CHAPTER 7: CASE STUDIES

The Peruvian Experience in Managing Dead Bodies in Disaster Situations: The Mesa Redonda Fire, 2001

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Introduction

The Mesa Redonda fire broke out just two days before the 2002 New Year, at 7:15 pm on 29 December 2001. It occurred when the Mesa Redonda shopping district in downtown Lima was jammed with people making purchases for New Year festivities. The area had very narrow streets, colonial era buildings, and stores and galleries that were occupied by both formal and informal businessmen who displayed their merchandise outside of the stores. The merchandise occupied two-thirds of the walkways and streets, blocking the passage of pedestrians and vehicles; added to this were street vendors (including children) who sold the fireworks needed to celebrate the New Year.

This large commercial center is well attended because the products are reasonably priced and accessible to people with limited resources. Large crowds of people gather there routinely, increasing during the holidays and resulting in the major congestion of people and vehicles, much like a procession.

According to accounts published in the media, the Ministry of the Interior had authorized the permit for entry of 1,100 metric tons of fireworks, approximately half of which were being stored clandestinely in the houses and buildings where the tragedy occurred; the rest were being sold in the streets.

Investigations report that the fire started when a customer asked for a demonstration of a firework called "chocolate", which is 50 cm long, has four internal spheres that detonate in the air like small bombs, setting off colored lights and sparks. One of these shot up and fell on the roof of the buildings that served as storage for tons of the fireworks (fire crackers, rockets, etc.) Ignited by the explosive fireworks, the fire spread rapidly and out of control, forming a huge fireball that ran through streets that were packed with shoppers and vendors, causing serious material damage and loss of life.

Accounts indicate that the huge fireball produced temperatures above 800ºC. The fire climbed through the roofs of the buildings at various places simultaneously; it caused an explosion and incineration of 14 vehicles (taxis) killing the people inside.

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An electrical substation with a capacity of some 10,000 volts was located near the center of the fire; it stood no more than three meters off the ground, and people in its vicinity were killed.

It was reported that there were approximately 4,000 people, shoppers and vendors, in the area at the time of the disaster.

It is calculated that some 20 percent of the victims died within the first 10 minutes of the fire. The firefighters could not extinguish the fire because it was impossible to enter the area since the streets were obstructed by large quantities of merchandise, corpses, onlookers, looters, and vehicles.

It is also important to point out the reaction of the people: many of the merchants chose to save their merchandise rather than leaving the area to save their own lives.

It took some five hours of continual work to finally control the fire.

The figures reported from this ghastly fire were: 277 bodies, 117 body parts, 200 people with serious burns, and 320 people were missing. There was serious property damage: many people lost their homes and others their livelihoods.

Actions of the Public Prosecutor's Office

Before the tragedy there had been concerns about fire in the same zone. During the months preceding the fire, the criminal prosecutors carried out operations in different areas of the country, mainly in the center of Lima, with the objective of preventing possible tragedies owing to the clandestine marketing of pyrotechnic articles. Large quantities of fireworks were seized; however, these measures were not sufficient since, as a result of the measures adopted by the authorities, merchants hid part of their merchandise in adjoining buildings.

When the events occurred, the Attorney General of Peru accepted responsibility and stated that:

- The Penal Prosecutor's Office would initiate corresponding investigations to find those responsible for the event;
- The Institute of Legal Medicine would identify the remains so that they could be delivered to their family members.

According to Article 239 of the Penal Procedure Code of Peru:

- When a death occurs under suspicious circumstances, the body is removed from the site of the event;
- It is recommended that the removal of the dead body be carried out by the prosecutor in charge of the investigation assisted by the medical examiner, and delegated to the justice of the peace or to the police.

In the Mesa Redonda fire, the removal of bodies was the responsibility of the criminal branch of the Peruvian National Police.

Actions of the Legal Medicine Institute of Peru

Once the fire was controlled by Peru's *Cuerpo General de Bomberos Voluntarios* (Volunteer Fire Brigade), the site was surveyed, and rubble was cleared. The duty officer of the public prosecutor's office arranged for the removal of the bodies and their transfer to the central morgue of Lima for corresponding medicolegal autopsy.

