

Epidemiologic Investigation of Injuries Associated With the 2013 Fertilizer Plant Explosion in West, Texas

Kristi Metzger, PhD; Hammad Akram, MD; Bonnie Feldt, MPH; Kahler Stone, MPH; Stephanie Alvey, BBA; Sandi Henley, RN; Alicia Hernandez, BSN; Sharon Melville, MD; Tracy Haywood, BS; David Zane, MS

ABSTRACT

Objective: On April 17, 2013, a fire and subsequent explosion occurred at the West Fertilizer Company plant in West, Texas, and caused extensive damage to the adjacent neighborhood. This investigation described the fatal and nonfatal injuries caused by the explosion.

Methods: Persons injured by the fertilizer plant explosion were identified through death certificates, medical examination reports, medical records, and survivor interviews. Data on patient characteristics, type of injury, and location of injury were collected.

Results: Medical record review indicated that 252 individuals sought medical care for nonfatal injuries directly related to the explosion immediately after the explosion. Fifteen patients died of injuries sustained by the blast. Almost one-quarter of patients were admitted for treatment of injuries. Injuries sustained in the explosion included abrasions/contusions, lacerations/penetrating trauma, traumatic brain injuries/concussions, tinnitus/hearing problems, eye injuries, and inhalational injuries. Patients located closer to the explosion were more likely to be admitted to the hospital for treatment of injuries than were those who were located further away.

Conclusion: Explosions of this magnitude are rare, but can inflict severe damage to a community and its residents. This investigation could be a useful planning resource for other communities, public health agencies, first responders, and medical facilities. (*Disaster Med Public Health Preparedness*. 2016;10:583-590)

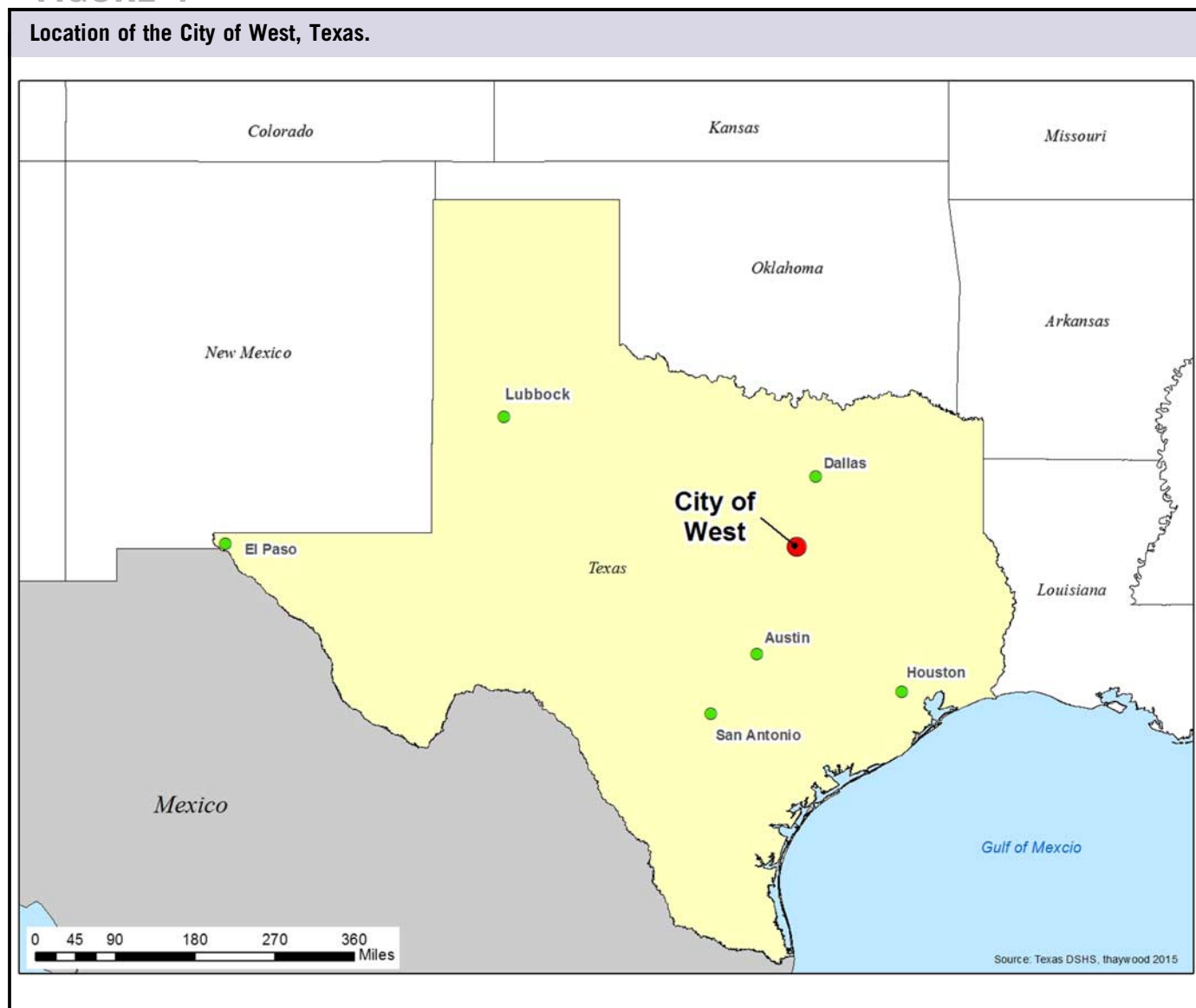
Key Words: disasters, injury, explosions, preparedness

