



Identifying Remains: Lessons Learned From 9/11

by Nancy Ritter

About the Author

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Nothing in the history of mass fatality events prepared America's forensic community for the task of identifying those who died when terrorists attacked the World Trade Center in New York City on September 11, 2001. The number of victims, the condition of their remains, and the duration of the recovery effort made their identification the greatest forensic challenge ever undertaken in this country.

To assist in this monumental effort, NIJ brought together a group of experts to advise and support New York City's Office of the Chief Medical Examiner during the identification effort. The Kinship and Data Analysis Panel (KADAP), made recommendations on forensic technologies, policies, and procedures to help identify victims who perished in the World Trade Center. (See sidebar on p. 21, "What is the KADAP?")

Five years and thousands of man-hours later, NIJ has published the KADAP's report on its recommendations, *Lessons Learned From 9/11: DNA Identification in Mass Fatality Incidents*.¹ Although the report is written primarily for laboratory directors, it contains information useful to any official involved in preparing a comprehensive plan to identify victims of a mass fatality incident using forensic DNA analysis. The report includes an indepth look at:

- Assessing the magnitude of a DNA identification effort and acquiring the resources to respond.
- Collecting personal-item reference samples and biological samples from the victims' families.
- Establishing laboratory policies and procedures for DNA extraction, typing, and interpretation, and determining the statistical thresholds to be met for identification of commingled, degraded, or fragmented remains.

- Managing the laboratory's work, including sample tracking and chain-of-custody requirements, data management, technology, and quality assurance.
- Educating and informing victims' families, officials, the media, and the public.

How DNA Is Used to Make Identifications

DNA analysis is the gold standard for identifying human remains and may be the only available method, when other methods, such as birthmarks, dental records, or fingerprints are not

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available. If sufficient DNA can be recovered, forensic DNA typing can identify biological samples—even when the human remains are fragmented and the DNA is degraded, as with the World Trade Center victims.

WHAT IS THE KADAP?

The idea of creating the Kinship and Data Analysis Panel (KADAP) to advise officials in the New York City medical examiner's office after the 9/11 attacks originated with W. Mark Dale, director of Forensic Services for the New York State Police. When Dale realized that the number of World Trade Center victims and the condition of their remains would require an unprecedented DNA-based identification effort, he asked the National Institute of Justice to create a "brain trust" of independent scientists to offer guidance in this monumental task.

"I knew we were facing enormous management challenges," Dale said. "The notion that we were to reassociate potentially hundreds of thousands of remains—let alone identify them by comparing their profiles to perhaps tens of thousands of kin and effects profiles—was beyond daunting. We needed human geneticists, statisticians, bioethicists, forensic DNA scientists/managers, genetic researchers, information technologists, database managers, and program managers—and we needed them *fast*."

The breadth of the combined experience of the KADAP members is stunning. The

panel was comprised of scientists from the following agencies and universities: the National Institutes of Health Human Genome Research Institute, the FBI, the National Center for Biotechnology Informatics, the National Institute of Standards and Technology, the Armed Forces Institute of Pathology, the New York State Police Department, the New York City Office of the Chief Medical Examiner, the University of Central Florida, Carleton University, Harvard University, Yale University, Indiana University, the University of North Texas, the University of California, Johns Hopkins University, and a number of private DNA laboratories.

Members of the private and public sectors also provided testimony to the panel that guided its recommendations. Early demonstrations of DNA matching software, developed for other mass fatality situations, were an important contribution. Input from the International Commission on Missing Persons in Bosnia, and the Royal Canadian Mounted Police, which shared a special computer program that was used in the World Trade Center identification effort, was also invaluable.

Everyone—the public, policymakers, and laboratory personnel—must understand the answer to the important question: “When are we finished?”

