

OPENING STATEMENT  
The Honorable Harry T. Edwards  
Co-Chair, Forensic Science Committee

Good afternoon. Dr. Constantine Gatsonis and I are here today as the co-chairs of the “Committee on Identifying the Needs of the Forensic Science Community” to announce the release of the committee’s report. Our work on this report commenced in 2007, after Congress authorized the National Academy of Sciences to create an independent committee to study forensic science practices in the United States. The congressional authorization directed that, among other things, our report should "assess the present and future resource needs of the forensic science community," "make recommendations for maximizing the use of forensic techniques," and "make recommendations for programs that will increase the number of qualified forensic scientists and medical examiners." The legislative history makes it clear that Congress was convinced that this study was necessary because, “outside of the area of DNA,” the American public does not have a good understanding of the forensic science disciplines.

Our committee was composed of a diverse and talented group of professionals, some expert in various forensic science disciplines, others in law, some in higher education, and others in different fields of science, engineering, and medicine. It was gratifying to work with Dr. Gatsonis – who taught me much about scientific methodology – and with the other wise and dedicated members of the committee as we waded through the complex maze of science, law, and policy issues before us. Dr. Gatsonis and I are also grateful for the superb support given to the committee by National Academy of Sciences staff, most particularly, Anne-Marie Mazza, Scott Weidman, Steven Kendall, and Kathi Hanna.

In assessing the forensic science community, the committee heard from and reviewed materials published by countless experts, including forensic science practitioners, heads of public and private laboratories, directors of medical examiner and coroner offices, scientists, scholars, educators, government officials, members of the legal profession, and law enforcement officials. The picture that they painted of the forensic science community and the problems that they illuminated were compelling.

"Forensic science" encompasses a broad range of disciplines (such as toxicology, drug analysis, fingerprints, writing samples, tool marks, bite marks, and specimens such as hair), each with its own set of technologies and practices. The "forensic science community," in turn, includes, variously, scientists (with degrees in chemistry, biochemistry, biology, and medicine); other practitioners without such degrees; laboratory technicians; crime scene investigators; and law enforcement officers. Within the forensic science community, there is also wide variability across disciplines with regard to techniques, methodologies, reliability, types and numbers of potential errors, research, general acceptability, and published material. Given this reality, it was no mean feat for the committee to meet Congress’ charge to "assess the present and future resource needs of the forensic science community."

It was easy for the committee to see that there are a number of talented and dedicated people

in the forensic science community. The problem that we found, however, is that too many scientists and other practitioners in the forensic science community are strapped in their work, for lack of adequate resources, sound policies, and national support. And the forensic science community is plagued by fragmentation and inconsistent practices in federal, state, and local law enforcement jurisdictions and agencies. The quality of practice in forensic science disciplines varies greatly. And the quality of practice often suffers because of the absence of adequate training and continuing education; the absence of rigorous, mandatory certification requirements for practitioners; the absence of mandatory accreditation programs for laboratories; failures to adhere to robust performance standards; and the lack of effective oversight. These shortcomings obviously pose a continuing and serious threat to the credibility of forensic science practice.

In considering the testimony and evidence that was presented to the committee, what surprised us the most was the consistency of the message that we heard. The message was simple: *The forensic science system in the United States has serious problems that can only be addressed by a national commitment to overhaul the current structure that supports the forensic science community in this country. This can only be done with effective leadership at the highest levels of both federal and state governments, pursuant to rigorous and mandatory standards, and with a significant infusion of federal funds.*

In other words, the committee found that, not only does the forensic science community lack adequate resources, talent, and mandatory standards; it also lacks the necessary governance structure to address its current weaknesses. Inefficiencies in the current system cannot be remedied simply by increasing the staff within existing crime laboratories and medical examiner offices. The forensic science community needs strong governance to adopt and promote an aggressive, long-term agenda.

- Governance must be strong enough – and independent enough – to identify the limitations of forensic science methodologies;
- it must be well connected with the Nation's scientific research base in order to catalyze meaningful advances in forensic science practices;
- it must be able to create appropriate incentives for jurisdictions to adopt and adhere to best practices and promulgate the necessary sanctions to discourage ineffective or faulty practices; and
- oversight necessarily must sweep broadly, beyond just criminal investigation and prosecution.