On April 17, 2013, a fire broke out at the West Fertilizer Company plant in West, Texas. This fire subsequently caused an explosion that killed 15 individuals and directly injured an additional 252 individuals. The plant stored bulk materials, including chemicals such as ammonium nitrate, potash, ammonium sulfate, diammonium sulfate, KMAG (a mixture of potassium, magnesium, and sulfur), and liquefied anhydrous ammonia, that were mixed at the plant to customer specifications. The plant was located at northeastern edge of the town, a rural community of 2834 residents in McLennan County in central Texas (Figure 1).¹ In close proximity to the plant on the west and south were residential areas, a nursing home, 2 schools, and an apartment complex building; to the north and east were agricultural fields, ranches, and sporadic homes. The explosion caused extensive damage to the homes, businesses, and schools near the plant. The explosion was registered as 2.1 on the Richter magnitude scale and left a 10-foot deep and 90-foot wide crater at the site.² The cause of the fire has not been determined.²

Ammonium nitrate explosions of this magnitude are rare. A chemical plant housing an estimated 390 to 450 tons of ammonium nitrate in Toulouse, France, detonated on September 21, 2001, registering 3.4 on the Richter magnitude scale. The explosion left a crater over 50 meters wide and 7 meters deep and resulted in 30 deaths and injured up to 2242 people.³ The Oklahoma City terrorist bombing in April 1995 had close to 2 tons (1814 kg) of ammonium nitrate detonated underneath the Alfred P. Murrah Federal Building, killing 167 people and injuring another 592.⁴ On December 13, 1994, the Terra International's Port Neal, Iowa, ammonium nitrate fertilizer plant exploded, resulting in 4 employee fatalities, 18 injured, and the leveling of buildings and equipment within a 200-ft radius.⁵ Approximately 2300 tons of ammonium nitrate detonated aboard the SS Grandcamp docked in the port of Texas City in 1947; the explosion resulted in 560 persons killed or missing, 800 patients hospitalized, and between 3000 and 4000 with less serious injuries.⁶

Knowledge about the injuries and deaths resulting from explosions is limited, particularly in residential

FIGURE 1



communities. In an effort to understand the types and characteristics of injuries and health care resources that were used during and after the explosion, an investigation team was formed to gather this data. We sought to describe the characteristics of fatal injuries caused by the explosion; to describe the physical injuries of survivors of the explosion; to describe the risk factors associated with injuries caused by the explosion, including location at the time of the blast, timing of injury, and demographic characteristics; to quantify the number of acutely injured patients who sought medical care; and to describe the medical care received by the injured.

METHODS

Case Definition

We reviewed death certificates to identify fatal injuries. Data from death certificates and medical examiner records were

collected on individuals who died in McLennan County within 1 week of the explosion as a result of injuries sustained in the blast. We used multiple data sources to identify individuals with nonfatal injuries who sought medical care. Immediately after the explosion, hospitals reported limited information on suspected blast-related patients to the Heart of Texas Regional Advisory Council (HOTRAC), a nonprofit organization that coordinates emergency services in the region. We reviewed emergency department and hospital records of these patients as well as patients treated for any injury at any hospital, emergency room, or urgent care facility in McLennan or Hill County within 5 days of the explosion. Patients were considered to have nonfatal injuries if data in the medical record included details consistent with being related to the blast in terms of location, timing, and cause.

