

Mass Murder in a University Setting: Analysis of the Medical Examiner's Response

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ABSTRACT

Background: Seung-Hui Cho, a student at Virginia Polytechnic Institute and State University (Virginia Tech), shot and killed 33 students and faculty, including himself, on the morning of April 16, 2007.

Methods: A retrospective review of the medical examiner system response to this multiple fatality event was undertaken to identify which procedures were and were not effective. Case records, spreadsheets, telephone call logs, notes, and after-action interviews of staff were reviewed and analyzed. Recommendations were developed to improve the management of the multiple components of a high-profile multiple fatality event.

Results: One autopsy took place on Monday, April 16, 12 on Tuesday, April 17, and 20 on Wednesday, April 18. Pathologists archived the biopsies of major organs in formalin. Slides were made of entrance wounds that exhibited residues. Blood for alcohols was collected from victims. Blood for alcohols, acid, base, and neutral drugs was collected from Cho for analysis.

Conclusions: Standard forensic pathology procedures worked and timely postmortem examinations were completed. The victim identification component of the family assistance center must be established and staffed at the time of the initial response. Public information officers need training in morgue and medicolegal death management and in ways to effectively communicate with different audiences about multiple fatality management procedures. (*Disaster Med Public Health Preparedness*. 2007;1(Suppl 1):S25–S30)

Key Words: autopsy, surge response, medical examiner

The Virginia Polytechnic Institute and State University (Virginia Tech) tragedy began April 16, 2007 at 7:15 AM, when a campus police officer received a call about a shooting in the West Ambler Johnston residence hall. A female student and a male resident advisor lay wounded in a hallway. The female student was transported to a hospital where she died a few hours later; the advisor was pronounced dead on arrival. The circumstances were unexplained. At 9:45 AM, a second shooting at Norris Hall, the engineering building, resulted in 31 deaths. It was unclear initially whether there was an association between the incidents, but by late afternoon investigators were fashioning a scenario in which the same person was responsible for the shootings at both locations.

VIRGINIA MEDICAL EXAMINER SYSTEM

The Virginia Medical Examiner System is a state-wide, centrally administered but regionalized death investigation system that provides services to 7.5 million citizens. Each city and county has an appointed physician medical examiner or medical investigator who receives the initial report of deaths and determines whether each is within the jurisdiction of the medical examiner's office. Deaths that are un-

pected but due to natural causes or nonsuspicious accidents are examined locally and certified by the local medical examiner. Deaths requiring autopsy to determine cause or manner of death, including all homicides; nearly all suicides; un-witnessed or unclear accidents; deaths in the workplace, police custody, or mental health facilities; or deaths requiring special examination to document injury or collect forensic evidence are referred to 1 of 4 forensic pathologist/medical examiners' regional offices. Medical examiners certify on average 5000 cases per year. The 3 district offices in Norfolk (eastern district), Roanoke (western district) and Fairfax (northern district) are each staffed by 3 forensic pathologists, 2 autopsy assistants, 2 medicolegal death investigators, 1 regional administrator, and support staff. The chief medical examiner resides in the central (Richmond) office. Approximately 4000 medicolegal autopsies are performed each year.

Virginia Tech is located in the western district, which when fully staffed has 3 pathologists (but at the time of the tragedy had only 1). The population of the western district is 1.9 million, for a homicide rate of 3.12/100,000 citizens. Firearms fatalities are the leading cause of death in homicides in the western

district and in Virginia. In 2006, 755 autopsies were conducted by 3 pathologists in the western district for an average of 0.08 autopsies per pathologist per 313 workdays. In 2006 the number of homicides in the western district was 59, for an average of 19.66 for each pathologist that year.

EVIDENCE COLLECTION AT THE CRIME SCENES

The essential elements of a multiple homicide investigation and examination are as follows:

- Assessment of the scene in relation to the bodies
- Preliminary examination to identify a cause of death
- Identification, if known; determination of what identification work-up is needed to identify or confirm identity
- Recognition and safeguarding of evidence on and near the bodies at the scene and during transport to the morgue
- Photography of the body(ies) and evidence at the scene.
- Determination of whether to examine locally at a temporary morgue or move to a medicolegal facility
- Performance of medicolegal autopsy to document injuries, determine cause of death, and recover evidence
- Certification of cause and manner of death for the death certificate
- Communication of autopsy and toxicology findings to assist in investigation and reconstruction of the event and to next of kin
- Proper completion of each death certificate

A death certificate lists the cause of death as the disease, injury, or poison that has resulted in the physiological death of the decedent. The manner of death is a description of the circumstances under which the death occurred. Manner of death is classified as natural, accident, suicide, homicide, or undetermined. The shooting deaths at Virginia Tech were certified as 32 homicides and 1 suicide, the suicide being the shooter, Seung-Hui Cho.

