

Épidémiologie et tendances de la mortalité par mésothéliome aux États-Unis, 1999–2016

Epidemiology and Trends in Mesothelioma Mortality in the United States, 1999–2016

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pulmonaires professionnelles

National Institute for Occupational Safety and Health
Respiratory Health Division



Asbestos

- A generic name given to six fibrous minerals that have been used in commercial products:
- One serpentine:
 - Chrysotile (most common in U.S.)
- Five amphiboles:
 - Crocidolite
 - Amosite
 - Anthophyllite asbestos
 - Tremolite asbestos
 - Actinolite asbestos
- Whether other, noncommercial elongate mineral particles should be included within the definition of asbestos remains controversial

Chrysotile
Photo by Getty Images

Asbestos Consumption in the United States

- **2017**
 - ~300 tons
 - Chrysotile
 - Chloralkali industry for manufacturing semipermeable diaphragms
- **1971–1994**
 - OSHA PEL
 - **Currently: 0.1 fibers per cubic centimeter (f/cc)**
 - **PEL is based on limit of detection of the phase-contrast microscopy analytical method**

USGS. Asbestos. Statistics and Information. <https://minerals.usgs.gov/minerals/pubs/commodity/asbestos/mcs-2018-asbes.pdf>
CDC. Malignant mesothelioma mortality—United States, 1999–2005. MMWR Morb Mortal Wkly Rep. 2009;58(15):393–6.

Type of Exposure

- **Primary (occupational)**
- **Bystander**
- **Environmental (naturally occurring)**
- **Household (family members)**

Workers removing asbestos
Photo by Getty Images

Asbestos Exposure

- Asbestos mining and milling
- Construction work, including bricklaying, plastering, painting, welding, electrical work, demolition and cleanup
- Installing insulation
- Textile workers in Italy
- Ship building, repair, or demolition
- Plumbing, pipefitting, or heating repair
- Chemical and petroleum workers
- Vehicle body workers (asbestos-containing autobody filler, brake or clutch repair)
- Non-asbestos miners

Health Effects

- Benign pleural reactions:
 - Effusions
 - Plaques
 - Diffuse pleural fibrosis
 - Rounded atelectasis
- Asbestosis
- Mesothelioma
- Bronchogenic lung cancer
- Laryngeal cancer
- Ovarian cancer

X-ray of lung with mesothelioma
Photo by Getty Images

Malignant Mesothelioma (MM)

- **Rapidly progressing and lethal**
- **Anatomical sites**
 - Most common: the pleura (~90%) and peritoneum (~10%)
 - Rarely (<1%): the pericardium and tunica vaginalis testis
- **Prognosis poor**
 - 4–12 months (pleural mesothelioma)
 - 5–7 months (pericardial mesothelioma)
 - 24 months (mesothelioma of the tunica vaginalis testis)
 - ~12% of patients with negative prognostic factors live >1 year

Mesothelioma is seen as a thick sheet of white tumor

Asbestos Exposure Level

- “Safe” exposure level, i.e., level that does not cause a specific disease, remains controversial
- No established borderline value below which the risk of mesothelioma can be considered to be zero

Photo by Getty Images

Mesothelioma: Latency and Population Attributable Fraction (PAR)

- The latency period:
 - 20–50 years
- PAR:
 - 85% for men
 - 23% for women (90% considering household exposure)

Figure. US asbestos consumption per capita, actual and projected deaths from asbestosis.

Source: Antao VC et al. Asbestosis mortality in the USA: facts and predictions. *Occup Environ Med.* 2009;66:335-8.

Steenland K, et al. Dying for work: The magnitude of US mortality from selected causes of death associated with occupation. *Am J Ind Med.* 2003;43:461-82.

