The Forensic Anthropologist in the Mass Fatality Context

Jason M. Wiersema, Allison Woody

ABSTRACT

Mass fatality incidents require a multi-agency, multidisciplinary response to effectively and efficiently manage the recovery and identification of human remains. The forensic anthropologist is uniquely suited for a significant role in the disaster response, demonstrated in the recovery and triage of human remains, interpretation of skeletal trauma, and identification of victims. However, the majority of published literature discusses these response operations in the context of large-scale incidents with significant numbers of highly fragmented and commingled human remains, which does not reflect the operational reality of mass fatality incidents in the United States. This article provides a realistic definition of the term “mass fatality incident” for medicolegal jurisdictions and provides the contributions of the forensic anthropologist for all types of incidents. *Acad Forensic Pathol.* 2016 6(3): 455-462

AUTHORS

Jason M. Wiersema PhD D-ABFA D-ABMDI, Harris County Institute of Forensic Sciences - Forensic Investigations and Emergency Management Division and Forensic Anthropology Division

Roles: Project conception and/or design, data acquisition, analysis and/or interpretation, manuscript creation and/or revision, approved final version for publication, accountable for all aspects of the work, writing assistance and/or technical editing.

Allison Woody MS, Harris County Institute of Forensic Sciences - Forensic Investigations and Emergency Management

Roles: Project conception and/or design, data acquisition, analysis and/or interpretation, manuscript creation and/or revision, approved final version for publication, accountable for all aspects of the work, writing assistance and/or technical editing.

CORRESPONDENCE

Jason M. Wiersema PhD D-ABFA D-ABMDI, 1885 Old Spanish Trail, Houston TX 77054, jason.wiersema@ifs.hctx.net

ETHICAL APPROVAL

As per Journal Policies, ethical approval was not required for this manuscript

STATEMENT OF HUMAN AND ANIMAL RIGHTS

This article does not contain any studies conducted with animals or on living human subjects

STATEMENT OF INFORMED CONSENT

No identifiable personal data were presented in this manuscript

DISCLOSURES & DECLARATION OF CONFLICTS OF INTEREST

The authors, reviewers, editors, and publication staff do not report any relevant conflicts of interest

FINANCIAL DISCLOSURE

The authors have indicated that they do not have financial relationships to disclose that are relevant to this manuscript

KEYWORDS

Forensic pathology, Forensic anthropology, Mass fatality

INFORMATION

ACADEMIC FORENSIC PATHOLOGY: THE OFFICIAL PUBLICATION OF THE NATIONAL ASSOCIATION OF MEDICAL EXAMINERS

©2017 Academic Forensic Pathology International • (ISSN: 1925-3621) • <https://doi.org/10.23907/2016.046>

Submitted for consideration on 30 Jun 2016. Accepted for publication on 3 Aug 2016

INTRODUCTION

Mass fatality preparedness is evolving as a discipline. Significant field, morgue, and laboratory work by a variety of practitioners has occurred in response to incidents around the world in many contexts including human rights investigations, natural and manmade disasters, and terrorist incident investigations during the last two decades. These large-scale incidents have resulted in a significant array of historical and planning guidance-oriented literature including Gursky et al., Saul and Saul, Mundorff, INTERPOL, International Committee of the Red Cross, and National Association of Medical Examiners (1-6). In particular, the discipline of fatality management is evolving to leverage the lessons learned from large-scale responses in order to benefit preparations by local medicolegal jurisdictions to respond to smaller-scale incidents. The primary audience for this article is the medical examiner/coroner jurisdiction whose susceptibility to large-scale catastrophic incidents is real, but far outweighed by its susceptibility to smaller incidents that may also disrupt their operations.

The occurrence of even a small mass fatality incident can present significant challenges to a local medicolegal authority. The fatalities associated with the incident must be managed in excess of daily caseload and often require additional or atypical processing methodologies. For example, there is often a shift in emphasis from determination of cause and manner of death to personal identification. In fact, the identification focus often associated with mass fatality incident response has resulted in development of the term “disaster victim identification” (DVI). The federally-supported activities of the Scientific Working Group on Disaster Victim Identification and the DVI Subcommittee of the Organization of Scientific Area Committees underscores the importance of identification in overall mass fatality incident management. On the other hand, some incident types, particularly mass shootings of the variety that have become commonplace in the United States, necessitate that the emphasis of the medicolegal investigation focus on careful analysis and interpretation of patterns of traumatic injury in addition to identification.

A medicolegal authority’s response to a multiple or mass fatality incident will vary based on the circumstances of the incident and the capability of the local medicolegal jurisdiction to manage it. Likewise, the utility of the anthropologist in mass fatality incident response varies considerably depending on the circumstances of a particular incident. The roles of the anthropologist in the mass fatality context have been previously described in detail, including historical accounts of incident responses during which anthropologists made significant contributions (1-3). These publications identify the following as the primary contributions made by the anthropologist during recent mass fatality incident responses: anthropological recovery of remains from the mass fatality site, resolution of commingling, provision of biological profile estimations, interpretation of skeletal trauma, and radiographic identification.

