



# 2011 Annual Report on 9/11 Health



2001-2011

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Mayor Bloomberg celebrated passage of the James Zadroga 9/11 Health and Compensation Act in Lower Manhattan with Senators Schumer and Gillibrand, Representatives Maloney, King and Nadler, first responders and survivors.

Credit: Ed Reed

# Letter to Mayor Bloomberg

November 2011

Dear Mayor Bloomberg:

Since the publication of our 2010 annual report, New York City achieved one of its major policy goals at the federal level: passage of the James Zadroga 9/11 Health and Compensation Act, which President Obama signed into law in January. We take pride in the fact that our ongoing review of the World Trade Center (WTC)-related literature documenting adverse health effects in WTC responders and survivors, and our assessment of the healthcare services needed to address these issues, as summarized in our annual reports and distributed to all members of Congress for the past two years, supported your vigorous advocacy of this legislation.

In addition to ensuring that health monitoring and treatment will continue uninterrupted for anyone who has become ill after their exposure to the WTC collapse, we are pleased that the Zadroga Act also affirms the need for continuing and expanding WTC-related research by the WTC Centers of Excellence, the WTC Health Registry and other entities.

Our previous reports have identified some important opportunities for WTC-related research, particularly in the area of treatment efficacy. We are hopeful that this information will be of use to the National Institute for Occupational Safety and Health (NIOSH), which is responsible for administering the WTC Health Program, as well as to independent researchers.

The Zadroga Act also establishes a Scientific/Technical Advisory Committee for the WTC Health Program, appointed in September 2011, which will review the scientific literature for the federal government as we have done for New York City over the past four years. The Committee will be assuming an even more critical role as it issues recommendations, also based on scientific evidence, to the Program Administrator about adding WTC-related health conditions that can be treated by the WTC Health Program.

In this report, we update you on the progress we have seen regarding the implementation of our recommendations since 2007, when we began reviewing the WTC literature and assessing the adequacy of services, and we summarize a decade's worth of research findings. The timeline of 9/11 health milestones that introduces this report shows how the City's ad hoc partnership with the federal government has built a solid scientific foundation for the expansion of 9/11 health services over the past decade. We are confident that even more can be accomplished in the years to come under the Zadroga Act.



Linda Gibbs, Co-Chair  
*New York City Deputy Mayor for  
Health and Human Services*



Thomas Farley, MD, MPH, Co-Chair  
*New York City Health Commissioner*

# World Trade Center Medical Working Group Membership

Mayor Bloomberg appointed the World Trade Center (WTC) Medical Working Group in June 2007. Members meet regularly to review clinical and research findings on the health effects of WTC exposure. In addition to publishing an annual report, they also review the adequacy of physical and mental health services available to WTC-exposed persons, and they advise city government on approaches to communicating health risk information related to WTC exposure.

## Membership

**Linda Gibbs, Co-Chair**

*New York City Deputy Mayor for Health and Human Services*

**Thomas Farley, MD, MPH, Co-Chair**

*New York City Health Commissioner*

**Thomas K. Aldrich, MD**

*Professor of Medicine, Pulmonary Division, Montefiore Medical Center and Albert Einstein College of Medicine  
Chair, New York State September 11th Worker Protection Task Force*

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*Associate Professor, Department of Environmental Medicine, NYU School of Medicine*

**JoAnn Difede, PhD**

*Director, Program for Anxiety and Traumatic Stress Studies  
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# 9/11 Health Services & Research: A Decade of Milestones

A decade of milestones in health services and research related to the September 2001 terrorist attacks on America illustrate a steady progression of private and public commitment to assist the 410,000 individuals<sup>1</sup> estimated to have been exposed to the collapse of the World Trade Center.

## 2001

- The federal government funds health screening and mental health treatment for Fire Department of New York (FDNY) members.

## 2002

- The federal government funds screening for non-FDNY rescue, recovery and clean-up workers at the Mount Sinai School of Medicine.
- 9/11 Mental Health and Substance Abuse Program, an insurance-like benefit, is launched with private funding to increase access to treatment for anyone in the nation directly affected by the September 2001 terrorist attacks.
- The *New England Journal of Medicine* publishes FDNY research defining World Trade Center (WTC) cough and noting other respiratory symptoms in firefighters.

## 2003

- Mount Sinai begins treating rescue, recovery and clean-up workers for WTC health problems with private funding.
- The New York City (NYC) Department of Health and Mental Hygiene (DOHMH) and the federal government establish the volunteer [WTC Health Registry](#) to monitor the health of people directly exposed to the WTC disaster.
- The New York Academy of Medicine publishes research about the mental health of NYC residents during the first six months after the attacks.

## 2004

- The federal government establishes the WTC Medical Monitoring Program to screen and monitor rescue, recovery and clean-up workers at FDNY, Mount Sinai and several other institutions.

## 2005

- Researchers from Bellevue Hospital and the New York State Department of Health publish studies reporting an increase in new, post-9/11 respiratory symptoms in Lower Manhattan residents.
- Private philanthropy funds treatment for rescue and recovery workers in the NYC area and elsewhere in the US, and for Lower Manhattan residents, area workers and students at a Bellevue Hospital asthma clinic.
- Columbia University researchers publish a study on WTC mental health impacts among NYC schoolchildren.

## 2006

- Mount Sinai and other members of the WTC Medical Monitoring Program publish research showing that more than 50% of rescue, recovery and clean-up workers being monitored continued to have respiratory symptoms up to 2.5 years after 9/11.
- The federal government provides funding to treat rescue, recovery and clean-up workers for the first time and establishes the WTC Medical Monitoring and Treatment Program.
- The NYC Department of Health and Mental Hygiene publishes and distributes [Clinical Guidelines for Adults Exposed to the WTC Disaster](#).
- Legislation is introduced in Congress to provide long-term physical and mental health care for WTC survivors and responders regardless of their ability to pay.

## 2007

- As private funding for WTC services is exhausted, NYC Mayor Bloomberg accepts all 15 recommendations in *“Addressing the Health Impacts of 9/11,”* a special report he commissioned to ensure that everyone with WTC-related health problems gets the care they need.
- NYC establishes the [WTC Environmental Health Center](#) at Bellevue Hospital Center, Gouverneur Health Care Services, and Elmhurst Hospital Center to treat Lower Manhattan residents, area workers and students.
- Mayor Bloomberg appoints the WTC Medical Working Group to review clinical and research findings on 9/11 health effects.

