WTC HP RECOMMENDATIONS FOR FUTURE RESEARCH PRIORITIES

In part from June 2017 PI meeting

Respiratory and other areas of chronic inflammation *

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* Excluding mental health (see Dr. Bromet's presentation)

More than 91,000 people exposed to Toxic Dust and organic matter

Dust covered survivors, coated buildings, seeped into ventilation systems:

- aerosolized toxic carcinogenic mix of particles, gases, vapors
- Silicates,
- freon,
- PCBs, PVCs
- Polyaromatic hydrocarbons
- asbestos,
- lead,
- pulverized concrete

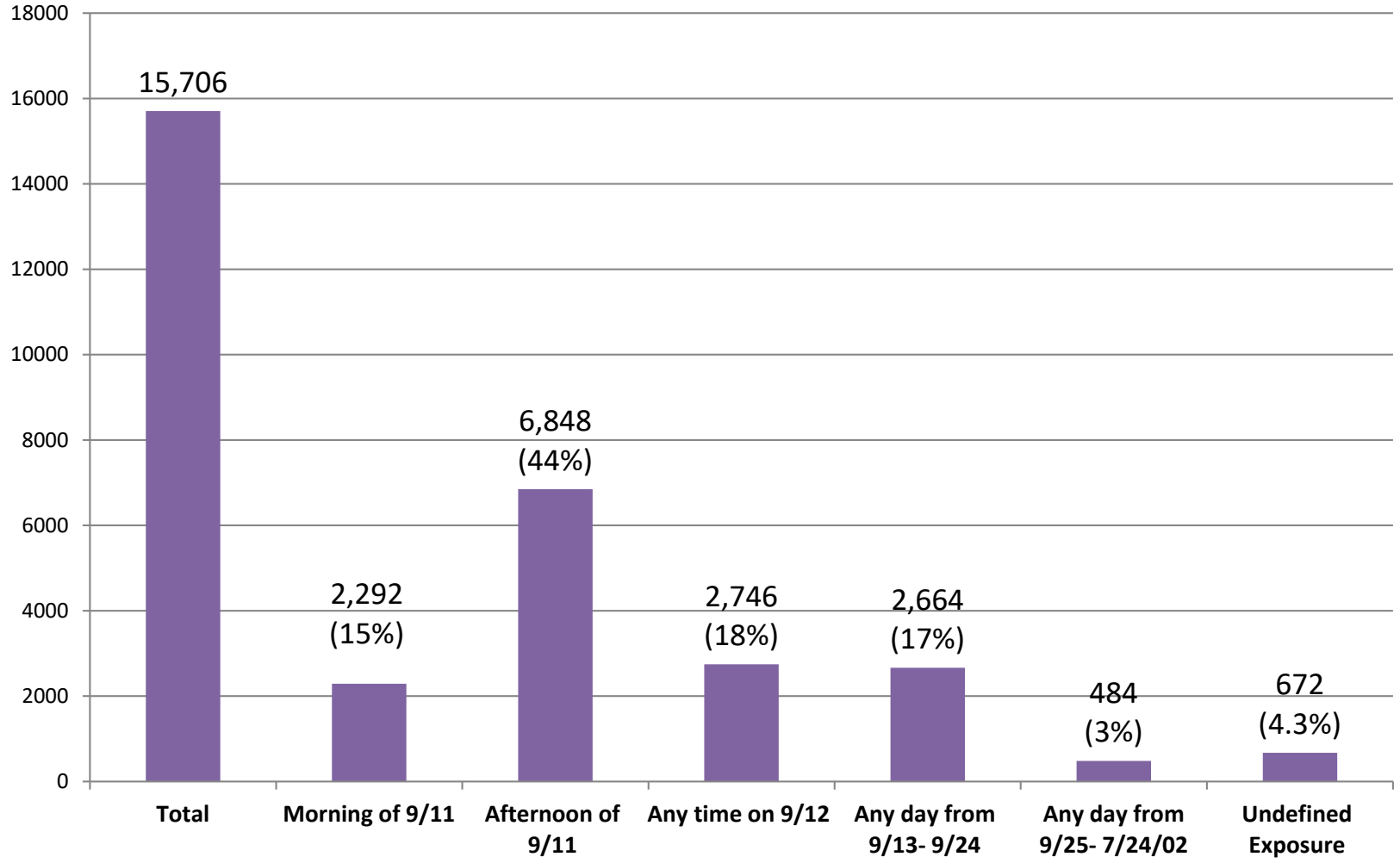
WTC HEALTH PROGRAM
Responders

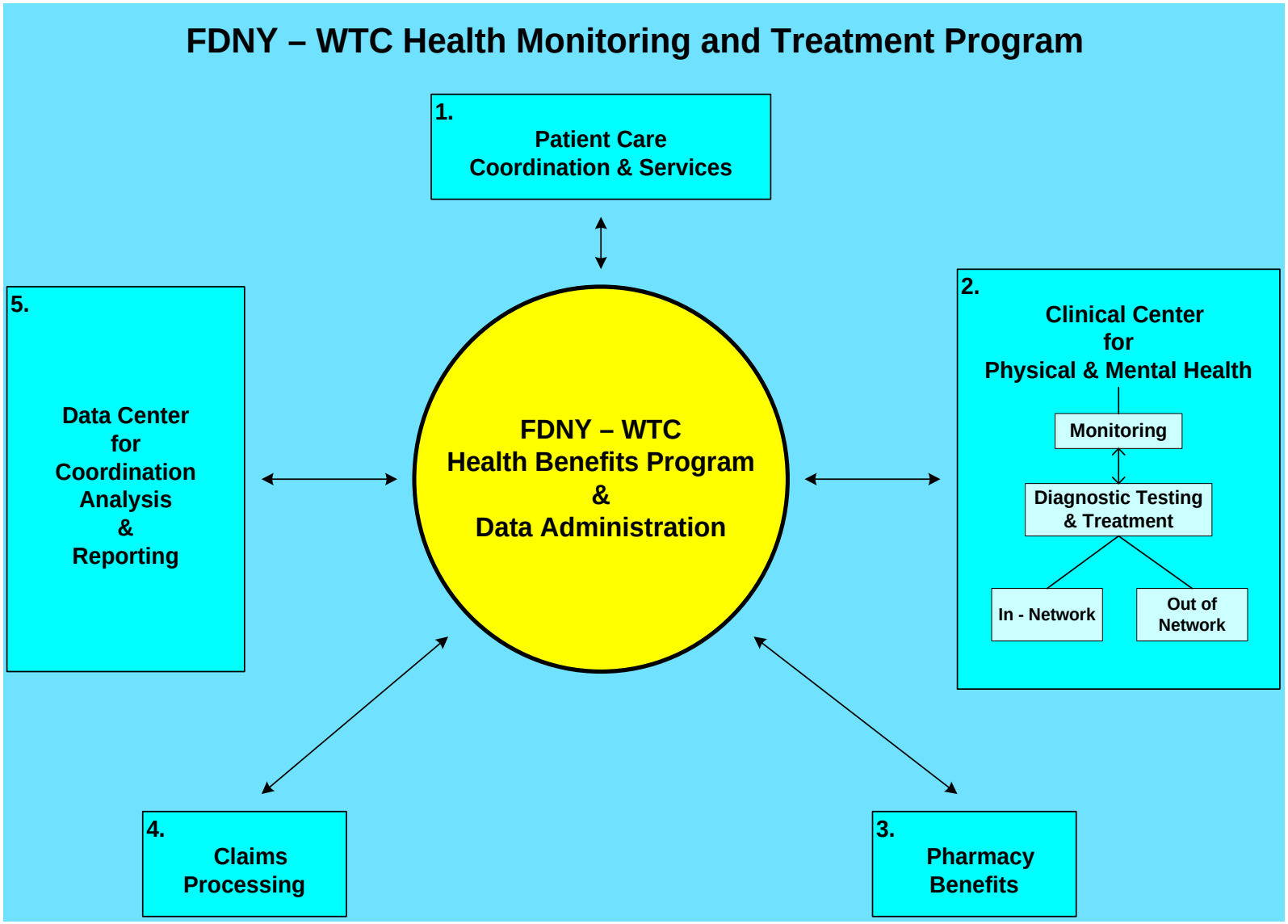
- FDNY
  - FDNY Firefighters
  - FDNY EMS Workers
- Non-FDNY General Responder Program
  - Law Enforcement
  - Communication Workers
  - Construction Workers
  - Sanitation
  - Other responders including some volunteers

FDNY WTC HEALTH PROGRAM DEMOGRAPHICS

FDNY WTC Health Program	
Enrolled	15,706
At least 1 monitoring exam	15,200 (97%)
At least 7 monitoring exams	12,000 (80%)
Monitoring exam within last 24 mo.	84%
Mean age on 9/11	44.0
English Primary language	100%
Firefighter Male	99%
Firefighter (non-hispanic white)	96%
EMS Male	78%
EMS (non-hispanic white)	50%

FDNY - Initial Arrival Time at WTC Ground Zero




FDNY – WTC Health Monitoring and Treatment Program
1.
Patient Care
Coordination & Services
5.
Data Center
for
Coordination
Analysis
&
Reporting
FDNY – WTC
Health Benefits Program
&
Data Administration
2.
Clinical Center
for
Physical & Mental Health
Monitoring
Diagnostic Testing
& Treatment
In - Network
Out of
Network
4.
Claims
Processing
3.
Pharmacy
Benefits

FDNY WTC Health Program

Clinical Center ⟺ Data Center

Patient

Micro Level

- Eligibility
- Monitoring
- Treatment
- Diagnostic Testing
- Certifications
- Prescription Meds.
- Medical Records
- Clinician-Patient Relationship
- Quality Assurance
- Quality Improvement

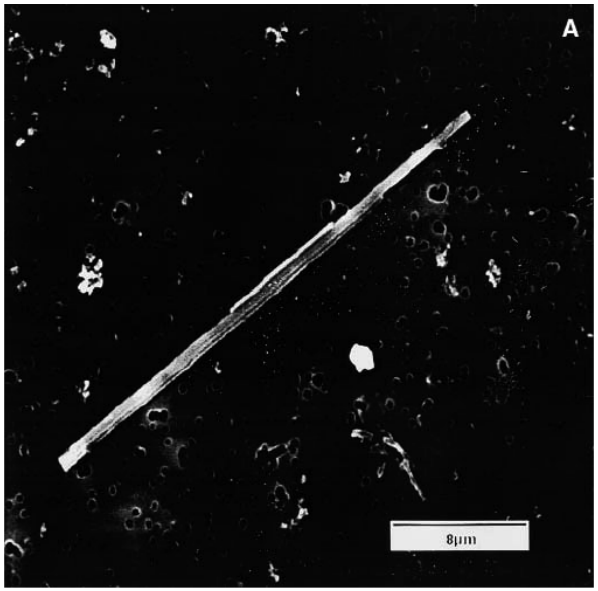
Cohort

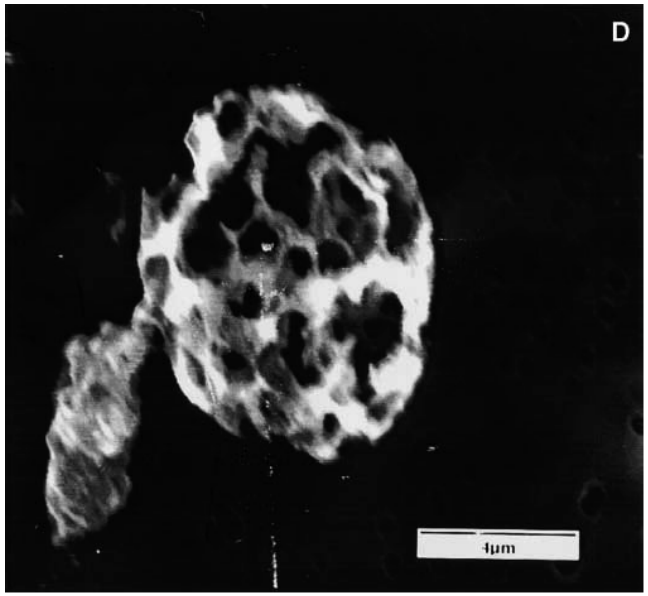
Macro Level

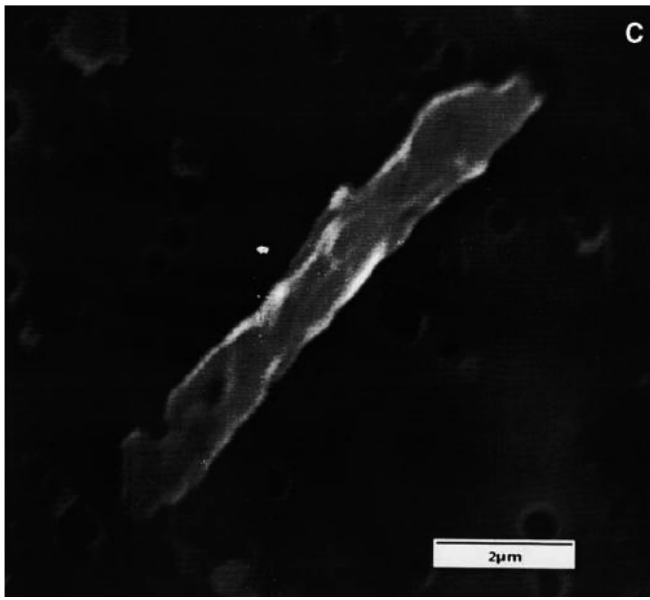
- Diagnostic Definitions
- Monitoring Protocols
- Treatment Protocols
- Disease Surveillance
- Outcomes
- Analytics & Research
- Quality Assurance
- Quality Improvement
- Programmatic Relationships
  - Patient Groups
  - Medical Community
  - Government