Data Collection

Standardized data collection tools were used to obtain data on injuries and risk factors associated with injuries, including a fatal injury abstraction form to collect data from medical examiner reports, a nonfatal injury medical record abstraction form, and a telephone survey for survivors. The data collection tools were based on survey instruments from other investigations, including questionnaires from the 1995 Oklahoma City bombing⁴ and the 2012 Alabama tornado outbreak⁷ and blast injury forms developed by the Centers for Disease Control and Prevention and the American College of Emergency Physicians.⁸ The fatal injury abstraction form collected data on the types of injuries sustained, mechanism of injury, who attended the death, and time of death. The medical record abstraction form collected information on time and mode of arrival, types of injuries sustained, the types of medical resources utilized, and patient disposition. Triage level, comorbidities, and patient demographics were also sought through the medical record abstraction form. The survivor interview survey gathered detailed data on the location of the person at the time of the explosion and additional information on the cause of the injuries. The survivor survey explored how they were injured (hit by flying debris, stepped on something, etc), when they were injured (during or after the explosion), what contributed to their injuries (flying glass, loud noise, etc), which direction were they facing, and whether they heard the explosion.

Eligible injured patients identified through medical records were contacted to participate in a survivor survey. Contact information, including residential address and telephone number, was obtained from medical records when possible. We also linked patient records with data obtained from the Federal Emergency Management Agency (FEMA) on West residents whose homes were damaged or destroyed and who subsequently applied for emergency assistance from the federal government. FEMA records included both the permanent and the temporary residential address and alternate telephone numbers.

We sent notification letters to eligible survivors 1 week before attempting to reach them by telephone. If the letter was returned undeliverable by the post office, a second letter to an alternative address was sent. We attempted to contact survivors twice during business hours and once after business hours or during weekends. If patients were unreachable by telephone, a hard copy of the survey with a postage-paid return envelope was mailed. The survey was also mailed if that preference was indicated by the patient during a telephone call. The survivor survey was designed to take approximately 15 minutes. For this part of the investigation, we established and documented verbal consent prior to conducting the survey. A written consent document was also included with the mailed survey.

The investigation protocol and participant consent process were reviewed and approved by the Texas Department of State Health Services Institutional Review Board.

Data Analysis

Data were entered into Epi Info (version 7.1.2.0; Centers for Disease Control and Prevention, Atlanta, GA) and analyzed in SAS 9.2 (SAS Institute Inc, Cary, NC). Descriptive statistics, including means and frequencies, were calculated. Chi-square tests and Satterthwaite *t*-tests were used to assess statistical significance among proportions and means, respectively. Logistic regression models were conducted to calculate odds ratios. An alpha of 0.05 was considered statistically significant. Using ESRI ArcMap 10.0 (www.esri.com), we geocoded the known approximate location, at the time of the explosion, of all chart-abstracted and interviewed cases. We then calculated the distance proximity of cases to the explosion epicenter.

RESULTS

Data Collection

The investigation team reviewed 654 patient records at 14 facilities, including 11 hospitals and 3 urgent care facilities. Of these, 308 patient visits by 288 unique patients were determined to be related to the explosion. Twenty patients presented either to 2 medical facilities or to the same facility at different times. A total of 252 patients had nonfatal injuries directly related to the explosion; an additional 10 patients had injuries indirectly related to the explosion. Of those injured directly by the explosion, 56 (22%) were admitted to a hospital. An additional 15 patients died of injuries sustained in the explosion. The injury fatality rate for this explosion was 5% (15 fatalities of 277 injured patients). Among the 2834 residents of the city of West, 10 residents were fatally injured and 197 residents were nonfatally injured. The injury rate among West residents was 7%.