## 2008

- The WTC Health Registry publishes a study examining physical health among WTC-exposed children.
- The insurance-like benefit program begun with private funding is extended as the NYC 9/11 Benefit Program for Mental Health and Substance Use Services for local residents.
- The WTC Medical Working Group publishes its first [annual report](#) on 9/11 health that summarizes findings from more than 100 studies published since 2001.
- The federal government establishes the WTC Responder Health Program to monitor and treat rescue and recovery workers who live outside the New York City area.
- The federal government provides funding for the first time to treat Lower Manhattan residents, area workers and students at the WTC Environmental Health Center.

## 2009

- The *Journal of the American Medical Association* publishes WTC Health Registry research estimating that as many as 88,600 adults have had symptoms of posttraumatic stress disorder and as many as 40,000 adults have developed new asthma as a result of their WTC exposure.
- The Health Department publishes *Clinical Guidelines for Children and Adolescents Exposed to the WTC Disaster*.

## 2010

- The *New England Journal of Medicine* publishes FDNY research showing that decreases in pulmonary function in firefighters and EMS workers have persisted for seven years, even among non-smokers.
- Congress passes the [James Zadroga 9/11 Health & Compensation Act](#) which provides federal funding for 9/11-related health monitoring, treatment and research through 2015.
- 53,485 responders and 5,130 survivors have enrolled in federally funded health monitoring and treatment services as of December 31.<sup>2</sup>

## 2011

- In compliance with the Zadroga Act, the National Institute for Occupational Safety and Health issues the *First Periodic Review of Scientific and Medical Evidence Related to Cancer for the World Trade Center Health Program*. It summarizes current scientific and medical findings in the peer-reviewed literature about exposures resulting from the WTC attack and cancer studies, and determines that it cannot currently propose a rule to add cancer to the list of WTC-related health conditions.
- 9/11 anniversary-themed scientific publications highlight current findings. *The Lancet* addresses the comorbidity of mental and physical health conditions and includes early reports on cancer and mortality.
- The federal government appoints the [WTC Scientific/Technical Advisory Committee](#) to review scientific and medical evidence and make recommendations to the WTC Health Program administrator about changing eligibility criteria and covering additional health conditions.
- WTC responders and survivors throughout the United States have access to federally funded treatment for both physical and mental health conditions for the first time through the federal [WTC Health Program](#).

(2008 – 2011)

# Progress on WTC Medical Working Group Recommendations

The World Trade Center (WTC) Medical Working Group has made a series of recommendations about 9/11 health treatment and services since its formation in 2007. These recommendations fall into three broad categories: funding; research and evaluation; and education. The WTC Medical Working Group remains committed to seeing these recommendations implemented in their entirety. The progress made up to the tenth anniversary of the September 2001 terrorist attacks is summarized below.

## Funding Recommendations

- Advocate for long-term federal funding so that the following critical activities can continue:
  - Treatment of WTC-exposed populations including rescue, recovery and clean-up workers, Lower Manhattan residents, area workers (including commuters living outside of New York City), and students for illnesses related to WTC exposure at the Centers of Excellence
  - Regular monitoring of firefighters, police, correction, sanitation and other rescue, recovery, and clean-up workers for WTC-related mental and physical health conditions
  - Tracking the health of 71,000 people enrolled in the WTC Health Registry, who now reside in all 50 states
  
- Advocate for federal funding to increase scientific knowledge about WTC-related health impacts including:
  - Research at the WTC Centers of Excellence, including the development of population-specific mental health screening tools
  - Investigations to identify how environmental conditions such as the WTC collapse can cause illness, specifically through laboratory experiments using stored or generated environmental dust samples
  - Research to identify biologic indicators of specific 9/11 exposures
  - Other research as needed to identify people at higher risk for illness due to WTC exposure

## Funding Progress

By passing the James Zadroga 9/11 Health and Compensation Act, signed into law by President Obama in January 2011, Congress implemented a 2008 recommendation of the WTC Medical Working Group: long-term federal funding for WTC-related health monitoring, treatment and research. Prior to passage of this legislation, the WTC Centers of Excellence and the WTC Health Registry relied on an uncertain mix of private funding, annual Congressional appropriations and New York City funding to continue health programs that began soon after 9/11, and others that developed as the mid-term health impacts of the attacks became evident.

Mayor Bloomberg and several members of the WTC Medical Working Group testified before Congress in support of the Zadroga Act, along with labor and community advocates who lobbied tirelessly for the bill in the nation's capital. In addition, the Congressional sponsors of the legislation distributed copies of the 2009 and 2010 annual reports of the



(2008 – 2011)

## Progress on WTC Medical Working Group Recommendations (continued)

WTC Medical Working Group to educate their colleagues in both the Senate and the House of Representatives about the growing body of scientific literature documenting the need for continued health services and national outreach.

The Zadroga Act establishes the WTC Health Program and funds it through at least 2015, with New York City paying ten percent of the overall cost. Implemented by the National Institute for Occupational Safety and Health in July 2011, the WTC Health Program serves both eligible responders and survivors, no matter where they live now in the United States.

Research opportunities addressing 9/11-related health issues are also expanded under the Zadroga Act. In addition to the kind of periodic, population-based health surveys that the WTC Health Registry has conducted with federal funding among people directly exposed to the disaster, the WTC Centers of Excellence and other scientific researchers also will be able to apply for grants to conduct clinical investigations and treatment outcome evaluations. It isn't yet clear if the Zadroga Act covers research to study how specific environmental factors may have caused WTC-related illness and to identify biologic indicators specific for 9/11 exposures.

### Research and Evaluation Recommendations

- Expand research on the prevalence of WTC-related conditions and determine their persistence. Document WTC-related treatment needs and effectiveness by:
  - determining the extent to which people with potential WTC-related health conditions are receiving treatment, and by identifying coverage gaps.
  - evaluating the effectiveness of treatment among patients with WTC-related mental and physical health conditions.
  - estimating the number of people who may seek mental and/or physical health treatment to help policy makers project future treatment costs.
- Determine whether cancer, chronic illnesses and other late-emerging diseases are elevated among WTC-exposed populations by comparing incidence and mortality rates among WTC-exposed populations to estimated background rates for New York City.
- Consider using the following methods when conducting cancer investigations among WTC-exposed populations:
  - Compare the number of cancer diagnoses among members of WTC cohorts who were highly exposed to the WTC disaster to the number of diagnoses among less exposed members when possible. Use of internal comparisons is expected to be more meaningful scientifically than external comparisons to other groups because of the difficulty in identifying comparable, non-exposed populations.
  - Develop a common WTC exposure matrix where possible, so that the degree of exposure within and across cohorts can be categorized more consistently when analyzing cancer and other late-emerging illnesses.
  - Schedule the timing of periodic cancer analyses in advance to ensure that this choice is independent of the results. Researchers also should consider conducting formal analyses no more frequently than every five years because of the length of the induction period between environmental exposures such as the WTC disaster and the development of cancer. However, during the interim, monitoring and tracking of the data can continue so that researchers would detect and share developments of interest.

