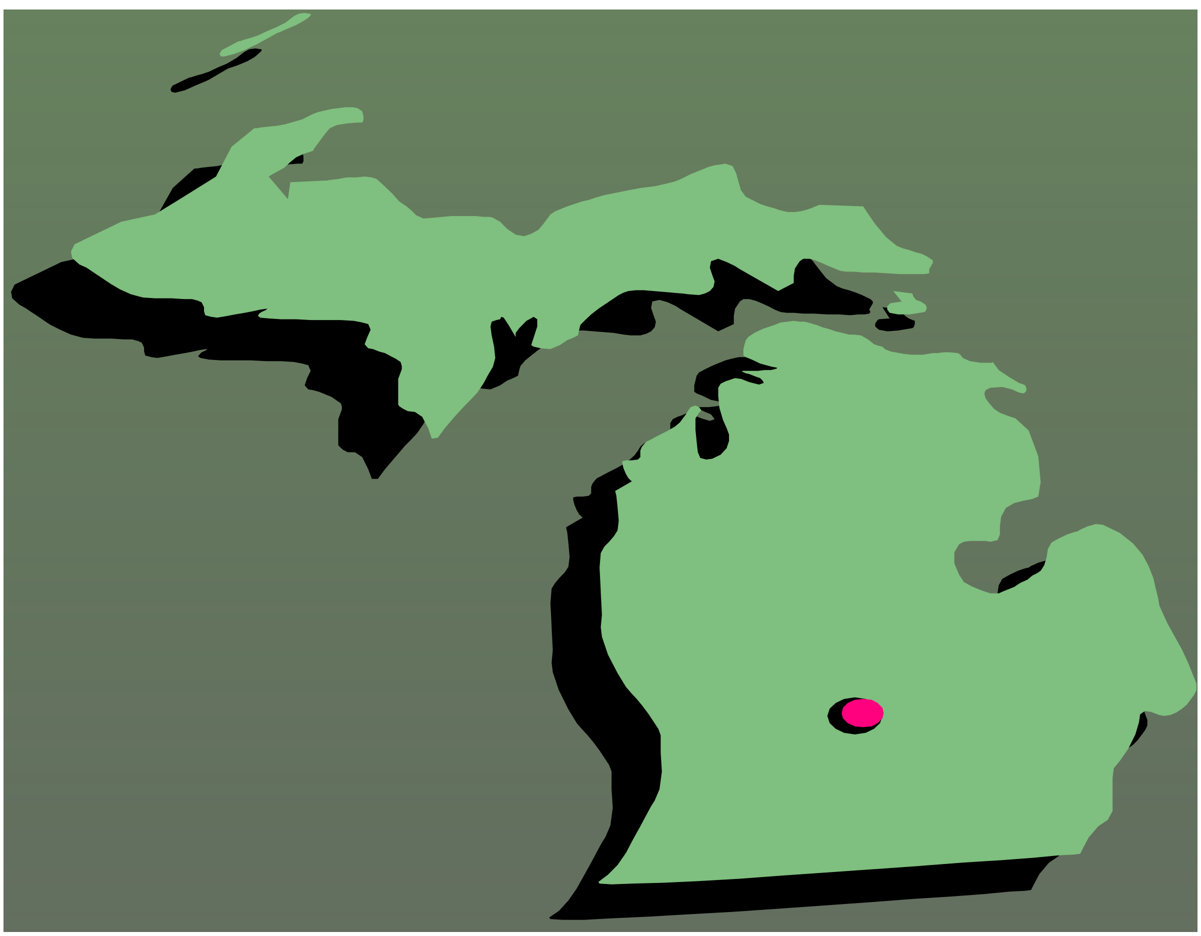
**March 15, 2024**

# 2022
# ANNUAL REPORT

## TRACKING SILICOSIS & OTHER WORK-RELATED LUNG DISEASES IN MICHIGAN



2022 Annual Report

Tracking Silicosis & Other Work-Related Lung Diseases in Michigan
March 15, 2024

# 2022 ANNUAL REPORT TRACKING SILICOSIS & OTHER WORK-RELATED LUNG DISEASES IN MICHIGAN

*Silicosis & Other Work-Related Lung Disease Surveillance Program*

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There are many resources available to help employers, employees, health care professionals and others understand more about work-related lung disease. Links to these resources can be found at: www.oem.msu.edu.

**Acronyms**

**AB** Asbestosis

**COPD** Chronic Obstructive Pulmonary Disease

**ED** Emergency Department

**LEO** MI Department of Labor & Economic Opportunity

**MIOSHA** Michigan Occupational Safety & Health Administration

**NAICS** North American Industrial Classification System

**NIOSH** National Institute for Occupational Safety & Health

**OLDs** Other Work-Related Lung Diseases

**PEL** Permissible Exposure Limit


**This report was funded by the National Institute for Occupational Safety & Health, under cooperative agreement U60-OH008466.**



*We sincerely appreciate the commitment of those health care providers who understand the public health significance of diagnosing a patient with an occupational illness, as well as the Michigan employees who took the time to share their experiences about their work and subsequent development of work-related lung disease.*


## Summary


This is the 31st annual report on silicosis in Michigan, and the 12th year of the expanded report to include surveillance data on the magnitude and nature of all work-related lung diseases in Michigan. In 2011, we expanded surveillance of silicosis in Michigan to include other lung disease, including asbestosis, work-related hypersensitivity pneumonitis, hard metal lung disease, minor pneumoconiosis, and emerging work-related lung diseases. Work-related asthma has always been covered under a separate annual report.

**Individuals with silicosis in Michigan have an increase of over 300% in the likelihood of dying from nonmalignant respiratory disease, both restrictive and obstructive, and an 80% increase in the likelihood of dying from lung cancer [1].**

♦ From 1985-2022, 1,217 silicosis cases have been identified through the Michigan tracking system.

♦ In 2022 only four new cases of silicosis were reported to LEO.

♦ Obstructive changes were found in two-thirds of the individuals with silicosis who had ever smoked cigarettes and among half of the individuals who had never smoked cigarettes.

♦ We estimate 67-139 adults in Michigan with silicosis were not reported in 2022.

♦ Medicare pays the health care costs for most patients with asbestosis.

♦ Acute irritative inhalations are the most common work-related lung disease reported in Michigan; in 2022 there were 139 cases reported as hospitalizations or treated in the emergency department.

# Background

In 1988, the State of Michigan instituted a tracking program for silicosis with financial assistance from NIOSH. In 2011, surveillance was expanded to include OLDs. This is a joint project of MIOSHA and Michigan State University, Department of Medicine, Division of Occupational and Environmental Medicine.

The reporting of an index patient is a sentinel health event that may lead to the identification of employees from the same facilities who are also at risk of developing silicosis or OLDs. The goal is to prevent work-related lung disease through the identification and workplace follow-up of these index patients.

# Work-Related Lung Disease Tracking Procedures

There are four main activities related to occupational lung disease surveillance in Michigan: identifying patients; interviewing patients and collecting relevant medical records; conducting workplace inspections; and sharing the overall results and lessons learned with industry, employees and other stakeholders.

**Part 56 of the Michigan Public Health Code requires reporting of all known or suspected occupational illnesses or work-aggravated health conditions to the Michigan Department of Labor & Economic Opportunity *within 10 days of discovery*.**

## PATIENTS

Patients are identified through mandatory reporting of any known *or suspected* occupational illnesses, including silicosis and other work-related lung diseases.