WTC RESPIRATORY RESEARCH: PAST/CURRENT

Bronchoalvelolar lavage in firefighter at Bellevue Hospital





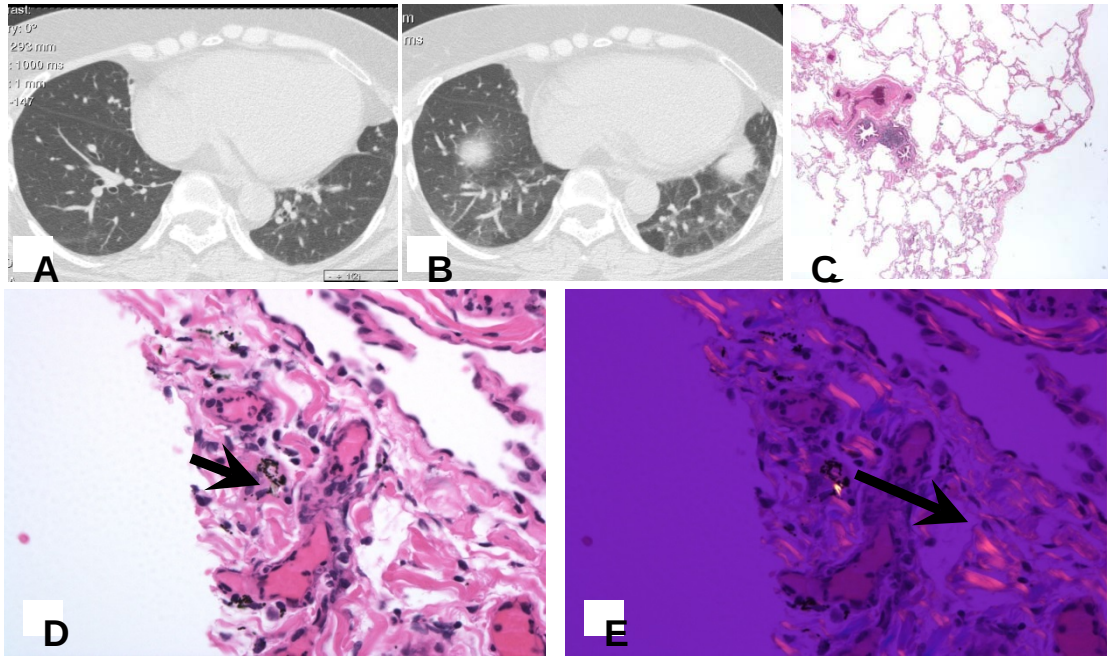


(*A*) Amosite asbestos fiber (uncoated) (B) Fly ash particle (*C*) Degraded fibrous glass.

- Environmental particles in the lung
- Large particles deep in the lung

Rom WN, Weiden M, Garcia R, Yie TA, Vathesatogkit P, Tse DB, McGuinness G, Roggli V, Prezant D
From NYU, HHC, FDNY

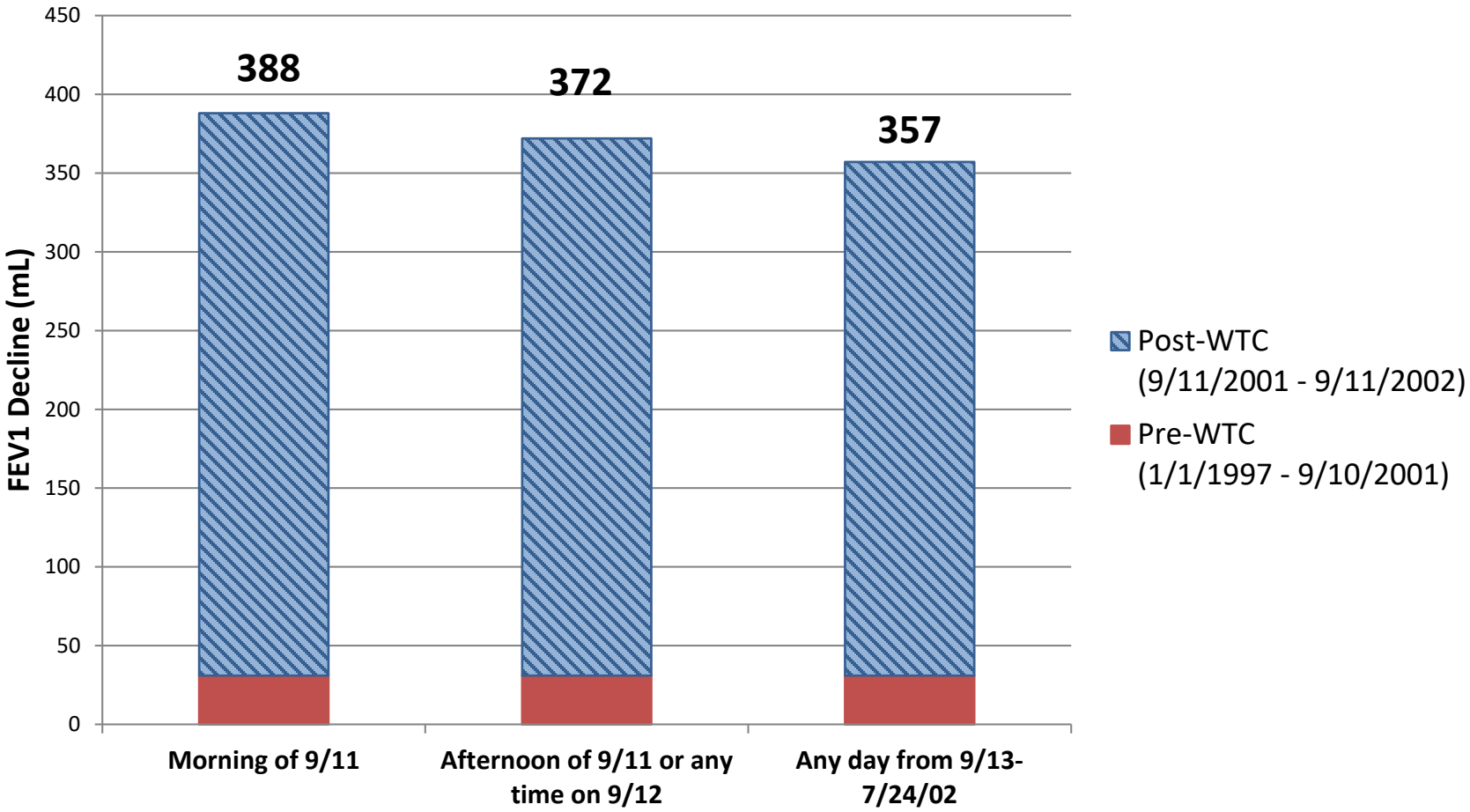
Pathologic analysis suggests destruction of alveoli, small airway inflammation



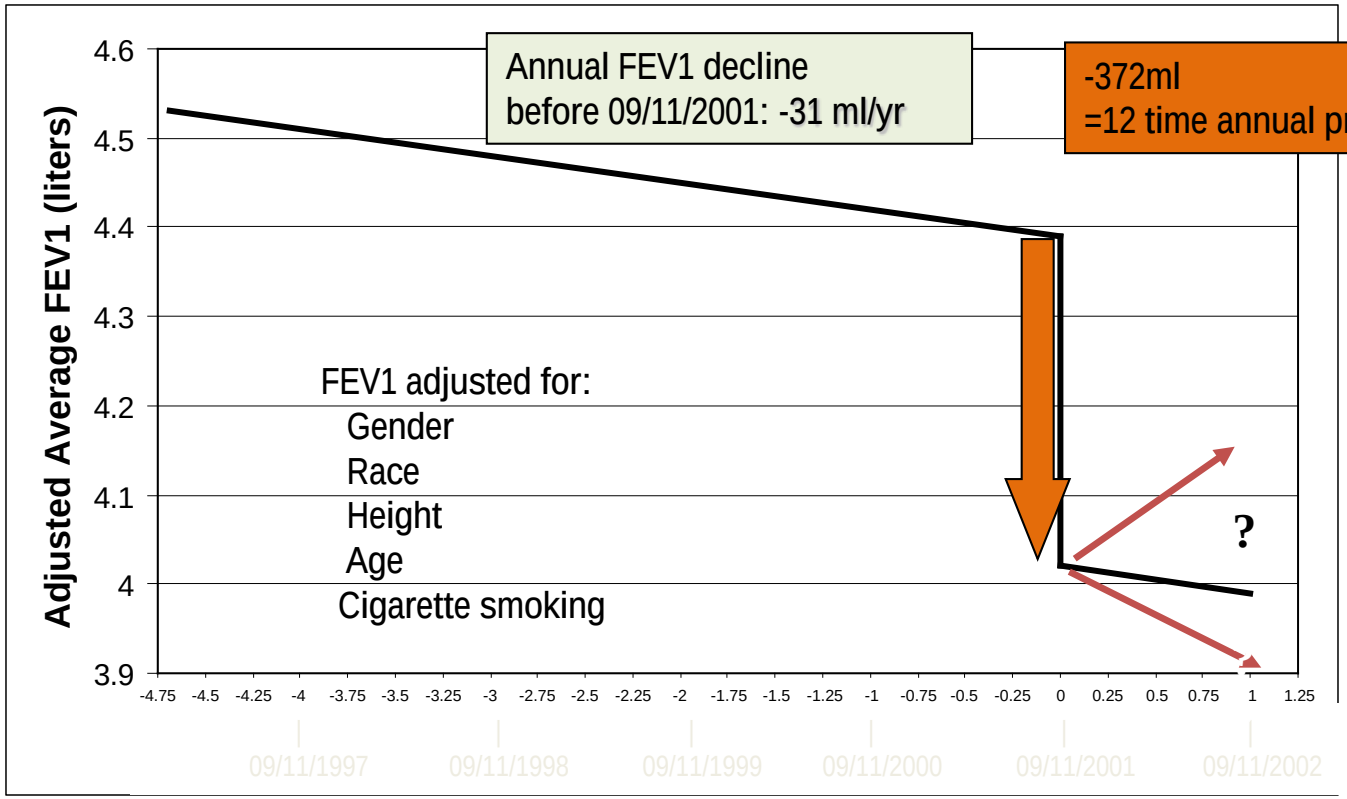
Scanning electron microscopy with energy dispersive x-ray spectroscopy (SEM-EDS) revealed silica, AlSi, Ti, Talc, Metals (steel, copper, chromium)

Caplan-Shaw CE, Yee H, Rogers L, Abraham JL, Parsia SS, Naidich DP, Borczuk A, Moreira A, Shiau MC, Ko JP, Brusca-Augello G, Berger KI, Goldring RM, Reibman J. J Occup Environ Med. 2011

Early Pulmonary Function Loss by WTC Arrival Time



FDNY PFT from MEDICALS Pre-WTC vs. 1- year Post-WTC Longitudinal FEV1 Decline

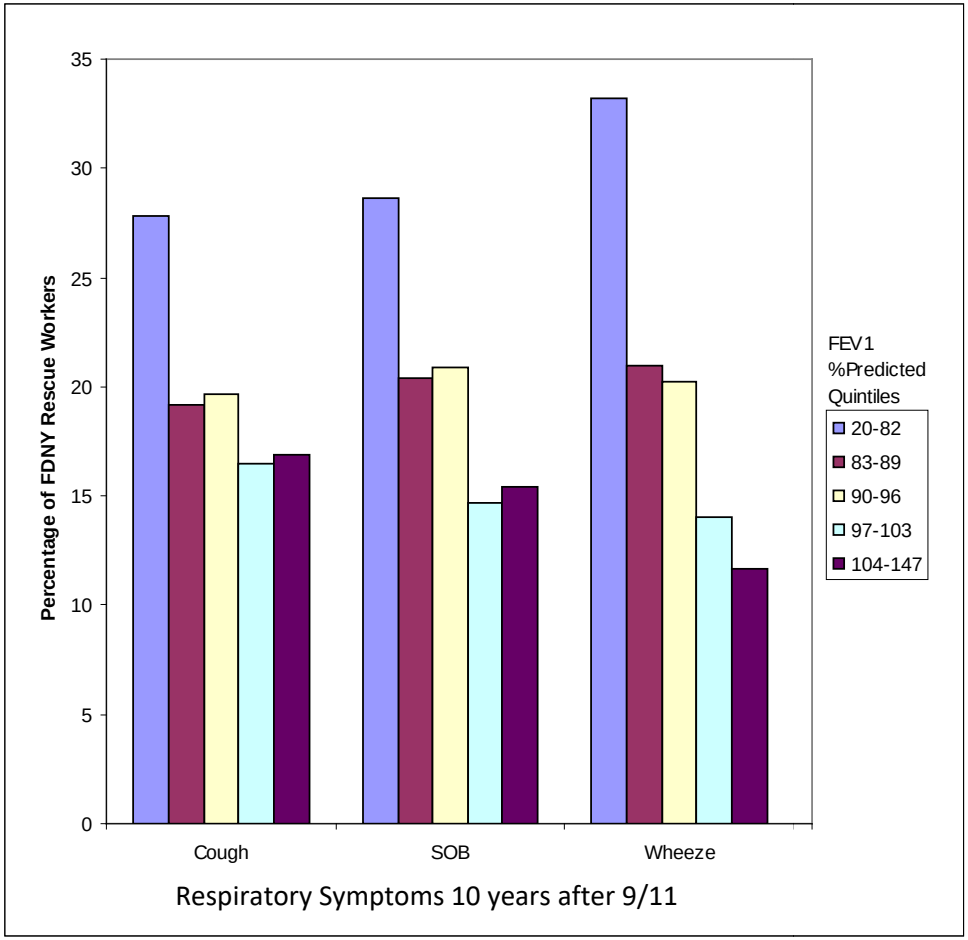


Not shown:
+ Significant Exposure Response Effect:
- Arrival Time
- Duration

Source: Banauch, Kelly, Prezant et al; Am J Respir Crit Care Med 2006

Past/Current WTC Research

Lung Function correlates with symptoms among FDNY Firefighters & EMS workers



Source: Webber et al 2011

2011

Respiratory Symptoms Were Associated With Lower Spirometry Results During the First Examination of WTC Responders

Iris Udasin, MD, Clyde Schechter, MD, Laura Crowley, MD, Anays Sotolongo, MD, Michael Gochfeld, MD, Benjamin Luft, MD, Jacqueline Moline, MD, Denise Harrison, MD, and Paul Enright, MD

Objective: Determine if World Trade Center (WTC) disaster responders had lower lung function and higher bronchodilator responsiveness than those with respiratory symptoms and conditions. **Methods:** We evaluated cardinal respiratory symptoms (dyspnea, wheezing, dry cough, productive cough) and determined the difference in FEV_1, FVC, and bronchodilator responsiveness. **Results:** All respiratory symptoms were associated with a lower FEV_1 and FVC, and a larger bronchodilator response. Responders reporting chronic productive cough, starting during WTC work and persisting, had a mean FEV_1 109 mL lower than those without chronic persistent cough; their odds of having abnormally low FEV_1 was 1.40 times higher; and they were 1.65 times as likely to demonstrate bronchodilator responsiveness. **Conclusions:** Responders reporting chronic persistent cough, wheezing or dyspnea at first medical examination were more likely to have lower lung function and bronchodilator responsiveness.