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## Progress on WTC Medical Working Group Recommendations (continued)

- Consider using other New York City data sets (including birth and school records) in addition to the WTC Health Registry in order to conduct cancer analyses of sufficient statistical power among pediatric populations exposed to the WTC disaster.
- Consult with other WTC researchers on an ongoing basis about the cancer analyses within WTC cohorts and coordinate the reporting of data and/or research. This kind of collaboration can help reduce confusion among the public when the results of these analyses are published and reported by the media.
- Expand research on the impact of 9/11 on mental health and substance use by:
  - collecting additional data on the prevalence of WTC-related depression, suicide and substance use among WTC-exposed populations.
  - assessing the impact of chronic WTC-related physical health conditions on long-term mental health.
  - studying the impact of tobacco use on WTC-related respiratory conditions.
- Increase research on mental and physical health effects on vulnerable populations who were exposed to the WTC collapse including children who went to school or who lived in the area, had first responder parents, or lost family members on 9/11.

## Research and Evaluation Progress

Members of the WTC Medical Working Group—or the institutions they represent—have contributed more than 125 articles to the scientific literature. Although many of these articles were published prior to the MWG’s formation in 2007, subsequent research, including articles published by such prestigious journals as the *New England Journal of Medicine*, the *Journal of the American Medical Association* and the *Lancet*, has focused on areas specifically recommended by the MWG.

This includes research estimating the burden of WTC-related illness to help policymakers allocate resources rationally; research about the persistence of both mental and physical conditions; research into co-occurring mental health conditions such as depression and substance use; research about the impact of tobacco use on WTC-related illness; and research about cancer and mortality risk among WTC-exposed populations. In addition, researchers not affiliated with the MWG have published studies on post-9/11 suicide rates.

Only now has sufficient time elapsed since 2001 to begin research into the potential long-term and late-emerging health impacts associated with WTC exposure, including cancer and premature mortality. Although the long-term health impacts of this exposure may not be fully understood for decades, if ever, the MWG already has begun to lay a foundation of shared methodological approaches for cancer research. After soliciting recommendations about methodological approaches from a group of nationally recognized experts including biostatisticians, environmental health scientists and cancer epidemiologists in 2010, MWG members representing each of the WTC Centers of Excellence and the WTC Health Registry formed a WTC Analytic Methods Workgroup that also includes labor and community advisers.

The WTC Analytic Methods Workgroup completed an analysis of exposure variables for rescue, recovery and clean-up workers and volunteers collected by its members from

(2008 – 2011)

## Progress on WTC Medical Working Group Recommendations (continued)

responses to a variety of surveys asking for similar information in different ways, and developed an exposure matrix that identifies just three common exposure variables: dust exposure on the day of 9/11; work periods at the WTC site; and work activities at the WTC site. The difficulty encountered in retrospectively aligning exposure measurements across cohorts underscores the importance of establishing cross-study collaborations at the outset for future disasters.

The WTC Analytic Methods Workgroup also produced common rules for classifying cancers. Abstracts describing both Workgroup efforts were presented at the June 2011 meeting of the Council for State and Territorial Epidemiologists and emphasized the importance of collaboration among institutions studying an already complex health issue.

Other areas of research recommended by the MWG must be more fully addressed. These include: assessing the mental and physical health of WTC-exposed children, and the children of WTC-exposed first responders; evaluating the effectiveness of treatment for WTC-related conditions; obtaining a better understanding of co-morbid mental and physical conditions and how this co-morbidity may influence disease progression, functioning and recovery; and initiating investigations into the relationship between WTC environmental contaminants and specific physical illnesses and the establishment of biologic indicators specific for WTC exposures.

### Education Recommendations

- Increase awareness of WTC-related symptoms and the availability of clinical resources among people who were exposed to the disaster.
- Increase awareness of *Clinical Guidelines for Adults Exposed to the WTC Disaster* among health care professionals, especially in areas where large numbers of WTC-exposed individuals may reside.
- Develop and disseminate clinical guidelines for children exposed to the WTC disaster.
- Educate policy makers, the media and the public about the difficulty in establishing a direct cause-effect relationship between WTC exposure and any one individual's illness for most diseases, especially those that are relatively rare.
- Gather and publish lessons learned after 2001 terrorist attacks on the World Trade Center about preventing and treating disaster-related health conditions (see section beginning on page 11).

### Education Progress

Members of the MWG have made enormous progress in increasing awareness of WTC-related symptoms and the availability of clinical resources among people who were exposed to the disaster. Major accomplishments since 2007 include the following:

- New York City's 311 system offers direct transfers to the NY/NJ WTC Clinical Consortium and the WTC Environmental Health Center for people seeking WTC-related services.
- The Department of Correction established a special unit to refer current employees and retirees who participated in WTC operations to appropriate treatment, and to assist them in filing for workers' compensation and pension disability.

(2008 – 2011)

## Progress on WTC Medical Working Group Recommendations (continued)

- FDNY published *WTC Health Impacts on FDNY Rescue Workers*, an illustrated, easy-to-understand report about findings from the first six years of monitoring and treatment, and will be publishing a ten-year update.
- The NY/NJ WTC Clinical Consortium conducts extensive outreach including commemoration of Responder Day in June; distributes *The WTC Responder Health Watch*, a quarterly newsletter for all program participants; and hosted a successful conference to explain health services under the Zadroga Act.
- NYPD created a members-only website centralizing information about all WTC-related services, including the department's own on-site health monitoring program, and established a toll-free number for additional information about the availability of services.
- The NYC Department of Health and Mental Hygiene launched a "one-stop shopping" [9/11 health website](#) with regularly updated information about WTC-related research and services which receives an average of 4,000 visitors each month; publishes a bi-monthly 9/11 health e-newsletter with nearly 9,000 current subscribers; and distributed two brochures City-wide: "*Is 9/11 Affecting Your Health?*," a Health Bulletin describing WTC-related symptoms and services, and a *9/11 Resource Guide*, listing dozens of organizations offering various kinds of assistance.
- The WTC Environmental Health Center awarded grants to ten community-based organizations to conduct outreach; developed "Lived There? Worked There? You Deserve Care," a subway advertising campaign and brochure; held health forums for potential adult patients and parents of exposed children and adolescents; and worked with the Department of Education to inform 15,000 Lower Manhattan parents who had children in school on 9/11 about the WTC pediatric program at Bellevue Hospital.