Objective

To provide information on malignant mesothelioma mortality in the United States for 1999–2016

Data Source

US National Vital Statistics System's multiple cause-of-death data for 1999–2016 from NCHS

- Available from CDC's Wide-ranging Online Data for Epidemiologic Research system at <https://wonder.cdc.gov/>

Study Population and Definitions

- International Classification of Diseases, 10th Revision codes C45.0–C45.2, C45.7, and C45.9 assigned as either the underlying or contributing cause of death
- Persons aged ≥ 25 years
- Industry and occupation information available from 6,519 death certificates provided by Vital Statistics Offices from 26 states (CO, GA, HI, ID, IN, KS, KY, LA, MI, NE, NV, NH, NJ, NM, NC, ND, OH, RI, SC, TX, UT, VT, WA, WV, WI) for 1999, 2003, 2004, and 2007–2013
- Job titles match the 2000 U.S. Bureau of Census Occupations Classification System codes

Measures

- Age-adjusted rate per 1 million (2000 U.S. standard population)
- Proportionate Mortality Ratio (PMR) = observed number of deaths from MM in a specified industry/occupation, divided by the expected number of deaths from MM
 - The expected number of deaths was the total number of deaths in industry or occupation of interest multiplied by a proportion defined as the number of MM deaths in all industries and/or occupations, divided by the total number of deaths in all industries/occupations. The MM PMRs for each sex were internally adjusted by 5-year age groups and race.
 - PMRs calculated using industry and occupation data provided by the 26 states

Results

Number and Rate of MM Deaths by Sex and Age Group, Decedents Aged ≥25 Years — United States, 1999–2016

Age Group (yrs)	Men			Women			All		
	No.	Rate	95%CI	No.	Rate	95%CI	No.	Rate	95%CI
Total*	38,231	24.6	24.4-24.9	9,697	4.6	4.5-4.7	47,928	12.9	12.8-13.1
25-34	83	0.2	0.2-0.3	60	0.2	0.1-0.2	143	0.2	0.2-0.2
35-44	331	0.9	0.8-1.0	235	0.6	0.5-0.7	566	0.7	0.7-0.8
45-54	1,359	3.6	3.4-3.8	654	1.7	1.6-1.8	2,013	2.6	2.5-2.8
55-64	5,044	17.5	17.0-18.0	1,506	4.9	4.6-5.1	6,550	11.0	10.7-11.2
65-74	11,277	63.2	62.0-64.3	2,497	12.0	11.6-12.5	13,774	35.7	35.1-36.3
75-84	14,661	150.0	147.6-152.5	3,217	23.3	22.5-24.1	17,878	75.8	74.7-76.9
85+	5,476	183.5	178.6-188.4	1,528	24.1	22.9-25.3	7,004	75.1	73.4-76.9

*Age-adjusted rate per 1 million

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85+	5,476	183.5	178.6-188.4	1,528	24.1	22.9-25.3	7,004	75.1	73.4-76.9

*Age-adjusted rate per 1 million

Number and Rate* of MM Deaths by Race/Ethnicity, Decedents Aged ≥25 Years — United States, 1999–2016

Race/Ethnicity	Men			Women			All		
	No.	Rate	95%CI	No.	Rate	95%CI	No.	Rate	95%CI
Race									
AIAN	110	10.3	8.2-12.5	36	2.7	1.9-3.8	6	6	5.0-7.1
API	344	6.1	5.4-6.7	126	1.5	1.3-1.8	470	3.4	3.1-3.8
Black or African American	1,574	11.9	11.2-12.5	426	2.1	1.9-2.2	2,000	5.8	5.5-6.1
White	36,203	26.6	26.3-26.9	9,109	5.1	5.0-5.2	45,312	14.1	14.0-14.3
Origin									
Hispanic	1,466	13.1	12.4-13.8	475	3	2.7-3.3	1,941	7.2	6.9-7.6
Not Hispanic	36,686	25.4	25.1-25.1	9,205	4.7	4.6-4.8	45,891	13.3	13.2-13.4
Not stated	79	-	-	17	-	-	96	-	-

*Age-adjusted rate per 1 million; AIAN: American Indian or Alaska Native; API: Asian or Pacific Islander

Number and Rate* of MM Deaths by Race/Ethnicity, Decedents Aged ≥25 Years — United States, 1999–2016

Race/Ethnicity	Men			Women			All		
	No.	Rate	95%CI	No.	Rate	95%CI	No.	Rate	95%CI
Race									
AIAN	110	10.3	8.2-12.5	36	2.7	1.9-3.8	6	6	5.0-7.1
API	344	6.1	5.4-6.7	126	1.5	1.31.8	470	3.4	3.1-3.8
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Number and Rate* of MM Deaths by Anatomical Site, Decedents Aged ≥25 years — United States, 1999–2016