### SOURCES TO IDENTIFY PATIENTS IN MICHIGAN

- ♦ **Health Care Providers** Private practice, working for industry, NIOSH-certified "B" readers
- ♦ **Hospitals** International Classification of Disease 10th Revision (ICD-10) Silicosis (J62, J65), Hypersensitivity Pneumonitis (J67), Other Pneumoconioses (J63, J64), Other Respiratory Conditions (J66, J68, Z57.2, Z57.3, Z57.5)
- ♦ **Workers' Disability Compensation Agency**
- ♦ **Michigan Poison Center**
- ♦ **Reports from Co-Workers or MIOSHA Field Staff** confirmed by a health care provider
- ♦ **Death Certificates**
- ♦ **Michigan 3rd Judicial Court** for asbestos-related disease
- ♦ **Mine Safety and Health Administration**
- ♦ **Michigan Cancer Registry** for mesothelioma
- ♦ **Clinical Laboratories** for specific IgE allergy testing
- ♦ **Emergency Medical Services (Ambulance)**

Once patients are identified, a letter is sent asking them to participate in a telephone interview. Afterwards, medical records are requested, including chest x-rays and pulmonary function test results.

### CLASSIFICATION OF WORK-RELATED LUNG DISEASE

A physician who is board-certified in internal and occupational/environmental medicine and also is a NIOSH certified B-reader reviews medical evidence which may include interview, medical records, breathing tests and chest x-rays. In addition, for silicosis and asbestosis the following criteria are applied:

**SILICOSIS**

1) History of silica exposure.

and

2a) Chest x-ray interpretation with rounded opacities of 1/0 or greater profusion in the upper lobes.

or

2b) A biopsy report of lung tissue showing the characteristic silicotic nodule.

**ASBESTOSIS**

1) History of asbestos exposure.

and

2) Chest x-ray interpretation showing linear changes in the lower lobes and/or pleural thickening.

### WORKPLACE INSPECTION

After the patient interview is completed, MIOSHA determines whether a workplace enforcement inspection will be conducted. During an inspection, co-workers are interviewed to determine if other individuals are experiencing similar breathing problems from exposure to the agent. Any workers reporting breathing problems are sent a letter advising them to see their doctor. Chest x-rays may be reviewed if the company performs periodic chest x-ray surveillance. Air monitoring for any suspected agent is conducted. The company's health and safety program and its Injury and Illness Log are reviewed. After the investigation is complete, a report of air sampling results and any recommendations is sent to the company and made available to workers. A copy of the report is also sent to the reporting physician.

### OTHER FOLLOW UP ACTIVITIES

Outreach, educational activities, and recommendations may be developed. An annual report summarizing the activity is completed. Brochures or other materials may be developed to address specific emergent issues identified.

## *Results*

The following sections report results in this order: **silicosis** surveillance in Michigan from 1985-2022, **asbestos-related lung disease and mesothelioma**, and all other **OLDs** surveillance for calendar year 2022.

Table 1 shows that 1,217 people were confirmed with silicosis from 1985 - 2022. Figure 1 shows the number of confirmed silicosis cases by year, for 1985 – 2022. Figure 2 shows the overlap of reporting sources. Hospital discharge data is the most common source of reports.

Figure 7 shows the number of individuals hospitalized in Michigan with silicosis from 1990 to 2022. Repeat admissions of the same individual within each calendar year are excluded from these counts of inpatient Hospital Discharge Data (HDC). For most patients, pneumoconiosis was not the primary discharge diagnosis listed on the hospital discharge record.

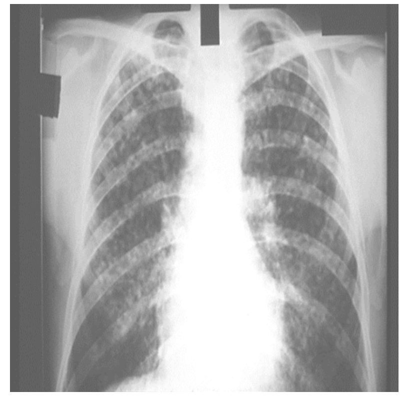
## TABLE 1
## Year and Reporting Source for 1,217 Confirmed Silicosis Cases: 1985-2022

Initial Reporting Source*

| YEAR | PR | HDC | DC | WC | ICFU |
|---|---|---|---|---|---|
| 85-87 | 0 | 67 | 35 | 42 | 0 |
| 1988 | 0 | 56 | 6 | 7 | 0 |
| 1989 | 7 | 40 | 9 | 4 | 3 |
| 1990 | 5 | 44 | 0 | 6 | 1 |
| 1991 | 5 | 37 | 1 | 6 | 0 |
| 1992 | 16 | 54 | 6 | 2 | 0 |
| 1993 | 6 | 31 | 1 | 4 | 0 |
| 1994 | 7 | 36 | 1 | 28 | 0 |
| 1995 | 26 | 35 | 3 | 2 | 0 |
| 1996 | 28 | 35 | 0 | 0 | 0 |
| 1997 | 13 | 48 | 1 | 0 | 0 |
| 1998 | 10 | 28 | 1 | 0 | 0 |
| 1999 | 5 | 25 | 1 | 1 | 0 |
| 2000 | 4 | 32 | 0 | 0 | 0 |
| 2001 | 8 | 11 | 1 | 0 | 0 |
| 2002 | 1 | 32 | 1 | 0 | 0 |
| 2003 | 8 | 26 | 0 | 0 | 0 |
| 2004 | 2 | 24 | 0 | 0 | 0 |
| 2005 | 4 | 26 | 0 | 0 | 0 |
| 2006 | 1 | 17 | 1 | 0 | 0 |
| 2007 | 2 | 19 | 0 | 1 | 0 |
| 2008 | 4 | 18 | 0 | 1 | 0 |
| 2009 | 1 | 12 | 1 | 0 | 0 |
| 2010 | 2 | 19 | 0 | 0 | 0 |
| 2011 | 0 | 11 | 0 | 0 | 0 |
| 2012 | 0 | 11 | 0 | 0 | 0 |
| 2013 | 0 | 17 | 1 | 0 | 0 |
| 2014 | 1 | 17 | 0 | 0 | 0 |
| 2015 | 2 | 11 | 0 | 0 | 0 |
| 2016 | 0 | 7 | 0 | 0 | 0 |
| 2017 | 1 | 4 | 0 | 0 | 0 |
| 2018 | 0 | 7 | 0 | 0 | 0 |
| 2019 | 0 | 6 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 |
| 2021** | 0 | 3 | 0 | 0 | 0 |
| 2022** | 0 | 3 | 1 | 0 | 0 |
| TOTAL | 169 | 869 | 71 | 104 | 4 |

*PR– Physician Referral; HDC-Hospital Discharge; DC-Death Certificate; WC-Workers' Compensation; ICFU-Index Case Follow-Up.

**Reports are still being processed for calendar years 2021 and 2022.



Top X-Ray shows Advanced Simple Silicosis.

Lower X-Ray shows Progressive Massive Fibrosis.