With input from MWG members at FDNY, the NY/NJ WTC Clinical Consortium and the WTC Environmental Health Center, as well as community and labor advisers, the NYC Department of Health and Mental Hygiene revised the *Clinical Guidelines for Adults Exposed to the World Trade Center Disaster* it first published in 2006, and also developed *Clinical Guidelines for Children and Adolescents Exposed to the WTC Disaster* in conjunction with child health experts.

The Health Department distributed these guidelines to physicians and pediatricians throughout New York State. In addition, the National Institute for Occupational Safety and Health distributed the adult guidelines to all state health departments in the US. The Health Department mailed the child and adolescent guidelines to more than 200 college health clinics in the northeastern US with a cover letter encouraging physicians to consider the potential impact of WTC exposure on student health.

# Lessons Learned

The September 11, 2001 attack on the nation's largest city by international terrorists—only the second time such an event has occurred on US soil, and one with far more devastating consequences than the 1993 bombing of the World Trade Center—altered life for millions of Americans. Government agencies, health care providers and researchers have learned a number of lessons about the health preparedness and response to environmental disasters in urban areas. Some of these lessons, broadly categorized below, have led to greater collaboration among these entities and resulted in important policy or program changes in New York City during the last decade.

## ■ The need to protect first responders by:

- restricting disaster-site access to individuals with the proper qualifications and training, identifying these individuals and recording the times they work for health follow-up.
- providing and enforcing use of adequate personal protective equipment, including pre-disaster training in the need for, and use of such protection.
- limiting the duration of physical and mental health exposures of individuals during rescue, recovery and clean-up efforts (to the extent possible) through shift rotation.
- providing early post-traumatic stress disorder (PTSD) screening for responders with known risk factors, such as a prior history of trauma.

## ■ The need to protect the health of all populations at risk by:

- promoting quality, evidence-based post-disaster services effectively.
- determining as early as possible those who were potentially exposed and registering them so that a clearly defined population risk is known and so that needs can be assessed and services provided.
- delivering exposure-appropriate physical health services for acute and chronic injuries/illnesses.
- providing counseling through rapid mobilization of community-based mental health organizations and major medical centers.
- referring anyone at higher risk for post-traumatic stress disorder and other mental health conditions for comprehensive, early psychological evaluation using standardized clinical assessment tools and providing evidence-based interventions if indicated.
- offering culturally competent mental health services.
- exploring how internet-based technology may help increase the capacity of evidence-based mental health providers, particularly among affected individuals who may not be comfortable seeking traditional services.
- implementing education and outreach programs to reduce the stigma associated with mental health treatment.
- providing appropriate social support services to facilitate physical and mental health recovery.

## Lessons Learned (continued)

- investing in advertising and outreach, both community-based and personalized, to reach exposed individuals with unmet healthcare needs when disaster-specific services are available at no cost.
- translating and providing culturally appropriate outreach materials for affected communities.

### ■ The need to collect high quality data by:

- maintaining a roster of the names, addresses, affiliations and duration of work of all responders from the very beginning of the response effort to establish a baseline for future follow-up and research.
- implementing real-time hospital surveillance systems to track disaster-related injuries and illnesses.
- coordinating a citywide effort to begin collecting and maintaining data about exposed individuals.
- involving labor and community stakeholders to facilitate health registry development and recruitment, and to encourage appropriate monitoring and treatment from the outset, thereby increasing transparency, credibility, and enrollment.



# Overview of 9/11 Health Findings: 2001–2011

The World Trade Center (WTC) Medical Working Group has reviewed more than 300 studies published from 2001-2011 (as of September 30, 2011) that are relevant to its mission.

In general, the health findings summarized below are remarkably consistent across WTC studies.

## Physical Health

- Dozens of studies indicated that respiratory symptoms, sinus problems, asthma, and loss of lung function were diagnosed in or reported by many who were exposed to WTC dust, including nearly 60,000 rescue and recovery workers, residents and office workers who have enrolled in 9/11 health programs. For many, these conditions have persisted for nearly a decade.
  - Epidemiologic studies indicate that diagnoses of new asthma among exposed groups peaked during the first 16 months after 9/11.
  - Clinical studies demonstrate that the steep declines in pulmonary function first detected among firefighters and EMS workers within a year of 9/11 have largely persisted even among those who never smoked; compared to pre-9/11 data, four times as many firefighters and twice as many EMS workers had below-normal lung function for their ages six to seven years after 9/11.
  - Recent studies also have identified persistent abnormal pulmonary function in other WTC rescue and recovery workers, including police, and in Lower Manhattan residents and area workers.
  - Both epidemiologic and clinical studies have identified substantial co-occurrence, or comorbidity, of mental health conditions with respiratory illness.
- Intense dust cloud exposure on the morning of 9/11 increased the risk for developing respiratory problems across all WTC-exposed groups. Other risk factors among specific WTC-exposed groups included:
  - *Rescue, recovery and cleanup workers*: arriving early or working for long periods of time at the WTC site. In addition, lung function declines were slightly greater among the relatively few firefighters and EMS workers who were active cigarette smokers before and after 9/11 than for nonsmokers.
  - *Residents*: not evacuating their homes or experiencing a heavy layer of dust in their homes.
  - *Office workers*: experiencing a heavy layer of dust in their offices.
  - *Both residents and office workers*: living and working in Lower Manhattan.
- Several studies have shown that WTC exposure is associated with sarcoidosis (an inflammation that can affect any organ, but typically affects the lungs) among rescue, recovery and clean-up workers, especially those who worked on the debris pile.
- Many WTC-exposed adults were also diagnosed with or reported having heartburn, acid reflux or other gastroesophageal reflux symptoms, often but not always in conjunction with other respiratory or mental health symptoms. Researchers have identified early arrival at the WTC and intense exposure to the dust cloud as risk factors. Acid reflux, however, is common among the general population; further research is needed to understand the relationship between reflux symptoms, WTC exposure and other WTC-related health conditions.