Anatomical site	Men			Women			All		
	No.	Rate	95%CI	No.	Rate	95%CI	No.	Rate	95%CI
Pleura	2,923	1.87	1.80-1.93	688	0.31	0.29-0.34	3,611	0.99	0.96-1.02
Peritoneum	1,205	0.71	0.67-0.75	804	0.36	0.36-0.41	2,009	0.52	0.49-0.54
Pericardium	50	0.02	0.01-0.03	27	-	-	77	0.01	0.00-0.01
Other	4,401	2.83	2.75-2.92	1,122	0.60	0.55-0.58	5,523	1.5	1.46-1.54
Unspecified	29,997	19.39	19.17-19.61	7,143	3.39	3.31-3.47	37,140	10.06	9.96-10.16

*Age-adjusted rate per 1 million

The sum of anatomical site totals is greater than the total number of deaths (47,928) because some decedents have more than one site listed on their death certificate.

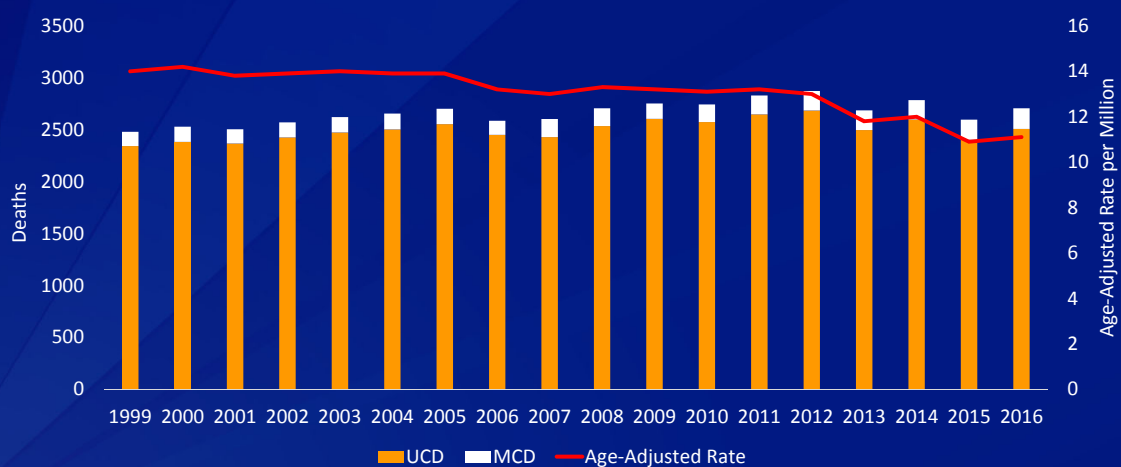
Number and Rate* of MM Deaths by Anatomical Site, Decedents Aged ≥25 years — United States, 1999–2016

Anatomical site	Men			Women			All		
	No.	Rate	95%CI	No.	Rate	95%CI	No.	Rate	95%CI
Pleura	2,923	1.87	1.80-1.93	688	0.31	0.29-0.34	3,611	0.99	0.96-1.02
Peritoneum	1,205	0.71	0.67-0.75	804	0.36	0.36-0.41	2,009	0.52	0.49-0.54
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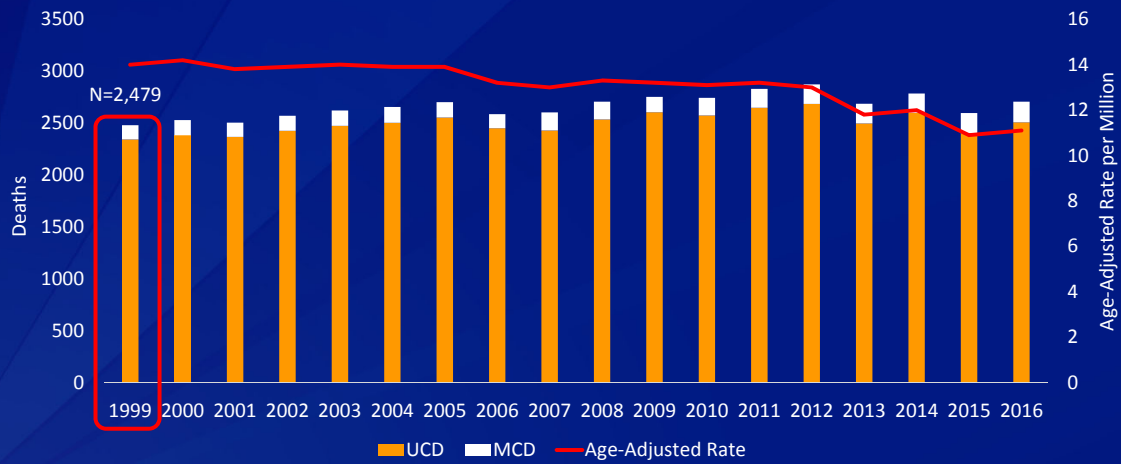
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Number and Rate* of MM Deaths by Year, Decedents Aged ≥25 years — United States, 1999–2016



