Panel 2.16: Forensic Aspects of Disaster Fatality Management

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Abbreviations:
DNA = deoxyribose nucleic acid
DVI = disaster victim identification
MFI = mass-fatality incident
WHO = World Health Organization

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Abstract

This is a summary of the presentations and discussion of Panel 2.16, Forensic Aspects of Disaster Fatality Management of the Conference, *Health Aspects of the Tsunami Disaster in Asia*, convened by the World Health Organization (WHO) in Phuket, Thailand, 04–06 May 2005. The topics discussed included issues related to forensic aspects that pertain to the responses to the deaths created by the Earthquake and Tsunami. It is presented in the following major sections: (1) overview of victim identification; (2) resource factors in mass-fatality management; (3) mass-fatality management in protecting public health; and (4) reasons to use deoyxribose nucleic acid (DNA) to identify the deceased.

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Overview

The Tsunami struck many countries on the coast of the Indian Ocean on 26 December 2004, and caused nearly 217,000 deaths. In Thailand, there were 5,935 reported deaths; approximately half of these were foreign tourists. Thai authorities tried to identify all of the victims. This large number of deaths in a single incident overwhelmed Thai authorities along with the authorities in many other countries. Prior to the Tsunami, there was no mass-fatality plan for the identification of so many deceased. Using limited resources, the Thai government examined and identified as many of the bodies as possible. Later, the process was supported by the international community. During this process, the management of victim identification in Thailand was discussed, along with the experiences of the Thai disaster victim identification (DVI) teams. Recommendations to improve identification processes in mass-fatality events were proposed.

Resources

Terrorist attacks, dense urban environments, high capacity transportation, and emerging infectious agents increase the potential for larger mass-fatality incidents (MFIs), and present new challenges to medical examiners and emergency response personnel. Computer technology and deoyxribose nucleic acid (DNA) science provide new tools for meeting this challenge, but MFIs and identifying the resource requirements needed to manage these incidents remains a challenge.

This panel presented four factors across three MFIs that characterize such incidents with the objective that proper resource allocations can be made during future MFIs. These factors included: (1) the existence of a manifest; (2) the condition of the remains; (3) the rate of recovery of the remains; and (4) the numbers of victims. All four of these factors impact the length of the process, the ability to determine the cause and manner of death, and the identification of the deceased. The timely application of response resources has implications for both the forensic community and for the public health aspects of managing a disaster.

Bio-Agents	Handling	Embalming	Viewing	Containment	Burial Type
Smallpox	Standard and contact precautions Vaccinations[1]	No[2]	No	Bio-seal and/or Zeigler Case[3]	Restricted permit[4,5]
Anthrax	Standard and contact precautions	No[2]	No	Bio-seal and/or Zeigler Case[3]	Restricted permit[4,5]
Viral Hemorrhagic Fevers	Standard and contact precautions	No[2]	No	Bio-seal and/or Zeigler Case[3]	Restricted permit[4,5]
Plague	Standard and contact precautions	No[2]	Yes	None	Regular
Tularemia	Standard and contact precautions	No[2]	Yes	None	Regular

Table 1—Management of remains of victims of biological agents ([1]If possible, personnel should be vaccinated prior to handling smallpox victims; [2]Embalming is a high-risk invasive procedure); [3]Burial is an acceptable method of disposition if strict precautions are followed in accordance with Centers for Disease Control guidelines; [4]"Restricted Burial Permit" would be issued to limit handling and prohibit exhumation of remains; [5]Cremation is the preferred method of disposition in cases of highly infectious agents such as smallpox and hemorrhagic fever viruses.)

Agent	Handling	Embalming	Viewing	Containment	Burial Type
Nerve	OSHA Level-C NBC APR[1]	No[2]	No[3]	Bio-seal and/or Zeigler Case[3]	Regular[4,5]
Blood	OSHA Level-C NBC APR[1]	No[2]	No[3]	Bio-seal and/or Zeigler Case[3]	Regular[4,5]
Vesicant	OSHA Level-C NBC APR[1]	No[2]	No[3]	Bio-seal and/or Zeigler Case[3]	Regular[4,5]
Toxic Inhalant	OSHA Level-C NBC APR[1]	No[2]	No[3]	Bio-seal and/or Zeigler Case[3]	Regular[4,5]
Radiological	OSHA Level-C NBC APR[1]	Yes[5]	Yes[5]	None[6]	Regular[5]

Table 2—Management of remains of victims of chemical or radiological agents ([1]Personnel should continue to wear PPE including an approved APR while handling previously decontaminated remains; [2]Embalming is a high risk, invasive procedure; [3]Due to the possibility of persistent, non-detectable contamination, remains should be placed in a containment device to ensure safety; [4]Burial may be acceptable. Cremation of contaminated remains always is the safest form of disposition; [5]A special category burial permit that would limit handling and exhumation should be considered if remains cannot be made "safe"; [6]If radiological containment remains cannot be made safe, they should be placed into a containment device.)

