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# Mass Fatality Incidents and the Role of the Dental Hygienist: Are We Prepared?

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# CRITICAL ISSUES IN DENTAL HYGIENE

## Mass Fatality Incidents and the Role of the Dental Hygienist: Are We Prepared?

Tara L. Newcomb, BSDH, MS; Ann M. Bruhn, BSDH, MS; Bridget Giles, PhD

### Abstract

**Purpose:** Dental hygienists can fill critical roles during mass fatality incidents in the area of disaster victim identification, providing much needed support to forensic odontologists. The purpose of this paper is to bring awareness that research is needed to assess current dental hygiene programs, continuing education opportunities and the type of approach being used to develop and implement pedagogy in the forensic specialty area, specifically mass fatality preparedness and response for the dental hygienist. Because of the threat of terrorism in the U.S. and natural disasters like hurricanes, the need to prepare dental professionals in disaster response and fatality management is real. The authors' recommendations are to incorporate training in the areas of risk management and infection control in the mortuary setting, antemortem and postmortem records comparison, safe usage of portable radiographic equipment, and proper radiographic technique for the deceased victim. Disaster victim identification training in these areas is necessary for the accurate, efficient and dignified identification of disaster victims while minimizing errors and increasing responder safety. The dental hygiene professional can assist disaster mortuary response efforts in a way that leverages multidisciplinary teams, if effective training programs are implemented.

**Keywords:** dental hygiene education, mass fatality incidents, forensic odontology, emergency preparedness and response, victim identification, radiology

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### INTRODUCTION

A mass fatality incident is an emergency management term used to categorize an event that causes loss of life which overwhelms a community's ability to locate, identify and process dead bodies for identification.<sup>1</sup> Mass fatality incidents may be either man-made (hazardous material incidents, transportation accidents or terrorist attacks), or caused by acts of nature (hurricane, tornado or tsunami). There have been many defining moments in history where challenges of responding to mass fatality incidents have been clearly realized. The terrorist attacks on the World Trade Center in New York City and on the Pentagon on September 11, 2001, resulted in nearly 3,000 deaths.<sup>2</sup> On August 29, 2005, Hurricane Katrina moved across the Gulf Coast, killing almost 1,800 people.<sup>3</sup> In October 2012, Hurricane Sandy was responsible for the deaths of at least 117 people.<sup>4</sup> These and other similar moments demonstrate the impact that mass fatality incidents have nationally and globally. Since dental forensic expertise played an important role in victim identification during these incidents, effective preparedness and response training programs related to disasters and victim identification must be created.

Forensic odontology is the proper handling, examination and evaluation of dental evidence, which

will be presented in the interest of justice, and has been a major contributor to victim identification in mass fatality incidents.<sup>5</sup> This includes collecting and recording both antemortem records and postmortem records. Antemortem records are victim's records created before their time of death to include dated, written notes, dental and social histories, radiographs, clinical photographs, study models, referral letters, and documentation of oral modifications (i.e. oral tattoos or piercings), which are very helpful when all other common identification methods (driver's license, photo id, etc.) are missing or unavailable.<sup>6,7</sup> Postmortem records are collected after death through a medical examination of a dead body. Under the severe circumstances of mass fatality incidents, dental identification is vital as the victim may be burned, disfigured, crushed or decayed, in such a way that identification by family members is not possible, not recommended or unreliable. Because of their preservability, the best means of biometric identification are the dental structures; teeth can provide evidence of identification even when victims are exposed to severe extremes of heat, trauma or decomposition.<sup>6,8-10</sup> Even in fires from aviation fuel after a plane crash, a victim's teeth can remain intact when other body parts are destroyed.<sup>10</sup> Dental structures are often preserved because they are well

insulated by bone and swelling of the tongue that occurs during intense heat. During the 2001 World Trade Center attack, at least 501 victims were identified by dental comparison,<sup>11</sup> and forensic dental efforts alone enlisted approximately 350 dentists.<sup>12</sup> Following the tsunami in Thailand in 2004, for the first 1,474 victims identified, 79% of the bodies were identified by dental comparison.<sup>13,14</sup>

