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Penn SRP Center

Environmental Asbestos Exposure and Asbestos-Related Disease.

The 2018 Carey Pratt McCord Lecture

Michigan Occupational and Environmental Medicine Association

Edward A Emmett

Professor in Occupational and Environmental Medicine, Director Community Engagement Core, Superfund Research & Training Program

Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA

Asbestos and OEH in Three Eras

- **Bernadini Ramazzini in the Preindustrial World**
- **Carey Pratt McCord at the Height of US Industrialization**
- **~2018 Living with the Legacy of Industrialization**

Bernadini Ramazzini

- **A Pre-eminent Physician of his Era**
  - Proposed the use of quinine in malaria
  - Increased breast cancer in nuns – attributed to lack of sexual activity
  - Prevention is better than cure
- **Medicine largely for the elite - Ramazzini spent time with workers**
- **Industrial Environment**
  - Work, often highly skilled.
- **Ramazzini's Occupational Medicine Tools**
  - The Question: What is your occupation?
  - Visited workplaces, observed worker activities
  - Discussed diseases with workers

Bernadini Ramazzini 1633 (Carpi)-1714 (Padua)

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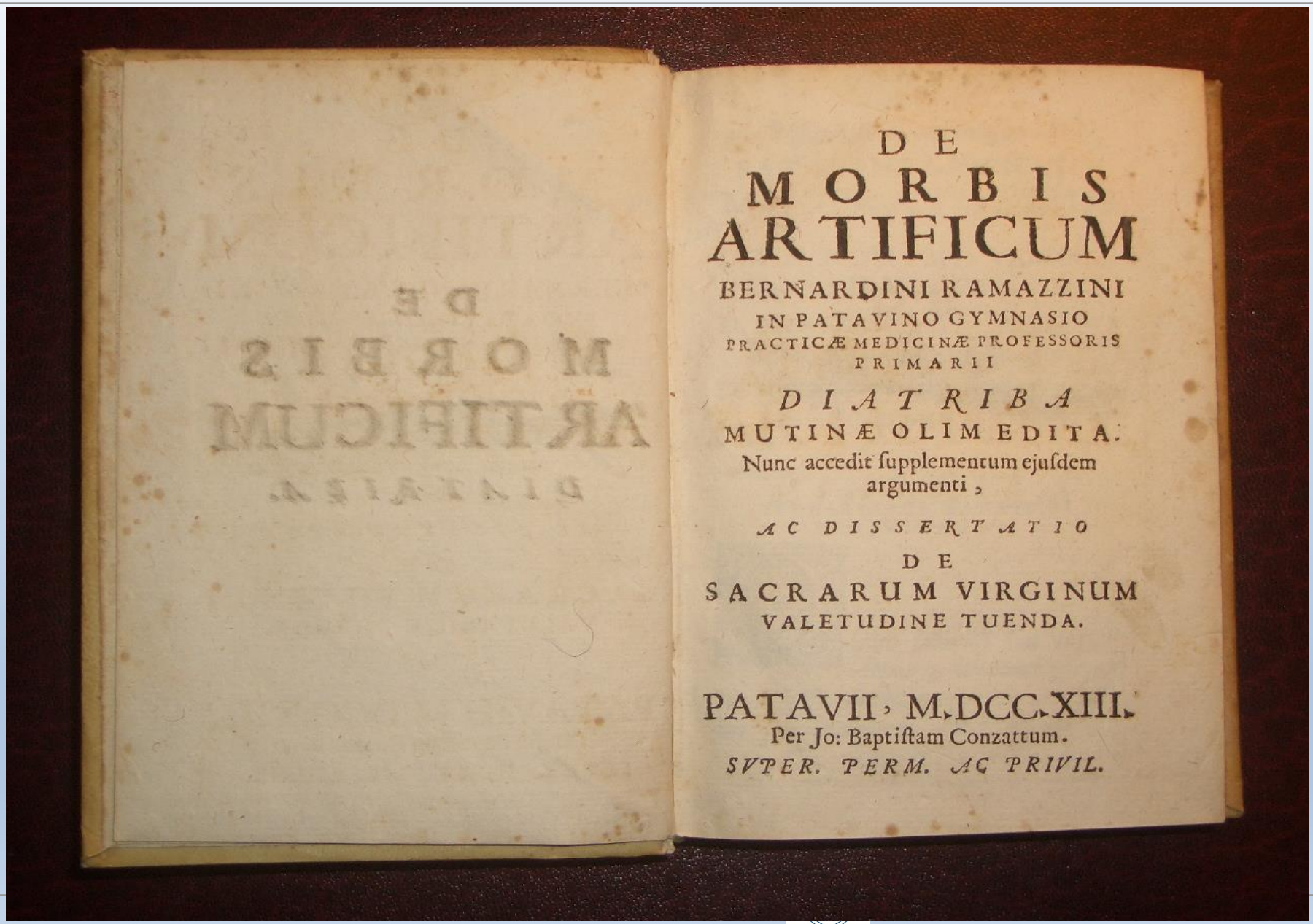
Ramazzini: De Morbis Artificum Diatriba 1713



DE
MORBIS
ARTIFICUM
BERNARDINI RAMAZZINI
IN PATAVINO GYMNASIO
PRACTICÆ MEDICINÆ PROFESSORIS
PRIMARII
DIATRIBA
MUTINÆ OLIM EDITA.
Nunc accedit ſupplementum ejuſdem
argumenti,
AC DISSERTATIO
DE
SACRARUM VIRGINUM
VALETUDINE TUENDA.

PATAVII, M.DCC.XIII.
Per Jo: Baptiſtam Conzattum.
SUPER. PERM. AC PRIVIL.

Syllabus of workers whose diseases are covered in the "De Morbis Artificum Diatriba"

- Miners
- Gilders
- Healers by inunction
- Chemists
- Potters
- Tinsmiths
- Glass-makers
- Painters
- Sulphur-workers
- Blacksmiths
- Plasterers and Lime-workers
- Apothecaries
- Cleaners of cesspits
- Fullers
- Oilmen, Tanners, Cheese-makers
- Lutestring-makers
- Tobacco-workers
- Corpse-workers
- Midwives
- Nurses
- Vintners and Brewers
- Starch-makers
- Corn-sifters and Measurers
- Stone-cutters
- Laundresses
- Hemp, Flax, and Silk-workers
- Coppersmiths
- Carpenters
- Razor and Lancet grinders
- Brick-makers
- Well-diggers
- Sailors and Rowers
- Hunters
- Soap-makers
- Bathmen
- Salt-workers
- Workers who stand
- Sedentary workers
- Runners
- Horsemen
- Porters
- Athletes
- Workers on minutes objects
- Voice-trainers and Singers
- Farmers
- Fishermen
- Soldiers
- The Learned
- Printers
- Writers and Notaries
- Confectioners
- Weavers

Translation by Wilmer Cave Wright, 1940 - From the presentation given at the Ramazzini Days, Carpi, 2000

Ramazzini's Observations

- The Disease associated with that Activity
- Workplace Description
- Questions for Workers
- Description of the Disease
- Remedies
- Advice

In Perspective

- **What Ramazzini Teachings have We Forgotten**

  The Question "What is your Occupation"

  - EMR that omit Occupation as a part of each record
  - What are the consequences?