Protecting Public Health

In disaster planning, whether those caused by natural hazards, terrorism, or infectious agent outbreaks, the possibility of massive numbers of fatalities grows as new threats emerge. A flexible plan for mass-fatality management that is adaptable to multiple events was outlined, and the methods by which effective management can contain the threat to public health were discussed.

Why DNA?

The identification of disaster victims is a multi-disciplinary effort requiring the expertise of police, medical examiners, and forensic scientists. The primary modalities of identification were outlined; then focus was placed on the instances in which DNA is the only resort. Methods of sampling, kinship analysis, and sources of error will be discussed, with the presentation of an actual case in which all modalities were needed to find the source of error. Additionally, research in electron-beam irradiation for decontamination of infectious remains while maintaining the integrity of the DNA, a subject that may prove timely as the threat of global pandemics grows, was discussed.

Findings

As is the primary mission in any disaster, the initial response to the Tsunami was focused on rescuing the living, treating casualties, and recovering essential systems for immediate survival. These critical tasks were done with varying degrees of success, depending on the level of devastation in each region, and the availability of resources in that area.

Discussion

The panel discussed the somewhat controversial area of mass-fatality management, including what resources, if any, should be directed toward the care of the dead? Although on the surface, this might seem to be a political or cultural decision that depends on the customs of the affected nation, it is a public health issue that rarely is addressed.

Effective mass-fatality management following a disaster can ensure the safety of the living through well-thought-

Deaths (n)	Dental examination by Thai Dentist Team	Identified and Released based on dental records
5,395	2,070	111

Table 3—Summary of victims identified by dental records during the early phase

out public health measures. In a new era of increasing threats from terrorism, hazardous materials such as nuclear waste, high-speed travel, and emerging biological agents, personnel must look beyond their usual practices to anticipate measures that must be implemented to mitigate the damage future events may engender.

The medical examiner's traditional role is to determine the cause and manner of death, identify the deceased, and arrange for the proper disposition of the remains. In doing so, they may discover a sentinel case and identify an agent before a disease can spread. Indeed, the anthrax terrorist attack in the US first was discovered by a forensic pathologist who autopsied the body of a man who had been exposed to a white powder. Tracing the powder to the Postal Service helped mitigate the exposure of countless others. In the role of final arbiters as to disposition of remains, medical examiners may decide to Bio-seal bodies, and require burial in restricted areas to prevent the spread of a virus. Remains contaminated by radiological waste following an accident at a nuclear power plant must be decontaminated effectively before they can be examined safely and handled by personnel, and finally returned to their families (Tables 1, 2, and 3).

What is the need for identifying the deceased? Is this really an important public health issue? Given the overwhelming grief witnessed from survivors of the Tsunami and the World Trade Center attacks, the loss of a loved one is compounded greatly by the uncertainty of never knowing if they really perished and the lack of proper burial rituals. The degree of psychological and emotional distress that results is immeasurable, but the resultant psychosocial problems will affect the community's ability to recover and rebuild their lives.

In order to compare and better elucidate the mistakes made and lessons learned in each disaster, this panel examined how mass-fatality management was handled following two events, the Tsunami and the World Trade Center attack. In the Tsunami disaster, the needs assessment for handling the dead was based largely on the level of devastation in each region. Thus, the nations hit hardest, like Indonesia, were overwhelmed by the sheer numbers of bodies found within a largely destroyed infrastructure. In that instance, there only is one appropriate and efficient method for the disposition of remains, painful though it may be for their families.

In Thailand, where a large number of foreign tourists died, a decision had to be made as to how many resources would be devoted to identification of the dead, when areas like KhaoLak were without adequate shelter and water. In a pragmatic assessment of the situation, it was decided to identify the deceased using the Thai Medical Examiner

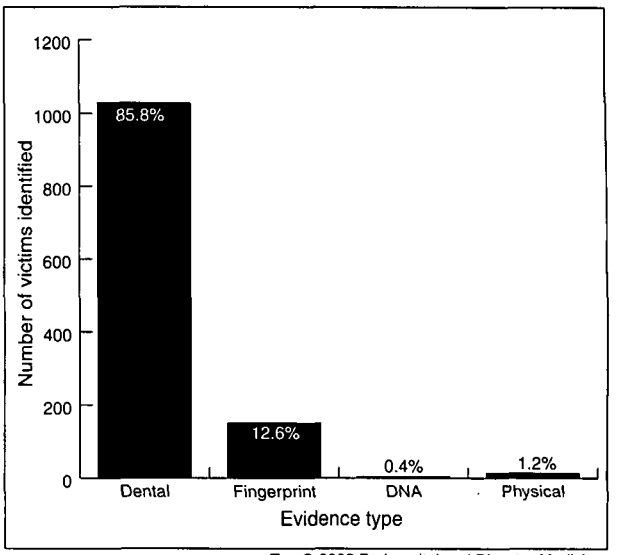

Figure 1—Reconciled bodies by primary evidence.