Virginia Tech Campus Police, Blacksburg City Police, Virginia State Police, Montgomery County law enforcement, and the Federal Bureau of Investigation established a command center in Norris Hall (the second scene) to provide basic information and to issue warnings that both scenes were still being processed. Medical examiner investigators had to proceed with caution to preserve evidence: In Norris, blood had pooled on the stairwells, in the halls, on the walls, and on the floors of 4 classrooms. As part of the medical response, emergency medical services had tracked through the blood, leaving little space to walk without disturbing evidence. Deformed bullets, cartridge cases, and ammunition clips delineated with plastic evidence markers were on the floors. The chains he placed on the inside of the exit doors had made escape impossible except through windows. The shooter had pursued 2 victims trying to escape, cornering them in a stairwell. A classroom door contained bullet holes where Cho shot a barricaded door. Another classroom door had been defended by a 76-year-old professor, who con-

fronted the shooter and laid where he was shot; his students escaped. The other classrooms contained a jumble of bodies intertwined with desks, located mostly by the windows, evidence of the students' failed attempts to escape by jumping 2 stories to the lawns below. Some students did escape and later described the assailant's persistence in killing as he moved back and forth between classrooms, shooting deliberately and without hesitation. Thirty-three people died: Cho, 5 faculty members, and 27 students (Table 1).

A Giles County medical examiner reported to the scene along with 3 western district (Roanoke) medical death investigators. Teams were formed with police crime scene investigators, and the circumstances of each death were systematically documented. Loose physical evidence on the bodies was collected and evidence not amenable to collection or that would be altered in the course of recovering the bodies was photographed. Both investigator groups photographed each decedent in place, from multiple angles, proceeding from the top layer of bodies to those admixed with desks or bodies covered by their classmates.

Team members searched the pockets and knapsacks and collected personal possessions for presumptive identifications. As the investigators progressed it was apparent that the visible injuries were gunshot wounds and that many decedents had been shot multiple times. Each decedent was carefully tagged with a presumptive identification when possible and placed with associated personal possessions in a sturdy body bag. Police officers carried the bags carefully from the second floor of Norris to an emergency medical service vehicle because the assistant chief medical examiner for the western district office determined that the event warranted examination at the district office rather than to establish a temporary morgue at Virginia Tech. Emergency medical services vehicles traveled 30 miles in successive trips to deliver the victims to the Roanoke western district office of the medical examiner system. Morgue staff logged in the last body at 8:37 PM on April 16.

METHODS

All of the shooting victims underwent radiography, external examination, photography, external evidence recovery, and medicolegal autopsy to determine internal findings and recover firearms evidence. Board-certified forensic pathologists performed all of the autopsies. The order of operations of the multiple gunshot medicolegal autopsy is contained in Table 2.

All records of the 33 fatalities, death certificates, and event after-action reports were collected and reviewed. A retrospective analysis with staff was carried out to determine what worked and what did not work.

RESULTS

One autopsy took place on Monday, April 16, 12 autopsies on Tuesday, April 17, and 20 on Wednesday, April 18. On

TABLE 1

Location and Status of Virginia Tech Decedents	
Location of Decedents	Virginia Tech Status
West Ambler Johnston Residence Hall, transported to hospital	2 students
Norris Hall (total no.)	
Room A (1)	1 faculty member
Room B (5)	1 faculty member, 4 students
Room C (10)	1 faculty member, 9 students
Room D (13)	1 faculty member, 12 students, 1 shooter
Stairwell (1)	1 faculty member, 1 student

average, pathologists conducted 11 autopsies over 3 days. Pathologists archived the biopsies of major organs in formalin. Slides were made of entrance wounds that exhibited residues (see also Tables 3–5). Blood for alcohols was collected from victims. Blood for alcohols, acid, base, and neutral drugs was collected from the shooter for analysis. Analyses of blood on all 33 decedents were negative for alcohols. Analyses on Cho's blood were negative for opiates (including drugs of abuse and street drugs), cocaine and its metabolites, amphetamines, barbiturates, benzodiazepines, methadone, alkali extractable drugs, and acidic and neutral drugs. The foregoing testing included analyses for antidepressants, antipsychotics, and tranquilizers.