Administration of medicolegal examination (Central Morgue of Lima)

The new Central Morgue of Lima is located in downtown Lima, next to the Medicine Faculty of the National University of San Marcos. It covers an area of 1,318 m^2 and has the following features: modern four-story building; state-of-the-art forensic laboratory equipment; forensic professionals trained overseas; computer network connected with other public institutions; complete services for forensic investigation; and capacity for 25 bodies per day. It is considered to be one of the best morgues in Latin America.

The objectives of medicolegal autopsy are to:

- Determine the cause of death of an individual;
- Determine the manner of death;
- Determine the time of death;
- Establish the identification of the deceased;
- Prepare the bodies and human remains for final disposal.

In the case of dead bodies coming from the Mesa Redonda fire, there was no difficulty in determining the first three objectives, because while the bodies arrived with serious burns, charring, and in some cases, asphyxiation, the cause and manner of death, as well as the time of death could be quickly determined. The more serious problem was the identification of the fire victims and burial of the large number of human remains.

Activities of the Public Ministry

Management activities

Coordination with:

- Duty officer of the Public Prosecutor's Office (28 Public Prosecutor's Office of the Penal Province of Lima), official in charge of investigating the event, and Legal Medicine (Central Morgue);
- Minister of Health, Dr. Luis Solari de la Puente, provided support with supplies, human resources, etc.;
- Dean of the San Fernando Faculty of Medicine, National University of San Marcos, provided use of their facilities next to the Central Morgue to store the large number of bodies; attended to family members, providing them with news or information about their loved ones; and performed victim recognition and identification tasks;

- National Police of Peru, Criminal Branch, Homicide Division;
- National Registry of Identification and Civil Status provided citizen registration files with fingerprints;
- The Registry in conjunction with the Public Welfare Office provided for burial of the victims;
- Ministry of Women and Human Development provided caskets.

Public Prosecutor and Legal Medicine operations

These authorities were responsible for setting up the working team for removal of the bodies, autopsies, and identification, and designation of the professional responsible for each area of work.

One forensic medicine expert was assigned to each autopsy table. The team had to work non-stop for 14–16-hour shifts for one week in order to accelerate the processes of autopsy, identification, and delivery of the bodies to family members.

Adaptation of physical environment

- The space in the Central Morgue of Lima was adapted for reception, custody, and initial deposit of the bodies, as well as for the performance of necessary forensic examinations.
- An additional table was set up in the basement, so there were 11 tables available for simultaneous examinations.
- Because the demand for services exceeded capacity of the Lima Morgue by more than 1,000 percent, work was coordinated with the Faculty of Human Medicine of the National University of San Marcos, which neighbors the Lima Morgue. A route for internal access was added as a passageway for corpses and personnel. The Morgue and Medicine Faculty functioned as a single working unit, consisting of:
  - Two areas for reception, registration, and deposit of bodies;
  - An area for storage of unidentifiable bodies (charred remains);
  - An area for deposit of the bodies that had macroscopic identification evidence, such as personal jewelry, objects, and identifiable documents;
  - An area for visual recognition of the bodies made by family members, friends, and others;
  - An area for attending to families and setting up ante-mortem files.

Examinations at the site of the tragedy; removal of remains

Hours after the fire was extinguished, personnel from the Central Morgue along with the Public Prosecutor arrived at the disaster site for removal of the human remains. This process had to be postponed until the early hours of the following

morning because the fire site posed a serious risk for personnel. The buildings were unstable because of the action of the fire and water, and there was no electrical power.

The Legal Medicine Institute assisted in the removal of the dead bodies, but the majority of work was carried out by the National Police.

Table 7.1. Reception of bodies in the Central Morgue, 30 December 2001

	Mesa Redonda victims	Routine admissions	Total received
Bodies	277	16	293
Body parts	117	--	117
Total no. of autopsies	394	16	410

There were 394 requests for autopsies, corresponding to bodies and body parts originating in the disaster zone, in addition to 16 bodies corresponding to the routine work performed by the morgue, which overwhelmed the morgue's response capacity. As an additional measure, an agreement was made to send corpses that were not central to the fire investigation to the Callao Province Morgue.

Registration of the bodies received at the morgue followed the numbering of the Central Morgue, beginning with autopsy No. 4.300-2001.

Record of evidence

Photographs were taken before initiating the autopsy in order to record the most notable external features, as well as clothing and personal objects.