## FIGURE 1
## Confirmed Silicosis Cases by Year Reported

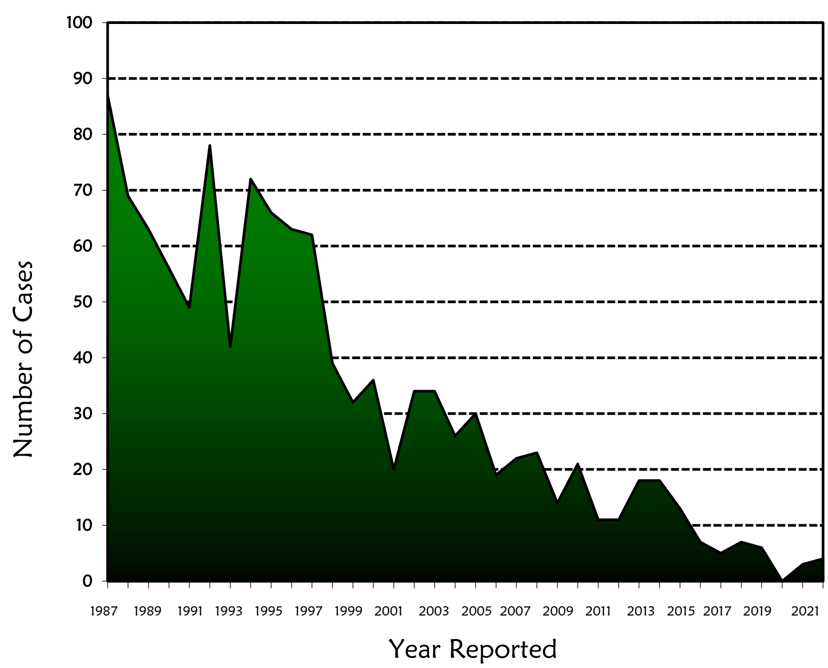
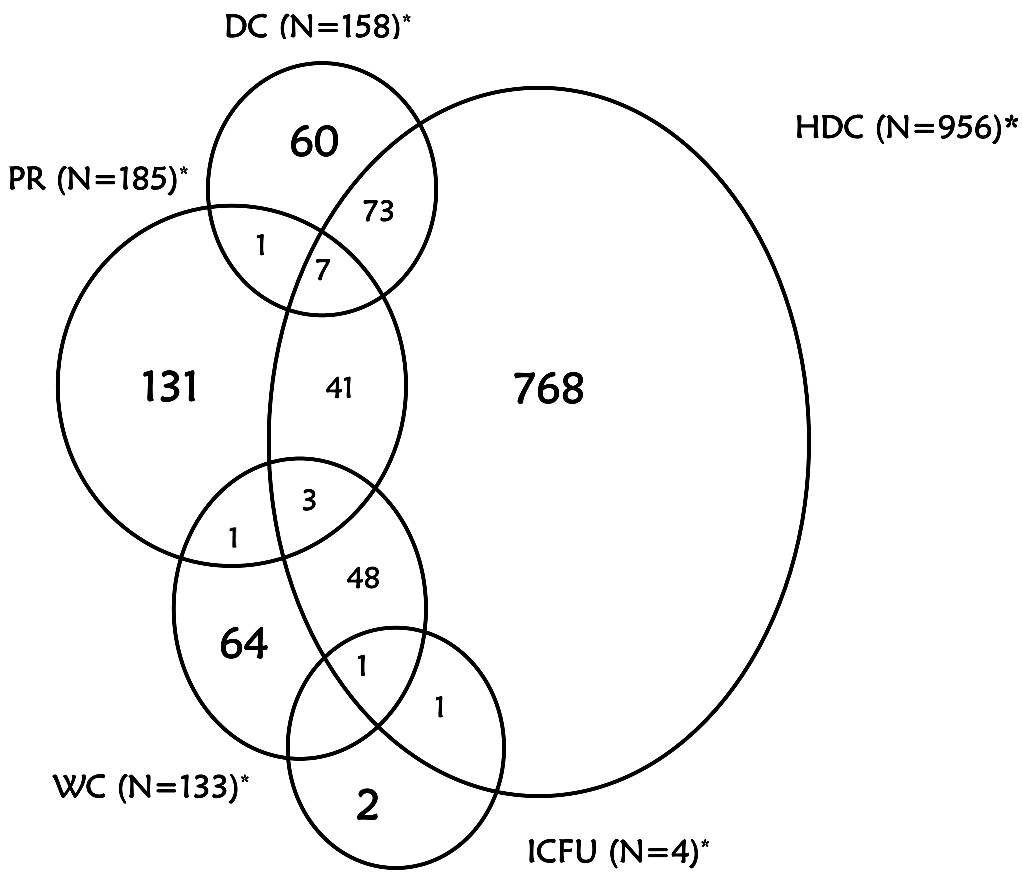


FIGURE 2
Overlap of Reporting Sources for 1,217 Confirmed Silicosis Patients: 1985-2022




*N's represent the total number reported at any time by that source.
Reporting Source Codes: HDC=Hospital Discharge Data; PR=Physician Referral; DC=Death Certificate; WC=Workers' Compensation; ICFU=Index Case Follow Up.
There was also an overlap of HDC-DC-WC for 13 individuals; an overlap of HDC-PR-WC-DC for one individual; an overlap of WC-DC for two individuals; and an overlap of HDC-DC-IFCU for one individual.

**Based on capture-recapture analysis we estimate that although on average we receive 20 reports of silicosis a year, there are an additional 67-139 cases that are diagnosed each year but are not reported [2].**

# *Demographics – Silicosis*

**GENDER**
- Women 30 (2%)
- Men 1,187 (98%)

**YEAR OF BIRTH**
- Range 1888 - 1984
- Average 1926

**RACE**
- White 718 (59%)
- Black 453 (37%)
- Alaskan/American Ind. 2 (<1%)
- Asian 2 (<1%)
- Other 30 (2%)
- Unknown 12 (1%)

**AVERAGE ANNUAL INCIDENCE RATE**

- Black
  6.1 per 100,000
- White
  1.2 per 100,000

The average annual incidence rate for Black workers is 5.1X greater than that of whites.

Numerator is the average number of silicosis cases by race for 1987-2020. Denominator Source: 2000 Census population data by race, age 40 and older.

# Medical Results – Silicosis

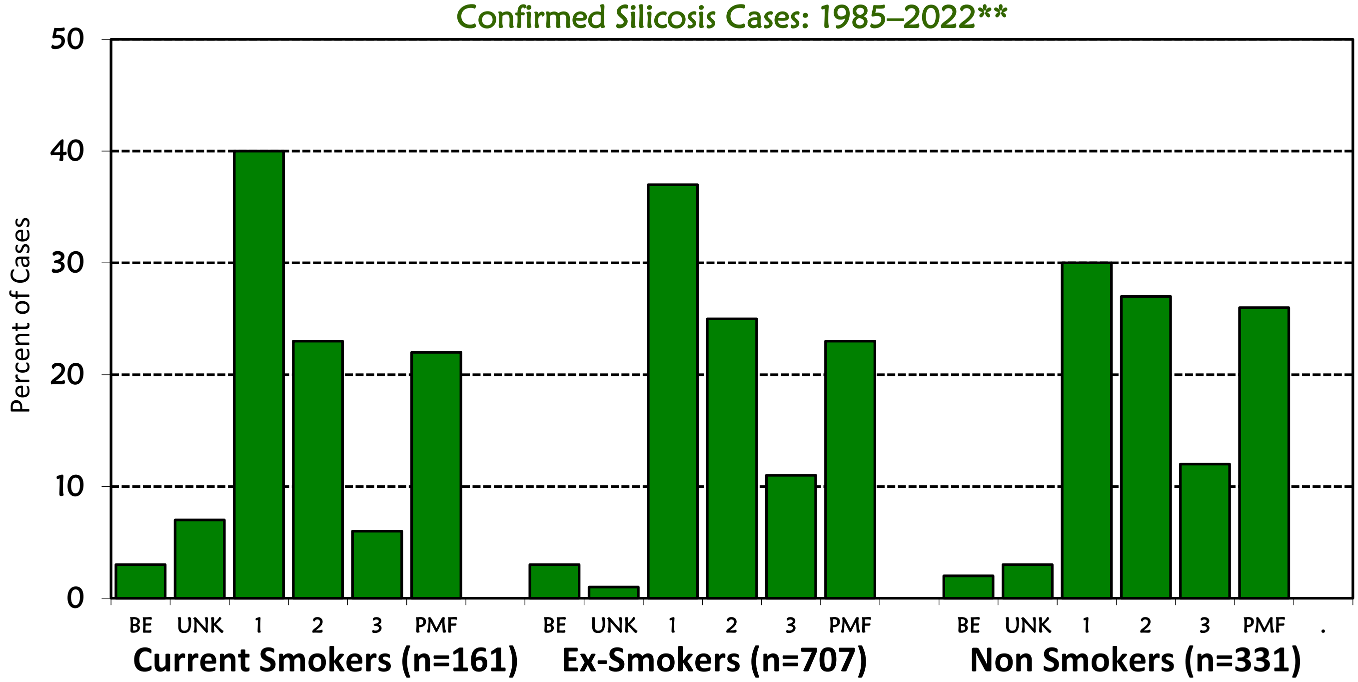
Overall, 866 (71.2%) of the 1,217 people with silicosis had simple silicosis and 283 (23.3%) had progressive massive fibrosis. Thirty-six (3.0%) individuals with silicosis had normal x-rays with lung biopsy evidence. Thirty-two (2.6%) individuals had x-ray reports which were consistent with silicosis, but the actual radiograph could not be obtained to classify.