DISCUSSION

Surge Capacity

One of the benefits of a statewide system is that it can accommodate a surge in cases quickly. The average 6 day per week autopsy case load is 2.7; usually 1 to 3 autopsies is performed per day with occasional surges of 10 to 12 per day.

TABLE 2

Steps in Multiple Gunshot Medicolegal Autopsy	
1. Photograph the body "as is"	13. Conduct internal examination to trace tracks and document injuries, including head and neck
2. Collect gunshot residue from suspect areas of residues and the hands	14. Recover firearms evidence in the body
3. Take radiographs of all injured areas to include 1 area up and 1 area down	15. Conduct internal examination to document natural disease
4. Conduct external examination with photography and recovery of external evidence	16. Collect samples for toxicology
5. Examine clothes for residues and correlate with wounds, and undress the body	17. Photograph and label recovered evidence, toxicology
6. Assess gun muzzle to target distance by presence, absence of residues on skin	18. Photograph radiographs
7. Remove clothing to dry for later forensic examinations	19. Close body and clean
8. Identify and characterize wounds, then clean the body and wounds	20. Certify cause and manner of death and sign certificate of death
9. Fingerprint and palm print the remains	21. Conduct final review for completeness of the record and identification by another pathologist
10. Determine whether entrances, exits, re-entrances/exits and metal in body correspond	22. Release the body to next of kin
11. Diagram injuries and measurements from top of head, midline, and landmarks	23. Provide receipt of recovered evidence to investigating officer/evidence technician to maintain chain-of-custody process
12. Photograph each injury: distant, intermediate, and close-up	24. Dictate report, proof and sign report, review photographs
	25. Send official copies of reports and photographs to the primary investigating agency
	26. Send copies of reports to next of kin upon request
	27. Archive paper record and enter data items into computer database

TABLE 3

Distribution of Cases	
Males	19
Females	14
Total	33

TABLE 4

Wounds and Fatalities		
Location	No. of Gunshot Wounds	No. of Fatalities
Head alone	1,1,1,1,2,2,1,2,1,9,6,1,4,5	14*
Head and neck	2,4	2
Head and chest	4,3,3,3,3,2,2,4	8
Head and torso	3,2,7,3	4
Head and back	6,2	2
Head/chest and abdomen	6,6,4	3

*Includes shooter.

Within a few hours of the Virginia Tech shootings, pathologists, autopsy technicians, investigators, and support staff were en route to the western district office, and most were in place before all of the bodies arrived. At 11:25 AM on April 16, the regional medical examiner offices were alerted. The central and northern teams arrived in Roanoke that afternoon, and the eastern group arrived early the next morning. Deployed medical examiner staff executed their duties as planned despite some gaps. A 12-hour work shift schedule allowed the morgue to be cleaned and restocked and for staff to rest.

A mobile command center and portable morgue would have been essential had the event included any of the following features: a greater number of victims with a prolonged recov-

TABLE 5

Identification of Shooting Victims

Method of Identification	No.
Visual (at hospital)	1
Fingerprints	27
Dental	5
Fingerprints and dental (combined method)	(5)

ery interval; chemically, biologically, or radiologically contaminated bodies that would have contaminated a working district medical examiner's office; a site outdoors; or an event that evolved in a location more distant or difficult to access.

A larger number (ie, hundreds) of fatalities would demand allocating more pathologist staff, shifts, and rotating schedules. A mid-Atlantic consortium of medical examiner systems, comprising Virginia, Maryland, Washington, DC, Delaware, North Carolina, and West Virginia, was formed in response to the terrorist attacks of September 11, 2001. Upon request for mutual aid, this consortium could have responded within hours to double or triple staff an office. The care of thousands of dead occurring simultaneously would result in requests for federal assets, including disaster mortuary response teams, which can deploy in 72 hours and provide a portable morgue.

Identification of Decedents

The decision to identify the Virginia Tech victims by scientific means and perform complete autopsies was never an issue for forensic pathologists, but this created consternation for some families and came under fire from some officials. There was pressure to release remains on presumed identities and to provide opportunities for relatives to view the bodies. Several bodies arrived as "unknown" or without presumed identities. Other bodies arrived with knapsacks containing effects that were labeled with differing names, and 1 was labeled with the presumed identity of a student who was actually alive. The students who were killed came from all over the United States, and several bodies were those of foreign nationals slated for return to their country of origin. The disaster plan of the National Association of Medical Examiners, as well as local, state, and federal disaster plans, demand scientific certainty of identification of remains when possible. Achieving this certainty includes conducting DNA analysis of suspected remains the size of a fingernail.