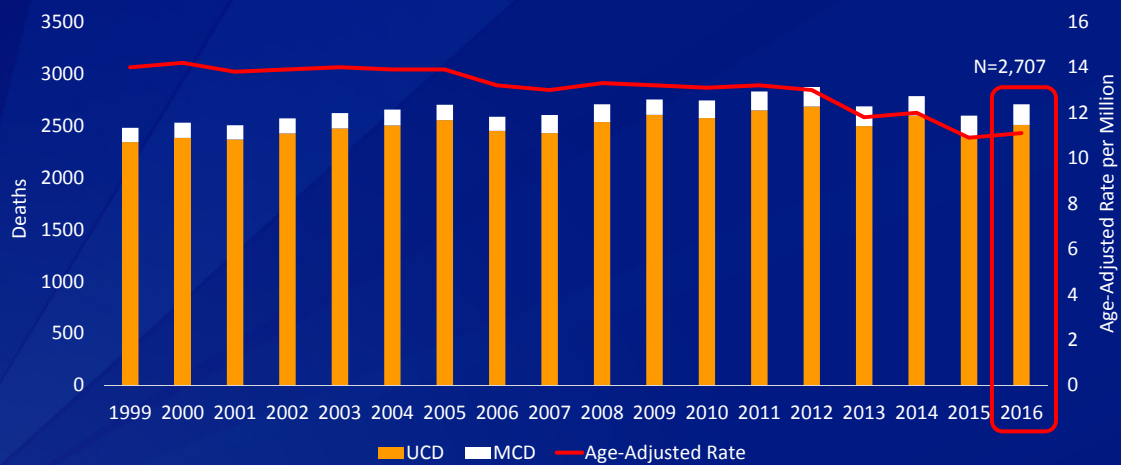
*Age-adjusted rate per 1 million; UCD: underlying cause of death; MCD: multiple cause of death

Number and Rate* of MM Deaths by Year, Decedents Aged ≥ 25 years — United States, 1999–2016