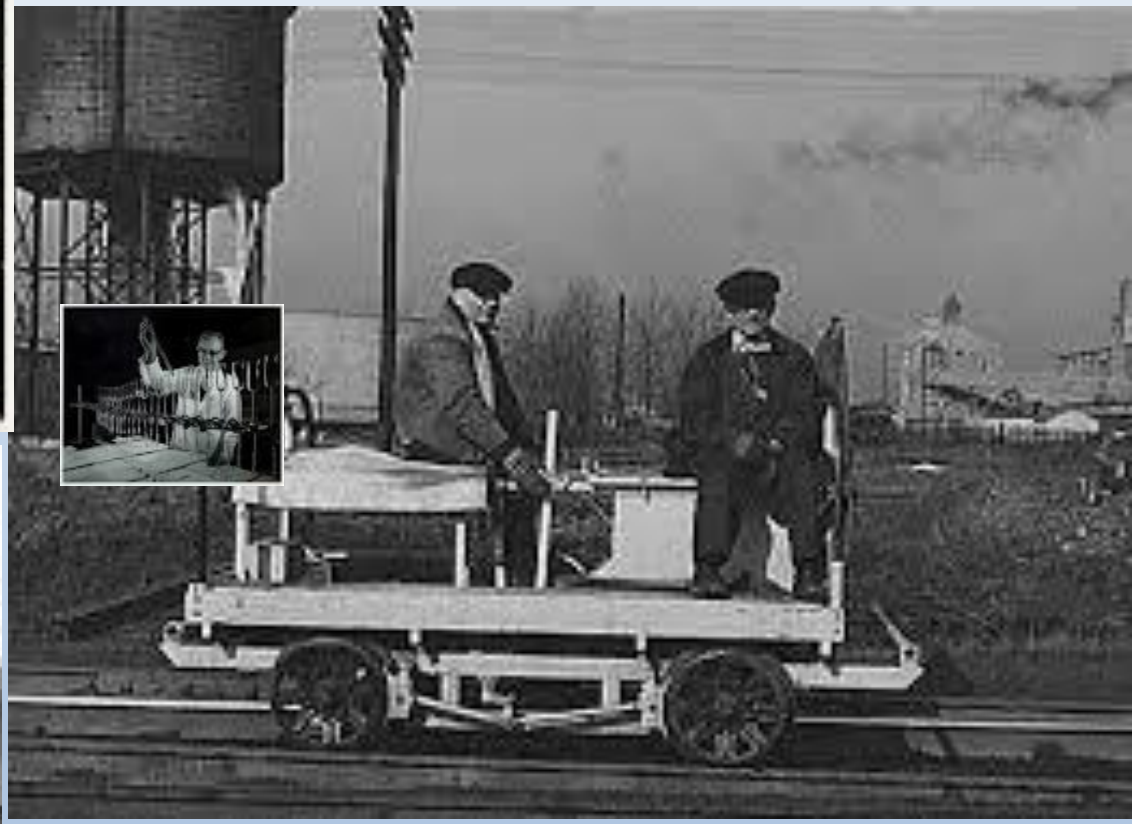
- **Asbestos in Ramazzini's Preindustrial World**

  - No widespread use

Cary Pratt McCord 1886 - 1979

- **Born Bibb County AL, father Baptist minister**
- **MD University of Michigan 1912.**
- **Research Physiologist Parke Davis for 4 years**
  - Pioneering work on Pineal Gland physiology, role in reproduction.
- **Industrial Hygiene Conservancy Laboratories**
  - Director 1919-1951.
- **Occupational Health Work**
  - Chrysler Corporation 15 years
  - Director Detroit Department of Health, Michigan State Department of Industrial Health
  - University of Cincinnati 1920-1935 (Associate Professor Preventive Medicine), University of Michigan 1940-1976

Cary Pratt McCord at Work



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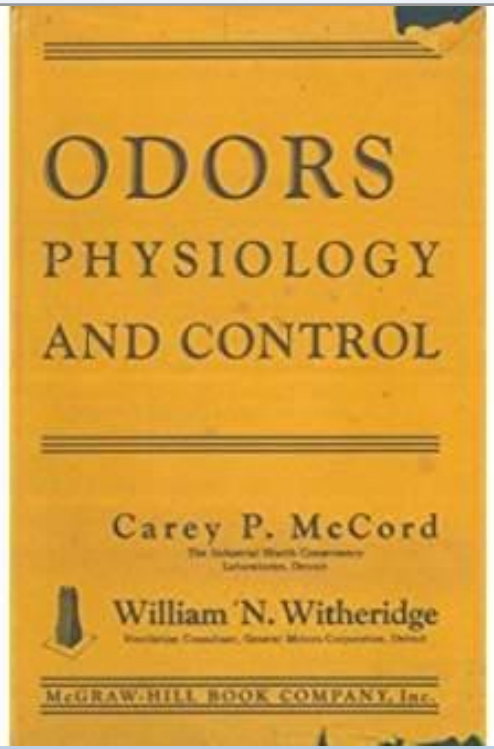
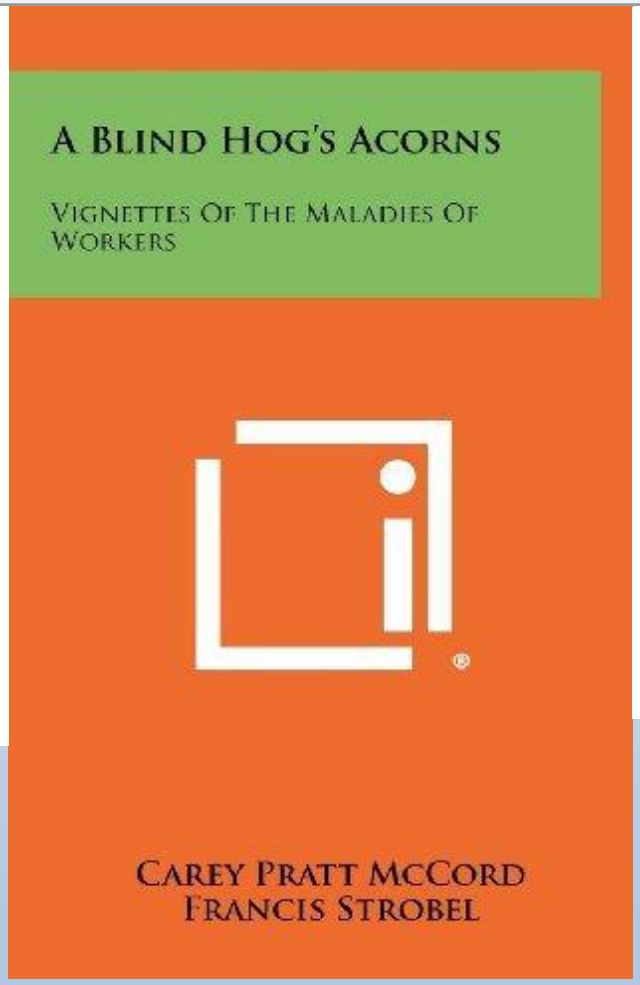
Selected Carey Pratt McCord Publications





20 books and over 3000 publications of various types
Large document collection in University of Michigan/Bentley Library archives

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Dr McCord and his Era

- **Carey McCord**
  - Physician
  - Laboratory Scientist
  - Industrial Hygienist
- **Occupational Medicine Tools**
  - Observations of workplaces, work activities
  - Physical and Chemical Measurements
  - History, examination, tests
  - Take into account the whole set of factors impinging on the person, physical, chemical, psychological
- **The Industrial Environment and Employment**
  - Jobs
  - Employers, Unions
  - Labor laws and regulations.