With these considerations in mind, the committee first considered whether such a governing entity could be established within an existing federal agency. We concluded that no existing agency has the capacity or appropriate mission to take on the roles and responsibilities needed to govern and improve the forensic science community. *Therefore, the committee's principal recommendation is that Congress should authorize and fund the creation of an independent federal entity, the National Institute of Forensic Science, or NIFS.*

This new agency should have a full-time administrator and an advisory board with members who have expertise in research and education, forensic science disciplines, the physical and life sciences, forensic pathology, engineering, information technology, measurements and standards, testing and evaluation, law, national security, and public policy.

NIFS, as we envision it, will, as appropriate, establish, enforce, oversee, and/ or encourage:

- best practices (including the enforcement of robust performance standards);
- mandatory accreditation of forensic science laboratories;
- mandatory certification of forensic science practitioners;
- peer-reviewed research and technical development in forensic science disciplines and forensic medicine;
- improved forensic science research and educational programs;
- funding state and local forensic science agencies, independent research projects, and educational programs, with conditions that aim to advance the credibility and reliability of forensic science disciplines;
- education standards and the accreditation of forensic science programs in higher education;
- programs for lawyers and judges to better understand the forensic science disciplines and their limitations; and
- the development and introduction of new technologies in forensic investigations.

We are convinced that if NIFS is established as envisioned, it will serve our country well, as a new, strong, and independent entity, with no ties to the past dysfunctions of the forensic science community, and with the authority and resources to implement a fresh agenda designed to address the many problems found by the committee.

There is one final point that I would like to make before turning the stage over to Dr. Gatsonis. The work of the forensic science community is critically important in our system of criminal justice. Indeed, as one scholar has noted, “forensic science is but the handmaiden of the legal system.” The goal of law enforcement actions is to identify those who have committed crimes and to prevent the criminal justice system from erroneously convicting the innocent. Forensic science experts and evidence are routinely used in the service of the criminal justice system. So it matters a great deal whether an expert is qualified to testify about forensic evidence and whether the evidence is sufficiently reliable to merit a fact finder's reliance on the truth that it purports to support.

Unfortunately, the adversary system, and its highly partisan approach to the submission of evidence in court, is not well suited to the task of finding "scientific truth." The judicial system is encumbered by, among other things, judges and lawyers who generally lack the scientific expertise necessary to comprehend and evaluate forensic evidence in an informed manner, defense attorneys who often do not have the resources to challenge prosecutors' forensic experts, trial judges (sitting alone) who must decide evidentiary issues without the benefit of judicial colleagues and often with little time for extensive research and reflection, and very limited appellate review of trial court rulings admitting disputed forensic evidence. Furthermore, the judicial system embodies a case-by-case adjudicatory approach that is not well suited to address the systematic problems in many of the various forensic science disciplines. Given these realities, there is a tremendous need for the forensic science community to improve. *Judicial review, by itself, will not cure the infirmities of the forensic science community.*

In reaching this conclusion, I want to make it clear that the committee's report does not mean to offer any judgments on any cases in the judicial system. The report does not assess past criminal convictions, nor does it speculate about pending or future cases. And the report offers no proposals for law reform. That was beyond our charge. Each case in the criminal justice system must be decided on the record before the court pursuant to the applicable law, controlling precedent, and governing rules of evidence. The question whether forensic evidence in a particular case is admissible under applicable law is not coterminous with the question whether there are studies confirming the scientific validity and reliability of a forensic science discipline.

Although the report offers no proposals for law reform, the committee believes, that with more and better educational programs, mandatory accreditation and certification, sound operational principles and procedures, and serious research to establish the limits and measures of performance in each discipline, forensic science experts will be better able to analyze evidence and coherently report their findings in the courts.

The *practices of science* provide two attributes that the law needs from the forensic disciplines: (1) reliable methodologies that enable the accurate analysis of evidence and reporting of results, and (2) practices that minimize the risk of results being dependent on subjective judgments or tainted by error or the threat of bias. Because of the many problems presently faced by the forensic science community and the inherent limitations of the judicial system, the forensic science community as it is now constituted cannot consistently serve the judicial system as well as it might. As the committee's report makes clear, what is needed is a massive overhaul of the forensic science system in the United States, both to improve the scientific research supporting the disciplines and to improve the practices of the forensic science community. And the creation of NIFS is the keystone for such an overhaul.