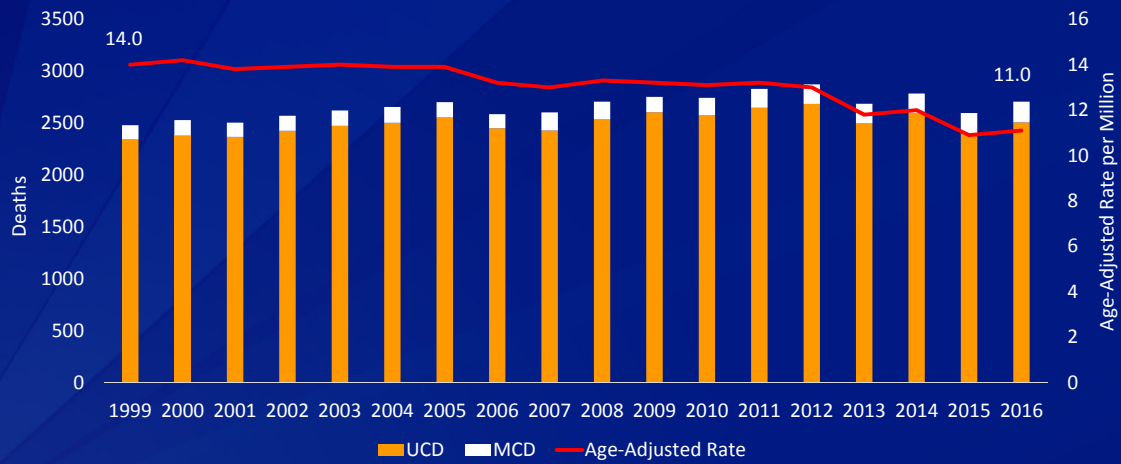
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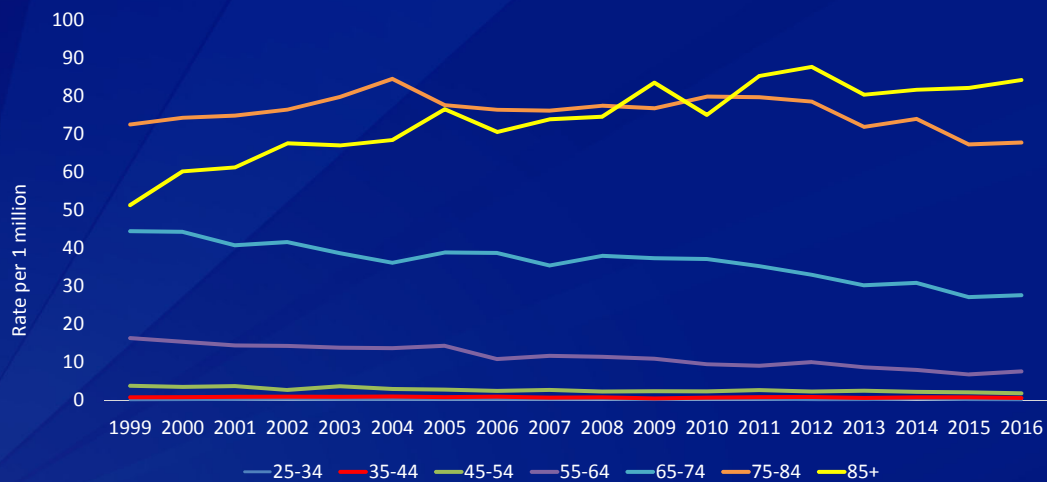
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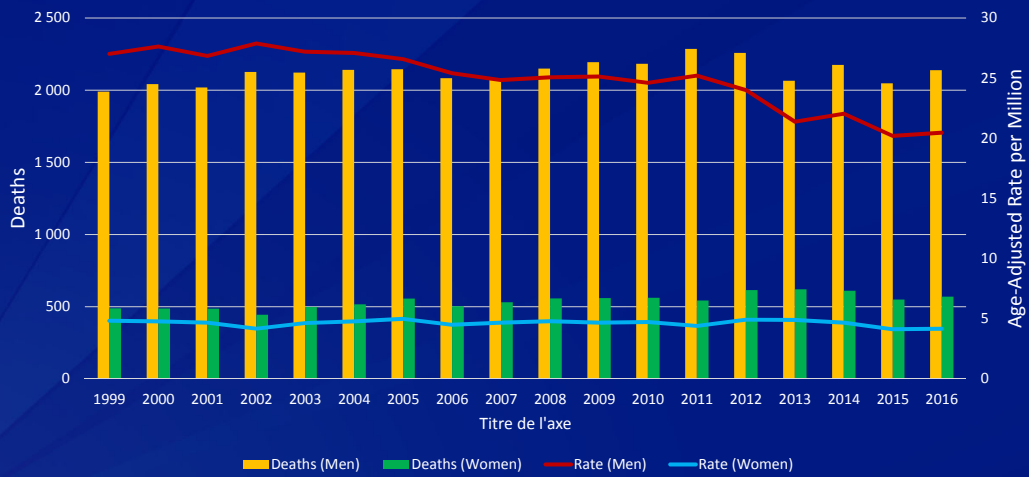