Severity of symptoms associated with abnormalities in small airways measured by Oscillometry (IOS) in WTC EHC

TABLE 4 Severity and frequency of wheeze and impulse oscillometry for the symptomatic cohort

	Subjects n	R_5 kPa·L^{-1}·s^{-1}	R_{5-20} kPa·L^{-1}·s^{-1}
Wheeze severity			
None	502	0.447 (0.212)	0.074 (0.087)
Mild	137	0.458 (0.260)	0.085 (0.123)
Moderate	128	0.473 (0.233)	0.102 (0.121)
Severe	67	0.503 (0.301)	0.113 (0.129)
p-value#		0.001	<0.0001
Wheeze frequency days per week			
0–1	524	0.441 (0.220)	0.076 (0.088)
2–6	194	0.461 (0.218)	0.086 (0.117)
7	100	0.510 (0.278)	0.126 (0.122)
p-value#		<0.01	0.0001

Data are presented as median (interquartile range) unless otherwise stated. R_5: resistance at an oscillating frequency of 5 Hz; R_{5-20}: difference in resistances measured at 5 and 20 Hz. #: Jonckheere–Terpstra test.

Berger KI, Turetz M, Liu M, Shao Y, Kazeros A, Parsia S, Caplan-Shaw C, Friedman SM, Maslow CB, Marmor M, Goldring RM, Reibman J.
ERJ Open Res. 2015

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NYU School of Medicine
NYU LANGONE MEDICAL CENTER

Lung Function

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 APRIL 8, 2010 VOL. 362 NO. 14

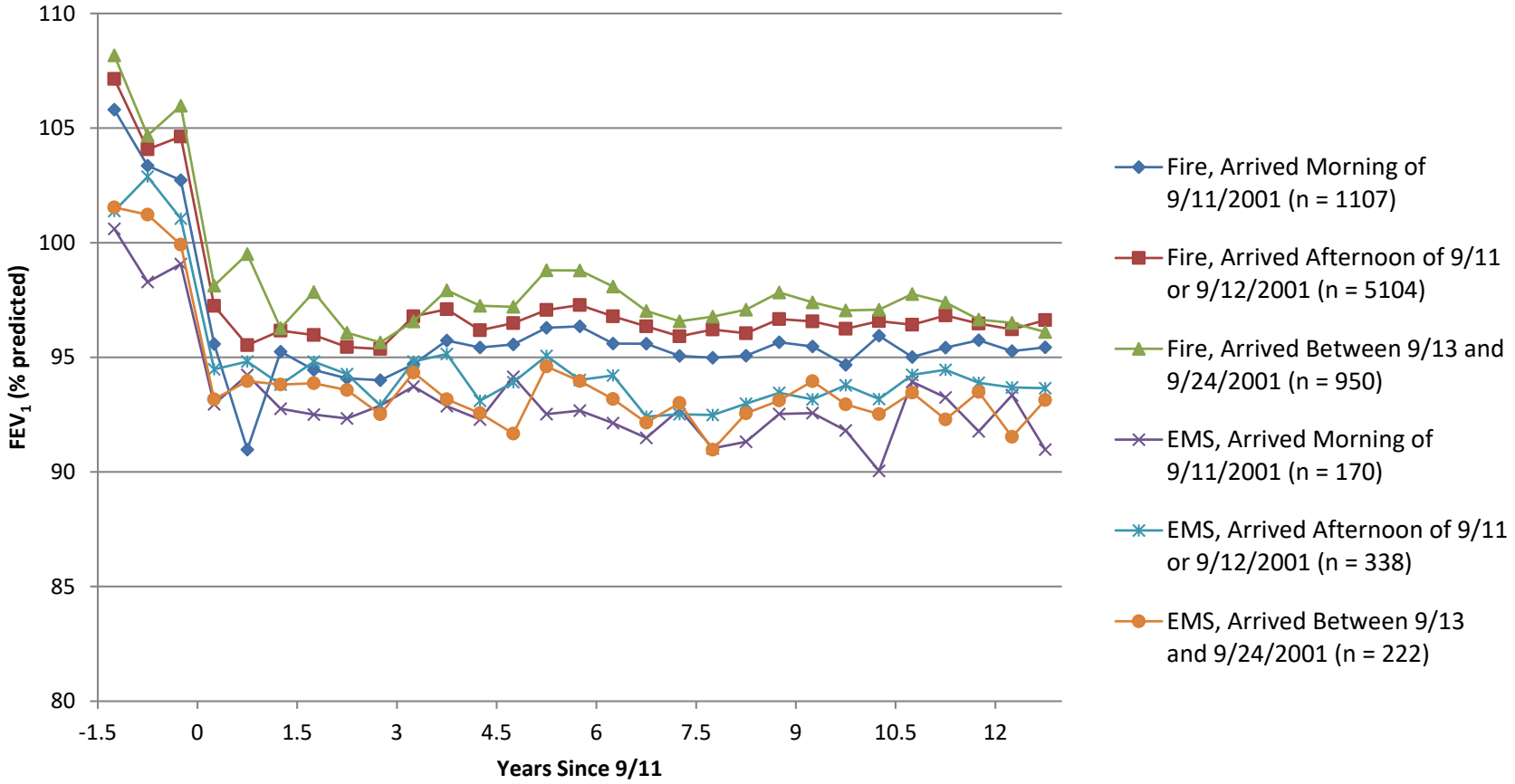
Lung Function in Rescue Workers at the World Trade Center after 7 Years

Thomas K. Aldrich, M.D., Jackson Gustave, M.P.H., Charles B. Hall, Ph.D., Hillel W. Cohen, Dr.P.H., Mayris P. Webber, Dr.P.H., Rachel Zeig-Owens, M.P.H., Kaitlyn Cosenza, B.A., Vasilios Christodoulou, B.A., Lara Glass, M.P.H., Fairouz Al-Othman, M.D., Michael D. Weiden, M.D., Kerry J. Kelly, M.D., and David J. Prezant, M.D.

Aim: To assess the longer-term lung function trends in FDNY workers exposed to WTC dust

On average, did the initial decline in lung function recover, persist or worsen?

Pulmonary Function over Time in Firefighters and EMS workers



2009

Longitudinal Assessment of Spirometry in the World Trade Center Medical Monitoring Program*

Gwen S. Skloot, MD; Clyde B. Schechter, MD; Robin Herbert, MD; Jacqueline M. Moline, MD; Stephen M. Levin, MD; Laura E. Crowley, MD; Benjamin J. Luft, MD; Iris G. Udasin; and Paul L. Enright, MD, FCCP

Background: **Multiple studies have demonstrated an initial high prevalence of spirometric abnormalities following World Trade Center (WTC) disaster exposure. We assessed prevalence of spirometric abnormalities and changes in spirometry between baseline and first follow-up evaluation in participants in the WTC Worker and Volunteer Medical Monitoring Program. We also determined the predictors of spirometric change between the two examinations.**

Methods: **Prebronchodilator and postbronchodilator spirometry, demographics, occupational history, smoking status, and respiratory symptoms and exposure onset were obtained at both examinations (about 3 years apart).**

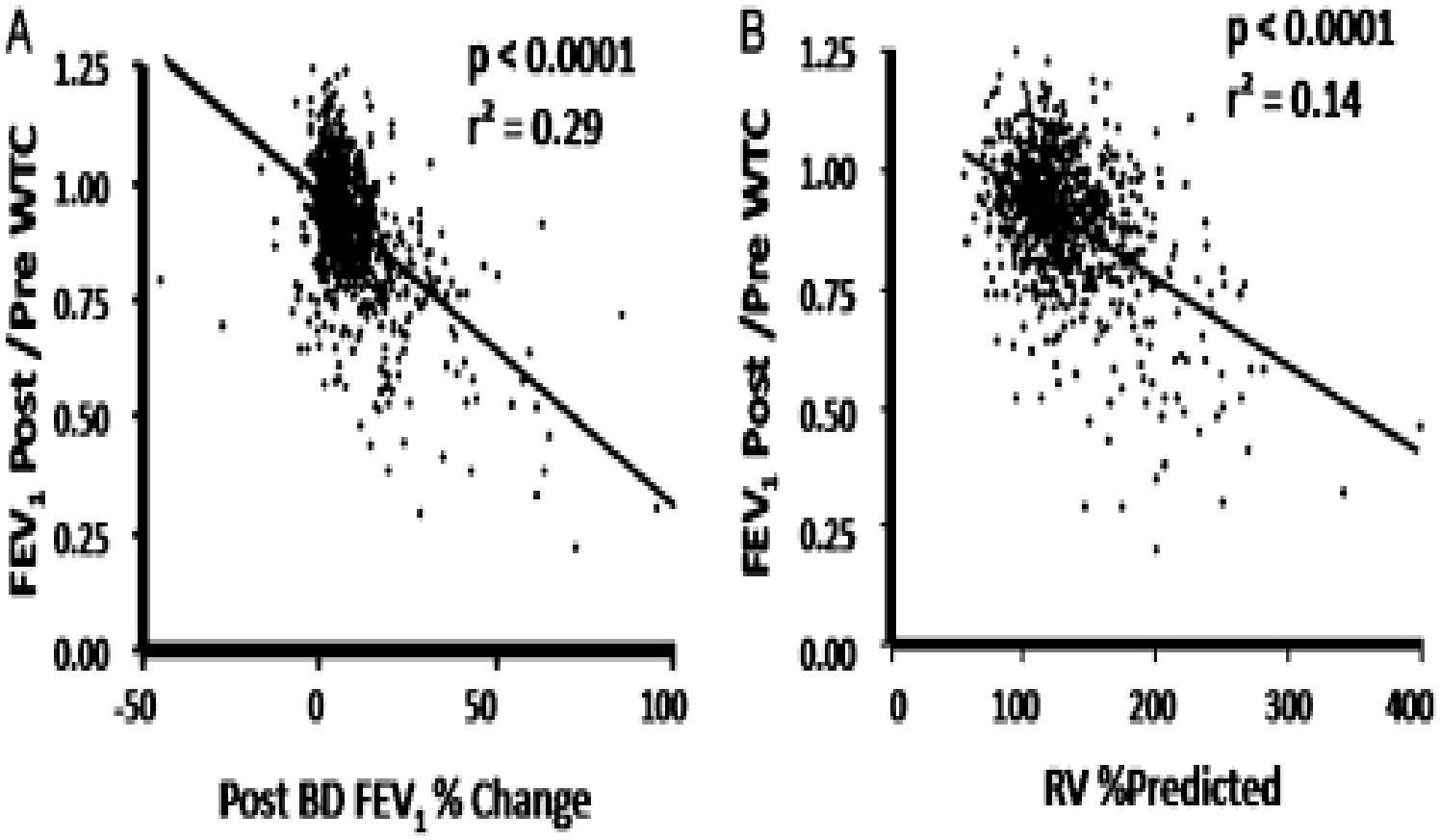
Results: **At the second examination, 24.1% of individuals had abnormal spirometry findings. The predominant defect was a low FVC without obstruction (16.1%). Between examinations, the majority of individuals did not have a greater-than-expected decline in lung function. The mean declines in prebronchodilator FEV_1 and FVC were 13 mL/yr and 2 mL/yr, respectively (postbronchodilator results were similar and not reported). Significant predictors of greater average decline between examinations were bronchodilator responsiveness at examination 1 and weight gain.**

Conclusions: **Elevated rates of spirometric abnormalities were present at both examinations, with reduced FVC most common. Although the majority had a normal decline in lung function, initial bronchodilator response and weight gain were significantly associated with greater-than-normal lung function declines. Due to the presence of spirometric abnormalities > 5 years after the disaster in many exposed individuals, longer-term monitoring of WTC responders is essential.** ***(CHEST 2009; 135:492–498)***

Key words: bronchodilator response; occupational lung disease; spirometry; weight gain; World Trade Center

Abbreviations: BMI = body mass index; LLN = lower limit of normal; RADS = reactive airway dysfunction syndrome; WTC = World Trade Center