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I would now like to pass the microphone to Dr. Gatsonis, who will outline the fundamental principles of the scientific method, explain why the committee's report raises doubts about whether some forensic practices can be credited as "scientific," and then conclude by highlighting some of the other recommendations in the committee's report.

## Opening Statement

Prof. Constantine Gatsonis  
Co-Chair, Forensic Science Committee

Good Afternoon Ladies and Gentlemen.

I will begin with a heartfelt note of thanks to the staff of this committee of the National Academy of Sciences, most particularly, Dr Anne-Marie Mazza, Dr Scott Weidman, Mr Steven Kendall, and Ms Kathi Hanna. I also want to thank Judge Edwards for his leadership and insight as we worked through a vast array of topics and all the members of the committee for their sustained commitment and major expertise they contributed to this project. In my opening remarks I will focus on the scientific aspects of the committee's report, both methodologic and subject matter. I will also review the committee recommendations, beyond those already covered by Judge Edwards.

As described in the chapters of this report, the level of scientific development is variable among the forensic disciplines and the research activity and infrastructure in most disciplines is low or non-existent. Much research is needed not only to evaluate the reliability and accuracy of current forensic methods but also to innovate and develop them further. In order to achieve these goals on a national scale, an organized and well-supported forensic science research enterprise is a key requirement.

The forensic science disciplines conduct analyses and are asked to provide information for a variety of purposes in the criminal justice process. Broadly speaking, the questions they address can be divided in two categories:

- a. Can a piece of evidence be associated with a particular class of sources?  
For example, can a hair specimen collected at the crime scene be reliably said to come from an individual of a particular ethnic group? Is a paint mark left at a crime scene consistent with the paint used in type of car defined by model and production year? Does a powder cargo contain cocaine?
- b. Can a piece of evidence be associated with an individual source?  
For example, can a particular DNA sample be reliably said to belong to individual X?

The first category of questions leads to classification conclusions. The second leads to individualization conclusions. It is important to keep in mind here that

- a. Although the goal of criminal investigations and trials is typically to assess the innocence or guilt of specific individuals, answers to both categories of questions are valuable. For example, classifying a piece of evidence may lead to decisions to exclude individuals from further consideration in the particular investigation.
- b. The accuracy and overall performance of a forensic method should be judged only against the question it is called to address. Thus, analyses that can lead to classification should be evaluated on the basis of how correctly they classify and not on the basis of whether they can match a piece of evidence to a specific individual. This point may seem straightforward but lies at the root of many common misconceptions about the proper role of specific forensic analyses.

As you know, there is a broad array of forensic disciplines that are called upon to provide evidence in support of one or the other, or sometimes both categories of conclusions. In Chapter 5 of the report the committee presents a précis of each of the main disciplines, intended to summarize the state of their scientific underpinning and development, the way in which evidence is reported and used in investigations and court proceedings, and an assessment of current research and educational activity and needs for further development.

In the scientific domain, there is wide variability across forensic science disciplines with regard to the techniques and methodologies used, the reliability of results, the types and numbers of errors that occur, the soundness of the research base, the general acceptability of the discipline, and the availability of published peer reviewed research. Some of the forensic disciplines are laboratory based (for example DNA analysis); others are based on expert interpretation of observed patterns (for example, fingerprints and tool marks). The scientific basis is generally better grounded and more developed for the analytically based disciplines in comparison to those disciplines involving extensive expert interpretation.

There is substantial evidence indicating that the level of scientific development and evaluation varies substantially among the forensic disciplines:

- In terms of the reliability and accuracy in making individualization conclusions, it is fair to say that, with the exception of nuclear DNA analysis, there is a lot we do not know about other forensic disciplines. Considerably more research and development is needed to provide a rigorous evaluation of the capacity of a method to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source. Such conclusions may be possible, but at present we simply do not have enough basic understanding to know.
- In terms of the reliability and accuracy in making classification conclusions, a number of forensic analysis methods show promise. However, even for classification analyses, there is only a modest amount of available research and systematic evaluation.