All of the decedents were suitable for fingerprinting and had dentition suitable for charting and comparison with antemortem records. A dried bloodstain DNA sample was collected from each victim; however, identification by DNA was deemed unnecessary because it would have been more complicated and timely. DNA identification would have required a search of each decedent's dwelling for a known example, as opposed to only those for whom prints were not easily avail-

able. Some decedents had fingerprints on file with Immigration and Customs Enforcement, and others were on file with the automated fingerprint identification systems. Through this process, it was discovered that there are several fingerprint databases that do not customarily share information.

Police officers visited the dwellings of decedents for whom a database match print could not be found. Personal papers and effects were collected for processing by the Virginia Department of Forensic Science to obtain latent fingerprints. A latent print is a fingerprint on some item's surface that is not apparent to the naked eye but can be made sufficiently visible by special processing (eg, dusting, Super Glue fuming). If ownership of the item by the decedent can be established, latent prints are helpful for identification. The examiners compared the latent prints to the fingerprints inked at autopsy and made additional identifications. The western district forensic odontologist charted the remaining decedents and compared the postmortem records with antemortem records sent by e-mail or overnight mail by the decedents' personal dentist. Comparison of antemortem dental records with postmortem records resulted in 5 more identifications; 5 decedents were identified by both fingerprints and dental comparisons.

Several years ago Virginia's medical examiner system adopted the disaster mortuary response teams' victim identification profile (VIP) form as its antemortem information gathering tool in an effort to develop interoperability with federal disaster mortuary response teams. An unanticipated misunderstanding occurred when the VIP form was interpreted as certain decedents being accorded VIP status. Explanation that VIP was simply the name of a form helped, but the name of the form should be changed.

All identification tags remained on a body until identified scientifically, at which time an office identification tag was added. The pathologist responsible for the case made a final review for identification before authorizing release, and another pathologist reviewed for completeness. After final review of identifications and autopsies, remains were released to the funeral homes engaged by the next of kin. The release process included a final check of the office name tag on the body and the office name tag on the body bag by 2 autopsy technicians and the funeral director. At that time, the autopsy technicians removed all other tags to be archived with the case record.

Tracking down identification information, responding to inquiries, and conducting follow-up investigations in the Virginia Tech tragedy were slowed by a deficiency of trained medical investigators. Two full-time and 1 part-time investigator are insufficient for an office serving a population of nearly 2 million. Two other district offices areas were also experiencing a shortage of investigators and could not provide additional support. Only 1 of the 4 district offices is able to provide around-the-clock professional coverage. Volunteers are not suitable for these complex tasks, which require

a background in medical sciences, forensic science, or law enforcement with appropriate cross-training. Investigators are certified by the American Board of Medicolegal Death Investigators. All employees must pass a criminal background check. At least 10 more investigators are needed to adequately cover weekday daytime and evening needs at 2 of the 4 offices.

Autopsy

With only 33 gunshot wound fatalities, it was apparent that the medicolegal autopsies could be completed by Virginia pathologists before any skilled supplemental forensic pathologists were needed from outside the state. All but 1 decedent was identified and ready for release by late evening Thursday, April 19. The experienced morgue staff described no particular problems other than heavy traffic in the morgue. They were, however, unsettled by the ringing of the decedents' cell phones, with the recognition that family and friends were calling seeking reassurance that the decedents were alive.

Two families expressed religious objections to autopsy. They were accommodated with an agreement to restrict examinations to outside body surfaces and recovery of forensically significant materials. If the religious accommodation had not resolved, then a court proceeding would have had to be taken. Given the urgent need to recover firearms evidence to determine the number of guns used, the number of shooters, and the type of ammunition used on each decedent for reconstruction, it is likely the medical examiner would have prevailed. Bureau of Alcohol, Tobacco and Firearms examiners were seeking possible weapons, comparing recovered firearms evidence from bodies to specific guns, and trying to reconstruct the sequence of events. Establishing the number of guns did not determine with certainty the number of shooters or whether the same shooter killed the decedents in both locations. The likelihood that a single shooter was dead could not be clarified without the recovery of all possible firearms material, making autopsy an absolute necessity. The distance of the gunshot wounds varied. Correlating the location of entrance wounds and trajectories helped in reconstructing the positions of the shooter and the victims. The examiners worked through the night of April 16 to identify the weapons as a .22 caliber and a 9-mm handgun.