protocols. In the confusion of the first critical days, however, appropriate methods were not always followed, and valuable information was lost, resulting in greater costs later in the process. For instance, some morgue sites heavily relied on getting DNA samples when photographs, fingerprints, and forensic dental examinations would have been far cheaper, faster, and more efficient overall (Figures 1 and 2). This points out the need for advance planning to maximize the effectiveness of even the most qualified practitioners.

After an initial period of work done solely by the Thais, Interpol DVI teams arrived from about 30 nations. Coordination did not go well at first, as some teams focused their efforts on finding only the dead from their own nations. Good communication and diplomacy resolved this issue, but time was stolen from the task at hand. Again, advance planning for international response would have precluded this problem.

In identifying the gaps in services, it can safely be said that the gaps in mass-fatality management were huge, and very few nations are able to cope effectively with large numbers of dead citizens. New York City, for all of its disaster planning and well-staffed agencies, was overwhelmed by the work involved in recovering and identifying the 3,000 dead from 11 September 2001, which continues today, more than three years after the event.

These methods have been found to be effective in filling those gaps:

1. *Assessment tools*—Practical methods to assess a disaster rapidly and identify resource needs, so that good decisions can be made as to where to allocate the available resources.
2. *Advance planning*—It is not practical to develop plans for every disaster imaginable, but all disasters have certain elements in common. The most important needs, such as communication systems, necessary personnel and training, command structure, logistical support, and strategies based on best prac-

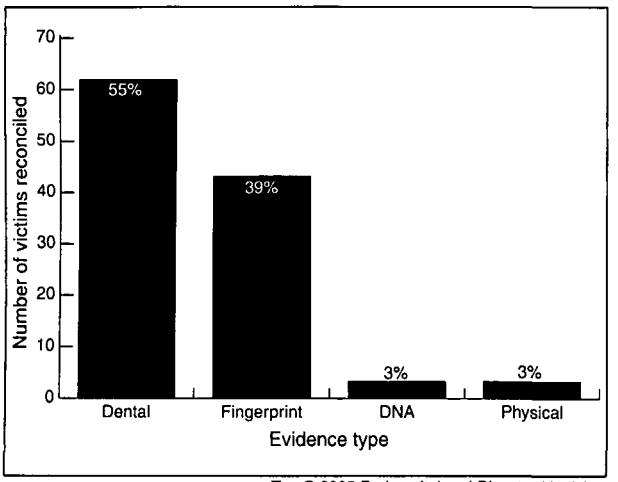

Figure 2—Reconciled Thai victims by primary evidence under TTVI

tices are pre-identified. For instance, body storage facilities like refrigerated trucks always are needed, but it would be impractical to buy them. However, it is easy to identify in advance where these trucks may be obtained quickly when an incident occurs.

3. *Shared expertise*—The panel described the work done by the Interpol DVI teams, and believed that the unified command structure worked effectively for the 30 different governments hosted by Thailand. The data systems used by DVI, and those used by the United States for 11 September 2001, were mentioned, as were the different modalities for DNA identification. Basic forensic practices were discussed, such as the desirability of using the simplest, cheapest, and fastest methods for identification.

Photographs, fingerprints, and dental comparisons are far easier to use than are DNA analyses. Recent research done with electron beam irradiation to destroy biological agents while preserving DNA was described. The role of non-governmental organizations, and their ability to collect antemortem data while providing services to the families is an valuable resource for forensic teams.

Recommendations

It is recommended that an international organization, such as the WHO, convene a task force of experts from all over the world to address these gaps. There should be little resistance, given that the world is shrinking, and what happens to one happens to all. The Tsunami has shown that death and disaster know no borders; the work done in the aftermath of 11 September 2001 has demonstrated that the mistakes and lessons of one country can be shared with others to prevent their being repeated.

Summary

Each country has something to contribute. An interesting and valuable new use for TeleMed on a remote island off the coast of India was discussed. They videotaped the deceased and sent the images to the mainland over TeleMed. There, relatives immediately were able to identify 200 people through the use of this innovative method.

In sharing their experiences and hearing those of others, every country also will build their own capacities for effective response and recovery. When needed, an international assessment team should be available not to direct, but rather to assist and recommend best practices and resource allocation, while respecting the sovereignty and native capacities of each nation.