Of the 1,217 people with silicosis, there were 1,199 who had a known cigarette smoking history, 331 (27.6%) never smoked cigarettes, 707 (59.0%) had quit, and 161 (13.4%) were still smoking. No information was available on 18 individuals. Figure 3 shows the distribution of x-ray results according to the International Labor Organization (ILO) classification and smoking status. Non-smokers tended to have more severe silicosis. This latter finding may be an artifact of our reporting system, which is mainly based on reports of hospitalized individuals. Non-smoking individuals with simple silicosis are less likely to be symptomatic and hospitalized and therefore less likely to have been reported to the surveillance system.

Tables 2 and 3 show the distribution of percent predicted forced vital capacity (FVC) and the ratio of forced expiratory volume in one second ($FEV_1$) to FVC by x-ray and cigarette smoking status. Approximately 60% of people with silicosis had reduced breathing function, either restrictive or obstructive. Obstructive changes (Table 3) were found in two-thirds of the individuals who had ever smoked cigarettes and among half of the individuals who had never smoked cigarettes. More comprehensive analyses of spirometry results was published in 2010 and 2018 [3,4].

Eight hundred thirty-five of the silicosis cases had information on tuberculosis (TB) testing; 680 (81.4%) indicated they had ever had a skin test for TB; and 104 (15.3%) had a positive result. The percentage with a positive TB skin test did not change over time. One hundred sixty-nine (16.6%) of 1,017 individuals reported they had ever had active TB, regardless of whether a skin test had ever been done. In comparison, the annual percentage of subjects with active TB in the United States from 1988 to 2016 was 0.003–0.010% and in Michigan from 2013 to 2017 was 0.001% [4].

**FIGURE 3**
**Severity of X-Ray Results* by Smoking Status for Confirmed Silicosis Cases: 1985–2022****




*BE = Biopsy Evidence; UNK = Unknown; 1-3 = International Labor Organization categorization system for grading pneumoconioses; Category 1 = 1/0, 1/1, 1/2; Category 2 = 2/1, 2/2, 2/3; Category 3 = 3/2, 3/3, 3/+; PMF = Progressive Massive Fibrosis.

**Total number of individuals: 1,199. Smoking status was unknown for 18 individuals.

## TABLE 2 – Percent Predicted Forced Vital Capacity (FVC) by X-Ray Results and Cigarette Smoking Status for Confirmed Silicosis Cases: 1985-2022

| | Percent Predicted FVC*** | | | | | |
|---|---|---|---|---|---|---|
| | <60% | | 60-79% | | >=80% | |
| X-Ray Results* | Ever Smoked | Never Smoked | Ever Smoked | Never Smoked | Ever Smoked | Never Smoked |
| | # (%) | # (%) | # (%) | # (%) | # (%) | # (%) |
| Biopsy Evidence | 4 (19) | -- | 9 (43) | 2 (50) | 8 (38) | 2 (50) |
| Unk Severity | 6 (38) | 2 (50) | 6 (38) | 1 (25) | 4 (25) | 1 (25) |
| Category 1 | 50 (23) | 18 (30) | 74 (35) | 17 (28) | 89 (42) | 25 (42) |
| Category 2 | 40 (30) | 22 (37) | 49 (36) | 19 (32) | 46 (34) | 19 (32) |
| Category 3 | 16 (34) | 15 (63) | 18 (38) | 5 (21) | 13 (28) | 4 (17) |
| PMF | 47 (38) | 22 (39) | 40 (33) | 18 (32) | 36 (29) | 16 (29) |
| Total** | 163 (29) | 79 (38) | 196 (35) | 62 (30) | 196 (35) | 67 (32) |

*Biopsy Evidence if no x-ray available; International Labor Organization categorization system for grading pneumoconioses: Cat 1= 1/0, 1/1, 1/2; Cat 2= 2/1, 2/2, 2/3; Cat 3= 3/2, 3/3, 3+; PMF=Progressive Massive Fibrosis.
**Total number of individuals: 763. Information was missing for 454 individuals.
***Percentages represent the proportion of individuals in each x-ray result category, within smoking status category.

## TABLE 3 – Ratio of Forced Expiratory Volume in 1 Second ($FEV_1$) to Forced Vital Capacity (FVC) by X-Ray Results and Cigarette Smoking Status for Confirmed Silicosis Cases: 1985-2022

| | <=40% | | 41-59% | | 60-74% | | >=75% | |
|---|---|---|---|---|---|---|---|---|
| X-Ray Results* | Ever Smoked | Never Smoked | Ever Smoked | Never Smoked | Ever Smoked | Never Smoked | Ever Smoked | Never Smoked |
| | # (%) | # (%) | # (%) | # (%) | # (%) | # (%) | # (%) | # (%) |
| Biopsy Evidence | 1 (5) | 1 (33) | 3 (14) | -- | 10 (48) | 2 (67) | 7 (33) | -- |
| Unk Severity | 1 (8) | -- | 1 (8) | -- | 3 (25) | 3 (75) | 7 (58) | 1 (25) |
| Category 1 | 21 (10) | 1 (2) | 43 (20) | 3 (5) | 73 (35) | 20 (33) | 73 (35) | 36 (60) |
| Category 2 | 5 (4) | 3 (5) | 27 (21) | 8 (14) | 52 (41) | 16 (28) | 43 (34) | 31 (53) |
| Category 3 | 2 (4) | 1 (4) | 8 (18) | -- | 5 (11) | 7 (30) | 30 (67) | 15 (65) |
| PMF | 20 (17) | 3 (6) | 38 (32) | 14 (26) | 36 (30) | 18 (33) | 25 (21) | 19 (35) |
| Total** | 50 (9) | 9 (4) | 120 (22) | 25 (12) | 179 (34) | 66 (33) | 185 (35) | 102 (50) |

*Biopsy Evidence if no x-ray available; International Labor Organization categorization system for grading pneumoconioses: Cat 1= 1/0, 1/1, 1/2; Cat 2= 2/1, 2/2, 2/3; Cat 3= 3/2, 3/3, 3+; PMF= Progressive Massive Fibrosis.
**Total number of individuals: 736. Information was missing for 481 individuals.
***Percentages represent the proportion of individuals in each x-ray result category, within smoking status category.

*Location* Table 4 shows the annual average incidence rates of silicosis among the working population, by race and county where there was at least one case in that county. Yellow-highlighted rates are for counties where both white and Black silicosis cases were reported. The highest rates were among Black males in Shiawassee (226 cases per 100,000), Muskegon (113 cases per 100,000), Saginaw (35 cases per 100,000), and Monroe (18 cases per 100,000). The incidence of Black males with silicosis was 5.1 times greater than white males with silicosis. More information about health disparities and occupational lung disease can be found in our Fall 2014 PS News newsletter (V25N4), at: www.oem.msu.edu. Figure 4 shows the counties of the companies at which the patients' silica exposure occurred; Muskegon, Wayne and Saginaw were the top three counties for silicosis cases.