An unfortunate corollary of the low level of research and evaluation in many of the forensic disciplines is a tendency to consider and present the results of analyses as free from error. Such a disposition would be unthinkable in the context of scientific research and practice. It is therefore imperative to foster, encourage, and ultimately require the adoption and continued development of scientific methods and practices across the forensic disciplines. A body of research is required to establish limits and measures of performance in the forensic sciences and to address the impact of sources of variability and potential bias. These disciplines need to develop rigorous protocols to guide subjective interpretations and pursue equally rigorous research and evaluation programs.

The development of scientific research and a scientific culture in the forensic disciplines is not only focused on the need to evaluate current methods and practices. It is indeed a precondition for the evolution of these disciplines and for the development of new methods that address the evolving needs of the legal system.

In parallel to an analysis of the science of the forensic disciplines, the committee undertook an examination of the practice in such disciplines across the country. As described in the report, there are great disparities among existing forensic science operations in federal, state, and local law enforcement jurisdictions and agencies. This is true with respect to funding, access to analytical instrumentation, the availability of skilled and well-trained personnel, and certification, accreditation, and oversight. As a result, it is not easy to generalize about current practices within the forensic sciences community. It is clear, however, that any approach to overhauling the existing forensic science system needs to address and help minimize the community's current fragmentation and inconsistent practices.

The fragmentation problem is compounded because operational principles and procedures for many forensic disciplines are not standardized or embraced, either between or within jurisdictions. There is no uniformity in the certification of forensic practitioners or in the accreditation of crime laboratories. Indeed, many jurisdictions do not require forensic practitioners to be certified, and many forensic science disciplines have no mandatory certification programs. Moreover, the accreditation of crime laboratories is not required in most jurisdictions. Often, there are no standard protocols governing forensic practice in a given discipline. And, even when protocols are in place, they may be vague and not enforced in any meaningful way. In short, the quality of forensic practice in most disciplines varies greatly because of the absence of adequate training and continuing education, rigorous mandatory certification and accreditation programs, adherence to robust performance standards, and effective oversight. These shortcomings obviously pose a continuing and serious threat to the quality and credibility of forensic science practice.

I will close with a review of the committee's recommendations.

As Judge Edwards commented, the committee's major recommendation is that Congress should establish and appropriate funds for an independent federal entity, the National Institute of Forensic Sciences, or NIFS. Such a federal body will 1) bolster our ability to more accurately identify true perpetrators and exclude those who are falsely accused; 2) improve our ability to effectively respond to, attribute, and prosecute threats to homeland security; and 3) reduce the likelihood of convictions resting on inaccurate data.

In addition to this major recommendation, the committee offers several additional specific recommendations regarding the separation of forensic science from law enforcement, addressing training and educational needs, improving certification and accreditation requirements, reforming the medicolegal death investigation system, creating interoperable fingerprint databases, and enhancing the role and quality of the forensic sciences in homeland security.

In particular

- **Recommendation 2 highlights the need for standardized terminology and reporting of the results of forensic analyses.**

The National Institute of Forensic Science (NIFS), after reviewing established standards such as ISO 17025, and in consultation with its advisory board, should establish standard terminology to be used in reporting on and testifying about the results of forensic science investigations. Similarly, it should establish model laboratory reports for different forensic science disciplines and specify the minimum information that should be included. As part of the accreditation and certification processes, laboratories and forensic scientists should be required to utilize model laboratory reports when summarizing the results of their analyses.

- **Recommendation 3 addresses research needs in the forensic sciences**

Research is needed to address issues of accuracy, reliability, and validity in the forensic science disciplines. The National Institute of Forensic Science (NIFS) should competitively fund peer-reviewed research in the following areas:

- (a) Studies establishing the scientific bases demonstrating the validity of forensic methods.
- (b) The development and establishment of quantifiable measures of the reliability and accuracy of forensic analyses. Studies of the reliability and accuracy of forensic techniques should reflect actual practice on realistic case scenarios, averaged across a representative sample of forensic scientists and laboratories. Studies also should establish the limits of reliability and accuracy that analytic methods can be expected to achieve as the conditions of forensic evidence vary. The research by which measures of reliability and accuracy are determined should be peer reviewed and published in respected scientific journals.
- (c) The development of quantifiable measures of uncertainty in the conclusions of forensic analyses.
- (d) Automated techniques capable of enhancing forensic technologies.