Identifications are made by comparing the DNA profile of reference samples with those from the human remains. The reference samples can be obtained from: (1) personal items used by the victim (a toothbrush, hairbrush, or razor); (2) banked biological samples (sperm or biopsy tissue from the victim); (3) biological relatives of the victim; and (4) human remains previously identified by other methods or other already-DNA-typed fragmented remains.

Often, however, the remains or the reference samples have severe limitations. For example, environmentally harsh conditions, such as those that occurred following the World Trade Center attacks, can limit the quantity and quality of recoverable DNA from the remains. There may also be insufficient personal items to serve as reference samples. For example, airline passengers often travel with their toothbrushes and hairbrushes, and these items can be lost or destroyed in a crash. Because families often travel together, there may also be a limited availability of kinship samples. Kinship samples may also be scarce because the victim has few living biological relatives or the relatives are unable or choose not to participate in the identification effort. The KADAP report discusses these contingencies and offers guidance to laboratories on how to deal with them.

Major Decisions Made Fast

Many critical management decisions are made within the first 48 hours of a mass disaster. To facilitate a plan of action for laboratory directors, the KADAP report contains a checklist of important questions,

such as: Who will the laboratory report to? Who is responsible for funding? How will the samples be collected and tracked? How many family reference collection kits are immediately available? Have procedures been established to handle incomplete data? Is staffing adequate for collection, accessioning, extraction, amplification, analysis, interpretation, reporting, quality control, family relations, and media relations? Can the laboratory handle the accumulation of a normal casework backlog while it works on the mass disaster identification effort? If so, how big can the backlog get?

By addressing many of these major questions, the KADAP report can help the Nation’s laboratories prepare a DNA identification plan. Among the issues to consider:

How important is DNA to the identification effort? The degree to which human remains are fragmented or degraded determines the importance of DNA analysis in a mass fatality identification effort. Intact body parts are often identifiable by less costly methods, such as X-ray, dental examination, or fingerprints. However, DNA analysis is the only viable method for identifying severely fragmented or degraded remains. Even when whole bodies are recovered, DNA analysis is still the best approach when dental records or verified body identification by friends or relatives is not an option.

Will every person or every fragment be identified? The answer to this question frames the scope of the entire identification effort. For example, after the 9/11 attacks, Rudy Giuliani, the mayor of New York City, directed the medical examiner to identify every fragment of human remains. If the goal is to identify all human remains—as opposed to every victim—the identification effort will take longer and be more costly. On the other hand, if the policy is to identify all the victims, the DNA identification effort would stop when the last victim is identified. This could mean that some

SAMPLE TRACKING AND MANAGEMENT

Information technology can be one of the most overlooked aspects of a DNA-based identification effort following a mass disaster. Advance planning for using information technology in sample tracking and management saves time, speeds identification, and improves testing reliability.

Without sophisticated software, the nearly 1,600 identifications made and nearly 20,000 human remains profiled in the World Trade Center identification effort would not have been possible. A laboratory responding to a mass fatality event must be prepared to track the physical location of each sample and the data associated with it through the entire identification process. The KADAP report considers sample accessioning, naming and numbering schemes, and advises how to handle the possibility that remains are commingled. The report also discusses matching and statistics software, and ways to organize, store,

and retrieve data; integrate different software systems; allow technical and administrative review of data; annotate problems and resolutions, report metrics; and track samples among partner laboratories.

Finally, the report explores the difficulties that can arise when working with reference samples, such as toothbrushes, razors, and medical biopsy specimens. A laboratory must keep in mind that bereft loved ones can inadvertently misidentify reference samples and misspell names or nicknames. Family members may also be mistaken in their belief that a missing relative was the only person to use a toothbrush: mixed DNA profiles will eliminate an item as a single-source reference. Other complications include assumed, but incorrect, parentage. The KADAP report discusses chain-of-custody documentation and how essential the managing and tracking of sample collection is to the identification process.

human remains would not be analyzed or returned to the families. Everyone—the public, policymakers, and laboratory personnel—must understand the answer to the important question: *“When are we finished?”*

What is the minimum fragment size that will be identified? The minimum fragment size to be analyzed must also be established at the beginning of the effort. From the laboratory’s perspective, the minimum fragment size (typically 1 to 10 centimeters) should be based on three criteria: (1) maximizing the probability that all victims are identified, (2) recognizing the emotional needs of the victims’ families and friends, and (3) providing forensically relevant information.