Medicolegal autopsy

Autopsies were carried out on all of the bodies and body parts received, in accordance with the Penal Procedure Code and in the presence of public prosecutors.

Collection of samples

Samples collected for supporting examinations that would be useful for identification purposes included:

- Samples for dental, anthropological, histopathology, biological, and radiology studies;
- Samples of long bones (femurs) for DNA typing.

Development of ante-mortem files

Family members and friends of the deceased were interviewed to reveal information about pathology, surgical interventions, amputations, other anomalies, and physical characteristics that would help in the identification of the victims.

Preparation and display of the body

Once the autopsy and supporting examinations were complete, the body of the deceased was prepared and put on view in a room in order to facilitate visual recognition by family members or friends.

Preservation of unidentified bodies

Unidentified bodies were preserved in refrigerated chambers (there were 18 available at that time) and with blocks of dry ice to slow decomposition because of the hot weather and the time elapsed.

Delivery of identified bodies

Identified bodies were delivered to family members for final disposal, accompanied by the documentation needed to proceed with burial (proof of burial; autopsy certificate).

Expedited death certificates

Death certificates were expedited so that family members could have them recorded in the municipal civil registry.

Verification of burial

Transfer of the bodies from the morgue to the El Angel cemetery for burial was done in the presence of the public prosecutor. Those who had not been identified were labeled as "NN" and the autopsy number was attached.

Public Ministry staff involved

Public Prosecutor's Office

Attorney General, senior public prosecutor, senior coordinating public prosecutor, provincial prosecutor, assistant provincial prosecutors, administrative personnel, assistant to the Attorney General, assistant administrator, chauffeurs.

Total: 149 prosecutors

Legal Medicine

Three directors, 12 forensic medical experts, 2 pathologists, 1 odontologist, 1 anthropologist, 4 pharmacists, 3 biologists, 11 autopsy technicians, 1 medical radiology technician, 4 medical technicians, 13 administrative officers, 2 chauffeurs, 7 cleaning service staff, 7 security staff.

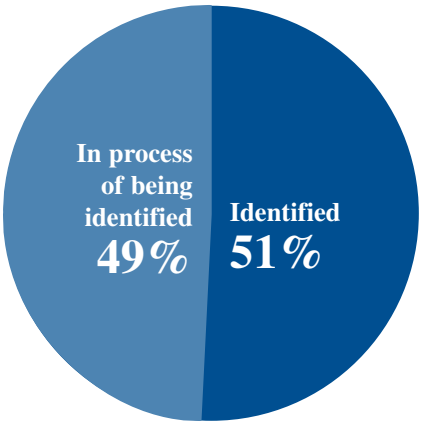
Achievements

Of the autopsies carried out on the 277 intact bodies, 82 percent were completed in the first three days. This made it possible to preserve certain evidence that assisted family members in visual identification before the bodies were altered any further by decomposition.

Date	Quantity	Percentage of total autopsies per day	Total (percentage)
30-12-01	60	22	22
31-12-01	70	25	47
1-1-02	97	35	82
2-1-02	50	18	100
Total	277		

Personnel demonstrated skill and professional ability, and they succeeded in identifying 31 percent of all of the intact bodies after performing autopsy and forensic examinations.

Autopsied bodies	**277**	**100.0%**
Post-autopsy identification	88	31.8%
DNA identification	52	18.8%
Not identified	137	49.4%
Autopsied body parts	**117**	**100.0%**
Not identified	117	100.0%



Professionals and administrative staff from other legal medicine divisions responded and provided direct attention to family members, which allowed the task of autopsy to continue without interruption from families.

The team of designated prosecutors, the forensics experts, and administrative staff in the Lima Morgue exhibited *esprit de corps* and identified with the institution and with the victims, even though many of them were in poor health.

The Ministry of Health was magnanimous in its support to the Legal Medicine Institute, providing human resources, logistics, food, and moral support.

A flow chart was designed that allowed family members access to the identification process for dead bodies, which provided some relief to those who were waiting for information about their loved ones.

Problems

The Public Ministry (Public Prosecutor's Office and Legal Medicine Institute) did not have a plan for emergency and disaster situations when this event occurred; it worked following a typical routine which meant that identifications were completed slowly.