## TABLE 4
## Average Annual Incidence Rate of Silicosis Among Michigan Workers by Race and County of Exposure: 1987-2020

| | White* Males | | | Black** Males | | |
|---|---|---|---|---|---|---|
| County | County Pop'n | # | Rate | County Pop'n | # | Rate |
| Allegan | 20850 | 2 | 0.3 | 275 | | — |
| Alpena | 7388 | 25 | 10.0 | 8 | | — |
| Arenac | 4168 | 1 | 0.7 | 62 | | — |
| Baraga | 1815 | 1 | 1.6 | 78 | | — |
| Barry | 12360 | 4 | 1.0 | 34 | | — |
| Bay | 23674 | 8 | 1.0 | 226 | | — |
| Benzie | 3898 | 1 | 0.8 | 9 | | — |
| **Berrien** | **30479** | **8** | **0.8** | **3594** | **4** | **3.3** |
| Branch | 9525 | 4 | 1.2 | 288 | | — |
| **Calhoun** | **25345** | **27** | **3.1** | **2650** | **14** | **15.5** |
| Cass | 10970 | 1 | 0.3 | 676 | | -- |
| Charlevoix | 5942 | 3 | 1.5 | 5 | | — |
| Chippewa | 7286 | 2 | 0.8 | 616 | | — |
| Delta | 9045 | 3 | 1.0 | 5 | | — |
| Dickinson | 6419 | 1 | 0.5 | 5 | | — |
| Eaton | 20377 | 3 | 0.4 | 781 | | — |
| **Genesee** | **69596** | **12** | **0.5** | **13423** | **6** | **1.3** |
| Gladwin | 6615 | 1 | 0.4 | 8 | | — |
| Gogebic | 4353 | 3 | 2.0 | 22 | | — |
| Gd Traverse | 16451 | 1 | 0.2 | 57 | | — |
| Gratiot | 8356 | 2 | 0.7 | 371 | | — |
| Hillsdale | 9857 | 9 | 2.7 | 36 | | — |
| Ingham | 41166 | 11 | 0.8 | 3987 | | — |
| Iosco | 7280 | 1 | 0.4 | 30 | | — |
| Iron | 3531 | 3 | 2.5 | 28 | | — |
| Isabella | 9294 | 1 | 0.3 | 77 | | — |
| **Jackson** | **31380** | **3** | **0.3** | **2685** | **2** | **2.2** |
| Kalamazoo | 39985 | 4 | 0.3 | 3004 | | — |
| **Kent** | **93136** | **16** | **0.5** | **6768** | **3** | **1.3** |
| Keweenaw | 639 | 1 | 4.6 | 1 | | — |
| Lake | 2817 | 2 | 2.1 | 251 | | — |
| Lapeer | 18176 | 2 | 0.3 | 226 | | — |
| Lenawee | 20192 | 4 | 0.6 | 573 | | — |
| Livingston | 32610 | 3 | 0.3 | 111 | | — |
| Mackinac | 2761 | 1 | 1.1 | 6 | | — |
| **Macomb** | **156926** | **28** | **0.5** | **3233** | **7** | **6.4** |
| Manistee | 5999 | 3 | 1.5 | 67 | | — |
| Marquette | 14199 | 18 | 3.7 | 224 | | — |
| Mason | 6683 | 1 | 0.4 | 41 | | — |
| Menominee | 6054 | 12 | 5.8 | 2 | | — |
| Midland | 16605 | 3 | 0.5 | 128 | | — |
| **Monroe** | **29452** | **8** | **0.8** | **497** | **3** | **17.8** |
| Montcalm | 12433 | 3 | 0.7 | 335 | | — |
| Montmorency | 2957 | 1 | 1.0 | 3 | | — |
| **Muskegon** | **30132** | **126** | **12.3** | **3564** | **137** | **113.1** |
| **Oakland** | **216359** | **18** | **0.2** | **20085** | **7** | **1.0** |
| Ontonagon | 2295 | 2 | 2.6 | 1 | | |
| **Ottawa** | **41916** | **4** | **0.3** | **270** | **1** | **10.9** |
| Roscommon | 7325 | 1 | 0.4 | 9 | | |
| **Saginaw** | **36097** | **66** | **5.4** | **5936** | **70** | **34.7** |
| **St. Clair** | **33209** | **6** | **0.5** | **623** | **1** | **4.9** |
| **St. Joseph** | **12266** | **4** | **1.0** | **251** | **1** | **11.7** |
| Sanilac | 9753 | 3 | 0.9 | 23 | | — |
| Schoolcraft | 2121 | 1 | 1.4 | 18 | | — |
| **Shiawassee** | **14737** | **3** | **0.6** | **26** | **2** | **226.2** |
| Tuscola | 12334 | 1 | 0.2 | 108 | | — |
| Van Buren | 15129 | 2 | 0.4 | 808 | | — |
| Washtenaw | 47535 | 8 | 0.5 | 5758 | | — |
| **Wayne** | **236472** | **141** | **1.8** | **134974** | **169** | **3.7** |
| Wexford | 6478 | 4 | 1.8 | 6 | | — |

*Rate per 100,000 among white men age 40+. Numerator: average number of white males with silicosis for the years 1987 – 2020; denominator: 2000 Census population data for white men age 40 and older, by county. In 2000, there were 1,730,017 white males 40 years and older living in Michigan.
**Rate per 100,000 among Black men age 40+. Numerator: average number of Black males with silicosis for the years 1987 – 2020; denominator: 2000 Census population data for Black men age 40 and older, by county. In 2000, there were 219,076 Black males 40 years and older living in Michigan.

# *Type of Industry – Silicosis*

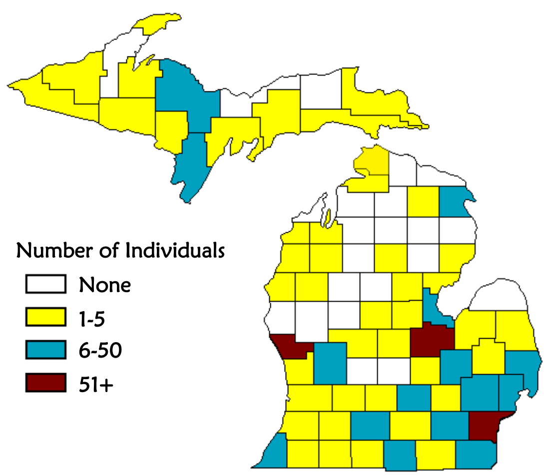
Table 5 shows the Michigan industries by NAICS codes, where exposure to silica occurred from 1985 to 2022. The predominant industries were in manufacturing (84%), construction (9%) and mining (4%). Most of the manufacturing jobs were in iron foundries. Exposure to silica is still occurring in foundries (Figures 5 and 6).

Although silicosis typically occurs after a long duration of exposure to silica, some patients develop silicosis after a relatively short period of time because of the severity of that exposure. The average year of hire is 1951, ranging from 1910 to 2012. Five individuals with silicosis began working in the 2000s, nine began working in the 1990s, 26 in the 1980s, 89 in the 1970s and 187 in the 1960s. The average number of years worked at a silica-exposed job was 27.3 years.