The 4 hospitals located in Hill (Hill Regional Hospital and Lake Whitney Medical Center) and McLennan (Hillcrest Medical Center and Providence Health Center) counties received 250 of the patient visits (81%) for medical care related to the explosion. The remainder of the visits occurred at hospitals in Dallas (*n* = 4), Fort Worth (*n* = 3), or Temple (*n* = 6); at urgent care facilities in McLennan County (*n* = 22); or at the mobile medical unit temporarily established in West (*n* = 23). We were not able to review records at 3 urgent care clinics in McLennan County, all of which reported not treating any patients for explosion-related injuries.

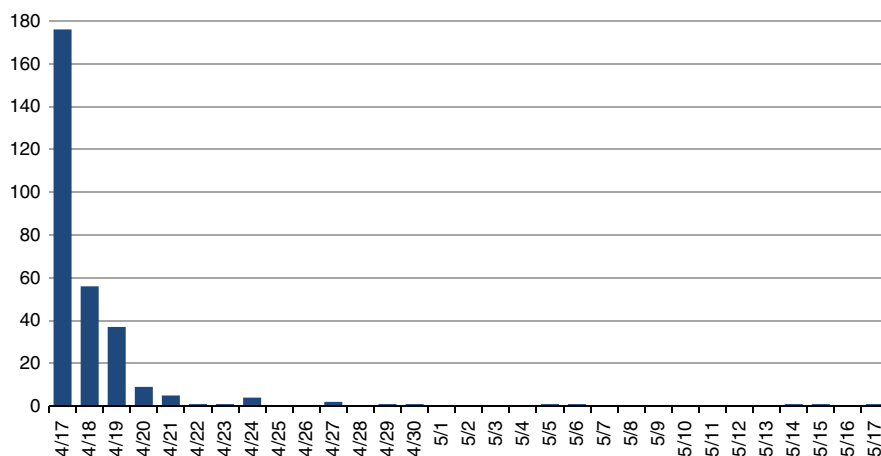
Medical Surge

The majority of patients arrived at medical facilities for treatment within hours of the explosion (Figure 2). On the night of April 17, 176 patient visits (of 308; 57%) occurred. By the end of the day on April 18, 232 patient visits (75%) occurred.

Of the 308 visits to hospital emergency rooms and urgent care facilities that were identified as being related to the explosion, 280 visits were for treatment of an injury. Noninjury visits

FIGURE 2

The 308 Patient Visits Related to the Fertilizer Plant Explosion in West, Texas, by Day of Visit.



included patients who needed medications or who wanted to be evaluated for possible injuries. Patients arrived at the medical facilities for treatment by several different modes. Walk-ins (via private vehicle, bus from the field triage location, law enforcement vehicles, other) accounted for 57% of all visits. Others were brought to the hospital by ground ambulance (21%) or air/helicopter (3%); mode of arrival was unknown for 19% of patients.

The majority of patients were treated and released upon their initial visit to a medical facility (220/288; 76%). A total of 58 patients (23%) were admitted to the hospital. Fifty-two patients were admitted to the hospital after their initial visit. Five additional patients were transferred to a higher-level acute-care facility and subsequently admitted. One patient was initially discharged and then returned 8 days later and was admitted. No one who reached a medical facility for treatment subsequently died.

A variety of medical resources were utilized to treat injured patients, including imaging studies such as X-rays, computed tomography scans, ultrasounds, or magnetic resonance imaging scans (57%, 160/280 visits); blood products (3%, 9/280); and endotracheal intubation (2%, 5/280). More patients who were admitted for treatment of their injuries received these medical resources; 96% of admissions (54/56) received a least one imaging study, 16% (9/56) received blood products, and 7% (4/56) received endotracheal intubation.

Fatal Injuries

Fifteen patients were killed by injuries directly as a result of the explosion. Fourteen died at the time of the explosion; one died a short time later. All fatalities resulted from fractures,

blunt force trauma, or blast force injuries sustained at the time of the explosion. Ten firefighters and 2 civilians responding to assist were killed. Two residents of a nearby apartment complex and one resident of the nursing home also died. The decedents ranged in age from 26 to 96 years; 14 were males.

Nonfatal Injuries

Of the 262 patients with nonfatal injuries, 61% were women. Average age was 53.6 years, with a range of less than 1 year to 98 years. Over one-quarter (72; 28%) of the injured patients were residents of the West Rest Haven nursing home. The nursing home census at the time of the explosion was 130 people; therefore, the explosion led to injuries in 55% of the residents.