Also, the lack of knowledge of some authorities regarding management of mass fatalities in disaster situations caused disorder and chaos at different stages of the expert study, such as the removal of bodies, processing the bodies into the morgue, and the registration and delivery of the bodies.

Procedures for admitting the bodies into the morgue were inadequate*:*

- Morgue admission forms were not attached to the records corresponding to the removal of human remains.
- Bodies were transported in black plastic bags, sealed, with the processing number written in ink on a white adhesive bandage. This tape smudged or fell off when it came in contact with the water used to extinguish the fire or with body fluids.
- The site or location of the bodies in relation to the central point of the fire was not indicated on the reports that accompanied the bodies to the morgue; this would have been very useful when identifying the remains.
- Information about preservation of evidence at the site of the event was not recorded.
- The facilities at the Central Morgue of Lima were insufficient for either storing the large number of bodies received from the disaster site for autopsy and preservation, or for storing and processing the samples obtained from these bodies for supporting examinations that were needed for identification.

When bodies were admitted to the morgue, triage was not carried out to classify them into the following two groups:

- Recognizable on sight because facial characteristics were intact;
- Unrecognizable owing to alteration of physical characteristics (charring) from the fire.

This classification would have allowed prioritization of autopsies by performing autopsies on recognizable bodies first. Had this been done, perhaps more of the bodies could have been identified quickly, since visual recognition on the part of family members would have been simpler in cases where the distinguishing characteristics were preserved.

Photographs were not taken at the time the bodies were received at the morgue. Documentation of physical characteristics of the corpses before decomposition altered them would have helped in visual identification, especially in bodies where death was caused by asphyxiation rather than burns.

At the time that the Mesa Redonda fire occurred, the Legal Medicine Institute did not have a laboratory for DNA studies.

Lack of inter-institutional coordination resulted in there being an excess of personnel, which in many cases meant that professional tasks were being repeated up to four times, causing confusion and delays. For example, dental exams on one corpse were conducted by specialists from the Legal Medicine Institute, Police, Ministry of Health, Navy, and Air Force.

There was a scarcity of personnel for other tasks, such as frequent cleaning of autopsy stations to maintain hygiene and to prevent the accidents that did occur.

The prosecutors assigned to the autopsy stations were not sufficiently prepared, physically or mentally, to endure the long hours of work, the odors from decomposing and burned bodies, or the impact of viewing the serious injuries sustained by the women and children.

Repercussions of the event

The Government of President Alejandro Toledo supported the victims and issued Emergency Decree 141-200 (1 January 2002) which stated that the Government would:

- Assume the burial costs for all of the victims;
- Ensure appropriate disposition of unidentified bodies while waiting for post-mortem results;
- Assume the expenses of the post-mortem studies, which were to be assigned to the Public Ministry;
- Authorize the Ministry of Health and Public Ministry to acquire medical teams to carry out carry out identifications;
- Permit the Public Ministry to contract 40 forensic medicine experts;
- Allow the Public Ministry to request necessary identification information from the Registro Nacional de Identificación y Estado Civil (National Registry of Identification and Civil Status—RENIEC).

With the budget assigned in the Emergency Degree, the Public Ministry has accomplished the following:

- Established the Biomolecular and Genetic Laboratory of the Institute of Legal Medicine to carry out DNA studies. They had succeeded in identifying (at the

time of writing this chapter) 52 more bodies, and they continue to work with family members of the missing to complete more identifications;

- A larger staff of forensic professionals (including physicians, dentists, anthropologists, pharmacists, and biologists) was hired for the Legal Medicine Institute;
- A forensics team for emergencies and disasters was created which can mobilize rapidly to any area of the country. Their first intervention was the crash of the TANS aircraft in Chachapoyas, Peru, on 9 January 2003, in which they identified the remains of 74 percent of the passengers, including nationals and foreigners;
- The Legal Medicine Institute is being decentralized and strengthened in department capitals in order to respond with physical infrastructure, personnel, and laboratories in cases of emergencies and disasters;
- The Legal Medicine Institute staff is assisting training programs for emergencies and disasters organized by the Pan American Health Organization (PAHO) and the Office of Foreign Disaster Assistance of the U.S. Agency for International Development (OFDA/USAID);
- There is an effort on the part of the Attorney General to strengthen the Legal Medicine Institute as the technical branch in the administration of justice.