- **Recommendation 4 urges independence of forensic laboratories from law enforcement and prosecutorial offices.**

To improve the scientific bases of forensic science examinations and to maximize independence from or autonomy within the law enforcement community, Congress should authorize and appropriate incentive funds to the National Institute of Forensic Science (NIFS) for allocation to state and local jurisdictions for the purpose of removing all public forensic laboratories and facilities from the administrative control of law enforcement agencies or prosecutors' offices.

- **Recommendation 5 emphasizes the need for assessing and minimizing bias and human error**

The National Institute of Forensic Science (NIFS) should encourage research programs on human observer bias and sources of human error in forensic examinations. Such programs might include studies to determine the effects of contextual bias in forensic practice (e.g., studies to determine whether and to what extent the results of forensic analyses are influenced by knowledge regarding the background of the suspect



and the investigator's theory of the case). In addition, research on sources of human error should be closely linked with research conducted to quantify and characterize the amount of error. Based on the results of these studies, and in consultation with its advisory board, NIFS should develop standard operating procedures (that will lay the foundation for model protocols) to minimize, to the greatest extent reasonably possible, potential bias and sources of human error in forensic practice. These standard operating procedures should apply to all forensic analyses that may be used in litigation.

- **Recommendation 6 addresses the need for uniform standards and adoption of best practices in forensic laboratories across the country.**

To facilitate the work of the National Institute of Forensic Science (NIFS), Congress should authorize and appropriate funds to NIFS to work with the National Institute of Standards and Technology (NIST), in conjunction with government laboratories, universities, and private laboratories, and in consultation with Scientific Working Groups, to develop tools for advancing measurement, validation, reliability, information sharing, and proficiency testing in forensic science and to establish protocols for forensic examinations, methods, and practices. Standards should reflect best practices and serve as accreditation tools for laboratories and as guides for the education, training, and certification of professionals. Upon completion of its work, NIST and its partners should report findings and recommendations to NIFS for further dissemination and implementation.

- **Recommendation 7 stresses the need for mandatory accreditation and certification**

Laboratory accreditation and individual certification of forensic science professionals should be mandatory, and all forensic science professionals should have access to a certification process. In determining appropriate standards for accreditation and certification, the National Institute of Forensic Science (NIFS) should take into account established and recognized international standards, such as those published by the International Organization for Standardization (ISO). No person (public or private) should be allowed to practice in a forensic science discipline or testify as a forensic science professional without certification. Certification requirements should include, at a minimum, written examinations, supervised practice, proficiency testing, continuing education, recertification procedures, adherence to a code of ethics, and effective disciplinary procedures. All laboratories and facilities (public or private) should be accredited, and all forensic science professionals should be certified, when eligible, within a time period established by NIFS.

- **Recommendation 8 calls for uniform quality control and quality assurance programs**

Forensic laboratories should establish routine quality assurance and quality control procedures to ensure the accuracy of forensic analyses and the work of forensic practitioners. Quality control procedures should be designed to identify mistakes, fraud, and bias; confirm the continued validity and reliability of standard operating procedures

and protocols; ensure that best practices are being followed; and correct procedures and protocols that are found to need improvement.

- **Recommendation 9 calls for a national code of ethics for forensic scientists**

The National Institute of Forensic Science (NIFS), in consultation with its advisory board, should establish a national code of ethics for all forensic science disciplines and encourage individual societies to incorporate this national code as part of their professional code of ethics. Additionally, NIFS should explore mechanisms of enforcement for those forensic scientists who commit serious ethical violations. Such a code could be enforced through a certification process for forensic scientists.

- **Recommendation 10 calls for major emphasis on graduate education in the forensic sciences**

To attract students in the physical and life sciences to pursue graduate studies in multidisciplinary fields critical to forensic science practice, Congress should authorize and appropriate funds to the National Institute of Forensic Science (NIFS) to work with appropriate organizations and educational institutions to improve and develop graduate education programs designed to cut across organizational, programmatic, and disciplinary boundaries. To make these programs appealing to potential students, they must include attractive scholarship and fellowship offerings. Emphasis should be placed on developing and improving research methods and methodologies applicable to forensic science practice and on funding research programs to attract research universities and students in fields relevant to forensic science. NIFS should also support law school administrators and judicial education organizations in establishing continuing legal education programs for law students, practitioners, and judges.