Underlying Cause of Pulmonary Function Loss is Obstructive Airways Disease



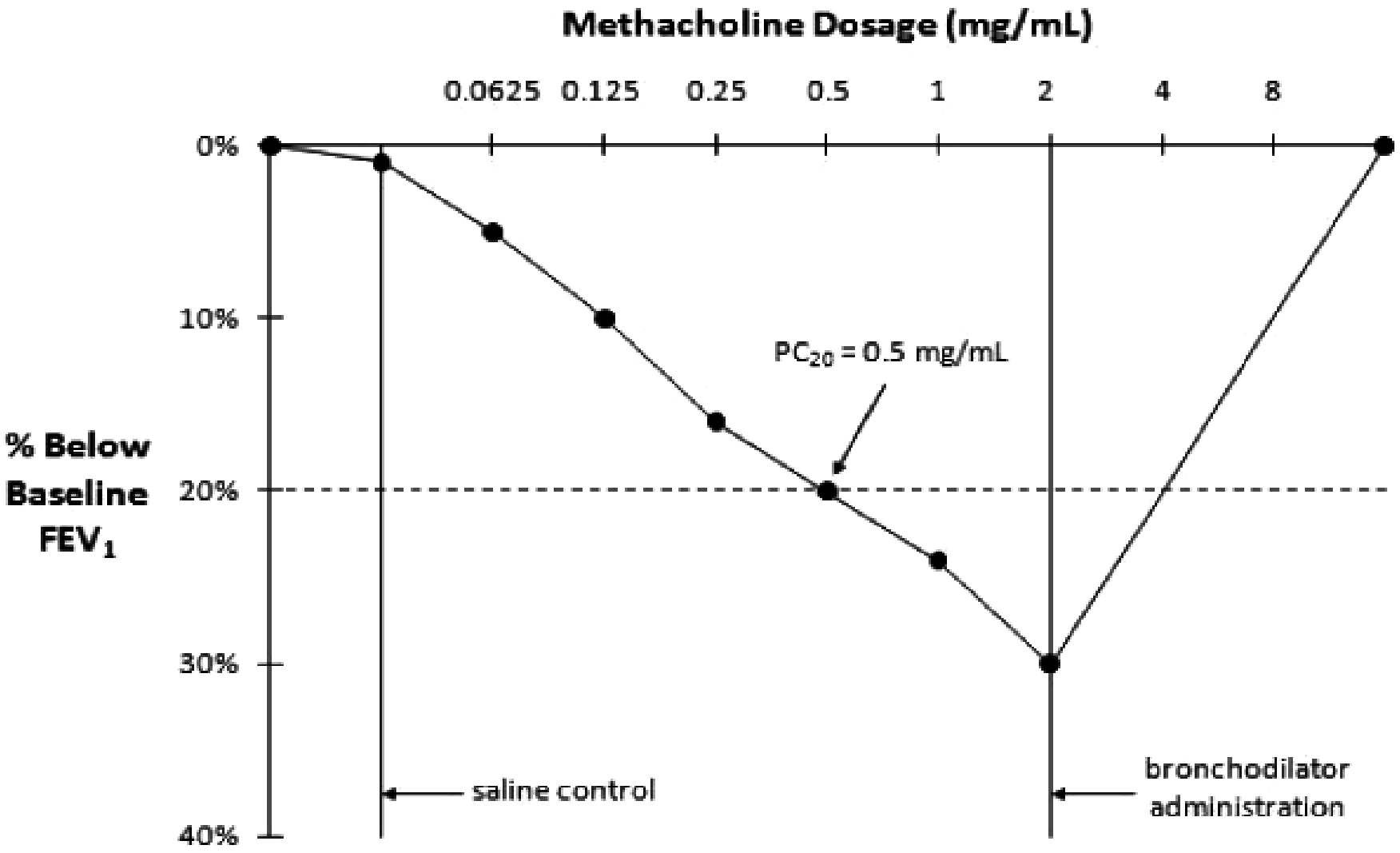
Conundrum - most patients in the WTC EHC had normal large airway function (spirometry)

Spirometry pattern	Total N=1109
Normal, N (%)	790 (71)
Obstructed, N (%)	67 (6)
Low FVC, N (%)	224 (20)
Obstructed and low FVC, N (%)	28 (3)

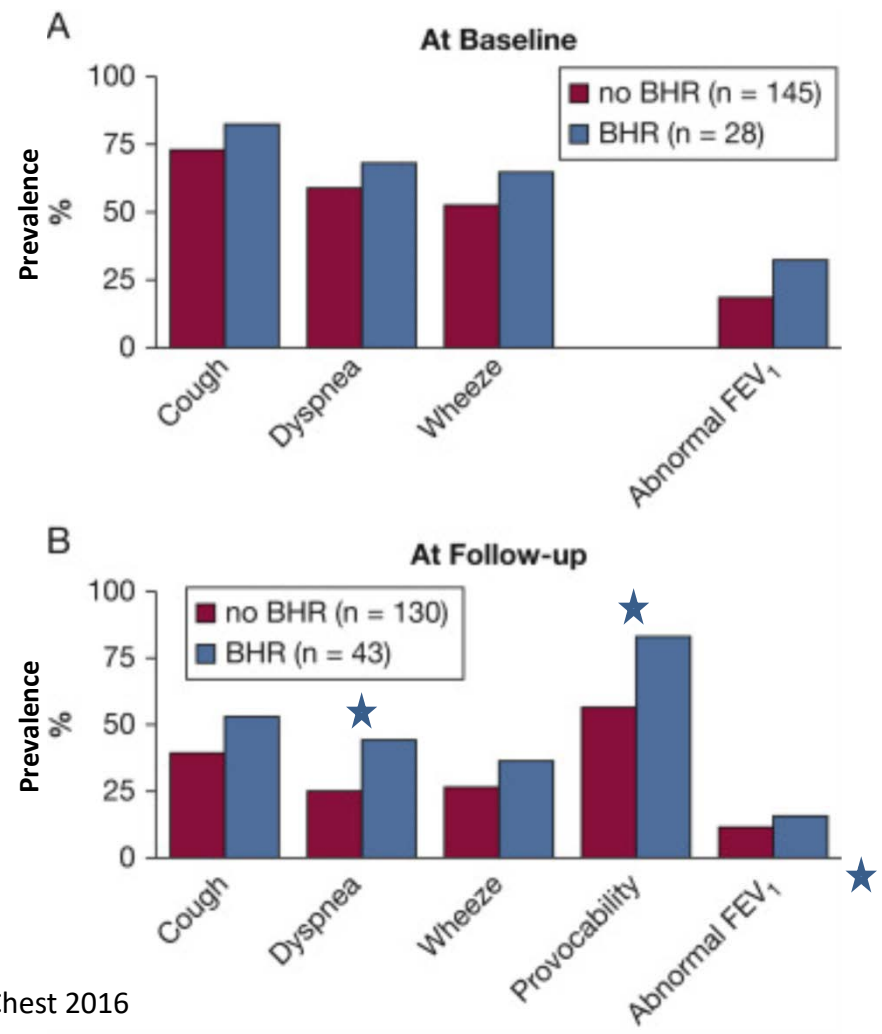
[1] If $FEV_1/FVC < LLN_{FEV_1/FVC}$ and $FVC > LLN_{FVC}$
[2] If $FVC < LLN_{FVC}$ and If $FEV_1/FVC > LLN_{FEV_1/FVC}$
[3] If $FEV_1/FVC < LLN_{FEV_1/FVC}$ and $FVC < LLN_{FVC}$

Source: Reibman J, Liu M, Cheng Q, Liautaud S, Rogers L, Lau S, Berger KI, Goldring RM, Marmor M, Fernandez-Beros ME, Tonorezos ES, Caplan-Shaw CE, Gonzalez J, Filner J, Walter D, Kyng K, Rom WN. J Occup Environ Med. 2009

Lung Function: Hyperreactivity



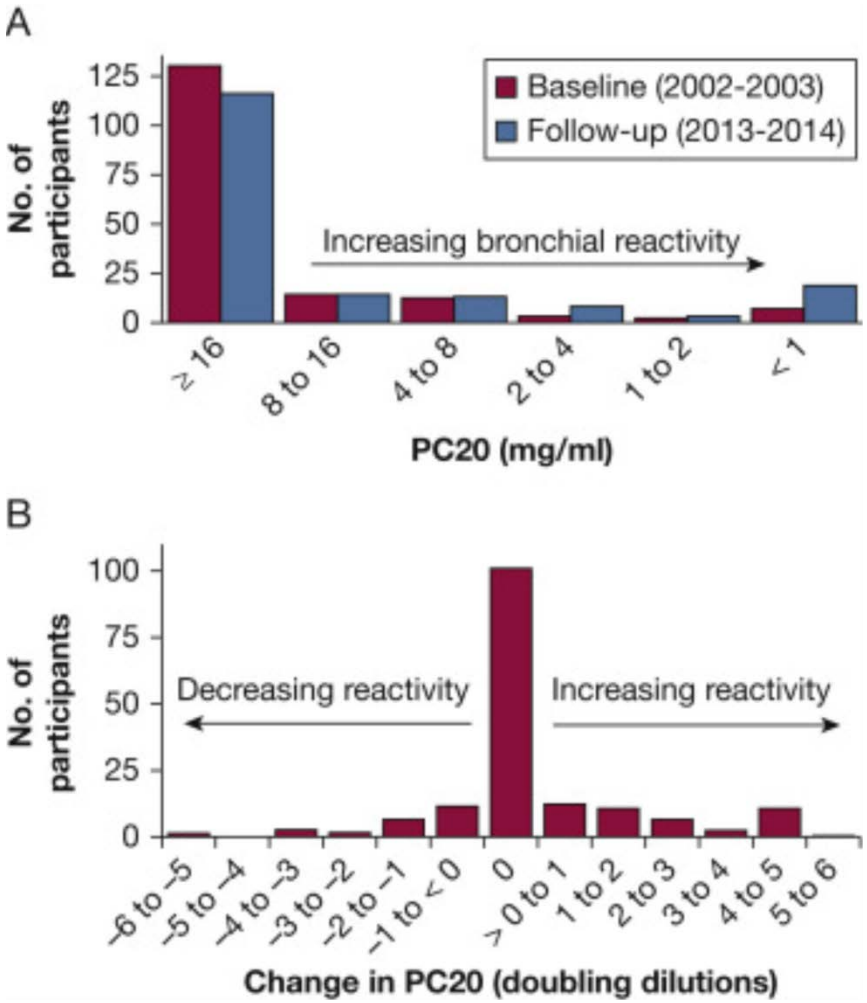
Lung Function: Hyperreactivity



Ref: Aldrich et al Chest 2016

- Baseline MCT within 2 years of 9/11
- Follow-up MCT 10-12 yrs after 9/11
- Hyperreactivity was associated with a greater decline in FEV_1
- Overall symptom prevalence was higher in those with hyperreactivity at both time points

Lung Function: Hyperreactivity



Hyperreactivity at follow up:

- Persistent and slight increase
- More people had increased hyperreactivity than decreased

ULRS study – Despite aggressive treatment, many had persistent airway hyperresponsiveness

+ AHR after methacholine challenge	N (%)
PC20 ≤ 4 mg	24 (40)
PC20 ≤ 16 mg	34 (57)

Caplan-Shaw C, Xu N, Liu M, Shao Y, Kazeros A, Cotrina M, …Reibman J
ATS abstract 2017