## Overview of 9/11 Health Findings: 2001–2011 (continued)

- Findings have been inconsistent regarding the impact of WTC exposure on birth outcomes. Some studies suggest that reduced fetal growth found in some women who were pregnant on 9/11 may be related to the stress caused by the attacks. Other studies, however, found no impact of WTC exposure on birth outcomes.
- Few studies have addressed the impact of WTC exposure on child/adolescent health, especially physical health.
- Research about cancer and mortality in WTC-exposed populations is in its initial stages because it takes a longer time for these potential health consequences to become evident. Additional studies are needed to determine if early results are replicated, if they are replicated in different populations with different exposure levels, and if they change over time.
  - The first WTC cancer risk study to be published found that firefighters with WTC exposure may be at greater risk for cancer than firefighters who weren't exposed.
  - The first mortality study to be published showed that persons in the WTC Health Registry were less likely to die in the eight years of follow-up than in the general New York City population. The study, however, also showed that among Lower Manhattan residents, area workers and passersby in the Registry, those with higher levels of WTC exposure may be at greater risk for all-cause mortality and cardiac-related mortality in particular compared to those with intermediate or lower levels of WTC exposure.
- WTC-related illness, especially respiratory illness, has resulted in considerable disability and increased pension costs for New York City.

### Mental Health

- Results from large epidemiologic studies have consistently shown that probable post-traumatic stress disorder (PTSD), identified by a positive screening using a standardized psychological assessment tool, is the most common WTC-related health effect among exposed adults, and that it often co-occurs with respiratory illness. Severity of symptoms may vary over time, however, and a face-to-face interview is required to make an individual diagnosis.
- Screening positive for PTSD was more likely among those who were:
  - caught in the dust cloud released by the buildings as they collapsed.
  - injured as a result of the attacks.
  - directly exposed to the events of 9/11, including proximity to the WTC site, witnessing horrific events, or knowing someone who was killed or injured in the attacks.
- Other PTSD risk factors include:
  - Among rescue and recovery workers, early arrival at the WTC site, working there for a long time, or doing tasks outside of their trained area of expertise.
  - Among WTC evacuees, being on a high floor in the towers, initiating evacuation late, or working for an employer that sustained fatalities.



## Overview of 9/11 Health Findings: 2001–2011 (continued)

- Trauma before or after 9/11 unrelated to the terrorist attacks, such as urban or domestic violence, was also associated with PTSD or with greater symptom severity. Lack of adequate social support was associated with reduced recovery from PTSD.
- Firefighters with probable PTSD (see definition on previous page) were significantly more likely than those without PTSD to report difficulty functioning at work or at home up to four years after 9/11.
- Police officers, firefighters and emergency medical technicians generally had lower rates of PTSD than untrained volunteers because of prior training and experience with emergency response.
- Despite widespread evidence of PTSD among exposed groups, suicide rates at the population level in New York City did not increase in the first four years after 9/11.
- Depression, anxiety and substance use disorders have not been as well studied as PTSD among WTC-exposed people. The studies to date, however, suggest that the prevalence of these conditions increased shortly after 9/11 and there is significant co-morbidity with PTSD in WTC-exposed populations.
- The PTSD impact of 9/11 on the US population who experienced it indirectly through media coverage may have been briefer and far smaller than studies conducted in the immediate aftermath of the attacks suggested.

Sources: 2008, 2009, 2010, 2011 WTC Medical Working Group annual reports, which can be accessed on line at [www.nyc.gov/9-11healthinfo](http://www.nyc.gov/9-11healthinfo).



(August 2010 – September 2011)

# Detailed Summary of Most Recent WTC-Related Research

The World Trade Center (WTC) Medical Working Group identified 90 published papers related to health among the WTC-exposed in the scientific literature since its 2010 annual report, including numerous studies that were published in conjunction with the commemoration of the 10th anniversary of the September 2001 terrorist attacks. Thirty-five looked at mental health, including six child studies; 17 looked at physical health; nine looked at both mental and physical health; four reported on environmental exposures and 23 examined other issues, such as the locations, tasks and experiences of responders, a sociopolitical analysis of WTC health issues from a community perspective and the emotional content of text messages on 9/11. Just two studies evaluated treatment efficacy, which the MWG previously identified as a major gap in the literature.

New research with the greatest relevance to the work of the MWG is summarized below. Research published by institutions represented on the MWG is noted in boldface type throughout the research summaries.

## Physical Health

### *Mid-Term Impacts (5-9 Years after 9/11):*

A longitudinal study of more than 27,000 rescue and recovery workers who sought treatment at the **New York/New Jersey WTC Clinical Consortium** (based at the Mount Sinai School of Medicine) conducted detailed physical examinations on each worker and also assessed workers' self-reports of physician diagnoses from 2002 to 2010. Nine years after the terrorist attacks, among those still in treatment, 18.1% (1,893) still had active asthma; 20% (2,042) had sinusitis, and 32.6% (3,195) had gastroesophageal reflux disorder (GERD). All three conditions were associated with higher levels of WTC exposure among workers.<sup>3</sup>

**FDNY** researchers demonstrated that eight years after 9/11, the prevalence of several physician-diagnosed respiratory conditions among 10,999 WTC exposed male firefighters remained high in comparison to men in the general population. Firefighters 44 or younger were much more likely to report sinusitis/rhinitis (17.2% vs. 8.4%); bronchitis (13.2% vs. 3.3%) and COPD/emphysema (1.5% vs. 0.3%). Firefighters ages 45-65 were much more likely to report sinusitis/rhinitis (19.5% vs. 12.2%); current asthma (14.5% vs. 4.9%); bronchitis (13.2% vs. 3.2%); and COPD/emphysema (7.6% vs. 3.2%).<sup>4</sup>

Spirometry, an objective test to measure how well the lungs' large airways are functioning, validated subjective respiratory symptoms in a group of nearly 19,000 rescue and recovery workers being monitored at the **NY/NJ WTC Clinical Consortium**. Workers reporting persistent cough, wheezing, or difficulty breathing upon exertion were more likely than workers without symptoms to have lower lung function and a higher rate of bronchodilator responsiveness during their first clinical visits between 2002 and 2008.<sup>5</sup> The nine-year cumulative incidence for spirometric abnormalities among 5,769 responders at risk in the **NY/NJ WTC Clinical Consortium** was 41.8%; three-quarters of these abnormalities were low forced vital capacity, a measurement taken when the responders were asked to exhale all the air in their lungs as forcefully as possible.<sup>6</sup>