**TABLE 5**
**Primary Industrial Exposure for Confirmed Silicosis Patients: 1985-2022**

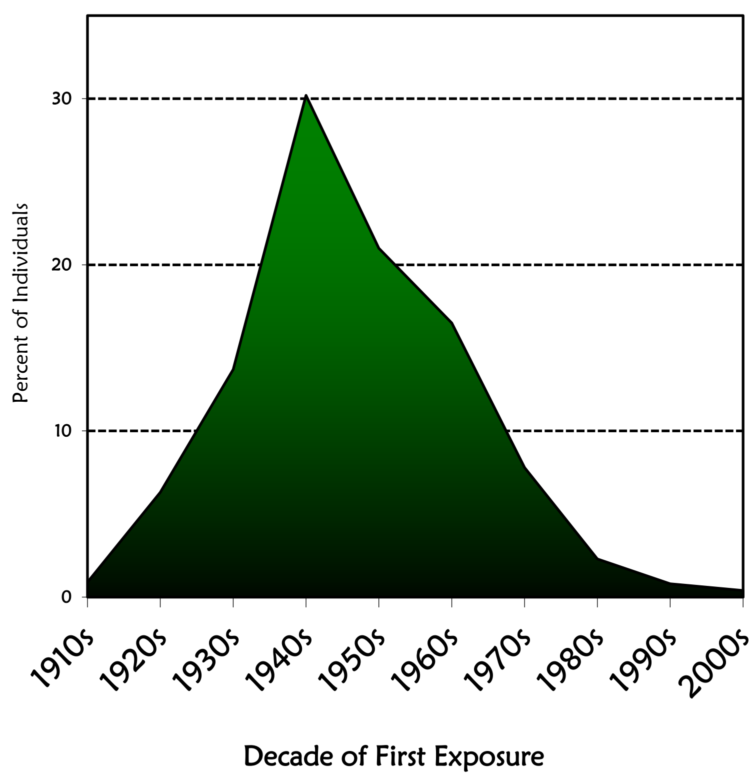
| | INDUSTRY (2002 NAICS) | # | % |
|---|---|---|---|
| 11 | Agriculture, Forestry, Fishing, & Hunting | 2 | 0.2 |
| 21 | Mining | 54 | 4.4 |
| 22 | Utilities | 1 | 0.1 |
| 23 | Construction | 109 | 9.0 |
| 31-33 | Manufacturing | 1,021 | 83.9 |
| 42 | Wholesale Trade | 2 | 0.2 |
| 44-45 | Retail Trade | 3 | 0.2 |
| 48-49 | Transportation & Warehousing | 7 | 0.6 |
| 56 | Administrative & Support & Waste Management | 1 | 0.1 |
| 62, 81 | Health Care & Social Assistance | 7 | 0.6 |
| 92 | Public Administration | 4 | 0.3 |
| 00 | Unknown | 6 | 0.5 |
| Total | | 1,217 | |

**FIGURE 4**
**Distribution of Confirmed Silicosis Cases by County of Exposure: 1985-2022**




*Seventy-seven individuals were exposed to silica out-of-state, and 33 individuals had an unknown county of exposure.

**FIGURE 5**
**Distribution of Decade when Silica Exposure Began for Confirmed Silicosis Cases: 1985-2022***




*Decade of first exposure was unknown for 82 individuals with silicosis.

# *Industrial Hygiene Results – Silicosis*

One thousand two hundred seventeen individuals were exposed to silica in 510 facilities (Table 6). There were no silica-related inspections conducted in 2020, 2021 or 2022 based on these individuals. Since 1988, inspections were performed by MIOSHA at 93 (18.3%) of the 509 facilities associated with silicosis cases. One hundred sixty (31.4%) facilities were no longer in operation, 70 (13.8%) were located out of state, 29 (5.7%) facilities no longer used silica, 78 (15.3%) workplaces were in the construction industry, nine (1.8%) were covered by the Mine Safety and Health Administration jurisdiction, and for 70 (13.8%), the specific location where the silica exposure occurred was unknown.

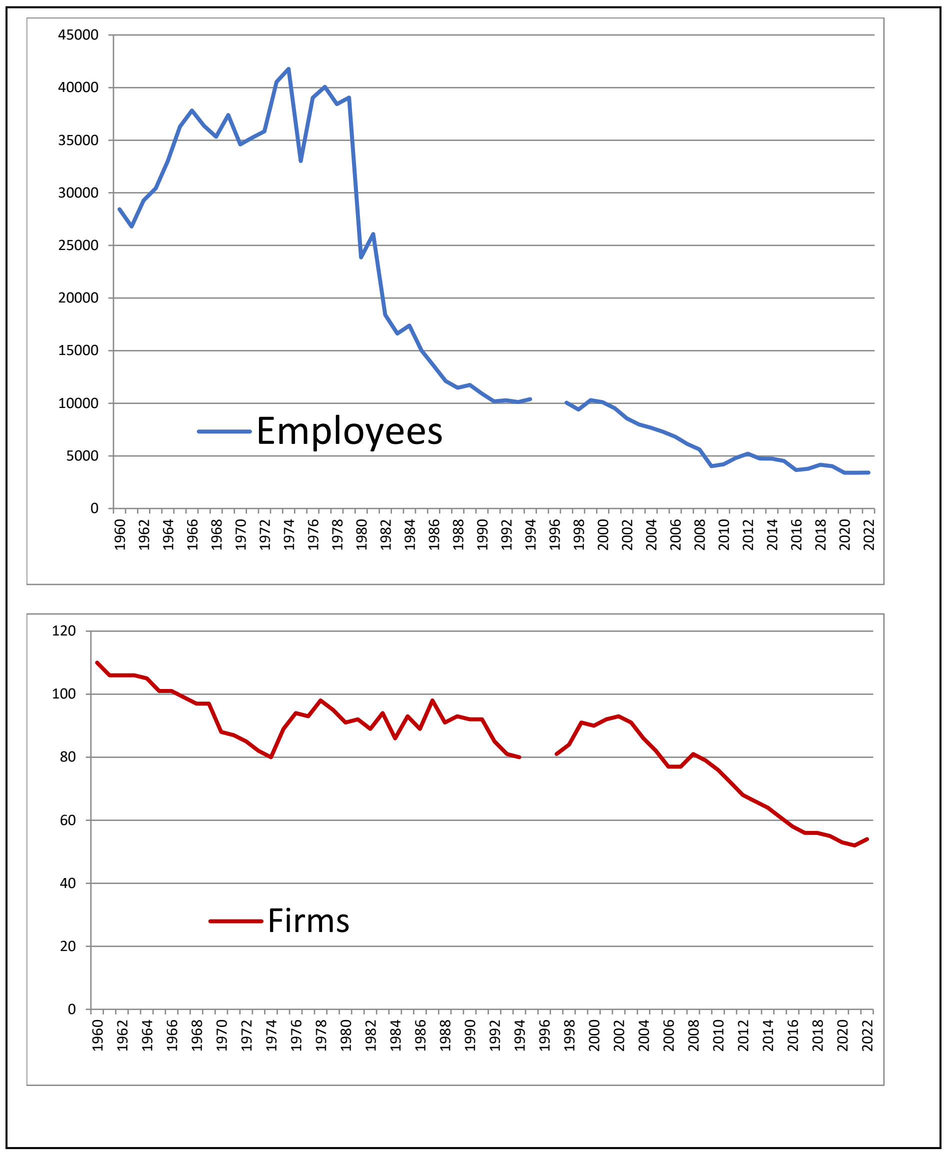
Air sampling for silica was conducted in 66 of the 93 facilities inspected (Table 7). MIOSHA adopted a new enforceable permissible exposure limit (PEL) of 50 µg/m$^3$, on June 23, 2018. This new PEL is the same as the NIOSH recommended exposure level (REL). The previous MIOSHA PEL was 100 µg/m$^3$. Forty of 66 (60.6%) facilities were above 50 µg/m$^3$. In 2007, MIOSHA inspected all 47 silica-using foundries in the state. Personal air monitoring for silica was conducted in 43 of the 47 facilities; 15 (35%) were above the PEL. From 2017 to August 2019, ten (22%) of 45 inspections at foundries, construction sites and a few other companies that use silica had at least one respirable silica sample above the PEL.

Twenty-three of the 66 (34.8%) were above 100 µg/m$^3$ for silica. The three (4.5%) most recent inspections were above 50 µg/m$^3$. Another two (3.0%) companies were above the MIOSHA standard for beryllium and one company was above the MIOSHA standard for silica and silver.

Prior to the 2018 silica standard that requires employers to provide a medical monitoring program, only eight of the 74 (10.8%) facilities where the medical surveillance program was evaluated provided medical screening for silicosis for its workers that included a periodic chest x-ray interpreted by a certified B-reader. Three (4.1%) companies provided periodic chest x-rays that were not interpreted by a certified B-reader. Twenty-two (29.7%) only performed pre-employment testing, 29 (39.2%) provided no medical surveillance, and 18 (24.3%) performed annual or biennial pulmonary function testing without chest x-rays. There has been no evaluation of the performance of medical surveillance after it became a requirement.