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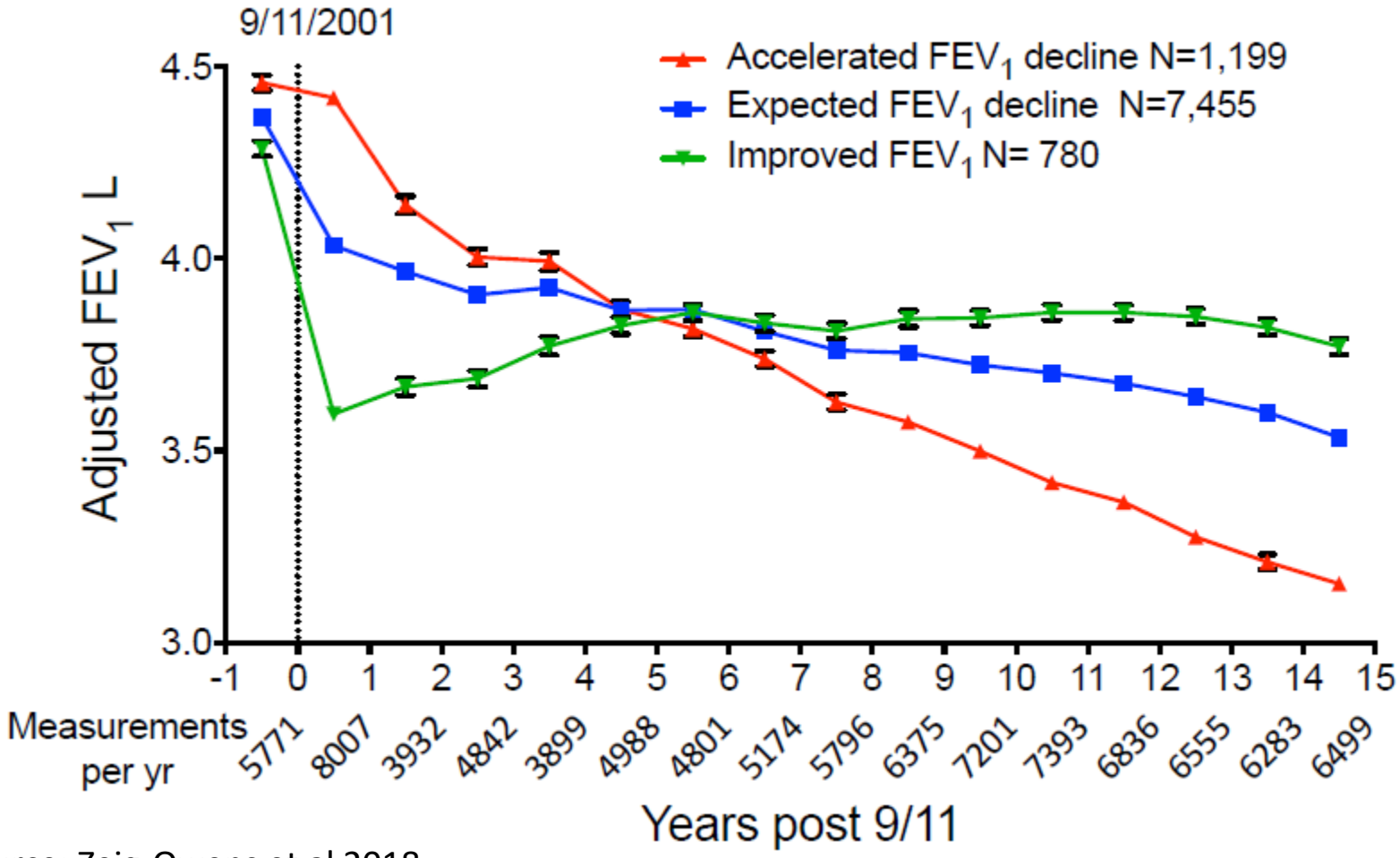
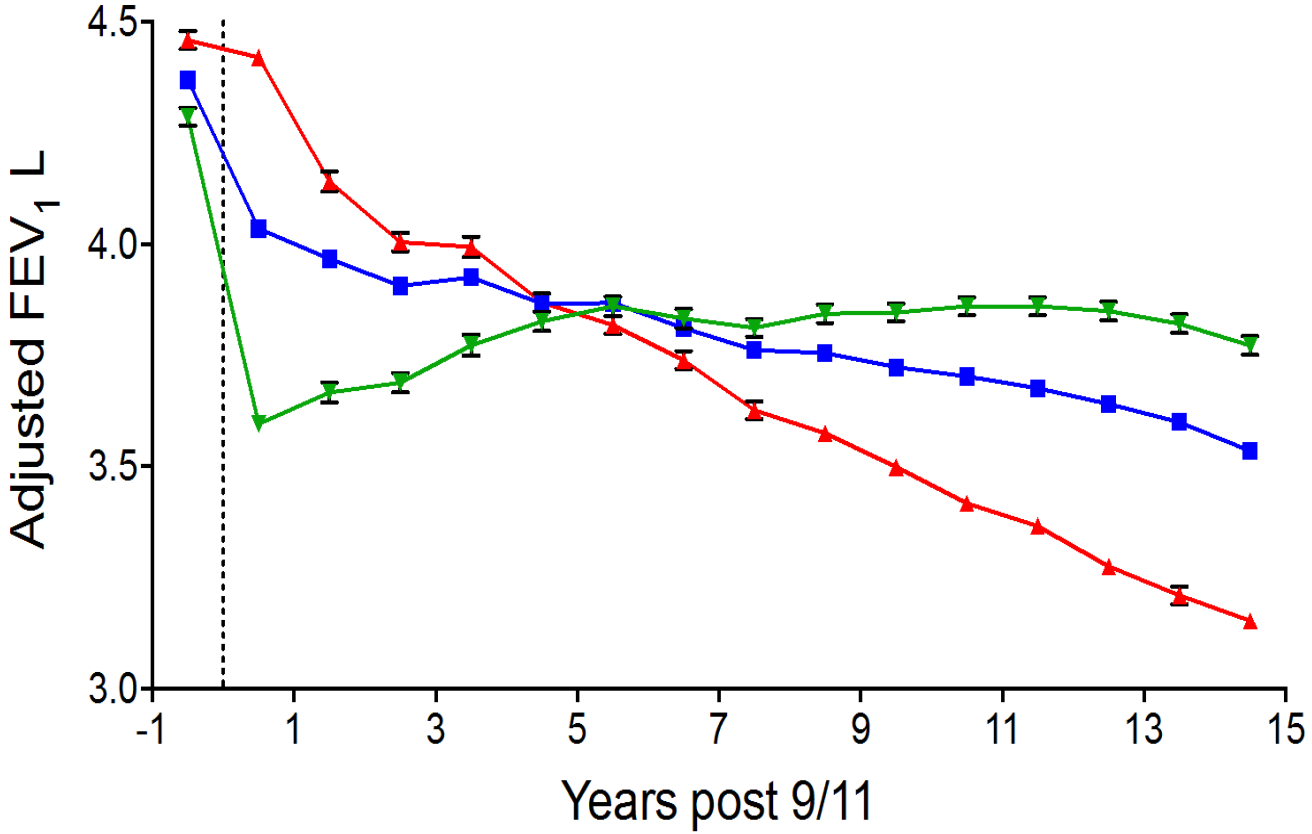
Lung Function Decline

Some are more vulnerable than others



Source: Zeig-Owens et al 2018

FEV_1 decline after WTC exposure predicts post exposure FEV_1 slope



FEV_1 trajectory is associated with Bronchodilator (BD) response

	N=2,059	
	OR	p
Age per years	1.023	0.016
First post-9/11 FEV1	0.96	< 0.001
Ever-Smoker	0.921	0.495
Post-BD Improved-FEV_1		
Expected-FEV_1-Decline	1.559	0.057
Accelerated-FEV_1-Decline	2.345	0.002

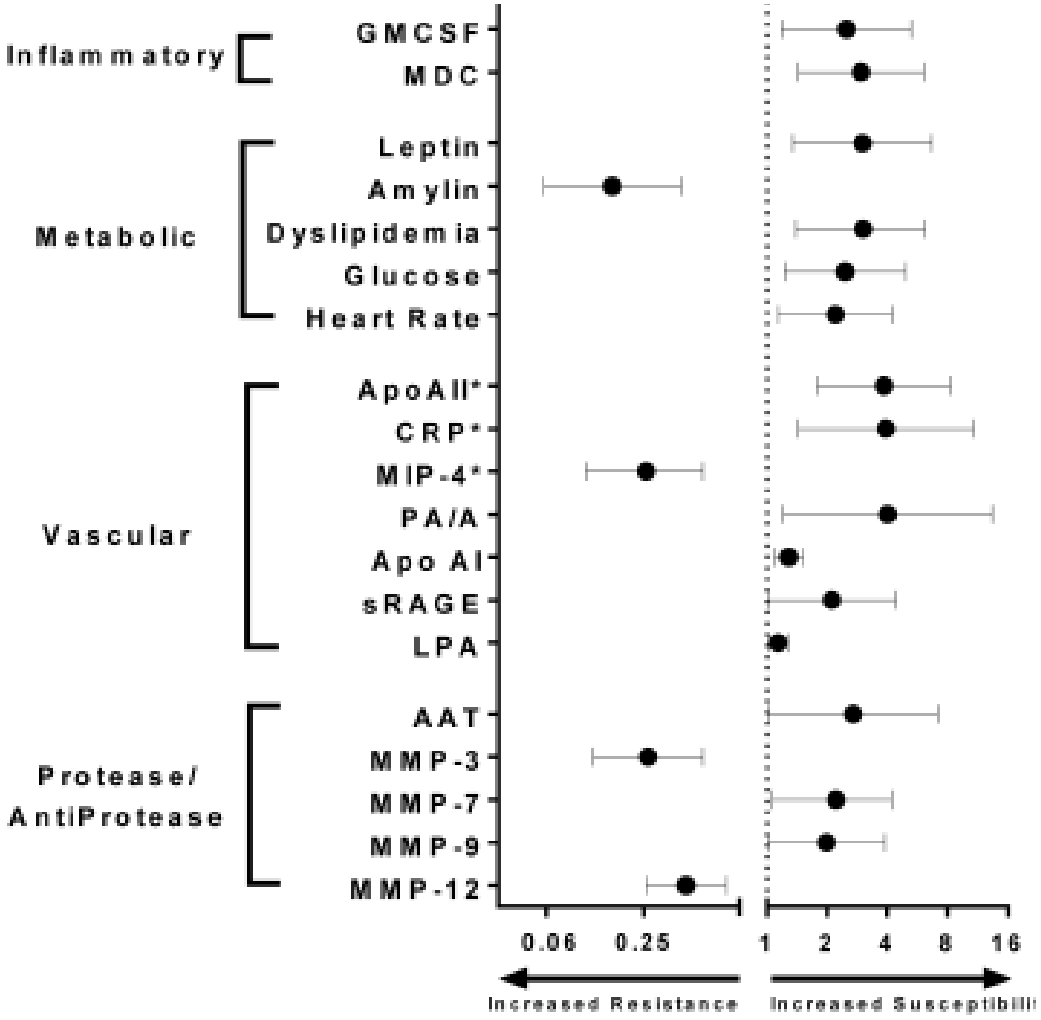
* Adjusted for race, WTC Arrival time

Biomarkers & Respiratory Disease

- Association of Lung Function with
  - Alpha-1 antitrypsin deficiency and FEV1 decline
  - MMP-1 and reduced odds of recovery
  - MMP-2 and TIMP-1 and regaining lung function
  - Lipid metabolites, CRP**,** apolipoprotein A2 and FEV1 decline
  - Triglycerides, HDL, leptin levels and FEV1 decline
  - Metabolic Syndrome and FEV1 decline
  - MDC and GM-CSF and FEV1 decline
  - Eosinophil and neutrophil concentrations were significantly associated with greater FEV_1 decline after 9/11

Serum Biomarkers of inflammation and metabolic syndrome predict abnormal FEV_1 in WTC exposed firefighters

Weiden et al., 2016

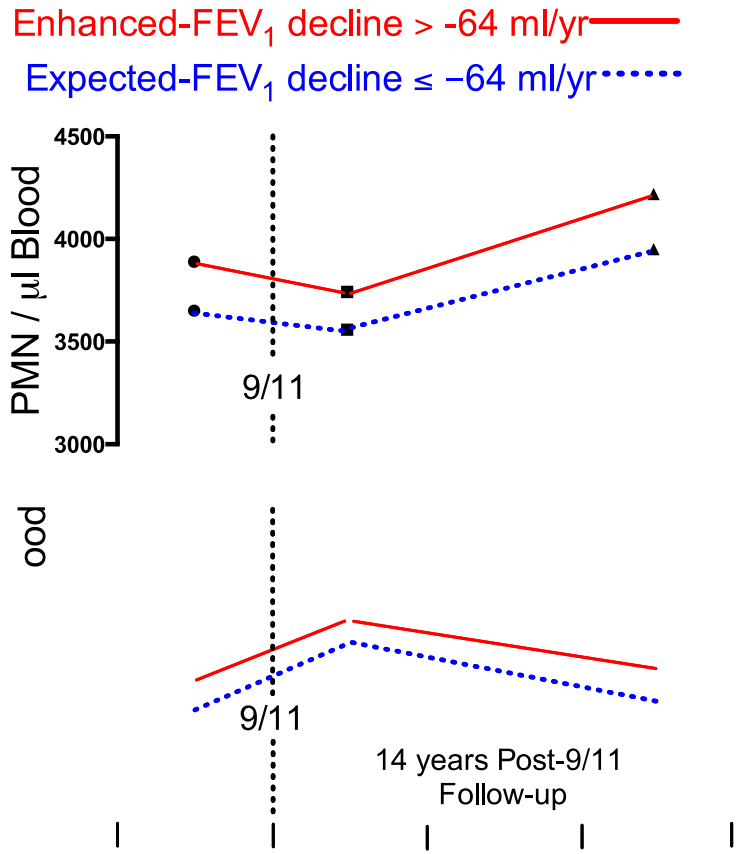


Inflammatory cells, age, smoking and weight predict accelerated-FEV_1-decline

Variable	N=9,402 OR	95%CI	p
Age per years	1.62	1.49-1.77	< 0.001
First post-9/11 FEV_1	1.05	1.05-1.06	< 0.001
Neutrophils 1,000 cell/μl	1.09	1.041-1.14	< 0.001
Eosinophils 100 cells/μl	1.10	1.047-1.15	< 0.001
Never smoker reference			
Former smoker	1.48	1.29-1.70	< 0.001
Current smoker	3.00	2.22-4.05	< 0.001
First post-9/11 BMI	1.02	1.00-1.04	0.045
Weight Gain	1.76	1.52-2.03	< 0.001

* Adjusted for race, WTC Arrival time

Longitudinal association between accelerated FEV_1 decline and inflammatory cells



Peripheral eosinophils associated with wheeze and airway obstruction

Category	High Eos N = 176	Low Eos N = 964	OR[†]	P value
Spirometry pattern, n (%)				
Normal	117 (66)	735 (76)	1	
Obstructed [a]	27 (16)	70 (7)	2.42	0.0002
Low FVC [b]	32 (18)	159 (17)	1.27	NS