DISCUSSION

Anthropological Recovery of Remains from the Mass Fatality Site

The typical forensic anthropologist has considerable training and experience in the application of archaeological field methods (7). These methods exist to ensure the preservation of contextual information associated with items recovered from archaeological sites, and can be employed in the forensic context to ensure that the location and contextual data recovered meet evidentiary standards. It is important to note two things about the application of archaeological recovery methods in the forensic/mass fatality context. First, the application of archaeological methods can be scaled up or down depending on incident circumstances. For example, detailed total station mapping is not necessary for simple incidents but may be of considerable utility for cases that may benefit from later reconstruction. Secondly, many of the techniques applied by the forensic anthropologist resemble those utilized by law enforcement crime scene technicians. The benefits of their application by an anthropologist is 1) that the anthropologist is operating as a medicolegal (rather than law enforcement) practitioner and 2) that anthropologists combine their knowledge of

recovery methods with a detailed knowledge of fragmentary skeletal anatomy.

Resolution of Commingling

Most forensic anthropologists have experience in the recovery and identification of isolated or fragmentary remains, and are thus adept at resolving commingling of remains both at the scene and in the morgue. In the morgue, anthropologists will use their detailed knowledge of skeletal anatomy to develop a minimum number of individuals (MNI) based on the inventory of remains present in a particular assemblage. At the mass fatality site, the anthropologist can often circumvent later commingling issues via *in situ* re-approximation of skeletal elements.

Provision of Biological Profile Estimations

Development of the biological profile (estimations regarding a decedent's race, sex, stature, and age using skeletal morphology) is a core capability of the forensic anthropologist (8). Physical anthropologists are typically trained to consider variation in these traits on a population level, but their methods are applicable to individual cases. These methods are appropriate for use during mass fatality incident responses, and are invaluable tools for facilitating identifications by reducing the pool of possible identities for a set of remains. Some portions of the skeleton are more valuable for the development of the biological profile than others, but limited demographic inferences can often be pulled from fragmentary remains making biological profile estimation a valuable tool in the DVI component of a mass fatality incident response.

Interpretation of Skeletal Trauma

The typical forensic anthropologist is adept at recognition and interpretation of skeletal trauma (9), and extensive skeletal trauma is often present on remains following a mass fatality incident. Detailed anthropological interpretation of these injuries is not always of particular utility, for example, in cases when trauma is pervasive and there is no criminal component. There are however, incidents that benefit heavily from an-

thropological interpretation of skeletal trauma, either because the overlying soft tissue is decomposed or otherwise damaged to the extent that soft tissue trauma cannot be evaluated, or because the particular pattern of trauma lends itself to skeletal reconstruction and interpretation. For example, direction of fire and sequence of injury can be very valuable in the investigation of mass shooting incidents.

Radiographic Identification

Comparison of antemortem and postmortem skeletal radiographs is the mechanism used by the anthropologist to secure identifications of deceased remains (10). The utility of radiograph identification as a means to identify decedents is largely limited by the availability or lack of antemortem records. The frequency of use of radiographic identification by medical examiners/coroners varies considerably, but availability of records should not vary significantly with daily cases at a single office. Mass fatality incidents may represent a significant and abrupt shift in the utility of radiographic comparison, depending on a variety of factors including the degree of fragmentation and the origin of the decedents requiring identification. An office that is accustomed to frequent use of radiographic identification on its daily cases may find that acquiring antemortem records for nonlocal decedents may diminish the utility of radiography as a means to identification.

Evolution of Mass Fatality Preparedness

The existing literature regarding anthropological contribution to mass fatality investigations adequately describes and justifies the inclusion of an anthropologist in large-scale mass fatality response (1-3). However, the focus of each of the above listed publications is on large-scale incidents with large numbers of fatalities and high levels of fragmentation, commingling, and other taphonomic factors. Incidents of this scale typically require significant workflow modification at both the scene and in the morgue. As a result of the focus on large-scale incidents, the current literature implies that mass fatality incidents necessitate an all or nothing response strategy. The reality is that these large incidents are relatively uncommon, but that the

small incidents that have become commonplace in the United States can present significant obstacles to effective management by a typical medical examiner/coroner operation. The other oft-cited component of mass fatality response that is not of particular utility in and of itself as an indicator of the complexity of a response is the number of fatalities. A large number of intact remains may be considerably easier to manage than a smaller number of fragmented, commingled and thermally damaged remains. Unfortunately, mass fatality variables like fragmentation, commingling, and thermal damage often co-vary, meaning that incidents become complex very quickly with the introduction of certain taphonomic influences. Similarly, a small open population incident where the victims' identities are unknown may be managed using standard operations, but may require additional emphasis on decedent identification and the utility of multiple identification methods (e.g., fingerprints, radiographs, dental, DNA). A measured, incident-specific response rather than a rigid all or nothing response strategy allows for reconciliation of the activation of modified methods with the continued demands of daily casework. For example, a mass shooting with eight victims may simply require an increased number of staff for scene response and pathology examination, incorporating the decedents into the daily case volume, rather than a complete departure from the office's daily operation.