In a longitudinal study of 139 NYPD emergency service workers who responded to the WTC disaster, **NYPD researchers** found evidence of mild declines in lung function six years later, in comparison to pre-9/11 baseline data. Abnormal spirometry, seen in 5.3% of the cohort, was associated with earlier arrival and longer duration at the WTC site. The greatest declines were seen in smokers and workers without respiratory protection.<sup>7</sup>

The **WTC Health Registry**, in collaboration with the **WTC Environmental Health Center**, also found abnormal lung function in Lower Manhattan residents and area workers who

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reported persistent respiratory symptoms seven to eight years after exposure to the WTC disaster. In a case control study using spirometry and oscillometry, a test to measure how well the lungs' small airways are working, researchers found that 180 enrollees with persistent respiratory symptoms (cases) were more likely to have abnormal lung function than nearly 500 enrollees (controls) who had not reported any new respiratory symptoms since 9/11. Oscillometric abnormalities were found even among cases with normal spirometry.<sup>8</sup>

Twelve patients with suspected interstitial lung disease or abnormal lung function underwent lung biopsies four to seven years after 9/11 at the **WTC Environmental Health Center**, which treats symptomatic Lower Manhattan area workers and residents. Pathologic findings included various degrees of interstitial lung disease, small airways disease and emphysema even though only four of the patients had a history of smoking. Researchers also noted the presence of particulate matter in lung tissue with a composition similar to that found in analyses of dust collected from the WTC site after the collapse of the buildings.<sup>9</sup>

Researchers at the **NY/NJ WTC Clinical Consortium** found an increased incidence of sarcoidosis among nearly 20,000 rescue and recovery workers who sought care for 9/11-related health problems in comparison with other published background rates, although no association was found with date of arrival at the WTC site, or exposure to the dust cloud released by the collapse of the buildings. Thirty eight new cases were verified from 2002 to 2007, with the highest incidence occurring two and three years after 9/11.<sup>10</sup>

Using biopsy results, **WTC Health Registry** researchers confirmed 43 cases of sarcoidosis among adults in its cohort of rescue and recovery workers, Lower Manhattan residents, area workers and passersby. A nested case control study found that working on the WTC debris pile significantly increased the sarcoidosis risk for rescue and recovery workers; no risk factors were identified for other groups.<sup>11</sup>

Researchers investigating obstructive sleep apnea (OSA) at the **NY/NJ WTC Clinical Consortium** compared a group of 50 rescue and recovery workers with aerodigestive symptoms who reported habitual snoring six to seven years after 9/11 to a similar group of men without WTC exposure who also snored habitually. OSA was associated with body mass index (BMI) and weight in the group without WTC exposure but not in the WTC workers, suggesting that factors other than obesity may contribute to OSA among WTC responders with aerodigestive disorders.<sup>12</sup>

In a study of more than 37,000 adults enrolled in the **WTC Health Registry** who reported no pre-9/11 gastroesophageal reflux symptoms (GERS), 13% reported that new GERS had persisted up to six years after 9/11. GERS were positively associated with higher levels of WTC exposure, asthma and PTSD but occurred even among enrollees who didn't report asthma or PTSD, suggesting for the first time an independent association with WTC exposure.<sup>13</sup>

### *Short-Term Impacts (1-4 Years after 9/11):*

Two literature reviews focusing on birth outcomes among WTC-exposed pregnant women suggest that environmental exposure or attack-related stress reduced fetal growth in some women, a finding similar to that in studies of birth outcomes after other terrorist attacks, environmental/chemical disasters and natural disasters. Disaster literature not specific to 9/11 indicates that child development may be more influenced by maternal mental health than by direct effects of disaster-related pre-natal stress.<sup>14,15</sup> A newer study not included in these reviews compared two groups of women who were pregnant between September 11 and December 1, 2001: 500 women who were enrolled in the **WTC Health Registry**, and 50,000 women who lived at least five miles from the WTC site. Although researchers found similar birth weight and gestational age at delivery in the groups, Registry enrollees with probable PTSD were more likely than women without PTSD to deliver premature or underweight babies.<sup>16</sup>

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## Mental Health

### *Mid-Term Impacts (4-9 years after 9/11):*

Rates of chronic post-traumatic stress disorder (PTSD) among WTC responders vary significantly by worker category nine years after 9/11:

- The prevalence of probable PTSD among more than 11,000 firefighters in the **FDNY WTC Medical Monitoring and Treatment Program** was four times higher than in the general population, 7.4% compared to 1.8%. Early arrival at the WTC site, exercising less and drinking more alcohol were associated with the persistence or onset of PTSD symptoms, as were co-occurring respiratory or gastroesophageal reflux symptoms.<sup>17</sup>
- Researchers at the **NY/NJ WTC Clinical Consortium** report that workers, excluding police responders, continued to screen positive at high rates for PTSD (19.2%), depression (17.9%) and panic disorder (12.3%). Police responders had much lower rates of these conditions: PTSD (5%), depression (4.5%) and panic disorder (4.8%).<sup>18</sup>

The **FDNY WTC Medical Monitoring and Treatment Program** screened nearly 2,000 retired firefighters, the majority of whom were disabled, for depression, PTSD, and alcohol problems four to six years after 9/11. Among those at elevated risk for depression (23%) or PTSD (22%), 70% were at elevated risk for both conditions. Problem alcohol use and early arrival at the WTC site were identified as unique risk factors for depression and PTSD, respectively.<sup>19</sup>

### *Short-Term Impacts (1-4 Years after 9/11):*

A longitudinal study suggests that modest increases in drinking and the use of psychotropic medication were associated with PTSD onset in New York City up to two years after the attacks on the World Trade Center. Among a representative sample of nearly 1,700 adults in New York City who were interviewed in late 2002 and again a year later, those with PTSD consumed one more drink per month and took psychotropic medication 20 more days per year.<sup>20</sup>

Researchers at the **WTC Health Registry** estimate that 15% of 3,271 civilians who evacuated either of the WTC towers on 9/11 had PTSD two to three years later. Being on a high floor in the towers, initiating evacuation late and working for an employer that sustained fatalities were among the exposures that increased their risk for PTSD.<sup>21</sup>

A longitudinal study of more than 5,600 firefighters at the **FDNY WTC Medical Monitoring and Treatment Program** that began six months after 9/11 found that those with PTSD up to four years after 9/11 were nearly 20 times more likely than those without PTSD to report substantial difficulty functioning at home or work. Among the 15.5% firefighters with PTSD, nearly half developed it after the first six months.<sup>22</sup>