During a mass fatality incident, dental teams are formed to collect and systematically record both antemortem and postmortem data, as well as compare data and report evidence. The American Board of Forensic Odontology (ABFO) recommends the use of dental hygienists on mass fatality victim identification teams while under the direct supervision of the forensic odontologist, since dental hygienists hold licensure in competencies that directly benefit the forensic dental team, including administrative skills, dental radiography and clinical oral examination of both hard and soft tissues.<sup>4,7,14,15</sup> Other expertise include knowledge in the areas of dental anatomy, tooth anomalies and dental charting, which are critical to successful identification of victims during mass fatality incidents. Table I defines possible roles that the dental hygienist could fill during a mass fatality incident.

Victim identification during mass fatality incidents is an essential process to maintain law and order in a civilized society. During a mass fatality incident, the lack of trained incident responders could prolong the process of victim identification, adding to the survivors' psychological trauma.<sup>16</sup> Not knowing whether a loved one is dead or alive can cause frustration, anger and even violence.<sup>17</sup> Furthermore, the mourning processes may not start until deceased victims are identified. The absence of appropriately trained professionals may also result in a lack of sensitivity to cultural and religious practices, an increase in identification errors, and delays in legal processes.<sup>18</sup> Identification is needed for the timely execution of insurance policies, wills, child guardianship and remarriage for the victim's family. Finally, as was seen in Japan and the South Asian Tsunami disaster, having unrecovered and unidentified bodies for a long period of time can undermine public trust and confidence in authorities.<sup>17</sup>

Research also shows mass fatality incident responders are at an increased risk of acute stress disorder, post-traumatic stress disorder and depression.<sup>19</sup> Increased distress was significantly related to the hours of exposure to the remains, prior experience handling remains, age, and the support received from spouses and co-workers during the identification process.<sup>16</sup> Since volunteers will be working in a highly stressful and emotionally challenging environment, they should have the requisite skills to operate effectively.<sup>18,20</sup> This includes the ability to

Table I: Duties of the Dental Hygienist During a Mass Fatality Incident<sup>4,11</sup>

Administrative Role	<ul style="list-style-type: none"> <li>• Serving as a the dental registrar</li> <li>• Management of dental support personnel</li> <li>• Providing standardized and quality documentation of antemortem and postmortem records</li> <li>• Provision of chain of custody for evidence</li> <li>• Conducting follow-up evaluations and research for future preparedness</li> <li>• Updating and maintaining a master list of identifications (Brannon and Connick 2000)</li> </ul>
Postmortem Team Role	<ul style="list-style-type: none"> <li>• Providing surgical assistance to the dentist in resecting procedures</li> <li>• Participating as a member of a multi-verification dental identification team</li> <li>• Exposure of postmortem dental radiographs</li> </ul>
Antemortem Team Role	<ul style="list-style-type: none"> <li>• Reconciliation of dental records to identify victim</li> </ul>
Records Comparison Role	<ul style="list-style-type: none"> <li>• Arrangement of data for comparison by the forensic odontologist</li> <li>• Serve as a multi-verification team member</li> </ul>

cope with exposure to traumatic events, to work under intense pressure, and to function in a variety of roles. It has been shown that psychological debriefing is effective in the preventive treatment of post-traumatic stress disorder.<sup>16</sup> Psychological impacts of a mass fatality incident must be considered by dental hygienists willing to volunteer.

Major differences exist when working in mortuary or temporary morgue settings often used during a mass fatality incident. Dental hygienists are viewed as an asset to mass fatality incidents and identification efforts; however, there are very few training programs that focus on preparing the dental hygienist for disaster response.<sup>12,14,21</sup> Specifically, more education is needed to prepare the dental hygienist to participate as a mass fatality incident responder and include the following:

1. Knowledge and recognition of associated risks and hazards in a morgue or temporary morgue site
2. Postmortem dental coding

3. Working on a multi-verification team
4. Safety and radiation technique when working with portable radiation equipment and victim remains

### Risks and Hazards in the Mortuary Setting

Infection Control: A mortuary setting may subject dental hygienists to a wide variety of infectious agents, including bloodborne and aerosolized pathogens such as human immunodeficiency virus, hepatitis B and C viruses, and Mycobacterium tuberculosis because of the unique characteristics of forensic practice. Studies have confirmed with the cessation of life certain pathogenic bacteria are released.<sup>22,23</sup> Also after death, there is a lack of the blood-brain barrier and endothelial cells to restrict the movement of pathogens to the brain.<sup>24</sup> In particular during a mass fatality incident, the deceased may be stored for prolonged periods of time, increasing the risk of infectious disease transmission.