What are we forgetting of McCord's Teachings

Observations of workplaces, work activities

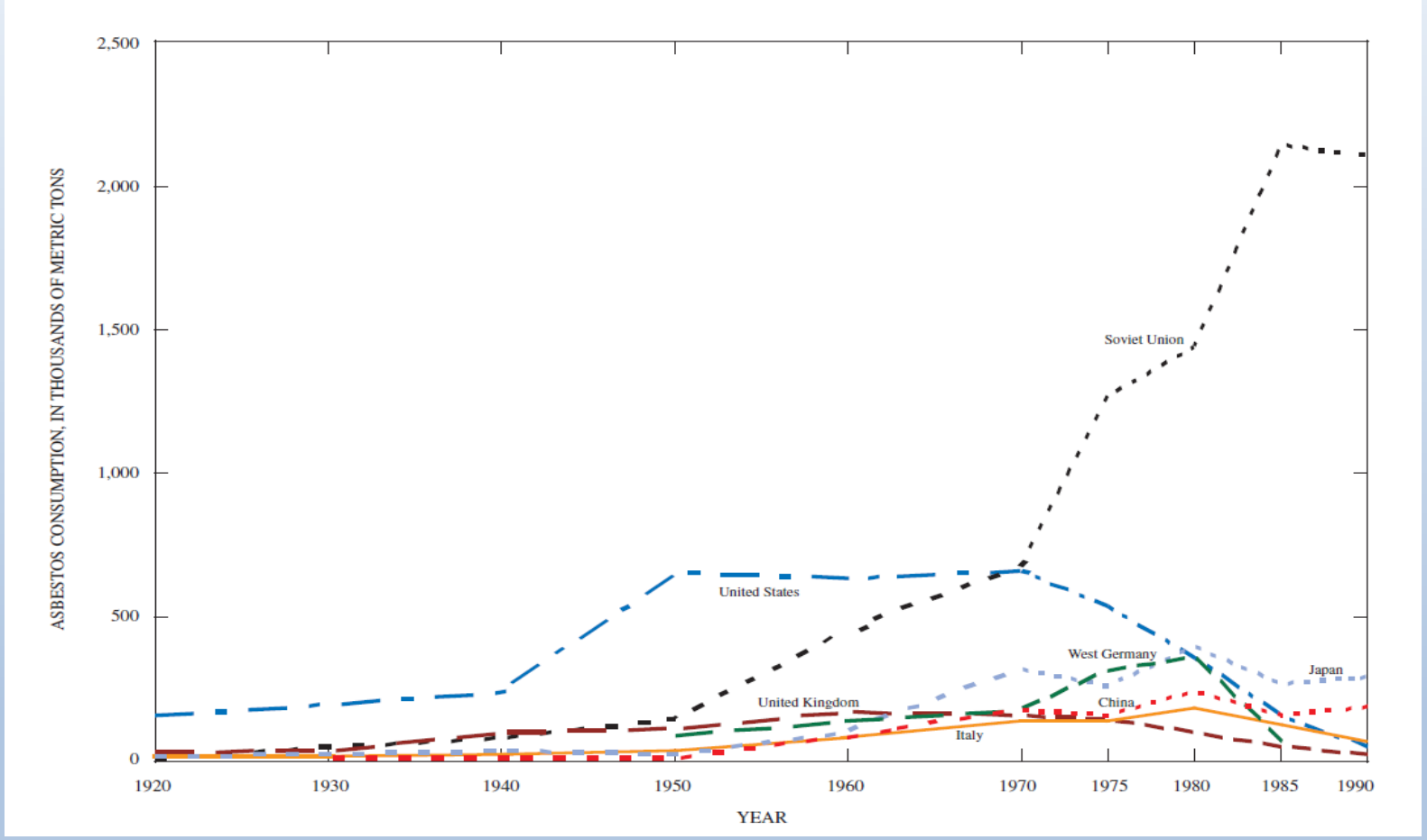
- Occupational Medicine -a "clinic" treatment activity.
- Reimbursement focused on in-the-clinic treatment

Take into account the whole set of factors impinging on the person, physical, chemical, psychological

- Limitations of evidence-based medicine focus
- Lack of customization for occupationally important variables

Asbestos in Carey McCord's Era

Calculated apparent consumption of asbestos by major asbestos-consuming countries, 1920-1990



Source: Virta, R.L., 2006, Worldwide asbestos supply and consumption trends from 1900 through 2003: U.S. Geological Survey Circular 1298, 80 p.

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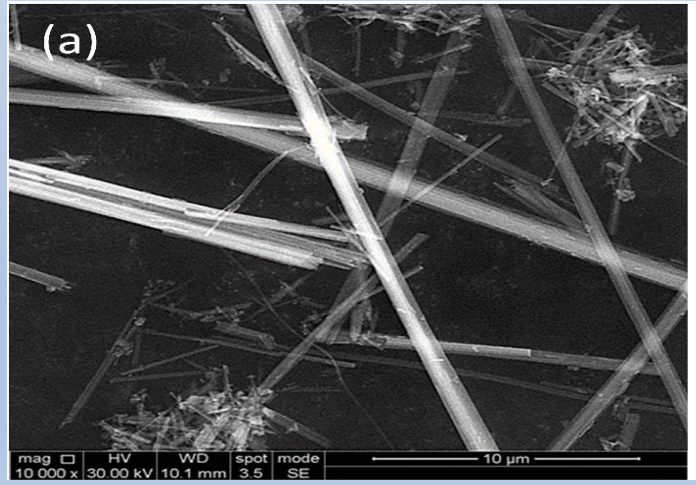
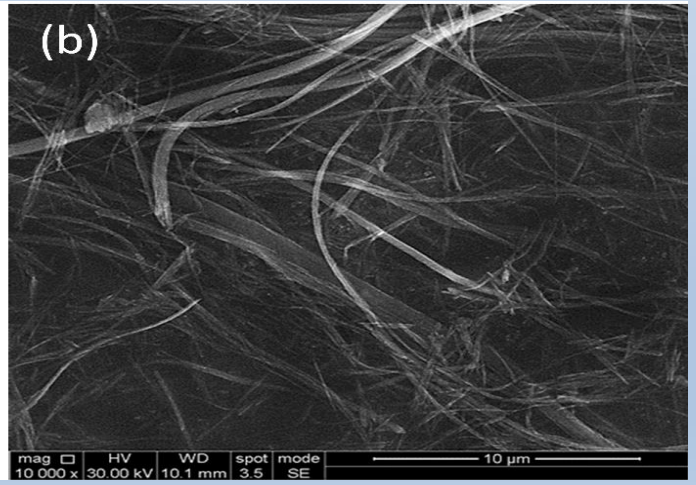
Work with Asbestos, Pre-OSHA

Deteriorating Asbestos Cement Roof Cladding





Scanning Electron Microscope: Asbestos Fibers are bundles of Fibrils

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Entry of Asbestos Fibers into Body

Inhalation of fine diameter fibers from air

Deposition throughout lungs - bifurcations of smaller airways, alveoli

Deposition extends to subpleural lung tissue

Some clearance (especially smaller fibers, chrysotile). Some chrysotile fibers may be dissolved.

Some longer fibers are coated forming asbestos bodies

Effects of Asbestos on the Lungs

Asbestosis

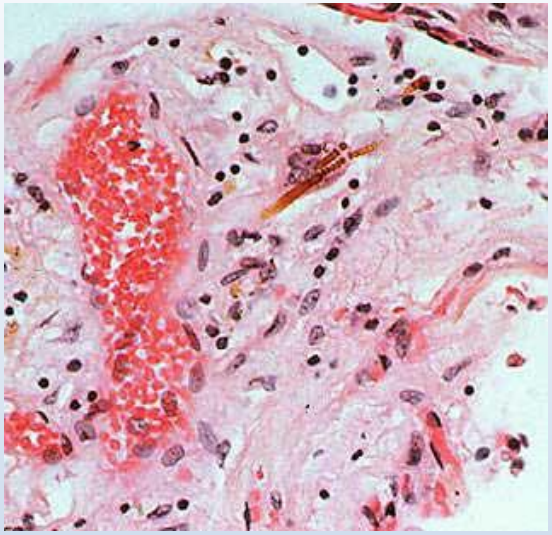
Pleural Plaques & Calcification

Benign Pleural Effusion

Lung Cancer

Mesothelioma

Asbestosis



A Pneumoconiosis (dust disease) – Interstitial Fibrosis caused by inhalation of asbestos fibers

Fibers pierce the alveolar wall; long thin fibers too long for macrophages to ingest, stimulates fibrosis & scarring; long asbestos fibers split damage progresses

Once 25-50% of the airways are involved, measurable changes in pulmonary function can be seen

Asbestosis some years after previous heavy exposure to asbestos dust. Dose response relationship to number of inhaled fibers. Historically workers dead by age 30; now death rare with earlier detection. Cessation of exposure reduces rate of progression

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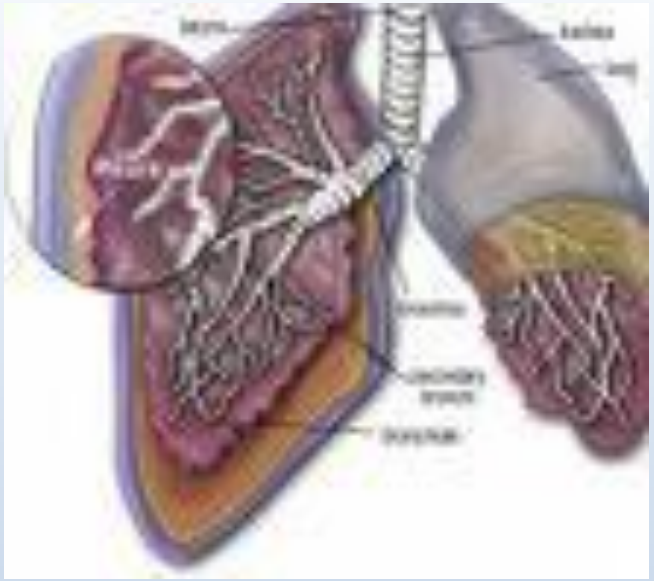
Pleural Plaques