Two studies conducted by **Weil-Cornell Medical College** researchers based on more than 3,000 mostly male utility workers who were screened for mental health conditions at their place of employment offer new insights about traumatic stress among WTC recovery workers:

- Ten to 22 months after 9/11, eight percent of 2,960 workers had symptoms consistent with full PTSD, 6% with depression, 3.5% with anxiety and 2.5% with panic disorder. Believing that their life had been in danger was the best predictor of PTSD among these workers.<sup>23</sup>

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- 216 workers with trauma symptoms who didn't meet the criteria for full PTSD within the first two years of 9/11 were screened again one and two years later. 29% met the criteria for sub-threshold or full PTSD at Time 2 and 24.5% met these criteria at Time 3. In addition, workers with sub-threshold PTSD reported levels of impairment roughly four times greater than workers with no PTSD symptoms.<sup>24</sup>

Among a sample of 455, mostly female patients who were screened for mental health conditions when they sought primary care at a general medicine clinic in New York City, the PTSD rate decreased significantly from 9.6% one year after 9/11 to 4.1% three years later. Patients who reported pre-9/11 depression, the only significant predictor of PTSD trajectory, were 10 times more likely to have PTSD four years after the WTC attacks than those who didn't.<sup>25</sup>

Research published soon after 9/11 reported elevated rates of PTSD among the US population ranging from 4.3% to 17%. However, data from a national epidemiologic survey conducted from 2004 to 2005 and including nearly 35,000 people suggests that indirect experience of 9/11, such as witnessing the attack on television, had the lowest risk of PTSD, 1.3%, of 32 traumatic events listed. Other events included sexual assault as an adult or child (PTSD risk 40.2%), being stalked (PTSD risk 19.5%) and experiencing a natural disaster (PTSD risk 5.1%).<sup>26</sup>

## Co-Morbidity

Substantial co-morbidity across physical and mental health conditions exists among firefighters. In a study of nearly 11,000 firefighters seven to nine years after 9/11, **FDNY** researchers found that 41.8% of those reporting symptoms of probable PTSD also self-reported a physician diagnosis of obstructive airways disease (OAD), which includes asthma, bronchitis or COPD/emphysema; 33.3% with probable PTSD or depression also self-reported a physician diagnosis of OAD. Among those with depression alone, 28.5% self-reported OAD. The researchers found similar results when they used medical records instead of self-reports for the analysis.<sup>27</sup>

Rescue and recovery workers who sought treatment at the **NY/NJ WTC Clinical Consortium** from 2002 – 2010 also reported substantial co-morbidity: in a clinical population of more than 27,000 workers, nearly half with asthma (1,459 workers) also reported at least one mental health condition, as did more than a third of workers with either sinusitis (2,006 workers) or gastroesophageal reflux disease (2,348 workers). Similarly, around 70% of workers who reported PTSD (2,806 workers), depression (2,153 workers), or panic disorder (1,129 workers) also reported a physician diagnosis of at least one physical disorder.<sup>28</sup>

## Cancer and Mortality

**FDNY** researchers confirmed 263 new cases of cancer from September 11, 2001 through 2008 among 8,927 male firefighters who responded to the WTC disaster, 25 more than would have been expected among men of similar age, race and ethnicity in the general population according to the National Cancer Institute Surveillance Epidemiology and End Results (SEER) reference population. When researchers compared the WTC-exposed firefighters to unexposed firefighters they found a 19% increase in cancer overall, after making an effort to correct for both potential surveillance bias (due to changes in medical screening tests given after 9/11) and lead time bias (it is unlikely that any WTC-related cancer would develop within two years of 9/11). Lack of statistical power prevented the researchers from drawing any conclusions about specific types of cancer.<sup>29</sup>

**WTC Health Registry** researchers identified 790 deaths from 2003 through 2009 among 41,930 adults who resided in New York City at the time of their enrollment in the Registry. The all-cause death rate among Registry enrollees was 43% lower than among NYC residents as a whole.

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Researchers detected exposure-related differences in mortality rates among those in the Registry: lower Manhattan residents, area workers and passersby with intermediate or high levels of exposure, including those with two or more injuries on 9/11, had elevated all-cause and heart disease mortality risks in comparison to those with intermediate or lower levels of exposure. The study did not detect exposure-related mortality differences among rescue and recovery workers even when internal comparisons were conducted.<sup>30</sup>

### Children

A survey of more than 8,200 New York City schoolchildren in grades 4 to 12 conducted six months after 9/11 indicates that 40% of their families experienced at least one of five disruptions: family relocation, job loss, restricted travel, school closure and school relocation. After adjusting for sociodemographic characteristics, WTC exposure and prior trauma, youth reporting that their parents allowed them to travel less freely around the city after 9/11 were three times as likely to have PTSD as youth whose parents allowed them to travel without restrictions. Youth reporting family job loss were twice as likely to have PTSD as those who didn't.<sup>31</sup>

### Volunteers

A longitudinal study of 4,974 adult volunteers enrolled in the **WTC Health Registry** draws distinctions between affiliated volunteers and lay volunteers. Compared to affiliated volunteers, lay volunteers were:

- more likely to have been present in lower Manhattan, experienced the dust cloud, witnessed horrific events, had an injury on 9/11 and reported unmet health care needs.
- nearly twice as likely to have reported an early post-9/11 mental health diagnosis or a diagnosis of asthma or reactive airways dysfunction syndrome.
- more than twice as likely to have had chronic PTSD, late-onset PTSD, or new or worsening lower respiratory symptoms.<sup>32</sup>

### Respiratory Protection

A longitudinal study of 9,296 rescue and recovery workers enrolled in the **WTC Health Registry** who worked at least one shift on the WTC debris pile offers new insights into the use of respiratory protective equipment (RPE):

- Fewer than 20% of workers reported use of standard respirator models on 9/11 and half of the workers wore no facial covering of any kind on that date.
- The strongest predictors of using adequate RPE were affiliation with construction, utilities or environmental remediation organizations, and prior training in the use of RPE.
- Workers who reported no respiratory protection were more likely to report recurrent respiratory symptoms and some respiratory disease compared to those who used respirators.<sup>33</sup>