- **Recommendation 11 calls for the establishment of medical examiner offices across the country and the eventual elimination of existing coroner offices.**

To improve medicolegal death investigation:

- (a) Congress should authorize and appropriate incentive funds to the National Institute of Forensic Science (NIFS) for allocation to states and jurisdictions to establish medical examiner systems, with the goal of replacing and eventually eliminating existing coroner systems. Funds are needed to build regional medical examiner offices, secure necessary equipment, improve administration, and ensure the education, training, and staffing of medical examiner offices. Funding could also be used to help current medical examiner systems modernize their facilities to meet current Centers for Disease Control and Prevention-recommended autopsy safety requirements.
- (b) Congress should appropriate resources to the National Institutes of Health (NIH) and NIFS, jointly, to support research, education, and training in forensic pathology. NIH, with NIFS participation, or NIFS in collaboration with content experts, should establish a study section to establish goals, to review and evaluate proposals in these areas, and to allocate funding for collaborative research to be conducted by medical examiner offices and medical universities. In addition,

- funding, in the form of medical student loan forgiveness and/or fellowship support, should be made available to pathology residents who choose forensic pathology as their specialty.
- (c) NIFS, in collaboration with NIH, the National Association of Medical Examiners, the American Board of Medicolegal Death Investigators, and other appropriate professional organizations, should establish a Scientific Working Group (SWG) for forensic pathology and medicolegal death investigation. The SWG should develop and promote standards for best practices, administration, staffing, education, training, and continuing education for competent death scene investigation and postmortem examinations. Best practices should include the utilization of new technologies such as laboratory testing for the molecular basis of diseases and the implementation of specialized imaging techniques.
  - (d) All medical examiner offices should be accredited pursuant to NIFS-endorsed standards within a timeframe to be established by NIFS.
  - (e) All federal funding should be restricted to accredited offices that meet NIFS-endorsed standards or that demonstrate significant and measurable progress in achieving accreditation within prescribed deadlines.
  - (f) All medicolegal autopsies should be performed or supervised by a board certified forensic pathologist. This requirement should take effect within a timeframe to be established by NIFS, following consultation with governing state institutions.

- **Recommendation 12 stresses the need to achieve interoperability of fingerprint data systems across the country**

Congress should authorize and appropriate funds for the National Institute of Forensic Science (NIFS) to launch a new broad-based effort to achieve nationwide fingerprint data interoperability. To that end, NIFS should convene a task force comprising relevant experts from the National Institute of Standards and Technology and the major law enforcement agencies (including representatives from the local, state, federal, and, perhaps, international levels) and industry, as appropriate, to develop:

- (a) standards for representing and communicating image and minutiae data among Automated Fingerprint Identification Systems. Common data standards would facilitate the sharing of fingerprint data among law enforcement agencies at the local, state, federal, and even international levels, which could result in more solved crimes, fewer wrongful identifications, and greater efficiency with respect to fingerprint searches; and
- (b) baseline standards—to be used with computer algorithms—to map, record, and recognize features in fingerprint images, and a research agenda for the continued improvement, refinement, and characterization of the accuracy of these algorithms (including quantification of error rates).

- **Finally, recommendation 13 calls for preparedness of forensic scientists and laboratories to address homeland security needs.**

Congress should provide funding to the National Institute of Forensic Science (NIFS) to prepare, in conjunction with the Centers for Disease Control and Prevention and the Federal Bureau of Investigation, forensic scientists and crime scene investigators for their potential

roles in managing and analyzing evidence from events that affect homeland security, so that maximum evidentiary value is preserved from these unusual circumstances and the safety of these personnel is guarded. This preparation also should include planning and preparedness (to include exercises) for the interoperability of local forensic personnel with federal counterterrorism organizations.

In opening the floor for questions I would summarize the committee's work by saying that the committee studied the science and practice of the forensic disciplines in the country and decided that a major buildup of the scientific enterprise and a massive overhaul of the forensic system is needed in order to meet the needs of the country, current and future.