Laboratory officials must also establish policies on the number of testing attempts that will be made to identify the remains and the statistical threshold that must be met to report an identification. These decisions are fundamental to a laboratory’s strategic planning.

How long will the recovery effort last? The size and location of a mass fatality disaster also determines how long the DNA identification effort will take. Remains from an airline crash on land, for example, are generally collected in about 2 weeks. In contrast, remains from the World Trade Center were collected over 10 months.

Waiting until all remains and reference samples have been collected is the most effective and efficient approach from the laboratory's perspective. However, when the number of victims or fragmented remains is large, collecting all of samples before the identification process begins is usually not possible. Delaying the identification process may not be acceptable to the victims' families, the public, and officials, who expect the identification effort to begin immediately and proceed rapidly.

What DNA technologies will be used?

The laboratory must make a preliminary decision about what DNA technologies will be used. For example, can all identifications be made with standard forensic short tandem repeat markers²? If the samples are severely compromised, are additional analyses, such as single nucleotide polymorphisms³ or mitochondrial DNA, necessary? Longer recovery efforts usually result in more DNA degradation, which, in turn, affects technology choices.

Can the laboratory do the work?

Ultimately, the question of whether a laboratory has the capability and capacity to perform the identifications must be answered. To help laboratory managers assess this, the KADAP report contains an "Estimated DNA Analysis Workload Worksheet" that can be used to estimate the labor and materials required. The report also includes an extensive discussion on contracting with outside laboratories.

What is the funding source? State or local forensic laboratories are not likely to have sufficient funding for a large DNA identification effort. The KADAP report discusses how the selection of resources can impact the identification effort. For example, the Federal Emergency Management Agency (FEMA) is the primary source of Federal funding in a mass disaster. Although FEMA is generally prepared to support new equipment purchases, if the DNA identification effort is to be funded solely through State or local budgets, there could be limitations on what purchases will be authorized.

These financial considerations, in turn, influence decisions about minimum fragment size and retesting policies. Laboratory managers must make sure the medical examiner understands the fiscal impact on the laboratory's ability to make identifications.

Project Management

Many laboratory directors are seasoned practitioners but lack management experience. Skills in technical troubleshooting, case management, molecular biology, and population statistics are important in the day-to-day running of a forensic laboratory. Managing a mass fatality identification effort, however, requires skills in communications, risk management, and integrating non-DNA disciplines.

The KADAP report examines a laboratory's project management in a mass fatality situation from many perspectives, including sample accessioning, analysis and tracking, quality control, information technology, human resources, media relations, family coordination, and procuring equipment, supplies, and services.

The report also offers guidance on the importance of establishing a procedure for handling requests for special analyses. In the World Trade Center effort, for example, the fire and police departments frequently asked the laboratory to reprioritize the testing of victim remains. Requests for expedited analyses could also occur later in an identification effort if, for example, new remains were recovered or more useful personal items or biological reference samples became available.

A laboratory manager may also encounter tremendous staffing challenges. The World Trade Center effort demonstrates that consultants and outside vendors can be hired to offer special expertise and to increase a laboratory's capacity to handle a large DNA analysis effort. The KADAP report discusses a variety of staffing issues (e.g., working with volunteers, confidentiality

concerns, and mental health and morale) that could arise in a mass disaster identification response.