Kazeros et al. J Asthma. 2013; 1 :25-32

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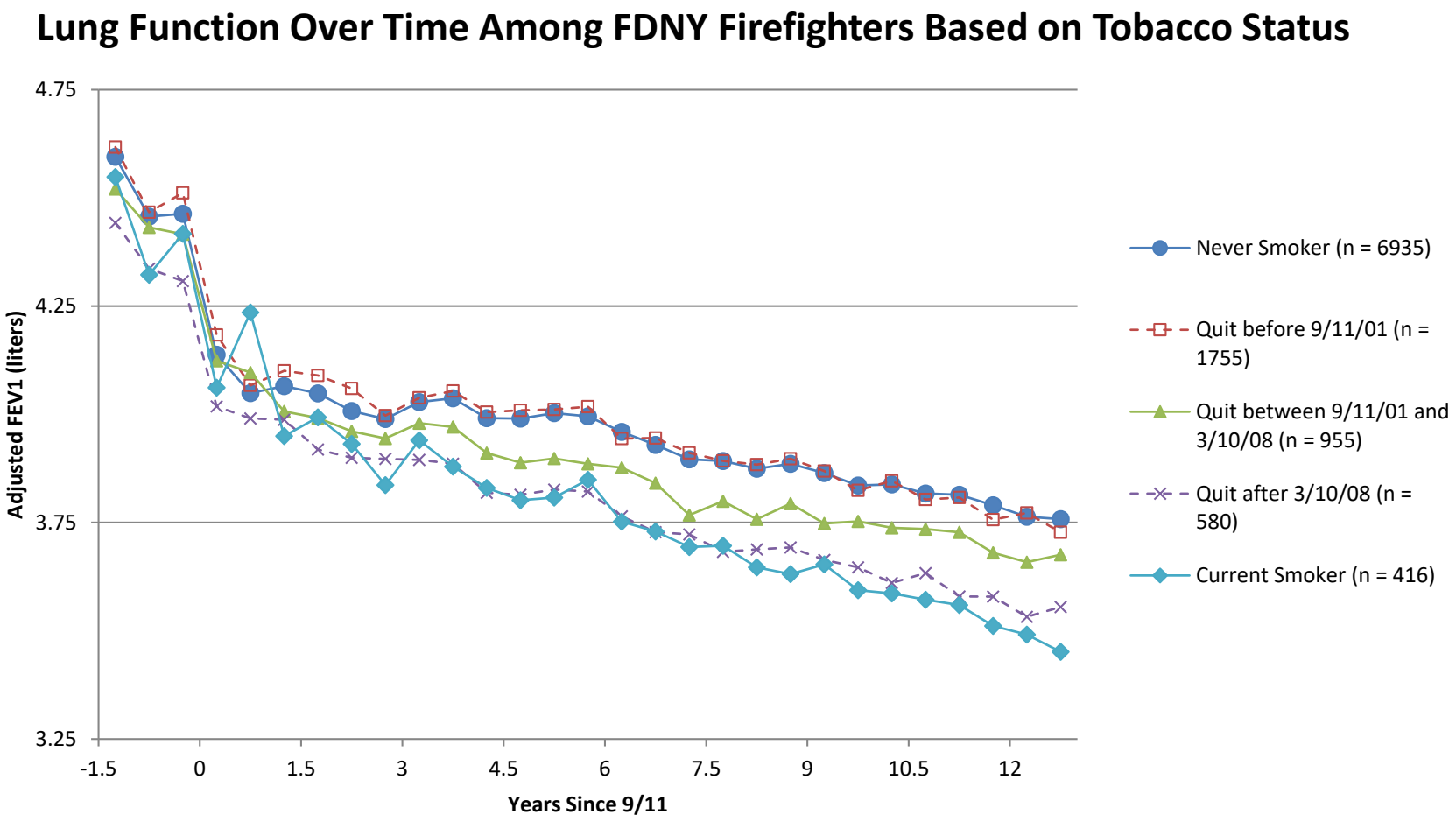
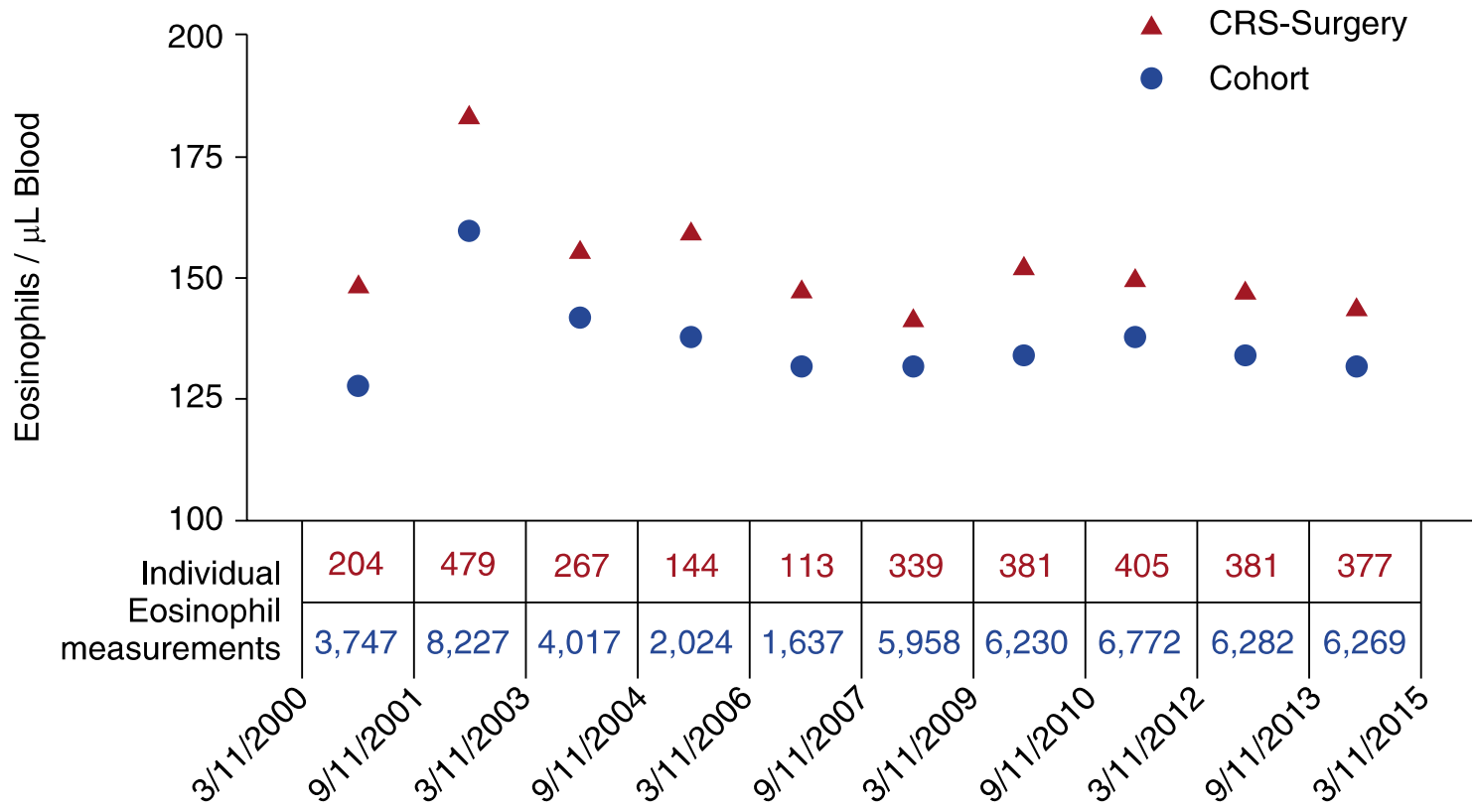
Lung Function Can Be Influenced



Source: Aldrich et al Chest 2016

Blood eosinophil counts predict WTC-related Upper airway disease (ex. sinus surgery)

Kwon et al., 2016
Ann Am Thorac Soc



RECOMMENDATIONS

Recommendation #1

- To analyze the trajectory of respiratory symptoms and pulmonary function over time
  - Identify the measures of lung function change over time (longitudinal change) that best define the subgroups with the most vulnerable and most resistant to decline.
  - What are the genetic, metabolic and biomarkers that can be measured today that define these subgroups?

Recommendation #2

- Conduct disease course/responsiveness studies to define the biologic mechanisms responsible for vulnerability and resistance to disease

Recommendation #3

- Conduct etiologic genetics studies for WTC-related diseases of interest (chosen based on prevalence, incidence & severity)
  - Pilot studies should include:
    - Collection of post-WTC-exposure specimens (such as induced sputum, nasal swabs/washes, breath condensates and blood specimens)
    - Take advantage of advances in transcriptomics, metabolomics and genomics
  - Studies would help to define
    - factors associated with vulnerability and resistance to WTC-related diseases
    - Treatment modalities focused in response to these factors

Recommendation #4

- Identify specific patients with poor response to standard treatment for respiratory disease using:
  - measures of lung function and biomarkers that best characterize response or lack of response to treatment

Recommendation #5

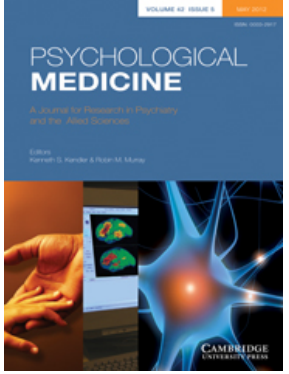
- Utilize the information gained from a better understanding of the mechanisms responsible for ongoing pulmonary injury (Recommendations 1-4) to then design, implement and evaluate interventions to improve control of respiratory symptoms and quality of life

Recommendation #6

- Further define the relationship between other 9/11-related comorbidities and respiratory symptoms/disease in this population
  - Define the relationship between comorbidities and severity of respiratory disease/ control of respiratory disease
  - Comorbidities with conditions such as Tobacco Addiction, GERD, Sinusitis, Allergies, Coronary Vascular Disease, PTSD, Depression, and Anxiety

2011

Exposure, probable PTSD and lower respiratory illness among World Trade Center rescue, recovery and clean-up workers



B. J. Luft[1], C. Schechter[2], R. Kotov[3], J. Broihier[1], D. Reissman[4], K. Guerrera[1], I. Udasin[5], J. Moline[6], D. Harrison[7], G. Friedman-Jimenez[7], R. H. Pietrzak[8,9], S. M. Southwick[8,9] and E. J. Bromet[3]*

Background. Thousands of rescue and recovery workers descended on the World Trade Center (WTC) in the wake of the terrorist attack of September 11, 2001 (9/11). Recent studies show that respiratory illness and post-traumatic stress disorder (PTSD) are the hallmark health problems, but relationships between them are poorly understood. The current study examined this link and evaluated contributions of WTC exposures.

Method. Participants were 8508 police and 12333 non-traditional responders examined at the WTC Medical Monitoring and Treatment Program (WTC-MMTP), a clinic network in the New York area established by the National Institute for Occupational Safety and Health (NIOSH). We used structural equation modeling (SEM) to explore patterns of association among exposures, other risk factors, probable WTC-related PTSD [based on the PTSD Checklist (PCL)], physician-assessed respiratory symptoms arising after 9/11 and present at examination, and abnormal pulmonary functioning defined by low forced vital capacity (FVC).

Results. Fewer police than non-traditional responders had probable PTSD (5.9% *v.* 23.0%) and respiratory symptoms (22.5% *v.* 28.4%), whereas pulmonary function was similar. PTSD and respiratory symptoms were moderately correlated ($r = 0.28$ for police and 0.27 for non-traditional responders). Exposure was more strongly associated with respiratory symptoms than with PTSD or lung function. The SEM model that best fit the data in both groups suggested that PTSD statistically mediated the association of exposure with respiratory symptoms.

Conclusions. Although longitudinal data are needed to confirm the mediation hypothesis, the link between PTSD and respiratory symptoms is noteworthy and calls for further investigation. The findings also support the value of integrated medical and psychiatric treatment for disaster responders.

Received 3 August 2011; Revised 2 October 2011; Accepted 14 October 2011; First published online 18 November 2011

Recommendation #7

- Develop comprehensive holistic treatment strategies based on knowledge gained from evaluating comorbid conditions that are known risk factors for poor control of respiratory disease

CANCER RESEARCH

World Trade Center and Cancer

- Studies have shown a possible relationship between WTC-exposure and cancer
- In 2011 FDNY published the first cancer study among WTC exposed
  - Cohort of 8,927 WTC-exposed firefighters
  - Study period 1996 through 2008
- We found:
  - Risk of all cancers among WTC-exposed male firefighters slightly higher than US male population but difference was not significant (standardized incidence ratio (SIR) 1.10)
  - Risk for thyroid cancer, prostate cancer and non-Hodgkin lymphoma were significantly higher than US male population
  - Risk of lung cancer was significantly lower than US male population
  - Risk of cancer among non-WTC-exposed male firefighters was lower than the US male population, for most cancers

Reference: Zeig-Owens Lancet. 2011

World Trade Center and Cancer

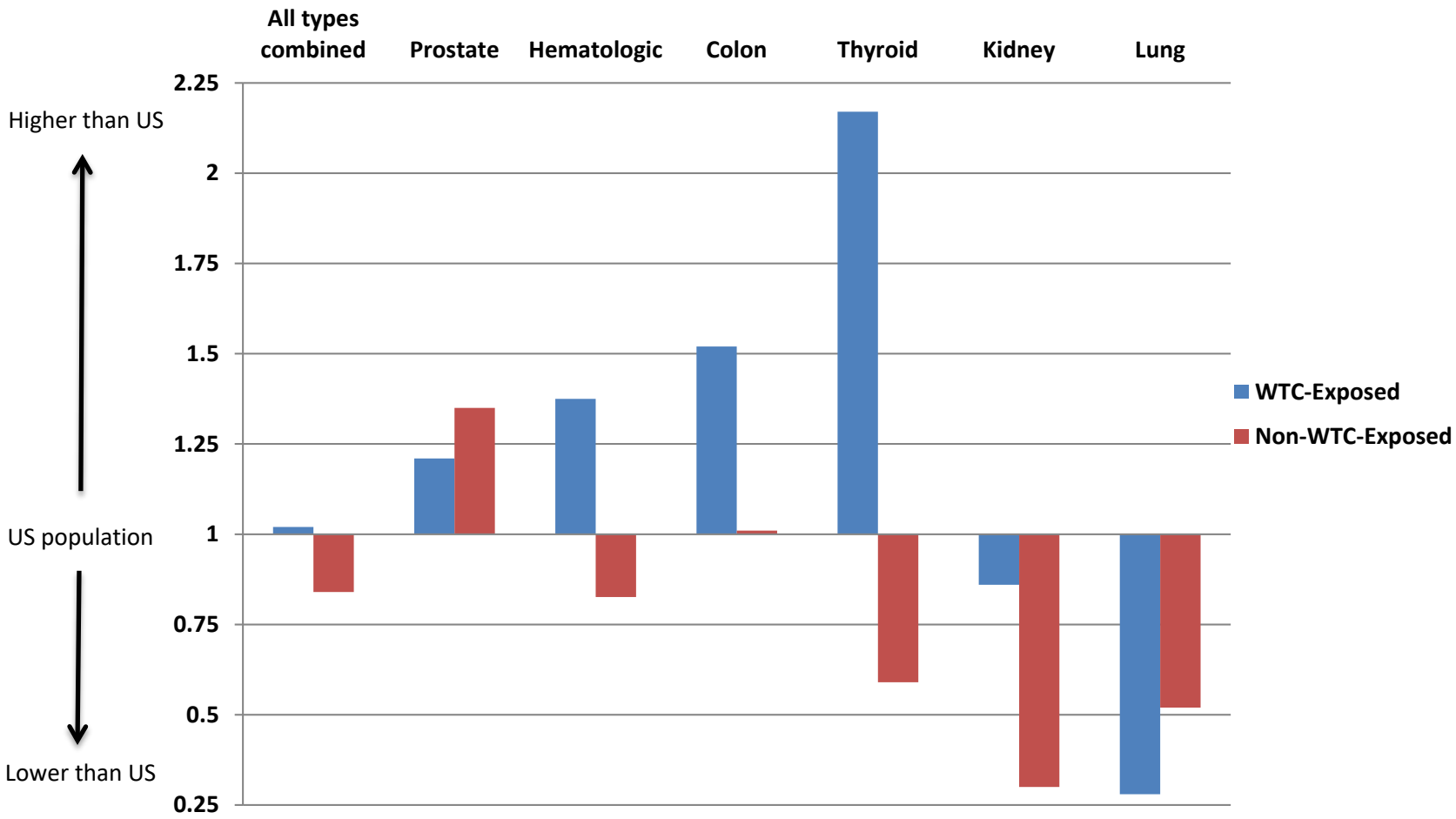
- These findings were replicated in 2 other WTC rescue/recovery worker cohorts
  - 2 studies through 2008 and 1 recent study through 2011