Conclusions and Recommendations

The Public Ministry of Peru and PAHO organized the seminar and workshop "Lessons learned from the Mesa Redonda fire" from 18-20 November 2003, with the participation of 26 institutions. In addition to the advances mentioned in the above section, the workshop agreed to pursue the following:

- Coordinate inter-institutional work regarding civil defense legislation
- Incorporate the Legal Medicine Institute into regional, provincial, and district Emergency Operations Committees;
- Encourage the participation of the Legal Medicine Institute and the Public Prosecutor's Office in inter-institutional and interdisciplinary training on management of victims in disaster situations;
- Promote the Unified Incident Command system for work at disaster sites;
- Endorse and distribute the Manual on *Management of Dead Bodies in Disaster Situations* published by PAHO;
- Create a directory of experts (national and international) from different disciplines in the management of emergencies and disasters to provide support should the need arise.

Management of Dead Bodies following the Avalanche of the Casitas Volcano in Nicaragua: Chronicle of a Disaster within the Disaster

Zacarías Duarte*

Summary

In October 1998, Nicaragua was hit by Hurricane Mitch, the most devastating hurricane to strike this country in a century. The disaster caused 3,045 deaths, 2,500 of whom perished in the avalanche of the Casitas Volcano, located in Posoltega in the extreme northwest of the country. The collapse of the volcano occurred on 28 October 1998 in the middle of the day. Three days later management of the corpses began, carried out by a brigade of army soldiers and Ministry of Health personnel from their program on vector disease transmission.

The disaster scene was not photographed, but according to a physician from the Posoltega Health Center, dead bodies were scattered across the low land that borders the communities of El Porvenir and Rolando Rodríguez. The decomposing bodies were trapped in the thick mud and nearly entirely nude; a few wore shreds of trousers. Many of these bodies were the object of predation by domestic animals. The injuries presented consisted of detached skin, hematomas, and mutilated limbs.

The dead bodies were located and marked with flags and then the majority were incinerated individually, in situ. Three months later the bones of all of the bodies were placed in concrete, at a site now known as the Memorial Park. In all cases, they registered only whether the body was that of an adult or child and the sex. Identity was not established, the cause or manner of death was not determined, and death certificates were not issued. As a consequence, the people who died in this tragedy continue to be counted as missing.

Introduction

At the end of October 1998, Nicaragua was the scene of one of the greatest tragedies ever caused by a natural disaster. We are referring to Hurricane Mitch, which caused economic losses of approximately $US 1.3 billion, with one million persons affected, and 3,045 deaths.[1]

In terms of loss of human life, the avalanche from the Casitas Volcano was the major disaster of Hurricane Mitch; it completely buried two rural communities, El Porvenir and Rolando Rodríguez, causing the death of approximately 2,500 persons.[2] For this reason the Casitas avalanche is referred to as the "disaster within a disaster."

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1 Olson RS, Alvarez RA, Baird BP, Estrada A, Gawronski VT, Sarmiento Prieto, JP, *Las tormentas de '98, Huracanes Georges y Mitch: impactos, respuesta institucional y política de desastre en tres paises* (Boulder, Colorado: Natural Hazards Research and Applications Information Center, Special Publication 38; 1999, pp. 47-60.

2 García Y, Personal communication, Posoltega Health Center, 2003).

The Casitas Volcano is located in the municipality of Posoltega, a rural area of the Chinandega Department in the northwest of the country; it is 116 km from Managua, the nation's capital.[3]

In disaster situations that result in hundreds or even thousands of deaths, the management of dead bodies is one of the greatest problems that must be faced by local and national authorities as well as by the affected community itself.

Countries such as Nicaragua, in spite of the large number of natural disasters that occur, still does not have sufficient experience in adequate management of dead bodies in disaster situations or about the medicolegal work that these circumstances require. For this reason we found it necessary to carry out a study to learn how the fatalities resulting from the Casitas Volcano were handled and what the institutional response was, and to evaluate the different actions taken from the medicolegal perspective and the legal consequences of the uncertified deaths.