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### Treatment

Prior research has established the effectiveness of prolonged exposure therapy, a form of cognitive behavioral therapy, in treating PTSD.<sup>34</sup> Researchers at the New York State Psychiatric Institute/Columbia University recruited 37 WTC-exposed patients for a randomized clinical trial comparing prolonged exposure therapy plus paroxetine, a selective serotonin reuptake inhibitor, to prolonged exposure therapy plus placebo. Although the study was small, it suggests that patients treated with therapy and paroxetine showed greater improvement in PTSD symptoms and remission status in ten weeks than the patients treated with therapy alone during this period.<sup>35</sup>

A study of 300 young people ages five to 21 drawn from a larger group of youth who had been exposed to the WTC disaster and referred to mental health services suggests that matching treatment intensity to need is effective. Researchers compared outcomes for youth with more trauma symptoms who received trauma-specific cognitive behavioral therapy (CBT) to youth with milder symptoms who received a brief CBT skills intervention over an 18-month period following the attacks. Trauma symptoms decreased in both groups six months after they began treatment; rates of improvement were similar even though the severity of need differed.<sup>36</sup>

### Disability

The **FDNY WTC Medical Monitoring and Treatment Program** assessed quality of life among a group of 275 disabled firefighters who retired because of lung problems and compared the results to active firefighters and retired firefighters without disability pensions, all of whom were exposed to the WTC collapse, six to eight years after 9/11. Among the three groups, disabled retirees were more likely to score lower on both physical and mental health quality of life measures, but the difference between the disabled firefighters and the other two groups was less pronounced for mental health.<sup>37</sup>

An analysis of retirement pensions awarded by **FDNY** found that in the seven years prior to 9/11, 48% of these pensions were for accidental disability. In the seven years after 9/11, accidental disability pensions comprised 66% of the total, with 47% (1,402 pensions) related to the WTC attacks and mostly due to respiratory illness. The FDNY study also estimated that WTC-related FDNY pensions added \$826 million in increased costs to the system.<sup>38</sup>

### Environmental Exposures

Toxicological studies conducted at **New York University** using dust samples gathered from the WTC site within 48 hours of the buildings' collapse clearly show that particles of a size likely to have been inhaled had an adverse effect on human cell function that may have contributed to chronic lung disease, either by themselves or in combination with 10% cigarette smoke extract.<sup>39</sup>

Federal researchers investigating chemical contamination of the Hudson-Raritan Estuary (HRE) before and after 9/11 found that measurements of eleven trace elements, including arsenic, copper, lead and zinc, in blue mussels were significantly higher in the HRE than elsewhere in the nation, but post-WTC attack measurements were not significantly higher than pre-attack measurements. However, high ambient levels of trace elements in the HRE may have made the impact of the WTC collapse less discernible.<sup>40</sup>

# Strengths and Limitations of Published WTC-Related Research

Much of the data presented in this report were gathered and analyzed by scientists and clinicians associated with a select number of institutions that recognized the need to monitor the health of individuals affected by the World Trade Center (WTC) collapse early after the disaster.

Particular strengths of this body of research include the fact that many different studies have found similar physical and mental health effects across exposed groups, and that research findings are gleaned from several large longitudinal cohorts, in addition to numerous one-time surveys. Weaknesses stem predominantly from the absence of pre-existing data in most populations and the lack of initial funding for studies.

Some of the largest WTC study groups include:

- Nearly all FDNY responders who responded to the disaster. All have pre- and post-9/11 medical records, and the population is restricted to FDNY rescue workers, thus minimizing recruitment bias. The group receives ongoing clinical monitoring with strong participation, even among retirees, indicating limited bias from longitudinal dropout.
- A large cohort of responders enrolled in the New York/New Jersey WTC Clinical Consortium at the Mount Sinai School of Medicine, the State University of New York at Stony Brook, New York University/Bellevue Hospital, Queens College and the University of Medicine and Dentistry of New Jersey for clinical screening, monitoring and treatment. This Consortium collects similar data to FDNY to facilitate comparisons across worker groups.
- A high percentage of NYPD members were exposed to the disaster at various locations. The NYPD Medical Division, like FDNY, has pre- and post-9/11 medical records for these individuals. The pre-9/11 exposure of this cohort is similar to that of New York City residents which makes study findings relevant to the larger population.
- A growing cohort of symptomatic patients who include residents, area workers and clean-up workers at the WTC Environmental Health Center at Bellevue Hospital Center, Gouverneur Health Care Services and Elmhurst Hospital Center.
- The WTC Health Registry, the largest post-disaster exposure registry in US history, enrolling more than 71,000 exposed individuals to be tracked for an expected period of 20 years. The diverse cohort includes rescue, recovery and clean-up workers; residents; office workers; students; and passers-by.

Several significant challenges also affect the ability to conduct accurate research on 9/11 health effects. It is important to highlight these limitations as they characterize many but not all of the published studies described in this report, and to review these limitations when planning data collection efforts after future disasters:

- With the exception of the FDNY cohort, the exact size and composition of the population affected by the disaster remains unknown, although estimates have been developed and published. This, along with selective participation in cohorts, can affect calculation of incidence rates and comparison of these rates across groups.
- It is difficult to measure how much and what type of exposure different people had to traumatic or environmental impacts of 9/11. All exposure measurements remain imprecise.



## Strengths and Limitations of Published WTC-Related Research (continued)

- Many studies are conducted on volunteer or clinic-based samples, which may not be representative of the true population of exposed people. Depending on the enrollment criteria of specific studies, they may suffer from recruitment bias with over-representation of those who are ill.
- People with post-traumatic stress disorder (PTSD) may be under-represented in studies because avoidance of anything that reminds them of 9/11 can be symptomatic of the condition.
- It is difficult to determine the incidence and prevalence rates for many potentially WTC-related conditions, including persistent cough, dyspnea, sinusitis, gastrointestinal symptoms, PTSD and depression because confirmatory laboratory or diagnostic testing is either not available or because an acknowledged “gold standard” does not exist for diagnosing a condition.
- Many studies rely on self-reports of a range of non-specific symptoms and conditions to measure the burden of these conditions in exposed populations without verification of diagnoses.
- The high frequency of certain conditions in the general population, especially acid reflux, as well as the absence of background incidence or pre-9/11 data in most WTC-exposed populations, make it difficult to draw firm conclusions about whether or not post-9/11 diagnoses can be attributed definitively to WTC exposure at a clinical level.
- Increased monitoring and diagnostic testing of WTC-exposed populations in comparison to the general public may result in a detection bias for some conditions, such as sarcoidosis and cancer.
- Few studies have examined the physical effects of WTC exposure on children and adolescents.



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