Pleural plaques - most frequent manifestation of asbestos

Irregular thickenings of the parietal pleura; may become calcified. Caused by irritation of the pleural tissue by asbestos exposure

Asbestos is the most frequent cause of pleural plaques

Asymptomatic

Seen on CXR (PA & lateral best); CT scan

Pleural plaques are generally considered a marker of asbestos exposure, but some studies show a statistical association with reduced lung function

Lung Cancer

Smoking and Asbestos Multiplicative

- **Smoker v Non-smoker ~11:1**
- **Asbestos v no Asbestos ~ 5:1**
- **Smoker+asbestos v neither ~54:1**

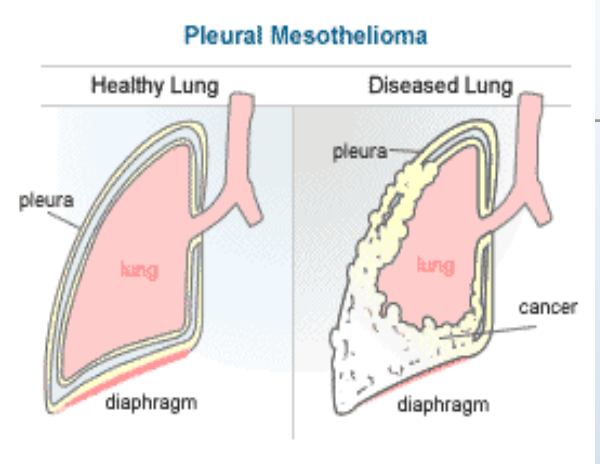
Symptoms: Cough, hemoptysis, pneumonia, weight loss

Diagnosis: CXR, CT, Biopsy, etc.

Cure Rate; relatively low, improving, early detection helps

[1]**Selikoff & Seidman Ann N Y Acad Sci 1991; 643: 1-14**

Mesothelioma



Tumor of pleural (or peritoneal) lining

Only likely cause is asbestos

Dreadful illness: cough, chest pain, SOB,, effusions, wasting. Aggressive local invasion, may metastasize.

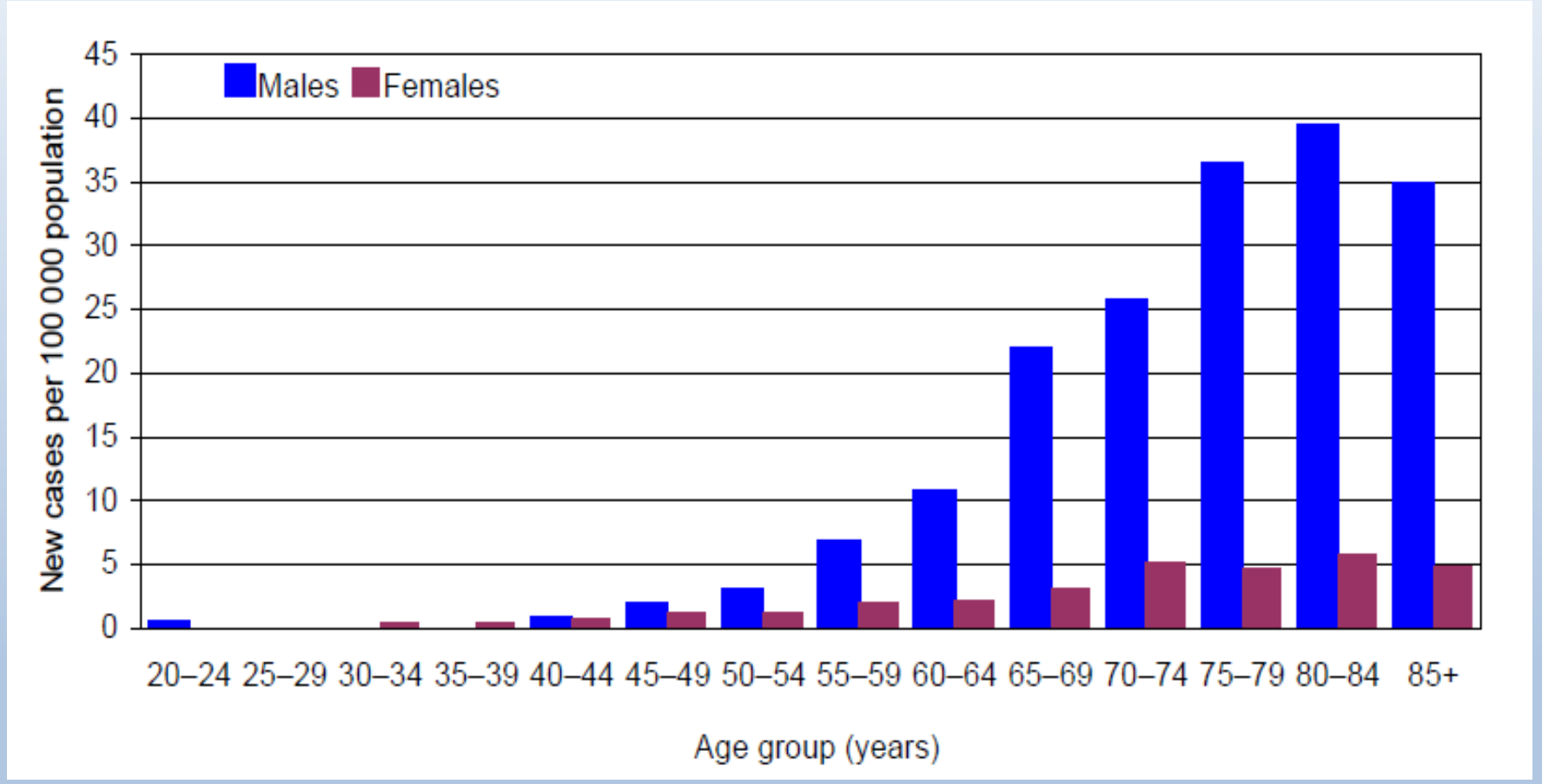
Refractory to therapy: immunotherapy, chemotherapy, surgery, radiotherapy limited benefit, (active research).

Latent period 30-50 years plus

Not related to smoking

Cases occur with low exposure - ? genetic predisposition, ? other factors

Australia - New cases of mesothelioma: age-specific incidence rate by sex, 2006



Source: Mesothelioma in Australia: Incidence 1982 to 2006; Mortality 1997 to 2007. Safe Work Australia:, April 2010.

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Absolute Increased Risk
Lung Cancer > Mesothelioma

US Insulators Prospective Cohort Study Causes of Death for 17,800 Insulation workers 1967-1986[1]

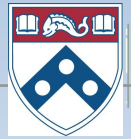
	Observed	Expected	Excess
Lung Cancer	1168	269	899
Mesothelioma	458	-	458

[1]Selikoff & Seidman Ann N Y Acad Sci 1991; 643: 1-14

Our Era - Living With The Legacy of Industrialization

- Occupational type Diseases/Exposures meet the Community
- Asbestos
- As do many others: lead, PFAs, metals, solvents, plastics…..