Materials and methods

To complete this study, we collected all of the information about Hurricane Mitch and the Casitas Volcano avalanche that had been issued between October 1998 and September 2003. This included official reports prepared by the institution responsible for managing the fatalities resulting from the Casitas avalanche, a study made by the National Autonomous University of León, and media accounts published on the Internet. Interviews were also carried out with individuals who participated directly in the management of the dead bodies resulting from the avalanche.

The information collected from these sources dealt with: geographic location of the event; the dates of the event; and the organization, coordination, and execution of the response. This included information about actions related to the management of the dead bodies, including: scene investigation; determination of the cause, manner, and time of death; the location, number, and disposal of the bodies; the execution of death certificates or medicolegal reports; and finally the legal consequences of unidentified deaths.

Results

Hurricane Mitch hit Central America at the end of October 1998. Among the countries of this region, Nicaragua was one of the most seriously damaged, in material losses as well as loss of human life.

In the past century, Nicaragua has been targeted by more than 24 major hurricanes and tropical storms, but Hurricane Mitch was the most damaging. The following table summarizes the losses caused by this hurricane as reported by the Government.

3 Universidad Autonóma de Nicaragua-León, "Sacando lecciones del desastre: taller de análisis de la respuesta en salud ante el huracán Mitch, en el municipio de Posoltega," 1999.

Hurricane Mitch in Nicaragua: official estimates of losses

Damages	Quantity
Deaths	3,045
Population requiring assistance in July 1999	400,000
Affected population	1,000,000
Damaged houses	151,215
Damaged or destroyed schools	512
Damaged or destroyed health centers	140
Damaged or destroyed roads	2,742 Km.*
Damaged or destroyed bridges	97*
Property losses	US $ 1.3 billion

* Source: ECLAC, "Nicaragua, Evaluación de los daños ocasionados por el huracán Mitch, 1998," Nicaragua, 1999.

Regarding human losses, the most deadly effect was the avalanche on the Casitas Volcano, which caused 2,500 deaths, or 82 percent of all deaths resulting from Hurricane Mitch in Nicaragua.

The scene of the disaster

The avalanche of the Casitas Volcano occurred in the municipality of Posoltega, a rural community of Chinandega Department in northwest Nicaragua. Posoltega covers an area of 144 km^2 and is located 116 km from the capital city of Managua. Prior to Hurricane Mitch it had a population of 16,697 inhabitants.

Casitas Volcano is located in Posoltega, north of the communities El Porvenir and Rolando Rodríguez. It has an elevation of 1,405 m and forms part of the Maribios range, a chain of volcanoes that extends for some 70 km.

Report of events

On 28 October 1998 at 11 a.m., the Casitas Volcano avalanche occurred, which consisted of an avalanche of water and mud that was several meters deep flowing from the southern flank of the volcano.

That day's events can best be illustrated with the testimony of the survivors. One survivor related the following: "I shouted that the mountain was coming down on top of us; later I heard a roar, like many helicopters flying over us. Then I felt the ground begin to shake and I said, 'God, I am in your hands,' when the mud current swept me, my family, and our few belongings away."

Another survivor described the event as follows: "A current of dirty water some four meters high came down on top of us. My mother was washing corn in the courtyard of her house that was close to mine, and she was lifted into the air. After the cur-

rent of water, there was a current of mud, carrying trees, rocks, and animals. It dragged me some 600 meters."

According to the version of the acting epidemiologist at the Posoltega health center during the time of Mitch, an avalanche of mud obliterated the communities of El Porvenir and Rolando Rodríguez, both located close to the southern slope of the Casitas Volcano. The scene left by the Casitas Volcano was Dantesque: there were some 2,000 human bodies dispersed in an area that was 18 km long and ranging between 3 km and 60 meters wide.

The bodies were half-buried or thrown on top of the mud. The majority were in the process of decomposition and nude or with shreds of their clothing. Many bodies were being eaten by domestic animals. One could see detached skin, multiple abrasions, hematomas, lesions, and mutilated limbs.

Institutional response

At the time of Hurricane Mitch and the Casitas avalanche, Nicaragua did not have an organized disaster response system, and such a system did not exist in the Legal Medicine Institute, the National Forensics System, or the Public Ministry, either. There was one forensic medicine specialist in each department who responded directly to a district judge, and post-mortem examination of disaster victims was not included in their responsibilities.