A total of 252 patients were directly injured by the explosion; the remaining 10 patients were injured after the explosion during cleanup or by debris in the neighborhood. Over half of the 252 patients injured directly by the explosion had documented abrasions/contusions and lacerations/penetrating trauma (Table 1). Fifty-three of the injured patients (21%) had traumatic brain injuries or concussions. Other common injuries included tinnitus/hearing problems (14%), eye injuries (12%), and inhalational injuries (12%). Eleven percent of the patients had sprain/strain; 8% had fractures/dislocations. Tympanic membrane ruptures were documented in 5% of injured patients. Blast injuries, including pneumothorax, blast lung, and blast abdomen injuries were seen in 5% of patients. Burns were observed for 2% of patients. Patients injured indirectly by the blast, such as during cleanup, had a variety of injuries, including abrasions/contusions, lacerations/penetrating trauma, sprains, and inhalational injuries. Patients sustained between 1 and 9 types of injuries.

TABLE 1

Types of Nonfatal Injuries Sustained by 252 Patients Directly Injured in the 2013 Fertilizer Plant Explosion in West, Texas^a

Injury	Total (n = 252)		Admitted (n = 56)		Not Admitted (n = 196)	
	No.	%	No.	%	No.	%
Abrasions/contusions	141	56.0	43	76.8	98	50.0
Laceration/penetrating trauma	134	53.2	38	67.6	96	49.0
Traumatic brain injury/concussion	53	21.0	20	35.7	33	16.8
Tinnitus/hearing problem	34	13.5	3	5.4	31	15.8
Eye injury	31	12.3	18	32.1	13	6.6
Inhalation injury	30	11.9	6	10.7	24	12.2
Sprain/strain	29	11.5	4	7.1	25	12.8
Fracture/dislocation	21	8.3	18	32.1	3	1.5
Blast injuries	12	4.8	8	14.3	4	2.0
Tympanic membrane rupture	12	4.8	4	7.1	8	4.1
Burn	6	2.4	2	3.6	4	2.0

^aPatients could sustain more than one injury, so percentages will sum to greater than 100%.

Location of Injured Patients

Using information from survivor interviews and medical record notes, the location of each of the 252 patients directly injured by the explosion at the time of the blast was determined, if possible. For 191 patients (76%), we could determine whether they were inside a structure, outside, or in a vehicle. We were able to determine the approximate geographic coordinates of their locations for 172 of the injured patients (68%).

Over half (55%, 138/252) of the injured patients reported being inside a structure, 13% (33/252) reported being outside, and 8% (20/252) reported being in a vehicle. All 72 injured residents of the West Rest Haven nursing home were inside at the time of the explosion. The types of injuries sustained by patients inside were different from the injuries sustained by those who were outside or in a vehicle. People who were inside were more than twice as likely to have abrasions/contusions (odds ratio [OR] = 2.19, 95% confidence interval [CI]: 1.15-4.18) and lacerations (OR = 2.40, 95% CI: 1.26-4.59). People who were outside or in a vehicle were many times as likely to have hearing loss/tinnitus (OR = 14.48, 95% CI: 4.57-45.95), tympanic membrane rupture (OR = 9.20, 95% CI: 2.38-35.51), or inhalational injury (OR = 8.64, 95% CI: 2.9-25.72). People who were inside and people who were outside or in a vehicle were equally likely to have eye injuries (OR = 0.90, 95% CI: 0.37-2.20) or traumatic brain injury/concussion (OR = 1.17, 95% CI: 0.56-2.42).

The median distance from the blast epicenter of the 172 directly injured patients with geocoded location at the time of the blast was 825 feet. Over three-quarters (134/172; 78%) of these injured patients reported that they were within 1000 feet of the blast, a radius that included the nursing home and apartment complex (Table 2). All patients who were

TABLE 2

Distance From the Blast for Patients Injured Directly by the 2013 Fertilizer Plant Explosion in West, Texas, by Admission Status

Distance	Total (n = 252)		Admitted (n = 56)		Not Admitted (n = 196)	
	No.	%	No.	%	No.	%
<500 feet	9	4	3	5	6	3
500-999 feet	125	50	47	84	78	40
1000-1499 feet	18	7	3	5	15	8
1500-1999 feet	6	2	0	0	6	3
2000-2499 feet	5	2	0	0	5	3
2500-2999 feet	1	1	0	0	1	1
3000-3499 feet	3	1	0	0	3	2
≥3500 feet	5	2	0	0	5	3
Unknown	80	32	3	5	77	39

