Halpert, Proposal to Reverse, supra note 1.} and lineup identifications not sufficiently accu-
rate to establish guilt beyond a reasonable doubt, but even the strongest sci-
entific evidence, including fingerprints and DNA matches, may be flawed.
Therefore, a requirement for additional evidence to convict is crucial.

Seventh, when there is a confession, there must be at least a 91% proba-
ability of guilt arising from the rest of the evidence in order to reach a
probability of 99% based on the confession. This was the result of a mathe-
natical calculation using Bayes’ theorem that we presented in a recent ar-
ticle.\footnote{Id. at 548.} Moreover, even if the legal system is willing to take a serious risk and
allow conviction according to Blackstone’s ratio, which can be translated
into a 91% certainty of guilt, this threshold can be met only if a 50% proba-
bility of guilt arises from the evidence not including the confession.\footnote{Id. at 550.} The
perhaps surprising ramification of this is that a confession should be treated
as only corroboration for other solid evidence, if any exists, and not as the
main piece of evidence requiring corroboration in order to convict.

In closing, it must be emphasized again that we do not purport here to
cover the full gamut of necessary changes for achieving safety in the crimi-
nal justice system, or even all of the central ones. Rather, we seek to offer
only some examples of possible specific measures that would comprise only
part of a comprehensive safety program in the criminal justice system.

\section*{Conclusion}

In this Article, we have described safety and how it is currently im-
plemented in various fields and industries, while showing that criminal law
lacks safety mechanisms. We presented examples of safety measures in
other areas so as to illustrate the possibility of safety implementation at minimal, if not negligible, cost to significantly reduce the risk of false conviction without impairing law enforcement. Some of the safety measures, such as improving the accuracy of scientific evidence, would reduce not only the rate of false positives—i.e., conviction of the innocent—but also the false negative rate—i.e., acquittal of the guilty—thereby killing two birds with one stone.

Under the Hidden Accident Principle in criminal law, even from a theoretical perspective, the criminal justice system does not usually benefit from feedback. And like any system that does not receive feedback, the criminal law system has become negligent, perhaps even aware of the possibility of false conviction.

If we use the rate set in *Limone* ($1 million per year of incarceration) to translate into economic terms the cost of all false convictions and incarcerations in the United States at any given point in time (approximately 105,000 people), we arrive at direct damage of over 100 billion dollars per year. This calculation does not incorporate the cost of unnecessary trials and the fact that the true perpetrators of the crimes roam free and are liable to continue in their criminal behavior. These both represent huge harms, the reduction of which entails significant resources.

Our specific, non-exhaustive recommendations are not sufficient to fully address the issue of safety in the criminal justice system. Given the considerable damage caused by false convictions, there is a need to develop a comprehensive and systematic safety theory for the criminal justice system. In light of the Hidden Accident Principle in criminal law, that theory must be guided by safety models from other fields, such as aviation, engineering, or medicine, without taking any shortcuts or relying on the unfounded belief that the criminal justice system is error-free. Safety must be incorporated into the law enforcement system. It must be implemented at all stages of criminal proceedings and thereafter as well. Police investigators, experts, prosecutors, defense attorneys, and judges must all receive the necessary education, guidance, and training so that the notion of safety is internalized in every law enforcement body and an atmosphere of safety is created. As part of a comprehensive safety theory, we call for the establishment of a centralized federal body to oversee safety in the criminal justice system, along the same lines as the National Highway Traffic Safety Administration and FDA. Included in its duties would be to investigate accidents (false convictions) and incidents (averted accidents) in the criminal justice system and to formulate concrete recommendations to prevent them, something that currently almost never occurs.

193. *Limone* v. United States, 579 F.3d 79, 104-05 (1st Cir. 2009); *see also supra text accompanying notes 65-67.*
Developing a comprehensive safety theory for criminal law will require considerable research in various fields. Researchers from law as well as other disciplines should be called on to contribute to the formulation of such a theory. The legal system must make greater use of scientific research and rely less on so-called common sense and “life experience.” Such research will enable an assessment of the risks innate to the system and raise possibilities for eliminating those risks without undermining the objectives of criminal law. Only once this has been accomplished will society be able to celebrate its legal system in which more actual criminals and fewer innocent people are convicted.