The Tales of Four Communities with Asbestos Exposures and Asbestos-Related Disease



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Ambler, PA

Suburban Philadelphia,18 Miles from City

1881- Keasby & Mattison, Milk of Magnesia manufacturer, moves to Ambler

1897- Dr Mattison's laboratory accident –discovers insulating and strength-dried Milk of Magnesia + Asbestos

1897- Sectional Pipe Coverings containing asbestos - instant success, more products

1910-1920- Worlds largest producer of asbestos products "The BEST in asBESTos"

Ambler, PA

Ambler PA An American Dream

- Quintessential factory town: company houses, electric lighting, reticulated water, Opera House
- 2000+ workers: Italian stone masons, African-Americans
- Canadian chrysotile mine purchased
- 1934- Great Depression- Turner and Newall purchase
- Integral to War Efforts WWI and WWII
- 1930s-1984- asbestos contamination and waste sites
- 1970s-1980s- Asbestos Regulations: plants close, urban decay

- 1990s- renaissance, art and restaurant scene, family friendly, top ranked schools

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Ambler Houses Near Old “Asbestos” Factory

Ambler Former K&M Executive House

Source: Images of America: Ambler by Frank Quattrone

Family Photo - Ambler 1960s Credit: Joe Marincola

Ambler playground after fence c.1984

Ambler, PA - the Asbestos Legacy

Ambler South

- Asbestos, the “White Mountains”

24 acres, 30 meters high,~ 800,000 cu meters of ACM & other wastes

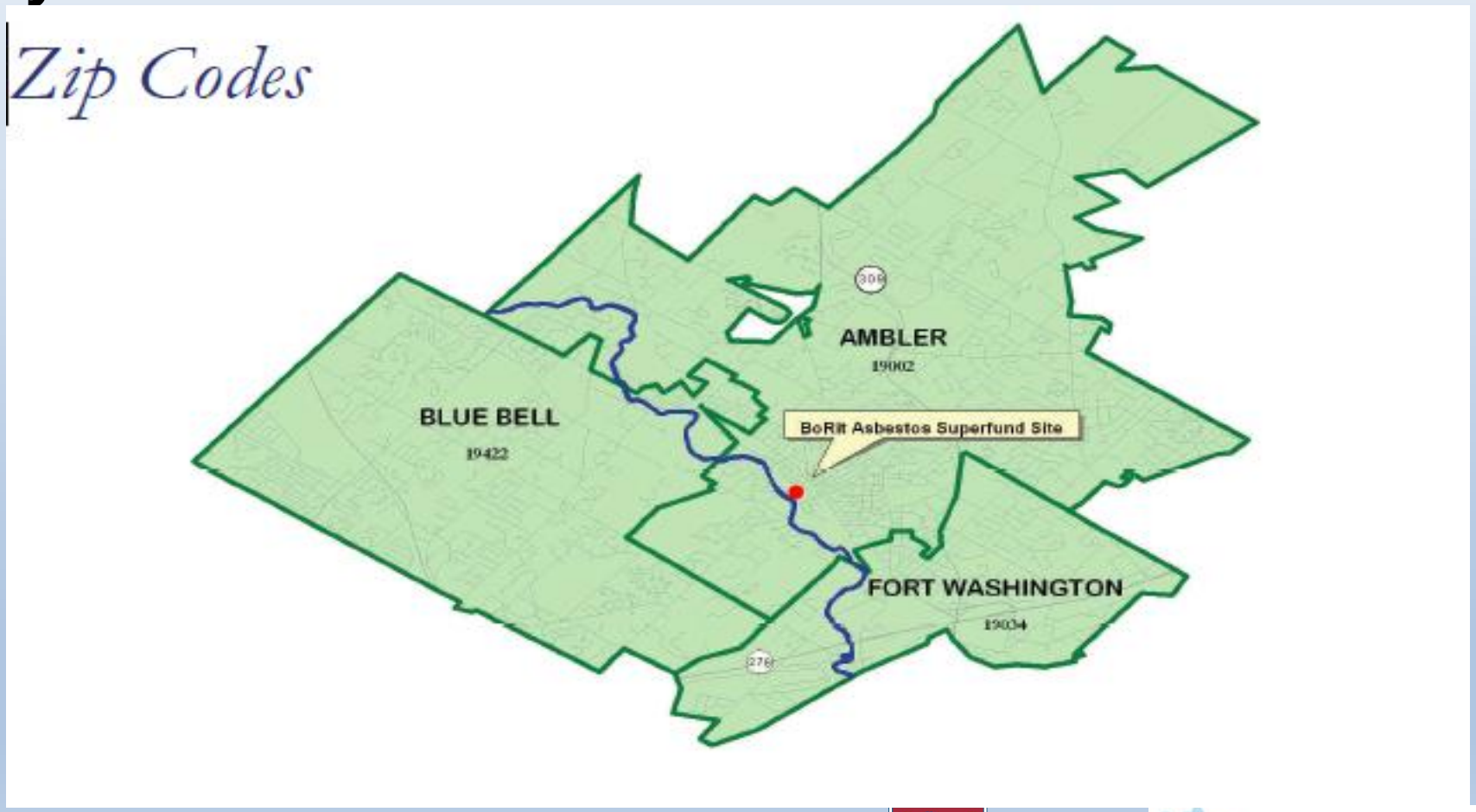
1984-1996- EPA “Superfund Site” capping, slopes graded, seeded, fenced with signs.

- Subsequent erosion, uprooted trees, animal burrows, unauthorized access

Current- Remains fenced off

Ambler, PA – The Mesothelioma Legacy 2012

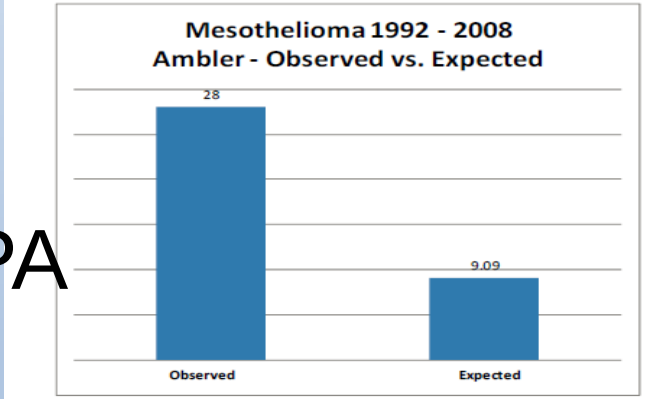
Using PA Cancer Registry of Cancer Incidence - by current residential address for 1992-2008



Ambler, PA – The Mesothelioma Legacy

Results:

- 2.7x higher incidence in men
- 4.5x higher incidence in women
- No elevation in neighboring post-codes
- Rates for all cancers combined and lung cancer lower in all three locations vs PA



pennsylvania DEPARTMENT OF HEALTH

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Diverse Exposure Pathways in Communities

Past Exposure

Occupational

Factory and outside operations

Para-occupational

Asbestos introduced into worker's home environment

Residential

Ambient air – dust, down-wind areas

Past and Potentially Current Exposures

Lifestyle/Behavioral

Individual activities and behaviors

Lifestyle/behavioral Exposures in Ambler PA

- Socialization in public venues after work (wearing dusty clothing, no hair washing or showering)
- Playing on asbestos waste piles as a child and **particularly as an adolescent**
- Picnicking or spending time near asbestos piles as an adult
- Outdoor sports
- Gardening
- Using asbestos waste for cooking (e.g. putting potatoes into asbestos laden pipes for cooking)
- Flooding into basements
- Flooding into gardens then eating produce from gardens

YouTube: How to Enter Fenced Off and Posted Area, Ambler Superfund Site

Source:
http://www.youtube.com/watch?v=kNoDfu_FDmo

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Ambler Adolescents - Paintball in Abandoned Asbestos Factory

Source: http://www.youtube.com/watch?v=lH-SsjoDFuw

The BoRit Asbestos Superfund Site 2009-

- **1984**- **fenced off**, no access to park/playground, 22% asbestos in soil.
- **2005 Proposal to build 17 story High Rise**
  - Provokes concern asbestos waste hazard “discovered”
- **2009 Declared Superfund Site ~** 32 acres EPA program Remove of immediate hazard: grading slopes, trees removal, capping-in-place, stream bank protection - rock and geocells, completed 2017
- **Issues included**
  - Disadvantaged residents/community closest to site
  - Flooding from Tropical Storm Lee 2011, requires reworking, widening streams

Aerial Map Bo-Rit Site 2010 credit: Sal Bocchuti

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Bo-Rit Rose Creek during stabilization 2009

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Permanent Remediation BoRit Site

- **EPA Options 2017**
  - Cap-in-place" cost $27.1m (present-day value) Already spent.
  - Excavation and remove ($269m),
  - In situ extreme heating (257m)
  - Excavation, Thermo-Chemical Conversion Treatment (TCCT) and on-site disposal ($267m).
- **Community Effects of Removal**
- **Thus asbestos remains on site**
- **What do we do with the site now?**

Before and After Hazard Removal

Proposed park, waterfowl reserve and Pile: Bo-Rit

THE NEW
WISSAHICKON PARK &
BOYS & GIRLS CLUB

An unparalleled place for recreation, learning, and reflection in harmony with a restored natural setting.