During the first days of the hurricane, the Government tried to minimize the gravity of the event and there was no coordination with the local governors, State institutions, the international organizations, or other sectors of society. It was not until 30 October 1998, six days after Hurricane Mitch began, that the National Emergency Committee decreed a "natural disaster situation," a declaration that had not been considered in Nicaraguan legislation prior to the event. Bishops and priests were appointed to head the Emergency Committees.

Management of dead bodies

Immediate actions

Activities related to the management of the thousands of deaths resulting from the Casitas volcano began three days after the event.

All of the actions were the responsibility of the Ministry of Health and the Army of Nicaragua. A team of 131 persons was formed with personnel from the following: Ministry of Health, Army, church, Christian leaders, regional teams, a team from the San Antonio sugar refinery, a team from Costa Rica, Dutch volunteers, and a North American with a rescue dog.

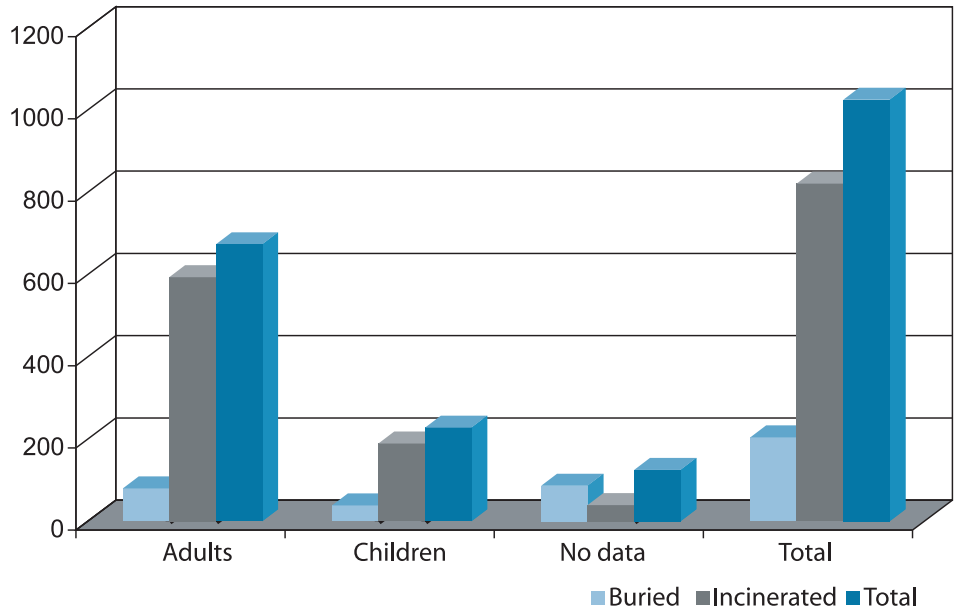
Two working teams were organized. The first team was in charge of searching for dead bodies in the area of the disaster. Once a body was located, a flag marked the site. The second team was responsible for determining the sex of the body, whether it was a child or adult, and also for disposal of the body.

Teams were not formed to attend to surviving family members, and there was no participation from forensic medicine experts.

Initially they located the dead bodies, transferred them to the cemetery, and buried them in individual graves. But because of the enormous number of bodies, the lack of equipment, and the difficult terrain, they decided to bury each corpse individually at the place it was found. However, in a short time the buried corpses surfaced, so this approach was abandoned. It was then decided to burn the bodies where they were found.

The official reports register the final disposal of 1,025 bodies; 80 percent (821 bodies) were incinerated where they were found, and the remaining 20 percent (204 bodies) were buried where they were found. Of the bodies recorded, 673 were adults and 227 were children; there was no indication of age for 125 of the bodies (see the following figure).

Disposal of dead bodies resulting from avalanche at Casitas Volcano, October 1998



Interim actions

One month after the Casitas Volcano avalanche, they proceeded to bury 869 corpses that had been incinerated *in situ*. A cross was placed at each burial location so that it would be possible later to find where they were buried. In January 1999, three months after the avalanche, all of the bodies that had been buried individually at the disaster site were disinterred. The majority of the remains found were skeletonized and they were massed together and buried in a type of common grave made of concrete.

At the site of the disaster, 2,000 trees were planted, each representing one of the victims that perished in the avalanche. This area was known as the Memorial Park.