		Zeig-Owens et al 2011	Li et al, 2012	Li et al, 2016	Solan et al, 2013
SIR (95% CI)	All cancer	1.02 (0.90-1.15)	1.14 (0.99-1.30)	1.11 (1.03-1.20)	1.06 (0.94-1.18)
	Thyroid	2.17 (1.23-3.82)	2.02 (1.07-3.45)	1.79 (1.26-2.47)	3.12 (2.04-4.57)
	Prostate	1.21 (0.96-1.52)	1.43 (1.11-1.82)	1.43 (1.25-1.63)	1.23 (0.98-1.53)

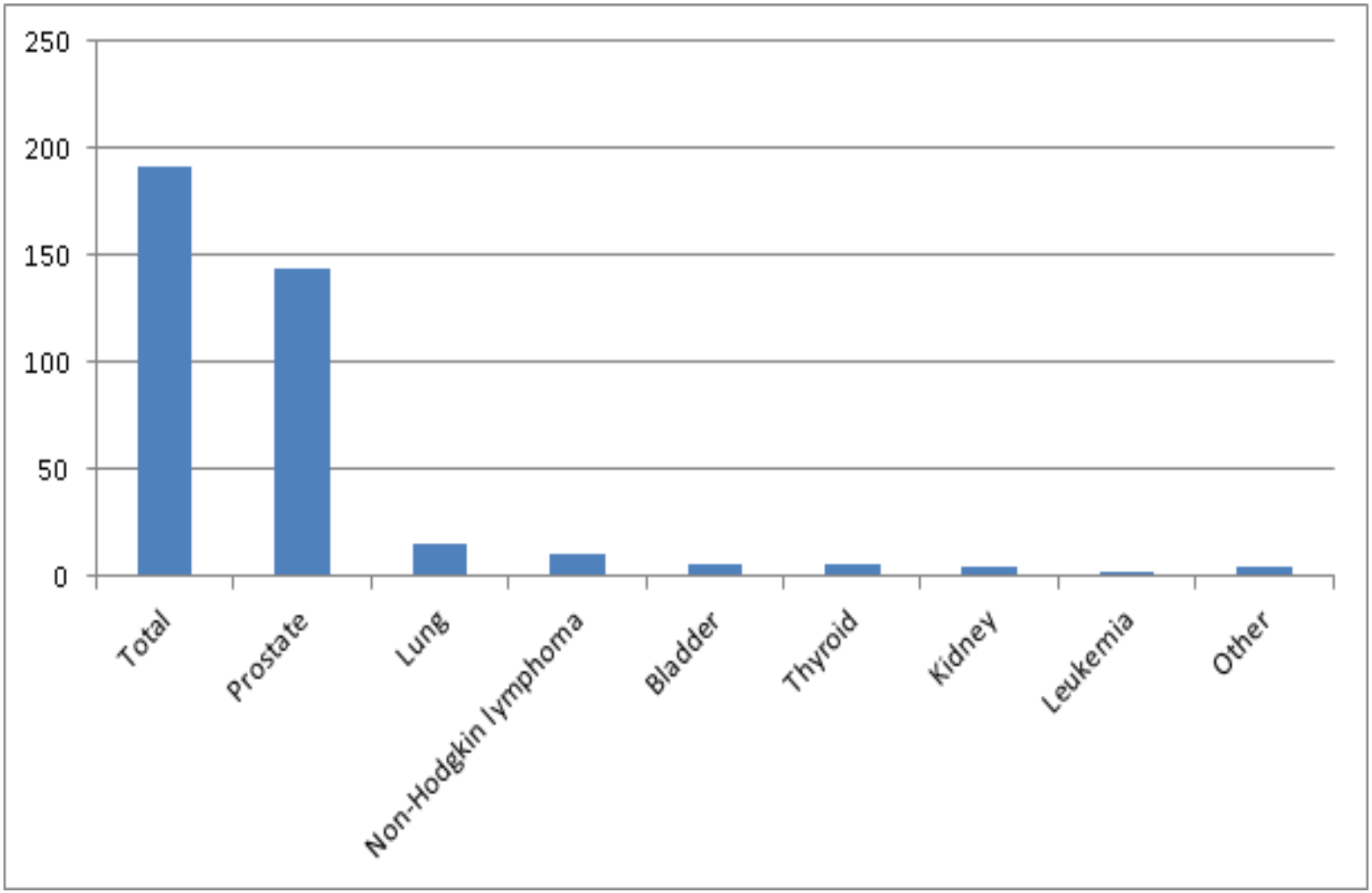
- Common findings:
  - All of the studies also reported significantly higher rates of thyroid cancer
  - Prostate cancer was elevated in all the cohorts
  - No exposure gradient was found
- Most recent study reported significantly higher rate of all cancers compared with the general population (SIR 1.11, CI 1.03-1.20)

References: Li J et al, JAMA 2012, Solan S et al, EHP 2013 and Li J et al AJIM 2016

Cancers Cases in the WTC-Exposed and Non-WTC-Exposed FDNY Firefighters 9/11/01 through 9/10/11 as Compared with the US Population



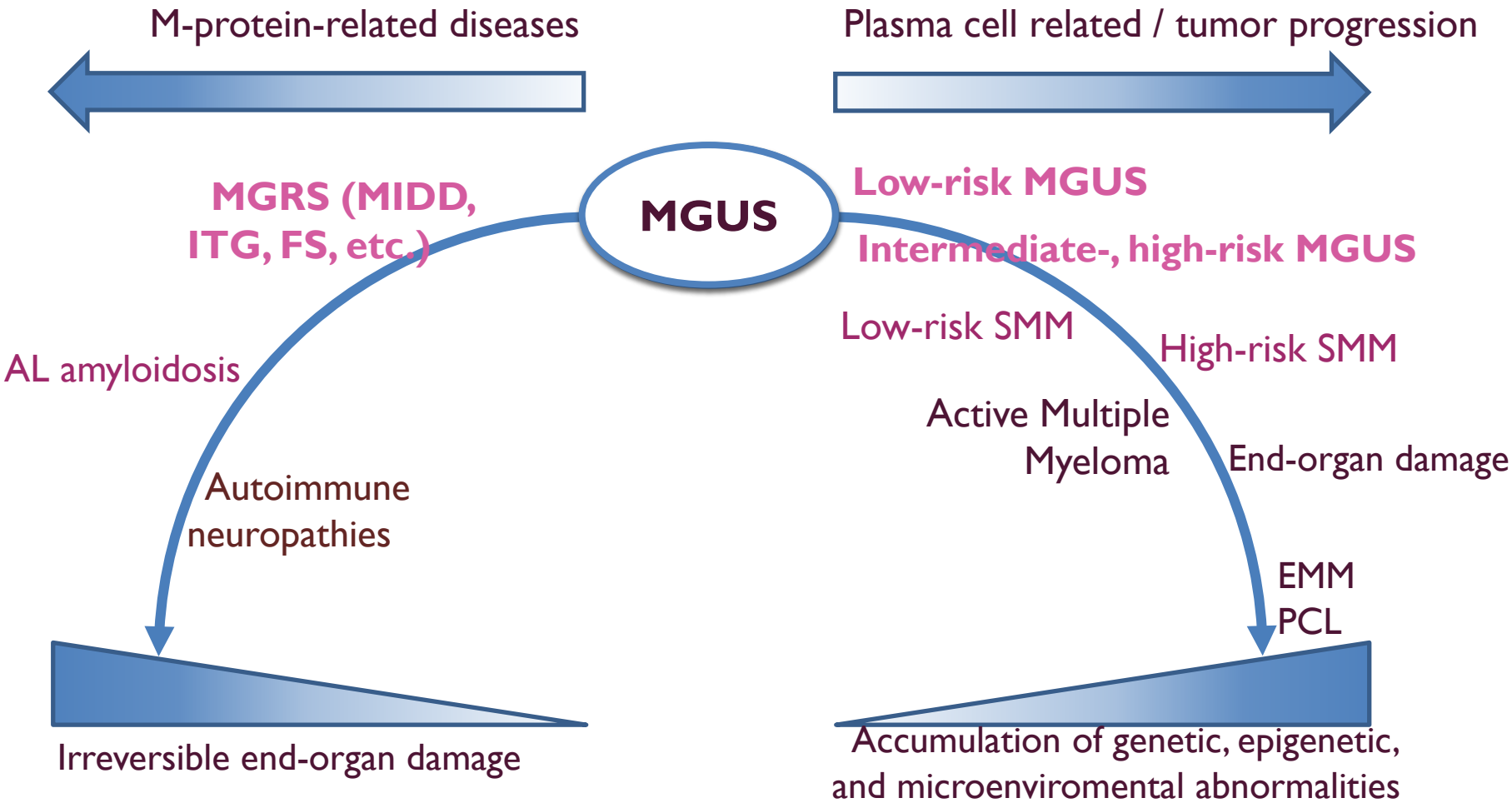
“Early” Detection of Cancers in FDNY Fire & EMS workers enrolled in WTC Health Program:
FDNY WTC Medical Monitoring Exam Cancer Screenings



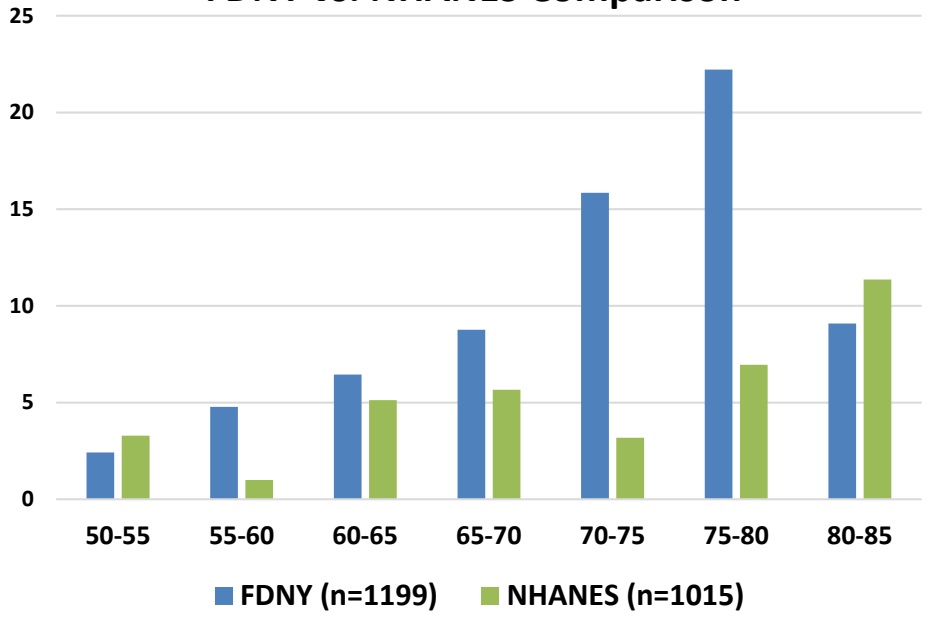
MGUS is an early precursor to myeloma:

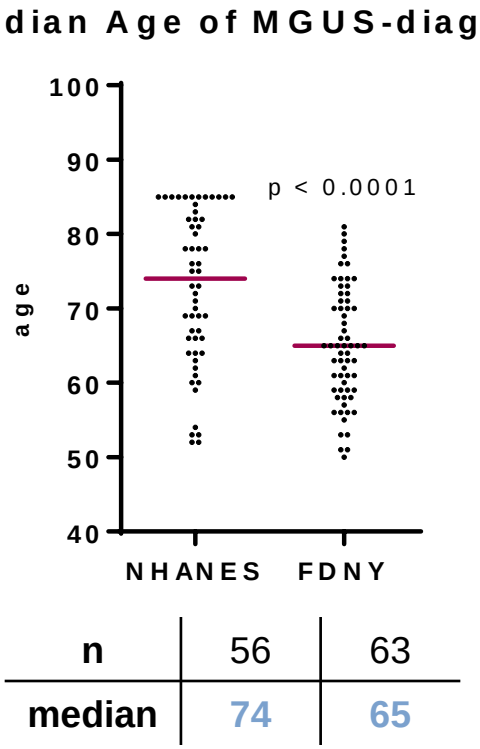
Spectrum of the possible progression of MGUS: the monoclonal gammopathies

sometimes it can progress over yrs to other disorders, including some forms of blood cancer