The exposure of the mucous membranes (eyes, nose and mouth) of dental hygienists to blood and body fluids of the deceased can be associated with the transmission of bloodborne viruses and other infectious. Therefore, dental hygienists must protect themselves from mucous membrane exposures with use of universal precautions, which are based on the principle that all blood, body fluids, secretions, non-intact skin, mucous membranes and body excretions may contain transmissible infectious agents (Table II). Hand hygiene is a major component of standard precautions and one of the most effective methods to prevent transmission of pathogens. Proper hand hygiene includes hand washing for 15 to 20 seconds with warm clean water and soap or use of alcohol-based hand rub, both before and after personal contact with the deceased. Universal precautions for mortuary settings include, but are not limited to, wearing 2 pairs of rubber gloves (i.e., "double gloving") for handling tissues or blood, as well as wearing eye protection, cap, disposable gown, mask, plastic apron, sleeve covers, shoe covers and mortuary issue scrubs. Frequent changing of the outer gloves is highly recommended. When assisting a forensic odontologist who is using sharp instruments, (scalpels, knives and saws) cut resistant gloves should be worn.<sup>23,25</sup> The appropriate personal protective equipment (PPE) should be worn by anyone participating in the autopsy dissection. Immunosuppressed staff or those with fresh or open wounds should not be involved with handling victims or victim remains.<sup>22</sup> Also, equipment or items contaminated with infectious body fluids must be handled in a manner to prevent transmission of infectious agents (e.g. wear gloves for direct contact, properly clean, disinfect or sterilize reusable equipment before use on another corpse). Following examination, protective clothing must be removed prior to leaving the morgue

Table II: Recommendations for Application of Universal Precautions for Mortuary Settings<sup>18</sup>

Component	Recommendations
Hand Hygiene	<ul style="list-style-type: none"> <li>• After touching blood, body fluids, secretions, excretions, contaminated items</li> <li>• Immediately after removing gloves</li> </ul>
Personal Protective Equipment (PPE)	
Two Pairs of Rubber Gloves	<ul style="list-style-type: none"> <li>• For touching blood, body fluids, secretions, excretions, contaminated items</li> <li>• For touching mucous membranes and non-intact skin</li> </ul>
Gown	<ul style="list-style-type: none"> <li>• During procedures when contact of clothing/exposed skin with blood/body fluids, secretions and excretions is anticipated</li> </ul>
Sleeve Covers and Shoe Covers	<ul style="list-style-type: none"> <li>• During procedures when contact of clothing/exposed skin with blood/body fluids, secretions and excretions is anticipated</li> </ul>
Mask, Eye Protection (Goggles), Face Shield	<ul style="list-style-type: none"> <li>• During procedures and activities likely to generate splashes or sprays of blood, body fluids and secretions</li> </ul>
Soiled Equipment	<ul style="list-style-type: none"> <li>• Handle in a manner that prevents transfer of microorganisms to other deceased and to the mortuary environment</li> <li>• Wear gloves</li> <li>• Perform hand hygiene</li> </ul>
Environmental Control	<ul style="list-style-type: none"> <li>• Develop procedures for routine cleaning, and disinfection of environmental surfaces, especially mortuary areas</li> </ul>
Textiles and Laundry	<ul style="list-style-type: none"> <li>• Handle in a manner that prevents transfer of microorganisms to the environment</li> </ul>

environment, and all protective clothing should be placed in plastic bags for proper disposal or decontamination.