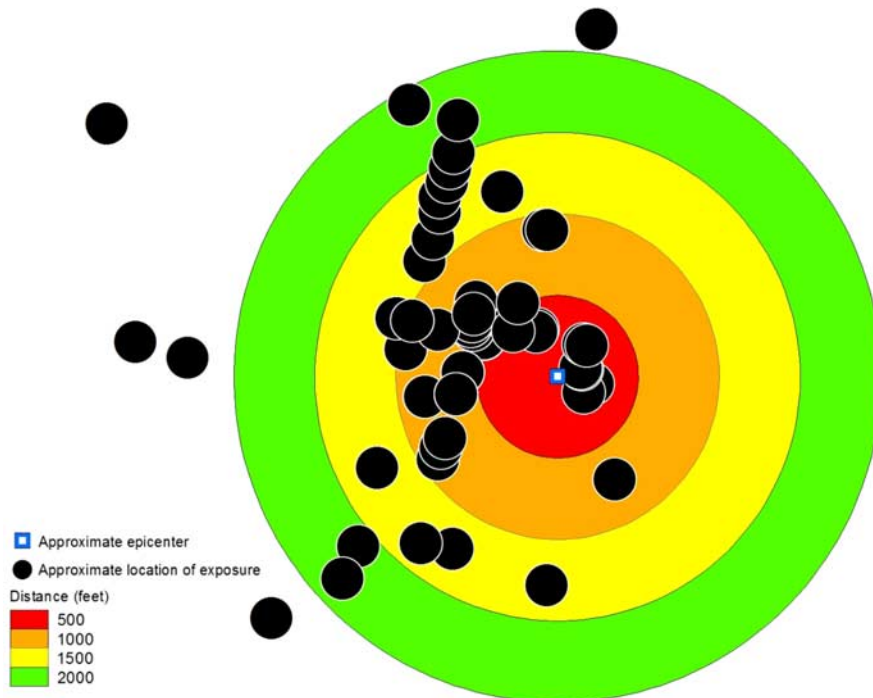
admitted to the hospital were no more than 1500 feet away when the explosion occurred ($P = 0.0001$). Those who were closer to the epicenter were more likely to be hospitalized than were those who were farther away. The types of injuries sustained from the explosion were similar regardless of the distance from the blast. Figure 3 is an illustration of approximate injury exposure locations of nonfatally injured patients within 1 mile of the approximate blast epicenter; each dot does not necessarily represent an individual person.

Survivor Interviews

After excluding nursing home residents and anyone aged less than 18 years, attempts were made to reach 149 patients. We interviewed 58 injured survivors, 53 of whom were directly

FIGURE 3

Map of Approximate Exposure Locations of Nonfatally Directly Injured Patients Within a Mile of the Approximate Blast Epicenter.



injured by the explosion. Of those directly injured by the blast, 45 (85%) heard the explosion. Using a noise intensity scale from 0 (no noise) to 10 (very intense), the mean score given by those who heard the explosion was 9.7. Thirty-eight (of 53; 72%) directly injured survivors were aware of the fire at the fertilizer plant prior to the explosion. They found out about the fire in numerous ways, including directly from a friend or relative (19; 50%), by seeing the fire (15; 39%), from a person of authority (7; 18%), by hearing the fire (3; 8%), or from TV (1; 3%). No one interviewed found out about the fire through social media. Six (11%) injured survivors were told to evacuate from their location prior to the explosion; 5 of 6 were located within 1000 feet of the epicenter.

DISCUSSION

The explosion at the West Fertilizer Plant led directly to 15 deaths, 12 of which were first responders, and to 252 injured persons who required immediate medical attention. Fatal injuries included fractures, blunt force trauma, and blast force injuries sustained at the time of the explosion; all deaths occurred immediately or within a few hours of the explosion. Of the 252 nonfatally injured persons, 23% were admitted to the hospital for treatment. Over half of the survivors experienced abrasions/contusions or lacerations/penetrating trauma. Over one-fifth of the survivors sustained a traumatic

head injury/concussion. Other injuries included tinnitus/hearing problems, eye injuries, inhalational injuries, and sprain/strain. Patients admitted to the hospital were more likely to be located closer to the epicenter of the blast than were those who were treated and released.