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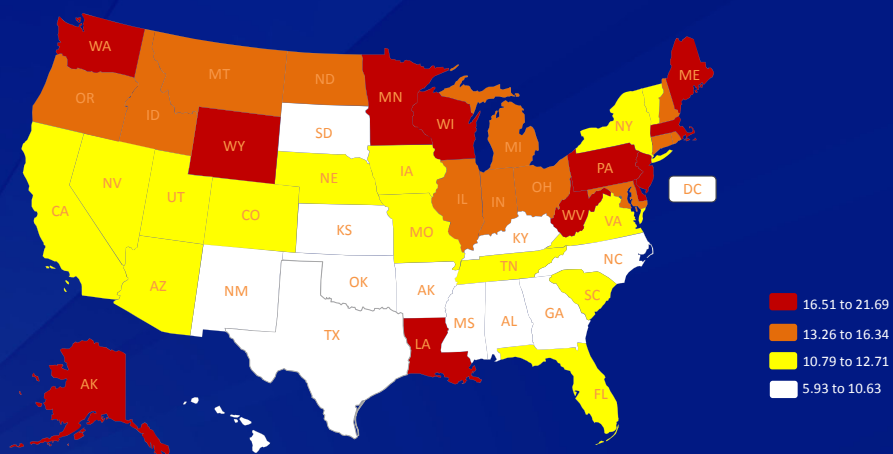
Age-Specific MM Death Rate by Year, Decedents Aged ≥25 years — United States, 1999–2016



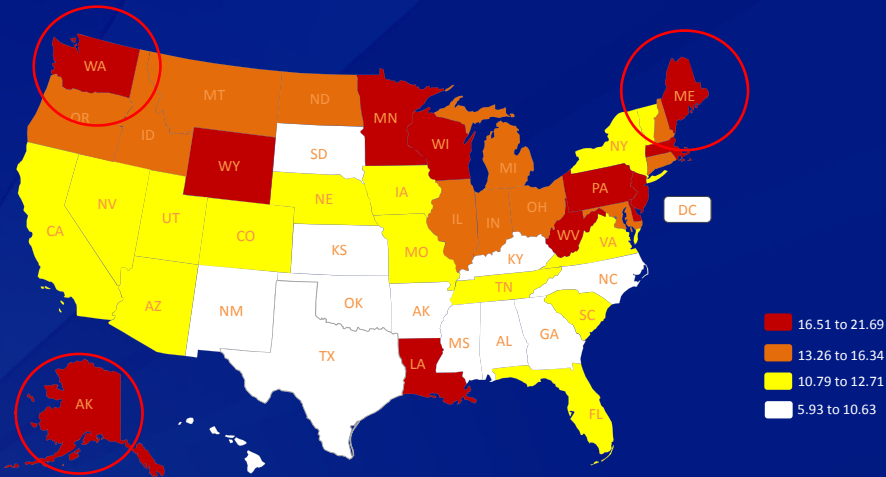
Number and Rate of MM Deaths by Sex and Year, Decedents Aged ≥25 years — United States, 1999–2016



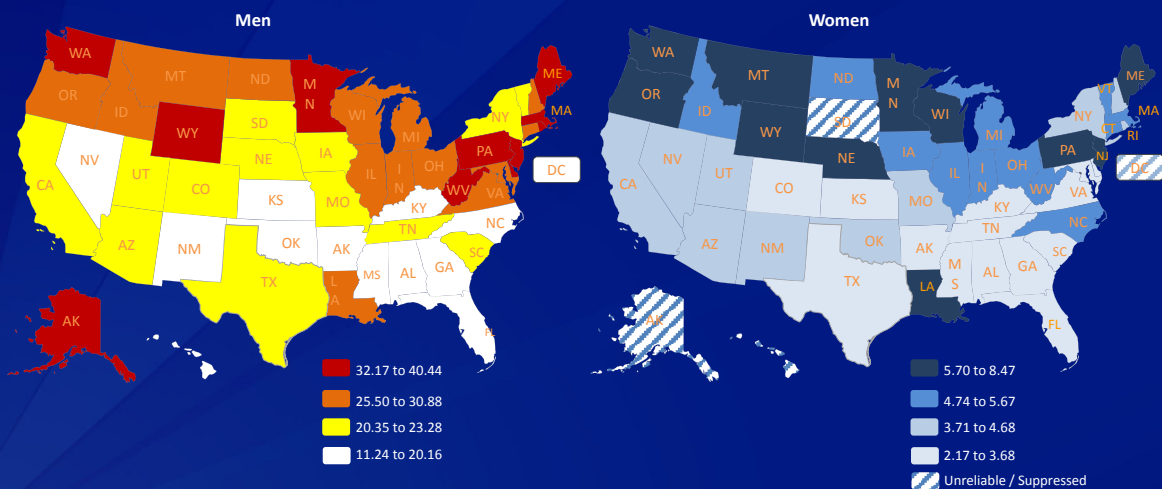
Age-Specific MM Death Rate by State, Decedents Aged ≥25 years — United States, 1999–2016