Education and training on the principles and rationale for universal precautions facilitate appropriate decision-making and are critical for an enhanced safety climate in the mortuary setting. These precautions are intended to protect all persons by reducing cross-contamination and ensuring infectious agents are not transferred among members of the victim identification team or other responders via hands,

clothing or equipment.<sup>23</sup> Another safety concern in the mortuary setting is airborne disease transmission. Some procedures, such as dissection procedures, can generate small particle aerosols (aerosol-generating procedures) associated with transmission of infectious agents to dental hygienists and to forensic odontologists. The high-risk infections transmitted by aerosols include tuberculosis, rabies, viral hemorrhagic fever, anthrax and influenza. Airborne precautions prevent transmission of infectious aerosols that can remain infectious over long distances and time periods when suspended in the air. Use of a particulate respirator (high-efficiency particulate air mask) is recommended during aerosol-generating procedures when the aerosol is likely to contain high-risk pathogens like *M. tuberculosis* and influenza viruses.<sup>22</sup> Other safe work practices include keeping gloved hands that are potentially contaminated from touching the mouth, nose, eyes, or face, and positioning the deceased such that direct sprays and splatter occurs away from the dental hygienist. Careful placement of PPE before decedent contact will help avoid the need to make PPE adjustments and consequently risk face or mucous membrane contamination during use. Additional precautions include: minimizing aerosols containing bone dust (i.e. with vacuum attachments to the vibrating saw) when assisting a forensic odontologist. In addition, it is prudent to maintain all vaccinations required for health care providers.

**Hazards:** As always, awareness and care to avoid cuts and punctures are paramount for prevention of both injury and infection. Other objects such as broken glass, needle fragments, bone pieces and fragmented projectiles often found in victims of mass fatality incidents can injure the dental hygienist.<sup>24</sup> The presence of these objects may or may not be known at the start of the examination and if suspected, dental hygienists should use cut resistant gloves. Staff involved in postmortem examination should also be aware that bodies may be contaminated with either chemical or radioactive sources; this type of contamination by radioactive materials could be deliberate, as a consequence of medical treatment, or as a consequence of the explosion of atomic devices.<sup>27</sup> To ensure the safety of mortuary staff, efforts must be made to maintain a safe working environment, and chemical and radiological monitoring protocol must be in place before postmortem examinations.<sup>23</sup>

### **Antemortem and Postmortem Records**

**Dental Coding:** Dental teams are assembled to start the difficult task of creating postmortem records. This process can be long and involved due to the nature of the incident and the need to quickly and correctly identify hundreds or thousands of victims. Victim identification software exists to facilitate efficiency in recording dental data by charting

dental considerations, physical intra-oral and tooth descriptors, pathological lesions and anthropologic findings of an unidentified human remain; they also have the capability to store and display graphics features such as digital radiographic images and intra oral photos.

It is important to know that there are several identification software applications used for electronic management of antemortem and postmortem dental records and comparisons. Some of the most commonly used include CAPMI® (U.S. Army Institute of Dental Research),<sup>28</sup> WinID®,<sup>5,29</sup> "DAVID web"<sup>30</sup> and the PLASS Data DVI® (PLASS DATA Software, Holdbaek, Denmark).

Dental records that are transcribed into victim identification software use various coding systems; therefore, several differences in antemortem dental charting and postmortem victim identification software coding exist. A graphic representation of dental conditions is observed, recorded and the exact location and condition of all teeth and restorations are documented in antemortem dental charting. Tooth coding involves use of nomenclature that is different or may not be recognized by a dental hygienist when working with victim identification software. A well-known victim identification software used by the ABFO, WinID®, uses primary and secondary codes to describe a tooth within a single dentition (Figure 1). For example, when documenting restored surfaces of a tooth, the restoration itself is not coded; more specifically, a disto-occlusal (DO) restoration and a mesio-occlusal (MO) restoration in victim identification software would be coded as a MOD, respectively. Codes include capital letters and/or symbols that are representative of a category. The letter V, in WinID® stands for a non-restored tooth-virgin, and (/) indicates no information about the tooth is available and may indicate portions of the skull are not present.<sup>5,28</sup> The letter Z can represent temporary filling material or can indicate gross caries.<sup>5</sup> Codes must be ordered correctly and may be autocorrected by the system, which is important as the main function is to rank records for a best match, and help find, sort or filter records.<sup>5</sup> Comparisons are made on a tooth by tooth basis within these systems. Coding using victim identification software is not the same as clinical dental charting; dental hygienists should have experience working in a victim identification system prior to a mass fatality incident.