For more information see here:

http://www.whitpaintownship.net/pages/news_westambler.php

Let us know what you think at:

Supervisors@whitpaintownship.org

KIMMEL BOGRETTE
Architecture + Site

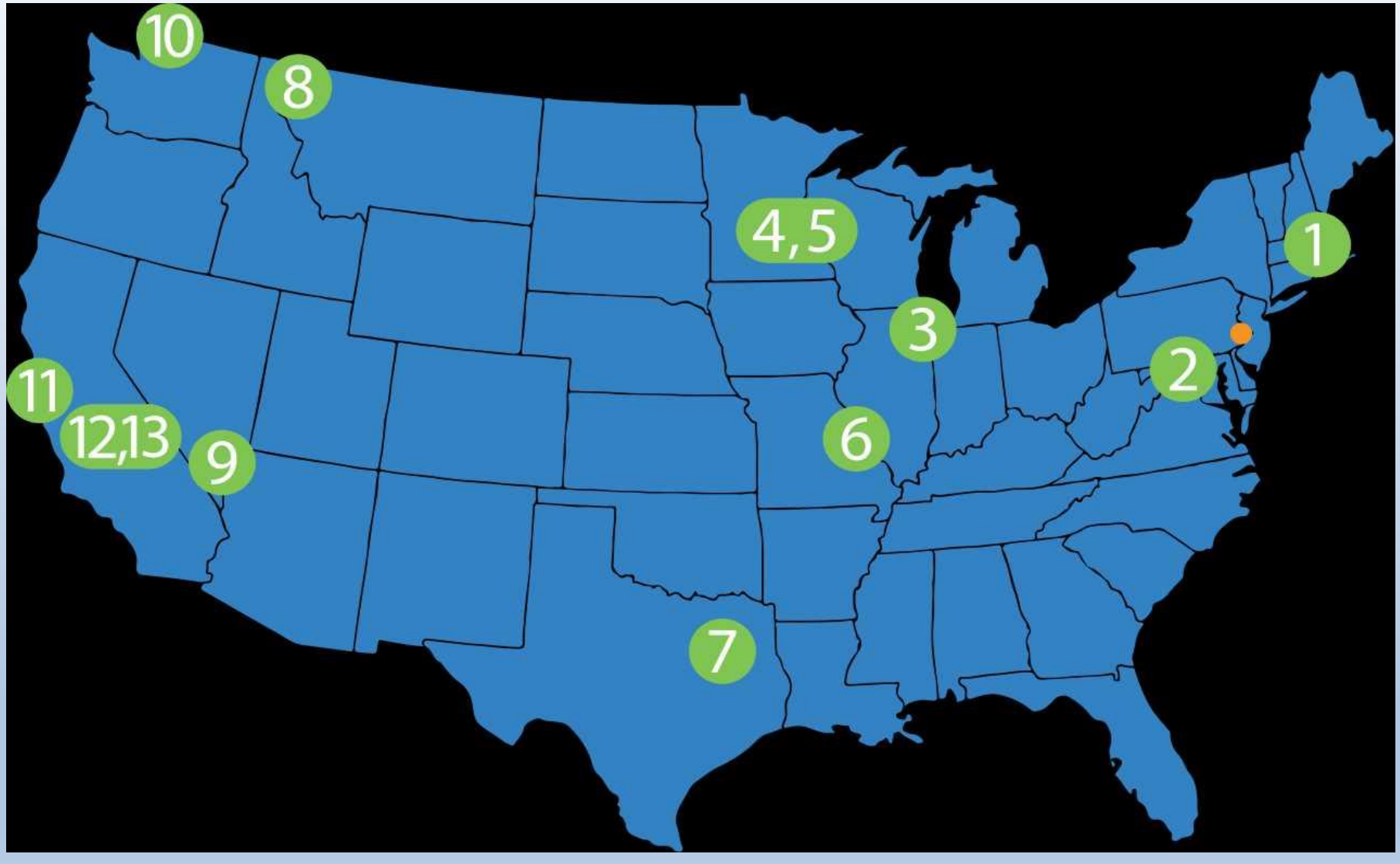
SIMONE COLLINS
LANDSCAPE ARCHITECTURE

NORTH PENN VALLEY
BOYS & GIRLS CLUB

WHITPAIN

WHITPAIN TOWNSHIP
1701
MONTGOMERY COUNTY, PENNSYLVANIA

Industrial Asbestos ~ Potential Sites Like Ambler?



Other High-Risk Communities

Libby, Montana

- Vermiculite mining and processing
- Contaminated with Libby Amphibole Asbestos
- Community exposure pathways delineated

Libby Montana

- **Vermiculite - Libby Amphibole Asbestos**
  - Mixture of fiber types- Winchite Richterite
- **Libby Center for Asbestos-Related Disease (CARD) Clinic.**

  Unusual effects observed

  -Rapidly progressive pleural disease

  -Positive ANA in 25%–association with rheumatic disease?

  Social Psychologic Support & counseling
- **Widespread Vermiculite Use in the US**

Vermiculite Shipments from Libby MT

Other High-Risk Communities

Karain, Turkey

- Erionite in native rock
- Houses made of rock

Genetic Vulnerability

- families with 50% mesothelioma

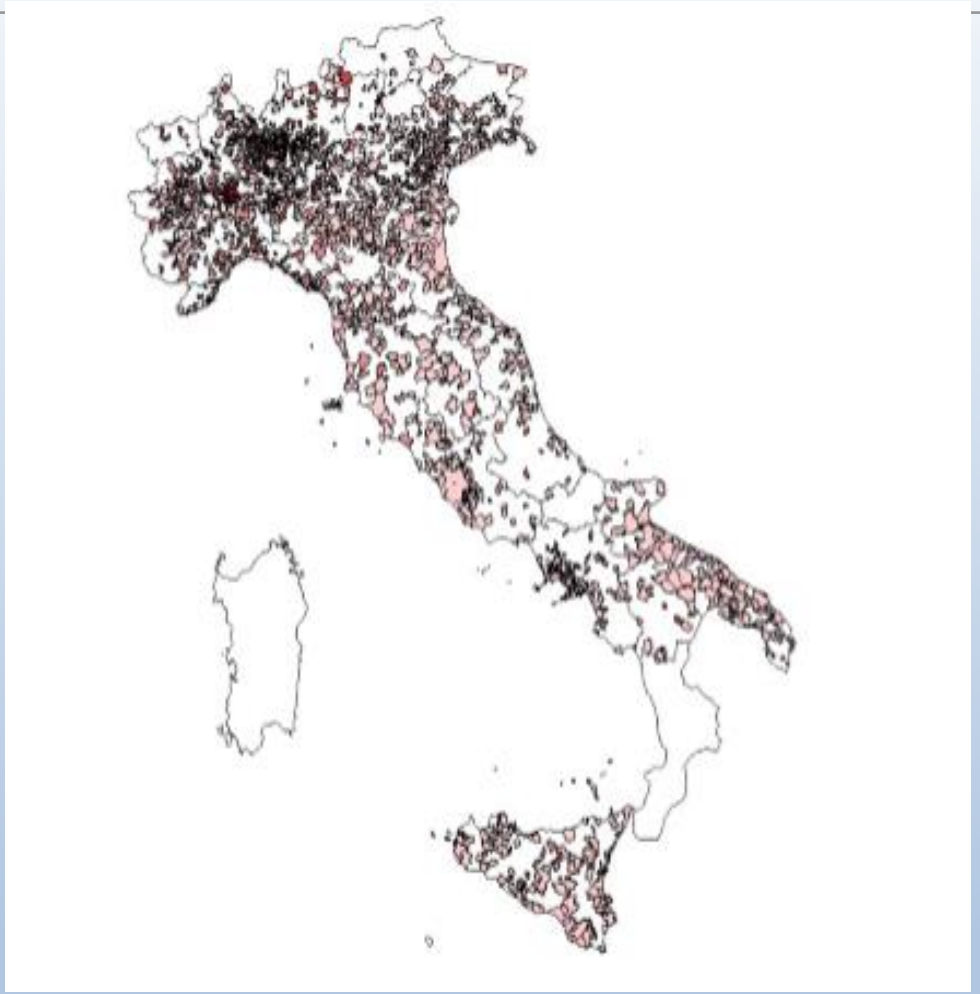
Wittenoom Western Australia

- Former Mining and Milling Site
  - Crocidolite (Blue Asbestos)
- High incidence mesothelioma, lung cancer, asbestosis
- Asbestos workers, families (paraoccupational and genetic), and community residents