Age-Specific MM Death Rate by State, Decedents Aged ≥ 25 years — United States, 1999–2016

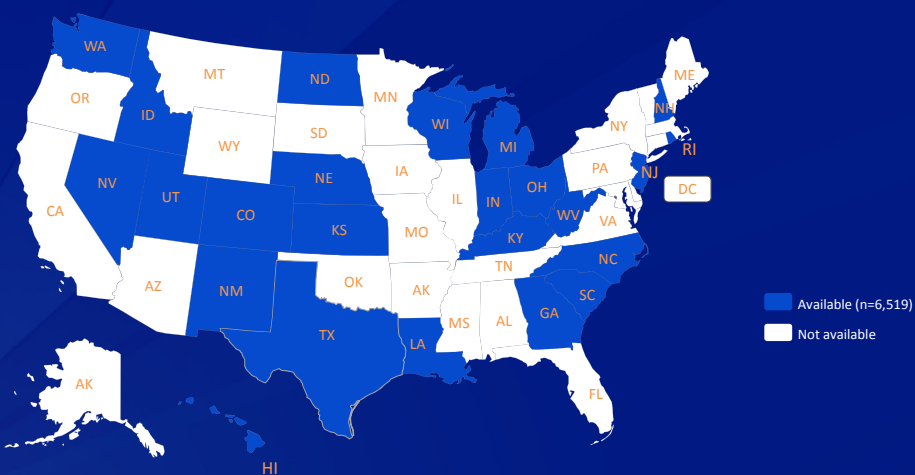


Age-Specific MM Death Rate by Sex and State, Decedents Aged ≥ 25 years — United States, 1999–2016

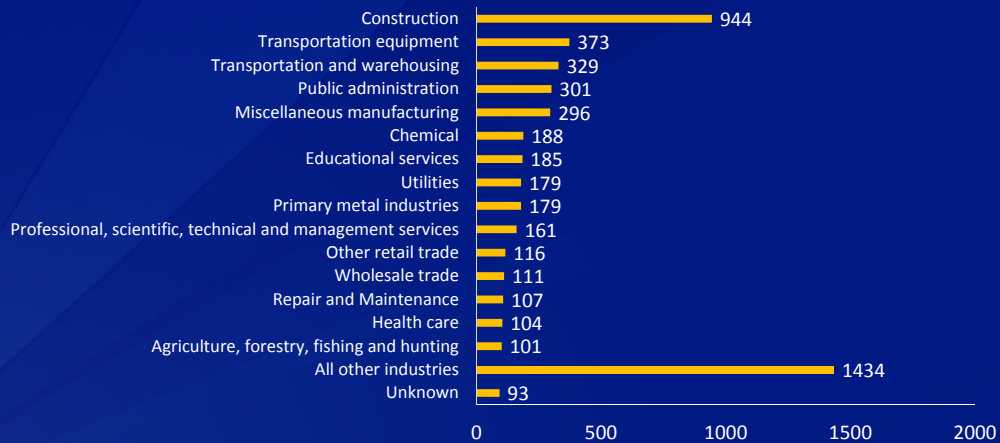


Industry and Occupation

Occupation information available from death certificates for 26 states for 1999, 2003, 2004, and 2007–2013

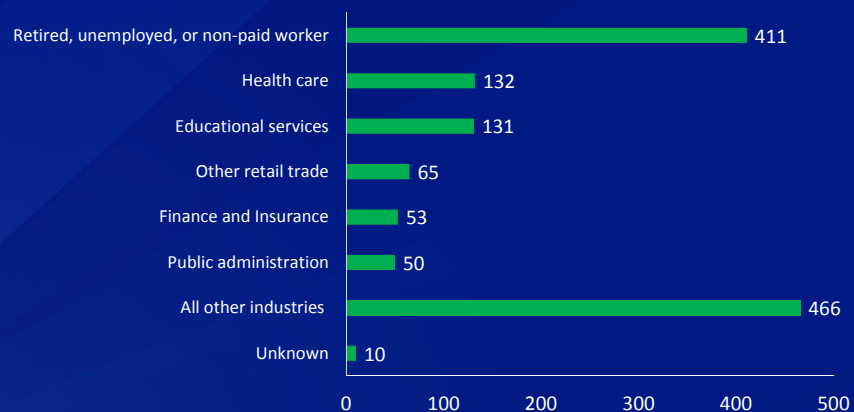


Malignant Mesothelioma Deaths Among Men Aged ≥ 25 Years, by Usual Industry Group* — 26 states, 1999, 2003, 2004, and 2007–2013 (n=5,201)