Nevertheless, local medical examiner/coroner jurisdictions often seek guidance for mass fatality planning from federal initiatives that are associated with emergency management grant programs (e.g., Urban Area Security Initiative [UASI], State Homeland Security Program [SHSP], Regional Catastrophic Preparedness Grant Program [RCPGP]) and thus intend to provide preparedness benchmarks for large emergency management jurisdictions located in large urban areas. These programs are typically focused on preparations for catastrophic manmade or natural incidents that involve large numbers of decedents in complicated environments. This guidance is often of minimal utility for medium or small jurisdictions with limited or no mass fatality response capabilities.

Regardless of incident scale, there is currently little in the way of data supported literature examining the importance of forensic scientists (including anthropologists) in mass fatality response; the above listed references are compelling but largely anecdotal. In 2016, Woody et al. developed a database from which a variety of inferences can be made, including the utility of particular expertise in mass fatality incident response (4). The database is intended to generate a realistic definition of the term "mass fatality" for local jurisdictions that are in the process of developing mass fatality incident response plans. The database includes all multiple fatality incidents that occurred in the United States between January 1, 2000 and December 31, 2014 that resulted in four or more fatalities. The data were extracted from federal databases including the National Transportation Safety Board (NTSB), National Oceanographic and Atmospheric Administration (NOAA), the Mine Safety and Health Administration (MHS), the Bureau of Safety and Environmental Enforcement (BSEE), the National Incident-Based Reporting System, and the Fatality Analysis Reporting System (FARS). Single incidents affecting multiple jurisdictions that resulted in fatalities were split by county/city to avoid over representing the burden of an incident on a single medicolegal jurisdiction.

A total of 2934 incidents met the criteria for inclusion in the database, accounting for more than 19 000 fatalities. The average number of fatalities per incident during the 15-year period included in the sample is seven (**Figure 1**). There is significant variability in the frequency of incidents by location and incident type, but the average number of fatalities is less variable by location (with the exception of the few locations within which very large incidents occurred [New York City and New Orleans]). The median number of fatalities in these areas resembles the median number in other areas.

The database also illustrates an urban distribution of mass fatality incidents (**Figure 2**), with high incident numbers centering around the large population centers (New York, Houston, Chicago, Los Angeles). Homicide incidents also center around population centers. Other trauma-related incidents including motor vehi-

cle accidents (both mass transit and non-mass transit are more broadly distributed with concentrations in population centers (**Figure 3**). Weather-related incident distribution reflects hurricane and tornado sus-

ceptibility with higher concentrations of tornadoes in the central section of the country and hurricanes distributed along the Gulf and Atlantic coastlines (**Figure 4**). In 2016, the database was updated to include the

Figure 1: Total deaths resulting from mass fatality incidents 2000-2014 (by State).

Figure 2: Heat map of mass fatality incident deaths 2000-2014.

Figure 3: Motor vehicle crashes from 2000-2014.

Figure 4: Weather incidents from 2000-2014.

most recent mass shootings in the United States. The revised mapping demonstrates a high density and frequency of mass shootings in the east, as well as more isolated large-scale incidents in California and Florida (**Figure 5**). These data represent a valuable data supported planning tool for local jurisdictions. Local jurisdictions can use the expertise and techniques described in the available literature to make preparations for the scale and type of incident that they are most susceptible and scale up as needed for larger-scale incidents (1-3, 5, 6, 11).

Operational Implications of Mass Fatality Incident Characteristics

There are some predictable associations between mass fatality response characteristics and incident types (**Table 1**) that can inform planning for and response to a particular incident. **Table 1** compares incident types with the presence or absence of the more complex variant of an array of mass fatality characteristics (e.g., open population incidents are generally more difficult to manage than closed population incidents).

Figure 5: Mass shootings from 2000-June 2016.