**Records Comparison:** When dealing with a large number of fatalities, it is recommended that a single victim identification software type be used to link antemortem and postmortem records to a particular disaster. The victim identification software used should be established prior to and be in place at the mass fatality incident site; this is necessary for uploading any antemortem records collected for records



Figure 1: WinID® Code Nomenclature<sup>2,21</sup>

WinID® Primary Codes	WinID® Secondary Codes
M - Mesial surface is restored	A - Annotation: An unusual finding is associated with this tooth. Specifics of the finding are detailed in the comment section.
O - Occusal surface of posterior tooth is restored	B - Tooth is deciduous
D - Distal surface of tooth is restored	C - Tooth is fitted with a crown. Shorthand for MODFL-C.
F - Facial surface of tooth is restored	E - Resin filling material
L - Lingual surface of tooth is restored	G - Gold restoration
I - Incisal edge of anterior tooth is restored	H - Porcelain
U - Tooth is unerupted	N - Non-precious filling or crown material. Includes stainless steel.
V - Non-restored tooth, virgin	P - Pontic: Used only when tooth has been marked as miss with code "X".
X - Tooth is missing, extracted	R - Root canal filled
J - The tooth is present but no other info is known. Missing postmortem, fractured crown, avulsed tooth/no information about tooth is available.	S - Silver amalgam
	T - Denture tooth: Used only when tooth has been marked as missing with "X".
	Z - Temporary filling materials. Also indicates grows caries (used sparingly).

comparisons.<sup>28,31</sup> Records comparison in a mass fatality incident uses victim identification software to order possible matches, and includes matching unique identifying factors such as individual tooth crown and root anatomy (wear, fractures, anomalies of size, shape and color), pulp morphology, size of restorations, base materials and trabeculation patterns.<sup>6,32</sup> Comparisons of antemortem and postmortem dental records can indicate 3 possible results for each tooth. A match result means a tooth is the same in the antemortem and postmortem records, a possible result is the condition of the tooth in the postmortem record may have developed or progressed from the antemortem record, and a mismatch result means the postmortem record is not the same or the possibility for similarities does not exist in the antemortem record.<sup>28</sup> Comparisons of dental features are limited to the dental codes used within each victim identification software system.

Using multiple verification teams for records comparison helps to reduce fatigue induced error, which can occur during mass fatality incidents.<sup>6</sup> Multiple verification teams can include several combinations of dental professions: a dentist can perform the dental examination while another dentist records, or a dentist and dental hygienist can work together; the dentist would perform the dental examination while the dental hygienist would record the findings. These persons would then reverse roles to ensure the examination and dental coding was done accurately.<sup>33</sup> Once the multiple verification teams agree that all information was discovered and entered correctly in

the victim identification software, a comparison of antemortem and postmortem records can begin.

### Radiographic Imaging

Radiographic Equipment and Safety: One of the most accurate methods for victim identification is the exposure of dental radiographic images.<sup>34,35</sup> Radiographs are significant during records comparison, postmortem profiling and age estimations; they provide critical information in detection and preservation of forensic evidence.<sup>35,36</sup> Dental hygienists are an asset on mass fatality incident teams because they can expose radiographic images and provide interpretation of antemortem and postmortem radiographs.<sup>14</sup> Portable, hand-held dental x-ray devices are recommended in forensic dentistry, since they can be carried to mortuary or temporary morgue settings and have ease of use with pre-set exposure factors.<sup>37</sup> The device also utilizes direct current and can be interchanged for use with film, photostimulable phosphor plates and direct digital sensors.<sup>38</sup> Portable x-ray devices have an external backscatter shield around the position-indicating device and internal radiation shielding to protect the operator from scatter radiation exposure during typical patient and operator positions, where the occlusal plane of the patient is parallel to the floor and the mid-sagittal plane of the patient is perpendicular to the floor. This shield does not offer optimal operator protection when used atypically, which is the case of fatality victim remains during a mass fatality incident.<sup>38</sup> For example, when the radiographer is imag-

