

Editorial

The Lessons of September 11

The attacks on the World Trade Center (WTC) of September 11, 2001 caused a massive environmental disaster and resulted in the deaths of 2,823 persons. They also generated a long-lasting burden of illness in the more than 50,000 rescue workers who responded to the attacks and in the 400,000 residents and workers in nearby areas of New York City. Many of these illnesses continue to this day.

We have learned much from the experience of September 11 about the acute and delayed health effects of civilian catastrophes. We have also learned critical lessons about the importance of having trained responders – medical as well as non-medical – in place in advance of disasters, and about the need to maintain medical surveillance of exposed populations long after a disaster has occurred.

The Medical Response to September 11

Our medical response to the attacks of September 11 began immediately following the attacks. Physician specialists in occupational and environmental medicine (OEM) and industrial hygienists at the Mount Sinai School of Medicine came together to formulate a medical response plan based on our extensive prior experience with injured workers and military veterans¹.

Within a few days we began to treat sick and injured workers. We observed respiratory health effects, especially cough and severe rhinosinusitis, as well as psychological effects, especially post-traumatic stress disorder (PTSD). On the basis of these early observations, we realized that a systematic program for medical monitoring would be required and that it must include physical as well as mental health examinations². This initial response would not have been possible without the presence of highly trained physicians and industrial hygienists.

Our physicians, in close partnership with the leaders of New York City's major labor unions, advocated to the US Congress and to the National Institute for Occupational Safety & Health (NIOSH) about the need for a comprehensive medical monitoring programs for rescue workers and civilian survivors. This advocacy resulted in the establishment of medical monitoring programs to care for rescue workers and civilian survivors. The medical program at the fire department of the City of New York (FDNY) has provided especially useful information about the health consequences of September

11, because for many years before the attacks FDNY's medical program had mandated an annual physical examination for all firefighters and paramedics that included spirometry. These baseline data obtained before the disaster have yielded a series of valuable insights³.

Initial Symptoms

September 11 rescue workers sustained intense, short-term exposures to airborne toxic materials that were generated during the collapse of the towers. Two-thirds of the mass of this airborne material was pulverized cement, and as a result the dust was highly alkaline (pH 10–11)⁴. Cough and bronchial hyperreactivity were the predominant initial physical symptoms. This cough was named the “World Trade Center Cough” and was defined as severe cough in rescue workers who had served at the WTC site that persisted for at least four weeks. World Trade Center cough occurred in 8 percent of firefighters with a high level of exposure, in 3 percent with a moderate level of exposure, and in 1 percent with a low level of exposure⁵.

Persistence of Symptoms

Banauch *et al.* (2003) studied the persistence of the initial findings and found highly exposed workers were 6.8 times more likely than moderately exposed workers and unexposed workers to be hyperreactive⁶. A parallel study of more than 9,000 September 11 responders other than firefighters found that 69% had developed new onset or worsened respiratory symptoms while working at the WTC site. These symptoms persisted up to 2.5 yr after the attacks². A nine-year follow-up of 27,449 rescue workers demonstrated that the cumulative incidence of asthma was 27.6%, of sinusitis 42.3%, and of gastroesophageal reflux disease 39.3%. Incidence of most of these disorders was highest in workers with greatest exposure. Extensive comorbidity was reported within and between physical and mental health disorders⁷. A nine-year follow-up of civilian survivors of September 11 found a cumulative incidence of 20% for post-September 11 gastroesophageal reflux symptoms (GERS) and 13% for persistent GERS⁸. Among civilian survivors with no stated asthma history, 10.2% reported new diagnoses of asthma after September 11⁹. Reibman *et al.* (2005) found new-onset respiratory symptoms in 55.8% of residents in the exposed area

after September 11, compared with 20.1% in a distant area¹⁰).