Consequences of the management of dead bodies

Of the 2,500 deaths that resulted from the collapse of the Casitas Volcano, not one identity was established for the corpses, and consequently, no death certificates were issued. Besides, there was no determination of the cause, manner, date, or circumstances of death.

As a result of the failure to certify the deaths, the 2,500 fatalities from the avalanche remain as "missing persons." One of the consequences of this legal vacuum could be seen in 1999, the year for mayoral elections. Since the victims were not officially dead, the Municipal Electoral Council of Posoltega did not delete their names from the electoral registries, so the 2,500 victims could vote. At the time of writing this account, it is unknown whether there are other consequences related to property inheritance, wills, or businesses.

Discussion

When the Casitas Volcano avalanche occurred as a consequence of the precipitation brought by Hurricane Mitch, in October 1998, Nicaragua did not have either the organizational structures or the legal framework that would permit it to confront this type of disaster.[4] Besides, neither the Legal Medicine Institute[5] nor the Public Ministry existed at that time. This institutional and judicial void influenced the fact that a medicolegal approach was not used when managing the dead bodies.

It is very likely that the management of the 2,500 corpses resulting from the avalanche was guided primarily by the urgency to avoid epidemic outbreaks by controlling a potential focus of infection, considering that the victims had been dead for three days and were beginning to decompose. For that reason, the authorities from the Ministry of Health and the Nicaraguan Army made the decision to burn and bury the bodies where they were found.[6] To this we should add the lack of physical facilities to deposit the thousands of corpses, the lack of transport, the serious damage caused to the network of roads needed to transfer the bodies to temporary morgues, and the nearly impenetrable conditions at the disaster site.

Part of Nicaragua's history has been written with natural disasters. The first account of such events comes from Columbus, whose boats were swept north of the Caribbean coast of Nicaragua by a hurricane in 1502. Other recent disasters include the Managua earthquake in 1931 which caused some 4,000 deaths and another in 1972 that killed some 10,000 persons.[7] It is likely that in all of the disasters in Nicaragua's history, the same criteria were used to manage dead bodies as in the case of the deaths caused by the Casitas avalanche: since there was no criminal act, it was not necessary to carry out a medicolegal investigation, and the most important issue became rapid disposal of the bodies to avoid epidemic outbreaks.

The observations made in other countries where disasters with mass fatalities occurred, suggest that the dead bodies of persons killed in a disaster are not impor-

4 Olson et al., *op cit*.
5 Decreto No. 63-99. Reglamento de la Ley 260, Ley Orgánica del Poder Judicial de la República de Nicaragua, Capitulo XII, Sección 1ra, Del Instituto de Medicina Legal y de los Médicos Forenses, La Gaceta No 104, 2 de junio de 1999.
6 García, *op cit*.
7 Olson et al., *op cit*.

tant foci of contamination, and that the risks of epidemics are minimal.[8] For that reason, it is advisable to take the time necessary to procure the basic conditions for proper investigation of the bodies, and deliver them to their families so that religious, cultural, and social traditions can be observed, including burial.

From the legal perspective it is very important to establish the identity of the victim, the cause, manner, time, and circumstances of the death, and it is essential to certify the death.[9] Besides, death in disaster situations is by its nature violent and accidental, requiring medicolegal investigation. For this reason the management of dead bodies in disaster situations should be the responsibility of medicolegal institutions in collaboration with the police, public prosecutors, ministries of health, and other supporting institutions such as the army, firefighters, and faculties of medicine, among others.

Hurricane Mitch, which occurred in 1998, led to the creation in Nicaragua of the Sistema Nacional de Prevención, Mitigación y Atención de Desastres (National Disaster Prevention, Mitigation, and Response System—SINAPRED), as decreed in Law 337, published in Gaceta No. 70 of April 2000. This structure is multisectoral, multi-disciplinarian, and intra-territorial and includes the Legal Medicine Institute, which is responsible for management of dead bodies in disaster situations.

8 Pan American Health Organization (PAHO/WHO). Workshop for review of the draft manual on management of dead bodies in disaster situations, 2003.

9 Argüello H, Duarte Z. *Manual de procedimientos del Instituto de Medicina Legal de Nicaragua*. Guía para el manejo de cadáveres en situaciones de desastres; 2002.

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