ing a bisected mandible, the x-ray device may have to be positioned with the device at a 90-degree angle to the floor. Due to this atypical use, the operator should adorn a lead shield, lead gloves and personal dosimeter to maintain proper radiation safety principles while taking postmortem radiographs. Personal dosimeter badges should be worn to determine occupational radiation exposures. This badge does not protect the operator — it measures how much exposure (if any) that the radiographer had obtained during the procedure. Handheld x-ray devices should never be touched with clinician (treatment) gloves when working with victim remains. Dental hygienists must use infection control standards to include use of protective barriers for radiology equipment that cannot be sterilized, and adhere to universal precautions for mortuary settings during postmortem exposures.

**Radiographic Technique:** Unique challenges exist when exposing x-rays on victim remains such as difficulty duplicating antemortem angulations with postmortem exposures.<sup>36</sup> Dental hygiene education and expertise in oral radiology is limited to living persons, with images taken in a supine position. Also, challenges exist in placing film or digital sensors in the absence of occlusion. Postmortem radiographic imaging is significantly different and can include bone fragments, decomposed tissue and sheared pieces of the dentition. Studies show that equipment necessary to expose quality radiographic images during mass fatality incident is often limited, and postmortem images tend to be of poor diagnostic quality and difficult to compare with antemortem dental records.<sup>36</sup> Therefore, the radiographer should make an attempt to obtain and view antemortem records before exposing postmortem images to determine which technique was utilized antemortem — the bisecting technique or the paralleling technique, and follow that technique postmortem. Every attempt should be made to view antemortem radiographic images before exposing postmortem images, however, this may not be possible in mass fatalities. If antemortem radiographs are not available, the paralleling technique should be implemented since intraoral radiographs exposed with the paralleling technique offer minimal image distortion and superimposition of adjacent oral structures. Postmortem exposure adjustments can be made as needed to include decreases in voltage (kVp), amperage (mA) or time (seconds) for adequate comparisons and identification.

The radiographer exposing postmortem images must be skilled in use of the bisecting technique because image receptor holders may not be available or it may be difficult to place image receptors parallel to the long axis of the teeth. Fractured victim remains or low palatal vault, tori present, primary dentition, edentulous areas, or missing/broken remains

increase the need for the bisecting technique. Images taken with the bisecting technique may produce increased magnification and distortion and greater chance for error; however, the bisecting technique provides acceptable results for victim identification. The image receptor should be placed close to the teeth, and vertical angulation directed perpendicular to an imaginary bisector that is estimated between the long axis of the teeth being imaged and long axis of the image receptor. The bisecting technique also requires the use of a short position-indicating device since the image receptor is placed close to the teeth of interest, which is found on most portable, handheld x-ray devices.

Although it is critical to expose quality postmortem radiographs, having quality antemortem images is just as important for comparisons and adequate identifications. For example, antemortem images must have open contacts, clear distinction of the cemento-enamel junction, pulpal outline, root apex, differentiation of restorative materials, and pathology and disease to make acceptable identifications.<sup>20,37</sup> Analysis after the South Asian tsunami of 2004 indicated 64% of 106 antemortem records received had either no radiographs or images were of poor quality.<sup>39</sup> To minimize errors, radiographers should follow the 4 steps for the exposure of diagnostic radiographic images: horizontal angulation, vertical angulation, centering the position-indicating device and proper placement of the image receptor.