Limitations

Our analyses had several limitations. This investigation focused only on the apparent acute physical injuries associated with the explosion and identified only injured people who sought medical care at a hospital or urgent care facility immediately after the explosion. We also collected data on those with injuries who were treated at the mobile medical unit set up in West 2 days later. We did not identify those who sought medical care at private physician offices or at other medical facilities or those who were treated later in time. We are likely to have identified the most severely injured patients, requiring more immediate treatment at a nearby medical facility or at a facility known to the HOTRAC, who was tracking this information during the emergency. The injured patients who were not identified during this investigation were thought to have had less severe injuries.

Medical records may not have included complete information that could have been useful in this investigation. Patients were

treated during an emergency situation with treatment as the primary focus, so data such as demographics, contact information, past medical history, detail of circumstances, and minor injuries may not have been noted or recorded. We also may have failed to identify some injuries due to miscoded injury diagnoses or codes. At the time of the fire, nursing home staff conducted a horizontal evacuation of residents, moving them within the facility to the side of the building farthest from the fire. Residents who subsequently needed medical treatment after the explosion were transferred quickly and many arrived at the emergency room without documented medical history or medication lists.

Some injuries, particularly ear injuries as well as traumatic brain injury, may not have been identified at the time of medical treatment immediately after the explosion, particularly in the presence of more acute and life-threatening injuries. About one-third of survivors of the Oklahoma City bombing in 1995 reported auditory injuries, but not all were diagnosed;⁴ only 12% of injured patients in our study reported this type of ear injury. In addition, this investigation found that 57% of patients were transported to the hospital other than by ambulance; this compares similarly to the approximately 68% in the 1995 Oklahoma City bombing.⁹ More than half of the World Trade Center–related traumatic brain injuries identified in one investigation were undiagnosed at the initial presentation to the hospital.¹⁰

Potential recall bias exists, because we conducted interviews with survivors several months after the explosion. Some participants may not have remembered everything that happened or may have remembered it differently than they would have if interviewed shortly after the explosion. Additionally, the survivors who did agree to take the survey and provide responses may have differed from those who did not agree to take the survey or did not answer the phone, leading to potential selection bias. We also did not interview anyone less than 18 years of age or the residents of the West Rest Haven nursing home, whose experiences may have been different from those of the adults we were able to interview.

Recommendations

Several recommendations for the medical and public health community based on the observations of this incident and investigation are outlined. The data presented in this investigation and in similar studies should be reviewed to inform hospitals to better predict and plan for the types of injuries that might be expected in a similar emergency incident, and when and how those patients might be arriving to the medical facility, which may improve medical recognition and management of those injured. While examining apparent physical injuries, medical providers should also screen for ear and brain injuries that may result from similar emergency incidents. Long-term care facilities (eg, nursing homes, assisted-living facilities) should review their process to gather

patient medical records when evacuating or moving patients in a similar emergency and also exercise their evacuation plans regularly. The Centers for Disease Control and Prevention's *Public Health Preparedness Capabilities: National Standards for State and Local Planning* assists public health departments in developing preparedness plans to guide their preparedness strategies.¹¹ This investigation can link to several of these capabilities: community preparedness (#1), information sharing (#6), public health surveillance and epidemiological investigation (#13), and responder safety and health (#14). In addition, the Office of the Assistant Secretary for Preparedness and Response (ASPR) provides funding and technical assistance to state, local, and territorial public health departments to prepare the health care system for disasters. ASPR has defined a set of 8 Healthcare Preparedness Capabilities; this investigation can link to several of these capabilities: health care system preparedness (#1), information sharing (#6), and medical surge (#10).¹² Public health entities are encouraged to use this investigation as a model for collaboration between local, regional, state, and federal agencies. A tabletop exercise using these specific incidence data and challenges would help epidemiologists improve their capacity to conduct these types of investigations in the future.

CONCLUSIONS

It is our hope that this investigation will assist people in the West community to better understand the public health impact of the acute injuries sustained in this tragedy. We believe this investigation will also be useful to medical providers and public health professionals in learning about the types of injuries that may occur and the medical and public health resources needed to plan for and respond to a similar emergency incident.