Communication With Victims' Families

The decision to establish identity by scientific means was ultimately successful, but the chief medical examiner and her superiors had to stand firm and take criticism, trusting that distressed complainants would validate the decision with outside experts and systems. The displeasure expressed by families and others occurred in spite of a meeting held with families the day after the event to explain the process and the anticipated timeline, and to answer questions. The event demonstrated the need to better integrate communication with families through the family assistance center (FAC). The FAC works with families to determine the location of possible fingerprints, dental records, and contact information

for the decedent's dentist. Official notification of the death is also a component of the FAC. The FAC got a late start in this case, and there seemed to be no effective plan for obtaining the information needed by the medical examiner, such as contact information for the families so they could be notified about the release of their loved one's body. The district office's having on staff an information technology expert to set up and keep current a Web site to provide information to families would be helpful.

Returning remains to countries halfway around the world without secure identifications would have been to risk misidentification(s) and exacerbate the profound suffering of the next of kin. Such a risk is unacceptable. Visual identification under stressful circumstances is an invitation to error. Dead bodies that have not been restored by funeral services appear different from how they looked in life. Dead bodies have been misidentified and mistakenly accepted as kin by next of kin.

Communication With the Media

After discussion with the assigned health department public information officer (PIO), the chief medical examiner participated in an all-parties press conference on the university campus on the morning of Tuesday, April 17, to express sympathy and outline the medical examiner's process. The chief explained the need for scientific identification and the recovery of evidence needed for investigation. Television coverage repeated throughout the day the chief's request for patience and the promise that the dead would be cared for respectfully and efficiently and would be returned to families as quickly as possible. The chief, working from a site 30 miles away, did not return to Virginia Tech for any further press conferences. All staff members declined interviews, television spots, and other media events because most information could not be released due to the active investigation. The media seemed to understand and accept this arrangement for interviews as long as it was consistently applied. However, the media did appear at the chief's office and disrupted the work of the administrative staff throughout the day. Other members of the media attempted to obtain videotape footage of bodies on stretchers and in transport vehicles. Assigning additional security was necessary to restrict access to the grounds. In the future, medical examiners would be well served to develop an ongoing working relationship with a PIO. Pre-event, the PIO should be invited to tour the morgue, observe pathologists at work, and develop a comfort level with how medical examiners respond to mass casualty incidents.

Mental Health Concerns

Medical examiners, homicide detectives, firefighters, and funeral directors are among the few who share the experience of working with dead, maimed, and cruelly devastated bodies. It is unrealistic to expect meaningful contemporaneous support and debriefing from earnest professionals who have not witnessed the cruelty that can be inflicted by another person. An intellectual understanding of outrage and sorrow is a

different frame of reference from that of workers who must deal with their memories of the young people who died while scrambling and fending for their lives. Even long-time autopsy staff can occasionally be emotionally overwhelmed. Importantly, morgue staff can help families. Participating in autopsy operations helps to tell the victims' tale and safeguards evidence for court proceedings that may follow. Morgue staff morale is buttressed by the knowledge that they help families by documenting the medical information about the victims' injuries, cause of death, interval of survival, and, often, the degree of pain and suffering. It is reassuring to staff to know that their attention to the details of preserving the chain of custody (legal receipting process) of medical evidence such as bullets, clothing, photographs, and toxicology samples ensures that no successful challenges to their integrity will arise in subsequent investigations and court proceedings.

CONCLUSIONS AND LESSONS LEARNED

A small event of <50 fatalities can be managed without additional out-of-state resources when the death investigation system has built-in surge capacity. Surge needs to include attendance by medical examiner professionals at the scene and at the site of body management. The chief medical examiner will be in charge of oversight and unavailable for casework. Presumptive identification needs to be confirmed by scientific means before release of any body. Rapid communication between the death investigation system and a decedent's next of kin must be established quickly and must be ongoing. Electronic methods promise improved assistance with obtaining information as well as conveying it to the next of kin. PIOs need training before an event occurs to be able to field questions at press conferences. State and local

family assistance centers need to be established expeditiously, with special attention paid to the interaction between the segment that involves communication with families, death notification, and other support services. Access to financial support for workers must be available at all times. Coordination of all of the above is essential to the successful resolution of multiple fatality management.

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