## DISCUSSION

Addressing mass fatality incident preparedness didactically is a challenge because the literature is void of curriculum models for dental hygiene training in the area of mass fatality incident and victim identification.<sup>20</sup> Additionally, there is a lack of advancement in forensic education, specifically catastrophe preparedness in dental curriculum — competencies and objectives for course content and delivery have been recommended by More et al,<sup>40</sup> Glotzer et al,<sup>41</sup> Stoeckel et al<sup>20</sup> and Hermsen et al,<sup>42</sup> but have not been fully evaluated or standardized. More et al<sup>40</sup> and Glotzer et al<sup>41</sup> recommend sequencing instruction throughout all 4 years of predoctoral dental school curriculum, given in units of progressively more challenging instruction in modular form. More et al recommends using lectures, case studies, drills and dramatizations using multimedia to simulate catastrophic events.<sup>40</sup> Proposed dental school curriculum have been based on More et al's proposed competencies and objectives; general competencies include the role of dentists in disaster events, emergency preparedness, and hazards and pathogens used in bioterrorism.<sup>40</sup> Hermsen et al's proposed forensic dental education in predoctoral dental school curriculum also recommends disaster preparedness,

including using WinID3 (computer-assisted identification program), Nomad (Aribex, Inc., Orem, Utah) and Dexis (Dexis Digital Diagnostic Imaging, Hatfield, Penn).<sup>42</sup> Stoeckel et al recommends forensic dental training in dental school curriculum, however, to third or fourth year students only.<sup>20</sup> This author also recommends victim identification exercises for mass disaster preparedness given through both lecture and hands-on simulated scenarios.<sup>20</sup> The specific number of lectures hours dedicated to mass fatality incident training varies significantly among each proposed curriculum. Programs addressing dental hygiene mass fatality incident preparedness and training are needed; specifically, research assessing current dental hygiene programs, continuing education opportunities and approaches used to develop and implement pedagogy in the forensic specialty area, specifically mass fatality preparedness and response for the dental hygienist. A combination of educational approaches using the suggested training topics listed in this paper and existing recommendations for dental curriculum (applicable to dental hygiene) may provide awareness toward addressing specific dental hygiene courses for supplementing mass fatality incident lectures, identifying the number of courses needed for training, and/or determining if a continuing education certificate would be beneficial.

Based on the defined roles of the dental hygienist during mass fatality incident and approaches utilized in dental curriculum, the authors make the following recommendations of objectives and assessment for future curriculum development:

1. Risk Management in the Mortuary Setting for the Dental Hygienist: Identify ways to reduce the risk and increase knowledge of hazards in the mortuary setting.
  - Provide gaming and simulation based training and lectures on situational awareness, risk and hazard identification and management, infection control in the morgue, toxicity, autopsy precautions and protocols, special equipment, surface and waste decontamination, and applying teamwork skills.<sup>24</sup>
  - Assessment: Virtual, game-based simulation as well as live simulation exercises to determine skill levels obtained by dental hygienists.
2. Victim Identification Software and Dental Coding: Apply knowledge of victim identification software and records comparison teams.
  - Develop hands-on case study practice entering antemortem records with postmortem

remains, working on multidisciplinary victim identification teams, dental coding, legality of obtaining patient records, chain of evidence for antemortem records, documenting dental evidence and best practices for evidence collection.

- Assessment: Use of case-study with mock missing persons records to correctly chart in victim identification software systems.<sup>20</sup>
3. Dental Radiation Safety and Technique on Human Remains: Demonstrate safety protocol and appropriate radiographic imaging technique skills on simulated victim remains.
    - Develop live simulations (radiology lab) on imaging dental fragments and intact skulls with portable radiographic equipment, how to reduce technique errors for records comparisons, common errors when exposing dental radiographs in an atypical position, knowledge about safe use of equipment and infection control.
    - Assessment: Repetitive practice and evaluation of technique errors and safety violations using standard retake criteria from existing radiology curriculum.<sup>37</sup>

## CONCLUSION

Currently, there is an underutilization of dental hygienists on mass fatality victim identification teams.<sup>14</sup> Dental hygienists have applicable competencies in infection control, dental charting, and radiation safety and technique; however, disaster preparedness and response training is needed to fill the gap in a way that leverages multidisciplinary teams, provides frequent and consistent training in a safe environment, and that is sustainable.<sup>20,43</sup> It is recommended that dental hygiene advocates petition change on collecting notice of willingness to volunteer for mass fatality incident through licensure and licensure renewal periods. The goal of the dental profession should be to increase the number of skilled and deployable oral health professionals able to participate in emergency relief efforts.

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