About the Authors

Texas Department of State Health Services, Austin, Texas (Dr Metzger, Ms Haywood, Mr Zane); Waco McLennan County Public Health District, Waco, Texas (Dr Akram, Mr Stone, Ms Alvey, Ms Hernandez); and Texas Department of State Health Services, Health Service Region 7, Temple, Texas (Ms Feldt, Ms Henley, Dr Melville).

Correspondence and reprint requests to Kahler Stone, MPH, Epidemiologist, Waco-McLennan County Public Health District, 225 West Waco Drive, Waco, Texas 76707 (e-mail: KahlerS@wacotx.gov).

Acknowledgments

We give special acknowledgment to the local West officials, residents, fire fighters, and others affected by the explosion who, despite enormous grief and displacement, graciously contributed information for this investigation. We also acknowledge the many organizations and agencies for their cooperation and assistance. A special thank you to Dr. Duke Ruktanonchai, Debbi Parker, and Judy Whitfield for their contributions.

Funding

Waco-McLennan County Public Health District by and through the City of Waco, Texas, Department of State Health Services, and the federal Hospital Preparedness Program and Public Health Emergency Preparedness Cooperative Agreements.

Supplementary material

To view supplementary material for this article, please visit <http://dx.doi.org/10.1017/dmp.2015.186>

Published online: March 2, 2016.

REFERENCES

1. Annual estimates of the resident population: April 1, 2010 to July 1, 2013. US Census Bureau Web site. <http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>. Accessed February 8, 2016.
2. Texas State Fire Marshall's Office. Firefighter Fatality Investigation. Investigation FFF FY 13-06. <http://www.tdi.texas.gov/reports/fire/documents/fmloddwest.pdf>. Published May 16, 2014. Accessed May 14, 2015.
3. Dechy N, Bourdeaux T, Ayrault N, et al. First lessons of the Toulouse ammonium nitrate disaster, 21st September 2001, AZF plant, France. *J Hazard Mater*. 2004;111(1-3):131-138. <http://dx.doi.org/10.1016/j.jhazmat.2004.02.039>.
4. Mallonee S, Shariat S, Stennies G, et al. Physical injuries and fatalities resulting from the Oklahoma City bombing. *JAMA*. 1996;276(5):382-387. <http://dx.doi.org/10.1001/jama.1996.03540050042021>.
5. US Environmental Protection Agency website. Chemical accident investigation report: Terra Industries, Inc., Nitrogen Fertilizer Facility Port, Neal, Iowa. <http://www.epa.gov/oem/docs/chem/cterra.pdf>. Published January 1996. Accessed January 14, 2015.
6. Blocker V, Blocker TG Jr. The Texas City disaster; a survey of 3,000 casualties. *Am J Surg*. 1949;78(5):756-771. [http://dx.doi.org/10.1016/0002-9610\(49\)90318-9](http://dx.doi.org/10.1016/0002-9610(49)90318-9).
7. Niederkrotenthaler T, Parker EM, Ovalle F, et al. Injuries and post-traumatic stress following historic tornados: Alabama, April 2011. *PLoS One*. 2013;8(12):e83038. <http://dx.doi.org/10.1371/journal.pone.0083038>.
8. Centers for Disease Control and Prevention; American College of Emergency Physicians. Medical record abstraction form for domestic bombing events. http://www.acep.org/uploadedFiles/ACEP/Practice_Resources/disater_and_EMS/Medical%20Record%20Abstraction%20Form.pdf. Accessed May 12, 2015.
9. Maningas PA, Robison M, Mallonee S. The EMS response to the Oklahoma City bombing. *Prehosp Disaster Med*. 1997;12(2):80-85.
10. Rutland-Brown W, Langlois JA, Nicaj L, et al. Traumatic brain injuries after mass-casualty incidents: lessons from the 11 September 2001 World Trade Center attacks. *Prehosp Disaster Med*. 2007;22(3):157-164.
11. Centers for Disease Control and Prevention. Public Health Preparedness Capabilities: National Standards for State and Local Planning. http://www.cdc.gov/phpr/capabilities/dslr_capabilities_july.pdf. Published March 21, 2011. Accessed October 30, 2015.
12. US Department of Health and Human Services. Healthcare Preparedness Capabilities: National Guidance for Healthcare System Preparedness. <http://www.phe.gov/Preparedness/planning/hpp/reports/Documents/capabilities.pdf>. Published January 2012. Accessed October 30, 2015.