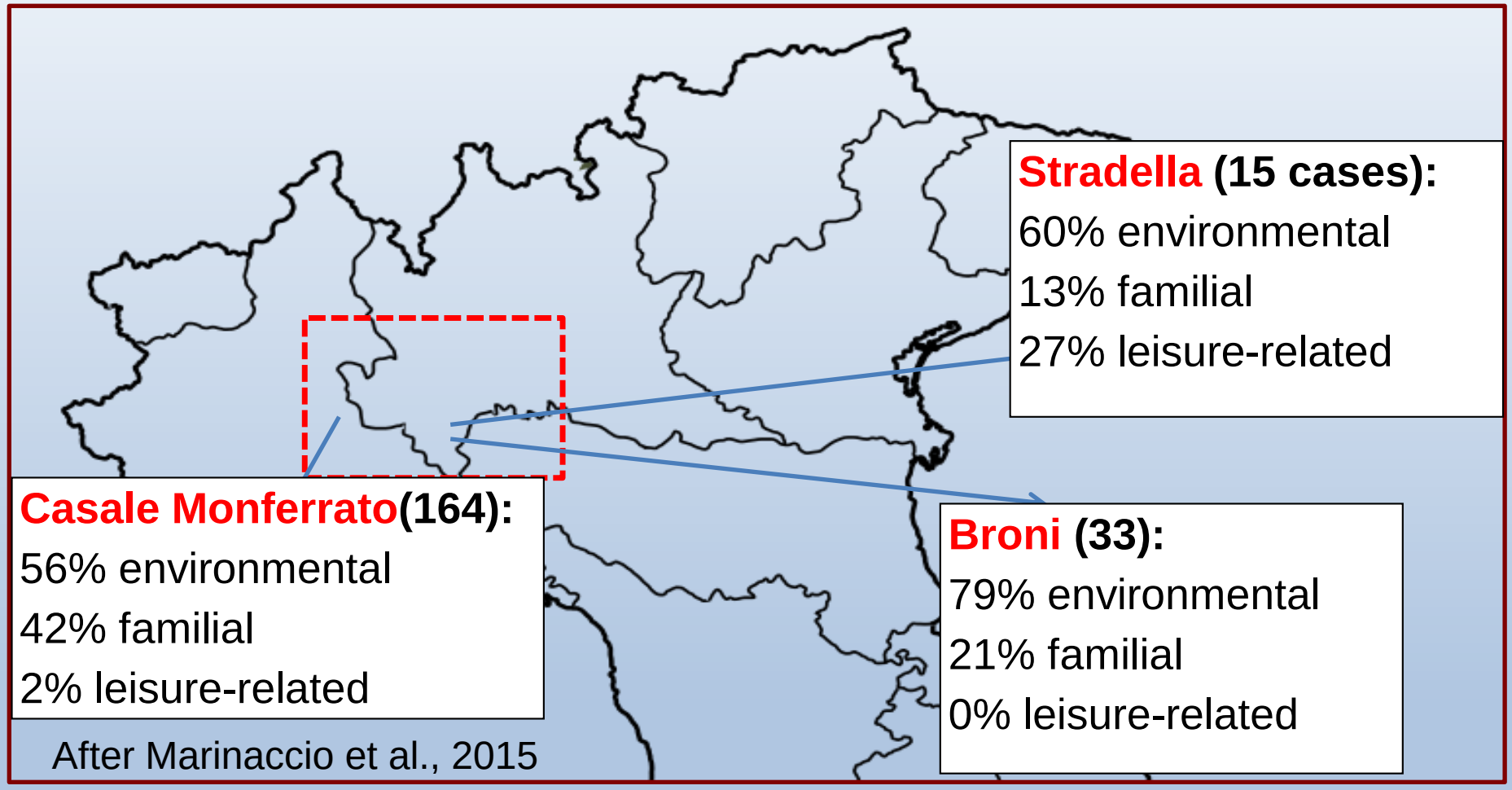
Mesothelioma in Italy 1993-2015

Concentration in Sites of Former Industrial Use and of Natural Tremolite and Fibroedenite Deposits

From Marinaccio et al, 2018



High Risk Mesothelioma Communities - Northern Italy



Selected Other Non-occupational Asbestos Exposures

- **Do-it-yourself Home Renovators**
  - Significant increase in mesothelioma from Australian mesothelioma registry studies (Olsen et al 2011).
- **Natural Asbestiform Fibers**
- **Disasters and Exposures**
  - Asbestos & 9/11 World Trade Center disaster
  - Asbestos Exposures from Weather-related events

General Questions Mesothelioma and other ARD in High-Risk Communities

- How well are ENVIRONMENTAL risks from asbestos controlled?
- How do we know if environmental asbestos is causing a problem?
- How can we help “asbestos-exposed” communities?
- Do we need to add to the tools of Ramazzini and McCord to address community environmental exposure issues?

Control: Banning Use and Import of Asbestos

- Will eliminate many future occupational exposures
- Will not eliminate asbestos already “in place” in communities
- May → dismiss asbestos as a solved problem?

OSHA Medical Surveillance for Asbestos Exposed Workers

- Employers responsibility to provide only during employment

- But the disease risks continue ….and become greater after employment terminates

Problematic Regulatory Definition for Asbestos

Currently regulated:

Chrysotile

Crocidolite

Amosite

Tremolite

Actinolite

Anthrophylite

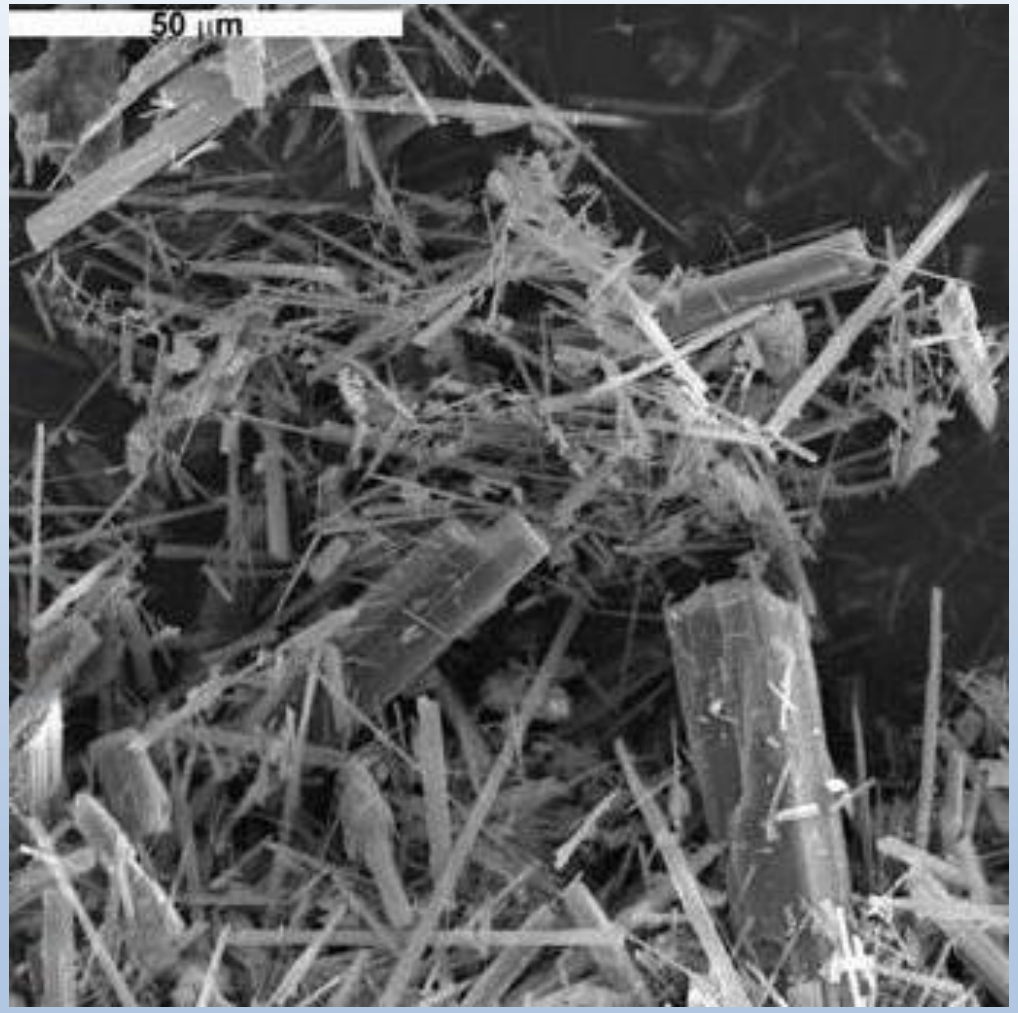
Unregulated - include "Natural" Fibers:

Erionite

Winchite

Richterite

Other carcinogenic asbestiform mineral fibers



Diffuse Locus of Control and Responsibility

Occupational Exposure – The employer is responsible, Occupational Safety and Health Administration (OSHA) enforces

Environmental Exposure such as Ambler, PA:

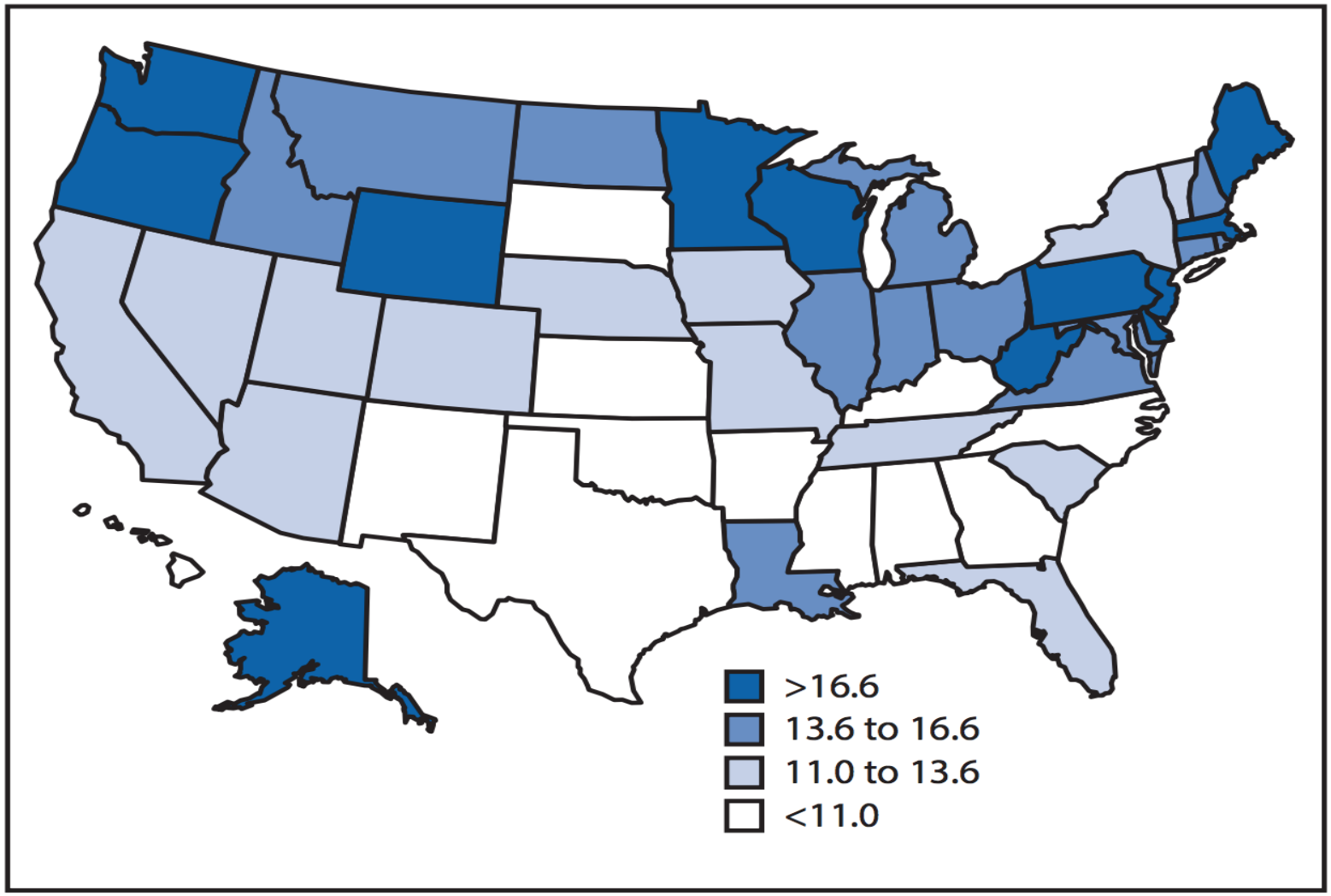
Federal EPA
Federal Department of Health
Pennsylvania Department of Environmental Protection
Pennsylvania Department of Health
3 Different Municipalities
3 Different landowners
Nearby residents (owners, renters)
Parks and Recreation Departments
Zoning Boards …
Planning Commissions
Permitting Authorities

Will legal redress, compensation always be available?

How Do We Know if a Community has an Asbestos Exposure/Disease Problem

- **Different Mesothelioma Demographics**
  - **Higher proportion of women**
  - **Slightly younger age distribution**
    - reflects exposure starting in childhood and adolescence
- **National Mesothelioma Registries**
  - **Italy, Australia, France:**
  - **Can incorporate surveillance for exposure patterns**

FIGURE. Malignant mesothelioma annualized age-adjusted death rate* per 1 million population aged ≥25 years,† by state — United States, 1999–2015



CDC MMWR, March 2017

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Diverse Exposure Pathways in Communities

Past Exposure

Occupational

Factory and outside operations

Para-occupational

Asbestos introduced into worker's home environment

Past and Current

Residential

Ambient air – dust, down-wind areas

Lifestyle/Behavioral

Individual activities and behaviors

Also: High asbestos content in lungs of many mesothelioma victims but no identifiable pathway!

Vulnerable Groups within Communities

Genetic and Familial Vulnerabilities

- Extreme - Karain
- Hidden - Wittenoom
- Include genetic predispositions to multiple conditions

Social Vulnerability

- Environmental justice, indigenous communities
- Those ignorant about hazard
- Non-dominant Language

Behavioral Vulnerabilities

- Adolescents
- Home renovators

Extreme Event and Weather Impacts

e.g. 9/11, Tropical storm Floyd

Other General Population Vulnerabilities?

How to Addressing Needs of High-Risk Communities

Libby Montana Pilot Program

- Availability of medical surveillance/early diagnosis especially as our capacity to identify, treat and prevent mesothelioma improves
- Social and psychological support for the community
- Advice/perspective to individuals & families

Assist in constructive community solutions

The Challenge of Early Detection

- **Long period where disease is present without symptoms**
- **Better outcomes with treatment when early stage**
- **Not a "Common" disease**
  - 2000 cases
  - 10 million exposed
- **Good tools for early diagnosis**
  - Imaging (e.g. CXRs and Chest CT scans)
  - Blood tests –research area
  - As therapeutic outcomes improve becomes more important
- **As/if therapeutic outcomes improve becomes more important**
  - Active Research: Surgery, Radiotherapy, Chemotherapy, Immunotherapy, and combinations

Diverse Community Attitudes to Risk

In-depth interviews of Ambler community stakeholders:

- Similar views on most issues
- Extreme range of views on risk
- Different attitudes about optimum remediation

- Not based on Environmental Health Literacy, knowledge of risk.
- Need for better understanding of different attitudes and perceptions to help us work together

Facilitate Constructive Solutions for Community Environmental Health Risk

- **Facilitate Constructive Understanding**
  - Present Day Communication issues
    - Argument to win, not to exchange views
    - Tribalization of views
  - Use of Theatre to present different sides of issues
    - "The White Hills"

- **Memorialization of Risk**

  How do we ensure the community remembers risk

  Avoid repeating the "17 story building" saga

Environmental Health Era: Do we need tools beyond those of Ramazzini and McCord?

- **Understanding and Skills around Group Behavior**
  - Social Sciences-Anthropology
  - Extends beyond psychology
  - “Meaning of exposure “ to a community

- **Memorialization of Risk**

  Preserve and use the history and the stories

- **Merging of Environmental and Public Health**

But retain the ability to see beyond the fashionable, authoritarian and paternalistic….

Environmental Health Era: What have we forgotten from Ramazzini and McCord?

Need for Helpful Advice

- From a Health Professional knowledgeable about environmental and occupational risks & exposures
- Personal: takes into account individuals situation, medical, environmental, psychological.
- Prudently preventive