*2-digit BoC codes; With at least 100 deaths

Malignant Mesothelioma Deaths Among Women Aged ≥ 25 Years, by Usual Industry Group* — 26 states, 1999, 2003, 2004, and 2007–2013 (n=1,318)



*2-digit BoC codes ; With at least 50 deaths

Malignant Mesothelioma Deaths Among Men Aged ≥25 Years, by Usual Occupation Group* — 26 states, 1999, 2003, 2004, and 2007–2013 (n=5,201)



*2-digit BoC codes

Malignant Mesothelioma Deaths Among Women Aged ≥25 Years, by Usual Occupation Group* — 26 states, 1999, 2003, 2004, and 2007–2013 (n=1,318)



*2-digit BoC codes

Occupation Groups* with Significantly Elevated PMRs†, Males — 26 states, 1999, 2003, 2004, and 2007–2013.

Occupation group (Deaths)	PMR§	95% CI
Insulation workers (49)	23.57	(17.46-31.18)
Hazardous materials removal workers (8)	14.37	(6.20-28.30)
Riggers (10)	7.77	(3.73-14.28)
Marine engineers and naval architects (9)	6.80	(3.12-12.91)
Ship engineers (6)	6.65	(2.44-14.48)
Lay-out workers, metal and plastic (6)	5.66	(2.07-12.33)
Pipelayers, plumbers, pipefitters, and steamfitters (216)	4.31	(3.77-4.94)
Environmental engineers (5)	4.09	(1.32-9.55)
Cost estimators (10)	3.84	(1.85-7.06)

*3-digit BoC codes; †Top 10 PMRs; §Adjusted by five-year age groups and race (i.e., white, black, and all other).

Occupation Groups* with Significantly Elevated PMRs, Females — 26 states, 1999, 2003, 2004, and 2007–2013.

Occupation group (Deaths)	PMR†	(95% CI)
Medical and health services managers (9)	2.21	(1.01-4.20)
Office clerks, general (32)	1.50	(1.03-2.12)
Elementary and middle school teachers (57)	1.36	(1.04-1.77)

* 3-digit BoC codes; †Adjusted by five-year age groups and race (i.e., white, black, and all other).

Summary

- During 1999–2016, 38,231 (79.8%) MM deaths occurred among men and 9,697 (20.2%) occurred among women.
- MM deaths among men:
 - Continue increasing (age-adjusted rate decreases),
 - Most frequently associated with insulation work construction trade workers
 - The greatest significant PMR was for insulation workers
- MM deaths among women:
 - Continue increasing (no change in age-adjusted rate)
 - Most frequently associated with unemployed or non-paid workers
 - The greatest significant PMR was for medical and health services managers

Limitations

- Information on decedents' occupation (n=6,519) was available only for 26 states and select years, and might not be nationally representative.
- Information on exposure to asbestos or a specific work history not available to assess the potential source of exposure.
- The occupation listed on a death certificate might not be the occupation in which the decedent's exposures occurred.
- MM did not have a discrete ICD code until the 10th revision of the ICD; thus evaluation of mortality trends before 1999 was not possible.
- Some mesothelioma cases might be misdiagnosed or miscoded.

Conclusions

- These results support previous findings that most men with MM had worked in industries and occupations where asbestos exposure would be expected, while most women with MM did not have work in such industries and occupations listed on their death certificates.
- Primary preventive efforts should be concentrated on exposure elimination through exposure controls accompanied by educational programs.
- Because of the continuing occurrence of mesothelioma deaths, ongoing surveillance to monitor temporal trends is warranted.

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The findings and conclusions in this presentation are those of the authors and do not necessarily represent the official views of NIOSH or CDC.