Table 1: Complex Variables Associated with Mass Fatality Incidents

	Taphonomic Factors				Incident Factors			
	Fragmentation	Commingling	Thermal	Wide Distribution	Unassociated Personal Effects	Criminal Component	Open Population	Inflicted Trauma
Weather				✓	✓		✓	
Other Natural				✓			✓	
Motor Vehicle Collision / Mass Transit	✓	✓	✓		✓			
Mass Shooting						✓	✓	✓
Accidental Explosion	✓	✓	✓		✓		✓	
Other Terrorism	✓	✓	✓	✓	✓	✓	✓	✓

Large-scale terrorist incidents like 9/11 are the most complex to manage because they involve a criminal component as well as a variety of taphonomic factors.

The management and response to these complex incident characteristics benefit from the involvement of a forensic anthropologist for the above described functions (e.g., scene processing, resolution of commingling, skeletal trauma analysis, identification). These characteristics also necessitate the development of a flexible and scalable mass fatality management plan that is specific to the hazards, risks, and capabilities of a particular medicolegal jurisdiction. Involving the forensic anthropologist (in addition to numerous other internal and external stakeholders) in this planning process is valuable in developing a strategy for implementation of minor modifications to daily operations versus a complete operational departure from normal procedures. For smaller jurisdictions, it may be more effective to plan regionally or statewide, relying on resources (including personnel) from outside the local jurisdiction to support mass fatality responses. This should include forensic anthropologists employed at medical examiner/coroner offices, colleges and universities, and other institutions. For example, a region or state may choose to work towards the development of a mass fatality incident response team replete with forensic specialists such as pathologists, death investigators, odontologists, and anthropologists.

CONCLUSION

The forensic anthropologist is often uniquely suited to support mass fatality incident operations and preparedness due to their varied expertise in site management, morgue operations, trauma interpretation and identification methods. While the role of the anthropologist has been described in the existing mass fatality literature, primarily within in the context of large-scale mass fatality incidents, there is significant utility for the forensic anthropologist in the smaller mass fatality incidents that occur much more frequently across the United States.

ACKNOWLEDGEMENTS

The authors would like to thank Sheronda Drew, Melvic Degracia, Richard Mauzy and Antonio Hernandez from the Applied Technology Services Team, Harris County Budget Management Department for developing the maps that were used.

REFERENCES

- 1) Gursky EA, Fierro MF. Death in large numbers: the science, policy, and management of mass fatality events. Chicago: American Medical Association; 2012. 491 p.
- 2) Saul F, Mather Saul J. Hard evidence: case studies in forensic anthropology. 1st ed. Upper Saddle River (NJ): Prentice Hall; c2003. Chapter 20, Planes, trains, and fireworks: the evolving role of the forensic anthropologist in mass fatality incidents; p. 266-77.
- 3) Mundorff A. Integrating forensic anthropology into Disaster Victim Identification. *Forensic Sci Med Pathol*. 2012 Jun; 8(2):131-9. PMID: 21877297. <http://dx.doi.org/10.1007/s12024-011-9275-0>.
- 4) Woody A, Wiersema J, DePaolo F, et al. Defining "mass fatality incident" for medicolegal jurisdictions in the United States: a planning tool [Internet]. In: Proceedings of the 68th annual meetings of the American Academy of Forensic Sciences; 2016 Feb 22-27; Las Vegas, NV, Colorado Springs (CO): American Academy of Forensic Sciences; c2016. p. 793. Available from: <http://www.aafs.org/wp-content/uploads/2016Proceedings.pdf>.
- 5) INTERPOL. Lyon (France): INTERPOL; c2016. Disaster victim identification guide; 2013 [cited 2016 Aug 1]. 127 p. Available from: <http://www.interpol.int/INTERPOL-expertise/Forensics/DVI-Pages/DVI-guide>.
- 6) Management of dead bodies after disasters: a field manual for first responders [Internet]. Washington: Pan American Health Organization; 2009 [cited 2016 Aug 1]. Available from: <https://www.icrc.org/eng/assets/files/other/icrc-002-0880.pdf>.
- 7) Dirkmaat DC, Cabo LL. Forensic archaeology and forensic taphonomy: basic considerations on how to properly process and interpret the outdoor forensic scene. *Acad Forensic Pathol*. 2016 Sep; 6(3): 439-54.
- 8) Austin D, King RE. The biological profile of unidentified human remains in a forensic context. *Acad Forensic Pathol*. 2016 Sep; 6(3):370-90.
- 9) Love JC, Wiersema JM. Skeletal trauma: an anthropological review. *Acad Forensic Pathol*. 2016 Sep; 6(3):463-77.
- 10) Wiersema JM. Evolution of forensic anthropological methods of identification. *Acad Forensic Pathol*. 2016 Sep; 6(3):361-9.
- 11) Standard operating procedures for mass fatality management [Internet]. Marceline (MO): National Association of Medical Examiners; 2010 [cited 2016 Aug 1]. Available from: <https://netforum.avectra.com/public/temp/ClientImages/NAME/31434c24-8be0-4d2c-942a-8afde79ec1e7.pdf>.