**FIGURE 6**

**Michigan Ferrous Foundries 1960-2022: Number of Employees and Number of Firms**




Source: www.bls.gov data extract from Quarterly Census of Employment and Wages, Michigan, NAICS 33151 Ferrous Metal Foundries, Private ownership, all establishment sizes, last accessed 2-8-2024.

**TABLE 6**
**Status of Facilities Where 1,217 Confirmed Silicosis Cases were Exposed to Silica: 1985-2022**

| | Cases | Facilities | |
|---|---|---|---|
| Inspection Status | # | # | % |
| Inspection Completed | 497 | 93 | 18.2 |
| Scheduled for Inspection | 0 | 0 | -- |
| MSHA* Jurisdiction | 23 | 9 | 1.8 |
| Facility Out-of-Business | 437 | 160 | 31.4 |
| Facility Out-of-State | 77 | 70 | 13.7 |
| Facility No Longer Uses Silica | 34 | 29 | 5.7 |
| Building Trade: No Inspection | 79 | 79 | 15.5 |
| Unknown | 70 | 70 | 13.7 |
| Total | 1,217 | 510** | |

*MSHA= Mine Safety and Health Administration.
**Four facilities are related to one silicosis case's work history, and two facilities are related to another silicosis case's work history.

**TABLE 7**
**MIOSHA Inspections of 93 Facilities of Silicosis Cases Exposed to Silica: 1985-2022**

| | Companies | |
|---|---|---|
| | # | % |
| Air Sampling Performed | **66** | |
| Above NIOSH* Rec Std for Silica | 40 | 60.6 |
| Above MIOSHA Enforceable Std for Silica | 26 | 39.4 |
| | | |
| Medical Surveillance Evaluated | **74** | |
| Periodic Chest X-Rays with a B-reader | 8 | 10.8 |
| Periodic Chest X-Rays without a B-reader | 3 | 4.1 |
| Pre-employment Testing Only | 22 | 29.7 |
| No Medical Surveillance | 29 | 39.2 |
| Periodic Pulmonary Function Testing | 18 | 24.3 |

*NIOSH National Institute for Occupational Safety & Health.

# *Sandblasting – Silicosis*

Nine hundred five of the 1,217 individuals had known sandblasting history; 329 (36.4%) stated they had done sandblasting as part of their work.

# *Silica Standard*

An updated silica standard was promulgated in Michigan on February 22, 2017:

**Key Provisions of the updated OSHA Silica standard**
https://www.michigan.gov/leo/bureaus-agencies/miosha/topics/silica

- Reduces the PEL for respirable crystalline silica to 50 micrograms per cubic meter of air, averaged over an 8-hour shift.
- Requires employers to: use engineering controls (such as water or ventilation) to limit worker exposure to the PEL; provide respirators when engineering controls cannot adequately limit exposure; limit worker access to high exposure areas; develop a written exposure control plan, offer medical exams to highly exposed workers, and train workers on silica risks and how to limit exposures.
- Employers are required to offer medical examinations to employees exposed above the PEL for 30 or more days a year and provide them information about their lung health.

**Content of Medical Examination** - Appendix B – Medical Surveillance Guidelines
https://www.osha.gov/sites/default/files/AppendixBtosect1926.1153.pdf

- Medical and work history, with emphasis on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing); history of TB; and smoking status and history.
- Physical examination, with special emphasis on the respiratory system - Initial examination and every three years.
- TB testing - Initial examination.
- Spirometry - Initial examination and every three years. Must be administered by a spirometry technician with a current certificate from a NIOSH approved course.

**Brief history of five individuals first exposed to silica in the 2000s**

**Case 1.** A male in his 50s worked one year at a company that made sandpaper. He never performed sandblasting. He formerly smoked cigarettes from his teens to his mid50s. He had advanced simple silicosis per x-ray ILO B-reader classification. He died in his 60s.

**Case 2.** A male in his 50s worked two years sandblasting metal parts. He was a lifelong non-smoker. He had progressive massive fibrosis (PMF) per x-ray ILO B-reader classification. He died in his 60s.

**Case 3.** A male in his 60s worked 13 years as a grinder at a foundry. He also performed sandblasting. He was a lifelong non-smoker. He had progressive massive fibrosis (PMF) per x-ray ILO B-reader classification.

**Case 4.** A male in his 60s worked 14 years as a sandblaster in construction. He was a lifelong non-smoker. He had advanced simple silicosis per x-ray ILO B-reader classification.

**Case 5.** A male in his 40s worked less than 10 years performing knockout at a foundry. He smoked a half pack of cigarettes a day from his mid-20s to his mid-30s. He had advanced simple silicosis per x-ray ILO B-reader classification.

- ♦ PA radiograph of the chest at full inspiration - Initial examination and every three years. Must be interpreted and classified according to the ILO International Classification of Radiographs by a NIOSH-certified B Reader.
- ♦ Additional testing the provider deems appropriate.

**Requirements on Reporting Results of Medical Examination**
Written medical report to employee within 30 days must include:

- ♦ The results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;
- ♦ Any recommended limitations upon the use of a respirator;
- ♦ Any recommended limitations on exposure to respirable crystalline silica;
- ♦ A statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine, where the B reading is 1/0 or higher for rounded opacities or where the physician or other licensed health care professional (PLHCP) has determined such a referral is necessary.

Written medical report to employer within 30 days must include:

- ♦ Date of the examination;
- ♦ A statement that the examination has met the requirements of this section; and
- ♦ Any recommended limitations on the employee's use of a respirator.

# *Asbestos-Related Lung Disease and Mesothelioma*

The following section reports the results of **asbestos-related lung disease and mesothelioma**. Figure 7 shows the number of individuals hospitalized in Michigan with asbestosis from 1990 to 2022. Repeat admissions of the same individual within each calendar year are excluded from these counts of inpatient Hospital Discharge Data (HDC). For most patients, pneumoconiosis was not the primary discharge diagnosis listed on the discharge record. From 1993 to 2006, there was a steady increase in the number of hospitalizations for asbestosis; from 2007-2016 the large increase in reports is due to the availability of additional secondary discharge diagnosis codes from up to six secondary codes through 2006 to up to 29 secondary diagnosis codes beginning in 2007 (Figure 7). There was a slight decrease in the number of asbestosis-related hospitalizations in 2020 and 2021 and a slight increase in 2022. The red line in Figure 7 for 2007 - 2022 shows that the number of asbestosis cases with up to six diagnostic codes was markedly less compared to the green line with 29 diagnostic codes.