Relative prevalence of MGUS by age groups





	NHANES	FDNY
n	56	63
median	74	65

FDNY workers are developing MGUS at earlier age

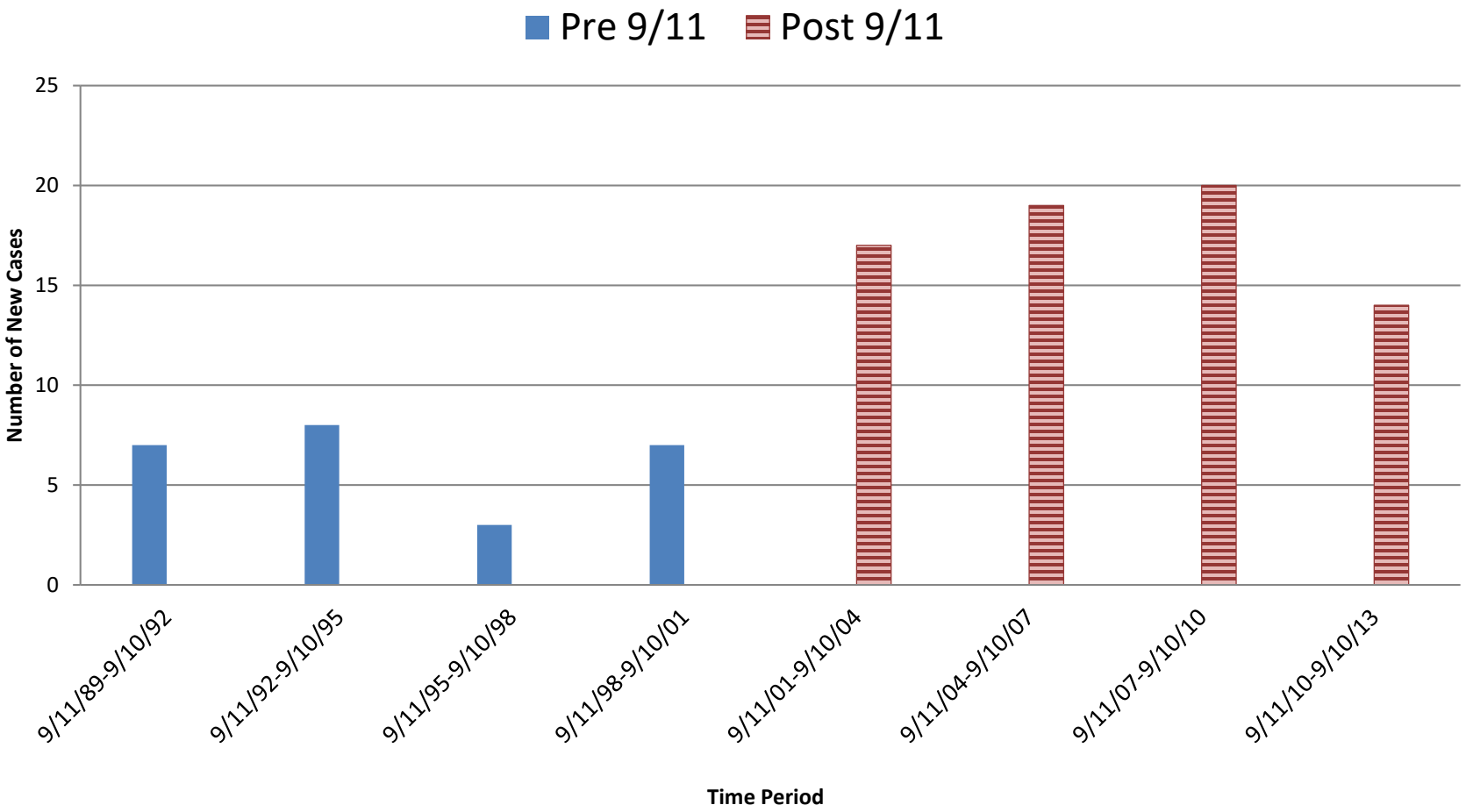
Source: In Press JAMA Oncology

Cancer Research Recommendations

The same recommendations presented above for respiratory research are applicable to cancer research

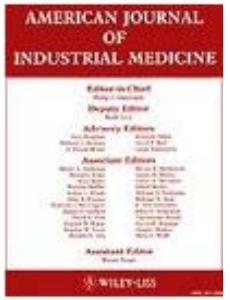
AUTOIMMUNE

Sarcoidosis or “sarcoid-like” granulomatous pulmonary disease (SLGPD) Amongst FDNY Pre- & Post-WTC



Source: Izbicki et al CHEST 2007

2010



"Sarcoid Like" Granulomatous Pulmonary Disease in World Trade Center Disaster Responders

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Background *More than 20,000 responders have been examined through the World Trade Center (WTC) Medical Monitoring and Treatment Program since September 11, 2001. Studies on WTC firefighters have shown elevated rates of sarcoidosis. The main objective of this study was to report the incidence of "sarcoid like" granulomatous pulmonary disease in other WTC responders.*

Methods *Cases of sarcoid like granulomatous pulmonary disease were identified by: patient self-report, physician report and ICD-9 codes. Each case was evaluated by three pulmonologists using the ACCESS criteria and only "definite" cases are reported.*

Results *Thirty-eight patients were classified as "definite" cases. Six-year incidence was 192/100,000. The peak annual incidence of 54 per 100,000 person-years occurred between 9/11/2003 and 9/11/2004. Incidence in black responders was nearly double that of white responders. Low FVC was the most common spirometric abnormality.*

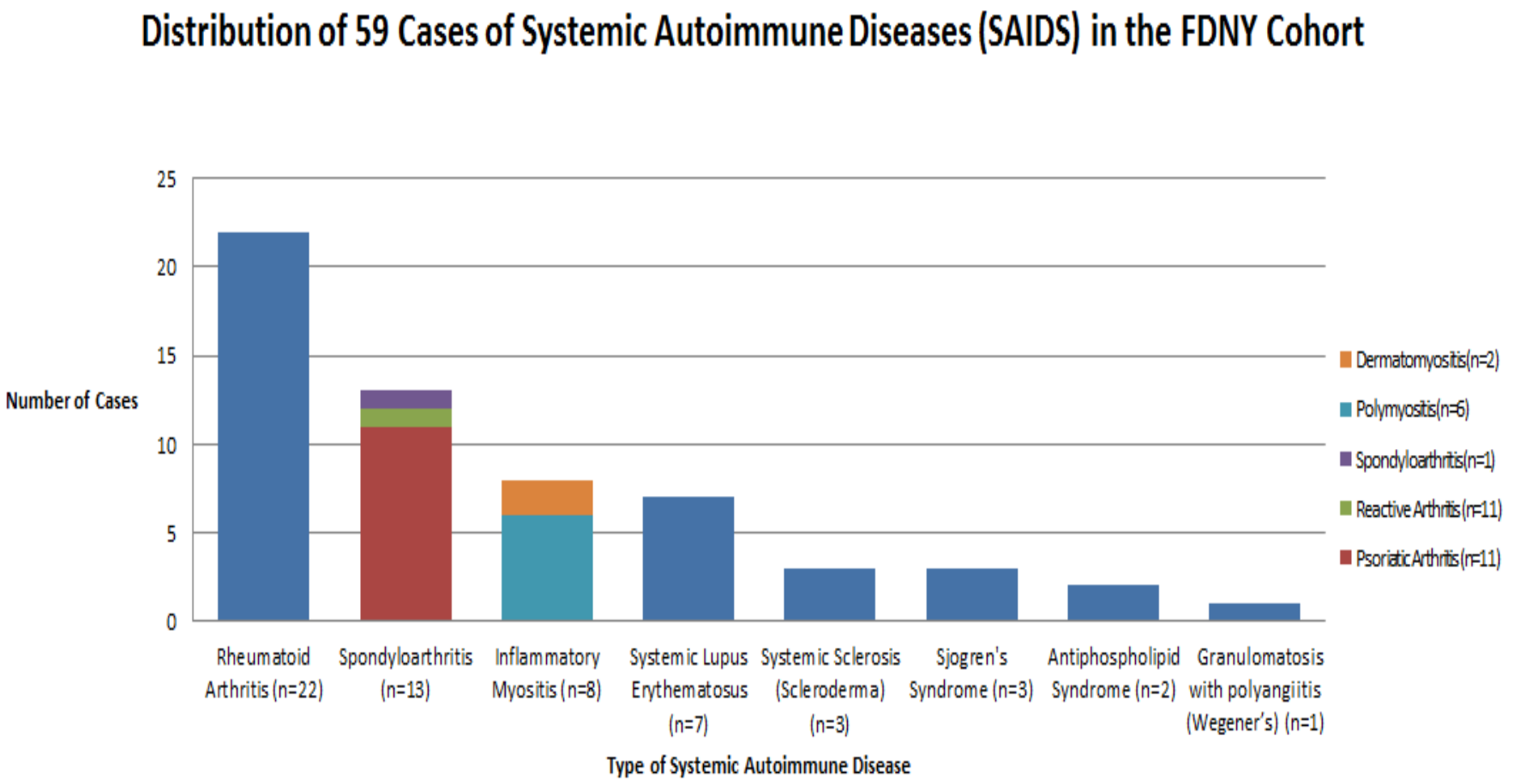
Conclusions *Sarcoid like granulomatous pulmonary disease is present among the WTC responders. While the incidence is lower than that reported among firefighters, it is higher than expected.* Am. J. Ind. Med. 54:175–184, 2011. © 2010 Wiley-Liss, Inc.

Sarcoidosis—Clinical Course
Years After Post-9/11 Diagnosis
Systemic Disease

Sarcoidosis organ involvement	Study Cohort (n=59) At Diagnosis	Study Cohort (n=59) At follow up
Intrathoracic	55 / 56 (98%)	29 / 57 (51%)
Joints/Bones	4 (7%)	9 (15%)
Eyes	3 (5%)	3 (5%)
Skin	1 (2%)	1 (2%)
Neuro	0 (0%)	1 (2%)
Heart	0/59 (no MRI)	6 / 52 (12%)
Liver	1 (2%)	1 (2%)
Hypercalcemia	0	0
Hypercalciuria	Not tested	2 (3%)

Source: Hena et al CHEST 2017

Rheumatologic Autoimmune Diseases in the FDNY WTC Rescue/Recovery Workers: 9/11/2001 – 9/10/2013



Source: Webber MP Mayo Clin Proc 2016

Systemic Autoimmune Diseases

Age Standardized Rate:
45.1 per 100,000 person-years

TABLE 2. Observed and Expected Cases of SAIDs in the FDNY Cohort Based on Rates From the Rochester Epidemiology Project

Variable	Observed	Expected	SIR (95% CI)
Entire FDNY cohort			
Rheumatoid arthritis	40.0	44.06	0.91 (0.65-1.24)
Psoriatic arthritis	21.0	24.64	0.85 (0.53-1.30)
Ankylosing spondylitis	3.0	8.48	0.35 (0.07-1.03)
Systemic lupus erythematosus	11.0	1.50	7.33 (3.66-13.12)
Sjögren syndrome	3.0	1.58	1.90 (0.39-5.55)
Total	78.0	80.26	0.97 (0.77-1.21)
FDNY cohort by WTC exposure			
Higher WTC exposure			
Rheumatoid arthritis	10.0	11.71	0.85 (0.41-1.57)
Psoriatic arthritis	11.0	7.30	1.51 (0.75-2.70)
Ankylosing spondylitis	2.0	2.51	0.80 (0.10-2.88)
Systemic lupus erythematosus	5.0	0.38	13.16 (4.27-30.71)
Sjögren syndrome	2.0	0.42	4.76 (0.58-17.20)
Total	30.0	22.32	1.34 (0.91-1.92)
Lower WTC exposure			
Rheumatoid arthritis	30.0	32.35	0.93 (0.63-1.32)
Psoriatic arthritis	10.0	17.34	0.58 (0.28-1.06)
Ankylosing spondylitis	1.0	5.96	0.17 (0.0-0.93)
Systemic lupus erythematosus	6.0	1.12	5.36 (1.97-11.66)
Sjögren syndrome	1.0	1.16	0.86 (0.02-4.80)
Total	48.0	57.93	0.83 (0.61-1.10)

FDNY = Fire Department of the City of New York; SAID = systemic autoimmune disease; SIR = standardized incidence ratio; WTC = World Trade Center.

Source: Webber MP Mayo Clin Proc 2016

Systemic Autoimmune Diseases

- WTC exposure may be associated with Systemic Autoimmune Diseases
- Continued surveillance for early detection of these Autoimmune Diseases in high WTC exposure populations is needed

Autoimmune Research Recommendations

- Replicate FDNY WTC findings in the other cohorts
  - WTC Registry
  - General Responder Cohort
- The same recommendations presented above for respiratory research are applicable to cancer research

IDENTIFYING NEW AND EMERGING DISEASES

New Questions Added to Monitoring Questionnaire

- Peripheral neuropathy questions
  - Based on the Diabetic Neuropathy Symptom Score additional questions were added after meetings with all CCEs
- Cognitive questions
  - Cognitive Function Instrument
- Diet questions
  - REAPS (Rapid Eating Assessment for Participants)

Lessons From the WTC HP:

- **Pre-Disaster Health Baselines including pulmonary functions, Chest Xrays are critical:**
  - **Workers with pre-existing cardiopulmonary or mental health conditions may not be suitable for certain types of disaster work**
- **Fully integrate Monitoring, Treatment and Research**
- **Multidisciplinary Approach to Treatment**
  - **Pulmonary, ENT, GI, Psych, Oncology, Rheum, etc.**
- **Nothing is possible without broad support**