Abnormalities in Pulmonary Function

Banauch *et al.* (2006) conducted a longitudinal study of pulmonary function in FDNY firefighters¹¹). The main finding was that rescue workers experienced an average 372-ml reduction in adjusted average FEV1 in the year following September 11, 2001, a decline equivalent to 12 yr of normal aging. These reductions persisted over at least 6 yr³). Most of this reduction in lung function was due to airways obstruction¹²). A nine-year follow-up of 27,449 rescue workers found that cumulative incidence for spirometric abnormalities was 41.8%; three-quarters of these abnormalities were low forced vital capacity⁷).

Sarcoidosis

Izbicki *et al.* (2007) demonstrated a dramatic increase in the incidence rate of “sarcoid-like” granulomatous disease in firefighters in the first years after September 11¹³). Incidence increased to 22/100,000 compared to 15/100,000 prior to the disaster. An increase in sarcoid-like illness has been demonstrated also in other WTC responders, especially in workers who served on the debris pile¹⁴).

Mental Health Consequences

Stellman *et al.* (2008) found that 11.1% of rescue workers met criteria for probable post-traumatic stress disorder (PTSD), 8.8% met criteria for probable depression, 5.0% met criteria for probable panic disorder, and 62% met criteria for substantial stress reaction¹⁵). PTSD was significantly associated with loss of family members and friends, disruption of family, work, and social life, and higher rates of behavioral symptoms in children of workers. PTSD prevalence was comparable to that seen in returning Afghanistan war veterans and was much higher than in the U.S. general population. Berninger *et al.* (2010) found that 15.5% of 5,656 FDNY firefighters reported probable PTSD after September 11, 8.6% at baseline and 11.1% at follow-up¹⁶). Among civilian survivors of September 11, Brackbill *et al.* (2009) reported that 23.8% reported PTS symptoms⁹).

The Importance of Worker Training in Preventing PTSD

Worker preparation and training substantially reduced risk of PTSD. Perrin *et al.* (2007) found that the overall prevalence of PTSD among rescue/recovery workers was 12.4%, ranging from 6.2% for trained police to 21.2% for untrained and unaffiliated volunteers¹⁷).

Debchoudhury *et al.* (2011) confirmed these findings and found that unaffiliated volunteers had greater risk of early mental health diagnosis, chronic PTSD, and late-onset PTSD¹⁸).

Co-Morbidity of Physical and Mental Health Problems

Li *et al.* (2011) found the incidence of post-September 11 GERS to be higher in individuals with asthma or PTSD than in those without either condition, and highest in those with both comorbid conditions⁸). Wisnivesky *et al.* (2011) found extensive comorbidity between and among physical and mental health syndromes⁷).

The Importance of Respiratory Protection

Antao *et al.* (2011) found that workers who wore respirators were less likely to report adverse respiratory outcomes¹⁹). Use of respiratory protection was most frequent among union workers who had previously received training.

Summary of Lessons Learned from September 11

The September 11 disaster has reinforced many of the basic teachings of occupational and environmental medicine (OEM). Five critical lessons are these:

1. Training in OEM supported by NIOSH for more than 20 yr before September 11 had created a cadre of OEM physicians and industrial hygienists. These trained responders were prepared to rapidly establish and build a medical program after the disaster. Without prior training in OEM, response would have been impossible.
2. The importance of collecting baseline health information collected before a disaster was demonstrated by the great value of the pre-September 11 data that had been obtained by the FDNY Medical Department.
3. Worker training and prior experience substantially reduced risk of PTSD and increased use of respiratory protection.
4. The critical need to anticipate mental health problems in responders to civilian disasters and to provide mental health treatment that is coordinated with medical treatment.
5. The recent findings of elevated cancer rates in FDNY firefighters²⁰) and of elevated heart disease mortality in civilian survivors of September 11²¹) underscore the need for continued, long-term monitoring of populations at risk from civilian disasters.

Disasters are inevitable, but the disease sequelae of

disaster can be minimized by appropriate training and adequate preparation.

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