Managing Expectations

Faced with managing a DNA-based identification effort after a mass fatality disaster, a laboratory is likely to encounter a host of new stakeholders. Although all of them seek the same outcomes—the maximum number of identifications and the most remains possible returned to families—their priorities may not be the same as those of the laboratory. Public officials might be focused on the speed of the process, whereas the laboratory’s primary concern is the quality of the collection and analyses. Although these goals are not mutually exclusive, they can occasionally clash.

“Striking the balance [between speed and accuracy] was one of the greatest challenges in the World Trade Center effort,” said KADAP member Thomas Parsons of the Armed Forces Institute of Pathology. “Pressure to establish working guidelines for the rapid reporting of results, while maintaining a high threshold to reduce the probability of misidentifications, was a constant concern—one that should be paramount throughout any identification effort.”

Laboratory directors should assume that the public—including public officials and the media—knows little about the realities of DNA analysis. To minimize the potential for misunderstandings and even greater emotional upheaval, the report advises that a laboratory director be prepared to answer questions such as:

- How many victims have been identified?
- Have you identified the terrorists?
- How much time until the work is finished? Why is it taking so long?
- Will you be able to identify everyone, and, if not, why not?
- What is the condition of the remains?

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- What is the mood in the laboratory? How is your staff holding up under the pressure?

The Family-Laboratory Relationship

Working with the families of victims of a mass fatality incident is likely to be foreign to most laboratory directors. The KADAP report discusses how the formation of family assistance centers and family hotlines can help in this regard.

The report also facilitates one of the most important aspects of a DNA-based identification effort—the collection of reference samples from the victims’ families. Currently, no standards govern the collection of personal items and kinship reference samples. To assist in this effort, the KADAP report includes three sample documents designed by the panel: a “Personal Items Submission Form,” a “Family and/or Donor Reference Collection Form,” and a “Family Tree Form.”

Grieving family members often may not know why they are being asked to provide a personal item that belonged to their loved one, or why the laboratory is requesting a DNA sample. They may not understand, for example, the difference between a biological relative and someone who is called “aunt,” but is not actually related. To help explain the DNA identification process to the general public, the KADAP report contains an NIJ brochure that was distributed to victims’ families after the 9/11 attacks.⁴

Preparing a Plan

For the Nation’s forensic laboratories, the primary lesson of 9/11 is clear: every jurisdiction—large and small, urban and rural—must have a plan for identifying mass disaster victims. Even before this report was published, NIJ was able to use the work of the KADAP to assist officials involved in identifying the victims of the 2004 Southeast Asia tsunami and Hurricane Katrina, a disaster that revealed how any State or municipality can be overwhelmed by the operational requirements of responding to a mass fatality event.

When NIJ released the report, Glenn Schmitt, NIJ’s acting director, encouraged every jurisdiction to carefully consider the guidance in the KADAP report. “The families of the victims of the next mass fatality disaster, indeed, the entire Nation, will need their public officials to be prepared,” he said. “This guide will help us accomplish that mission.”

Notes

1. The report can be downloaded at www.massfatality.dna.gov. To order a hard copy or CD of the report, call 1-800-851-3420 or visit www.massfatality.dna.gov. The KADAP report is designed to augment another NIJ publication, *Mass Fatality Incidents: A Guide for Human Forensic Identification* (www.ojp.usdoj.gov/nij/pubs-sum/199758.htm), which is also contained on the CD.
2. Short tandem repeats—repeating sequences of DNA nucleotides (that is, A, T, C, or G)—are called markers in DNA testing.
3. A single nucleotide polymorphism (SNP) occurs when a single nucleotide—that is, A, T, C, or G—in a DNA sequence differs between individuals or between paired chromosomes in an individual. Because SNPs are inherited and do not change much from generation to generation, they can be used to determine the level of a genetic relationship between individuals.
4. *Identifying Victims Using DNA: A Guide for Families*, is available at www.ncjrs.gov/pdffiles1/nij/209493.pdf and is contained (in English or Spanish) on the CD mentioned in note 1 above.

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