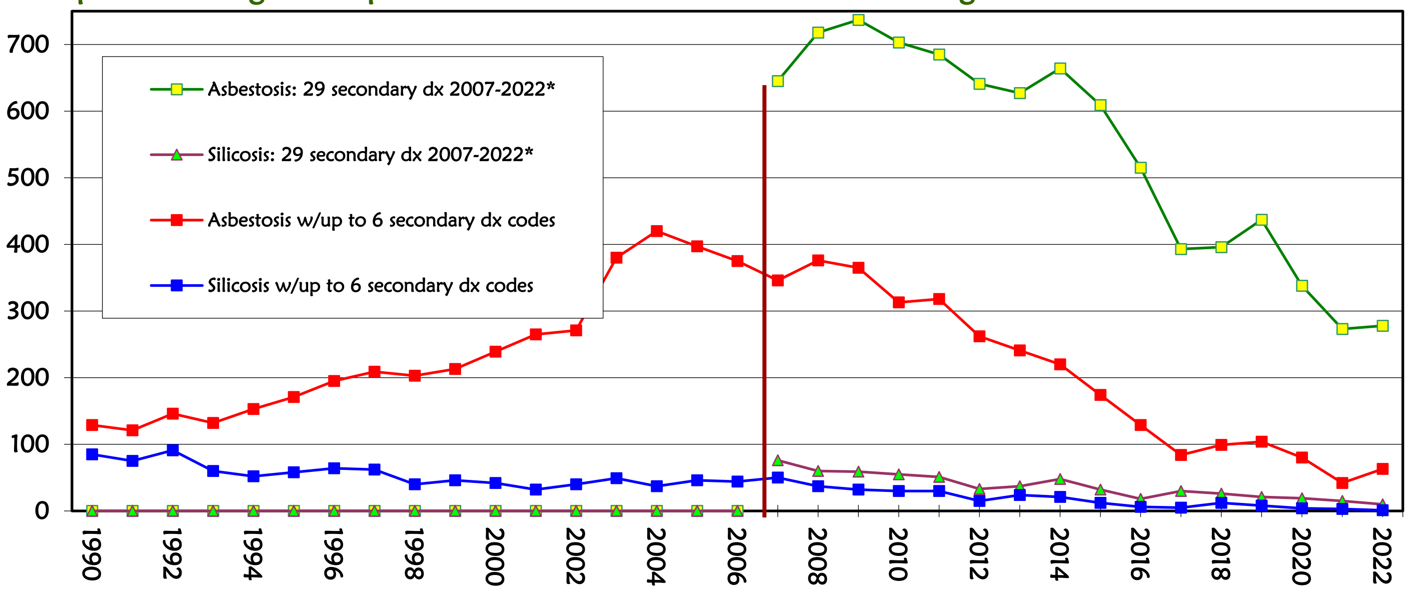
Regulations to control asbestos exposure were not promulgated until the early 1970s and were not widely implemented until the 1980s.

Given the 25-year or greater latency period from the time of first exposure to the development of asbestos-related radiographic changes, the cases being identified now represent exposures from these earlier less-regulated years. The trend we are seeing in Michigan is consistent with national data published by NIOSH through 2014 [5].

Payment source from the Michigan Health and Hospital Association (MHA) is the source of data displayed in Figure 8. Medicare is the primary payment source for hospitalizations for these dust diseases of the lung. WC insurance is very rarely the source of payment, which is consistent with previous reports in both Michigan and New Jersey that the majority of patients with pneumoconiosis never apply for WC insurance [1,6]. It should be noted that if the anticipated payment source was initially Workers' Compensation but then changed to a non-work-related payment source, the record in the MHA file would still indicate the initial source after the patient was discharged, or vice-versa. Again, for this discharge data of payment source, there is increased availability of secondary discharge diagnosis codes since 2007.

FIGURE 7

Hospital Discharges of Inpatients with Asbestosis & Silicosis in Michigan: 1990 - 2006 & 2007 - 2022

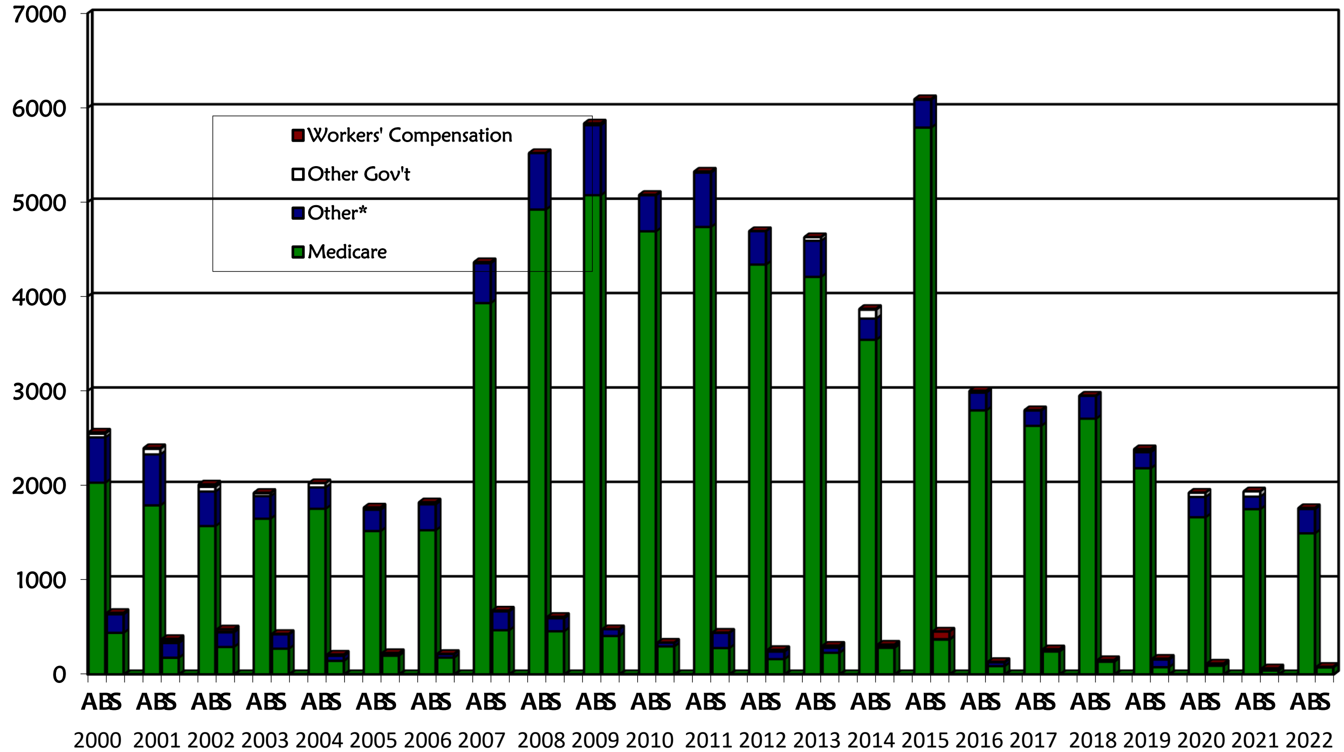



In addition to identifying asbestos-related disease from HDC inpatient data, occupational disease reports submitted to LEO constitute another source of reports. In fact, asbestos-related lung disease is the most common dust disease reported to LEO (Figure 9), through individual physicians certified as B-Readers, death certificates and the Michigan 3rd Judicial Court. In 2022, for example, 148 cases of asbestos-related lung disease were identified through B Readers, death certificates or the 3rd Judicial Court (Figure 9). Some of these patients reported may overlap with those reported in the HDC data (Figure 7). The total number of asbestos-related cases would therefore be less than the combined total of HDC cases (Figure 7) along with the cases reported directly to LEO (Figure 9 and Table 8) as this may or may not overlap as they each represent a different way to obtain a count of asbestos-related disease from these two different sources (reports to LEO and reports from HDC data).

**B-READER SURVEY**

In 1995, there were 16 B-readers in Michigan. Since 2016, there are only five physicians in Michigan who were certified and active as B-readers. Table 8 shows the number of B-readers, chest x-rays that were reviewed, and x-rays that showed evidence of asbestos-related lung disease, with pleural and parenchymal changes separately and combined. Since 1995, about 20% of the x-rays reviewed showed evidence of occupational disease, ranging from a low of 23 (1.4%) of 1,590 x-rays reviewed in calendar year 2022, to a high of 3,640 (34%) of 10,575 x-rays reviewed in calendar year 1999. The overall downward change in percentages over time may represent a decreased incidence of radiographic changes and/or a change in the source of reports (more radiographs being interpreted from current rather than retired workers). Table 8 is based on an annual survey that the B-readers in Michigan complete.

## FIGURE 8
## Days Hospitalized by Payment Source at Discharge for Asbestosis & Silicosis in Michigan: 2000-2006 & 2007-2022




*Other includes: Medicaid, HMOs, PPOs, Other Insurance, Self-Pay and No-Charge payment sources. AB = Asbestosis, S= Silicosis.

## FIGURE 9
## Asbestos-Related Cases Reported from B-Readers, Death Certificates and the 3rd Judicial Court: 1989-2022

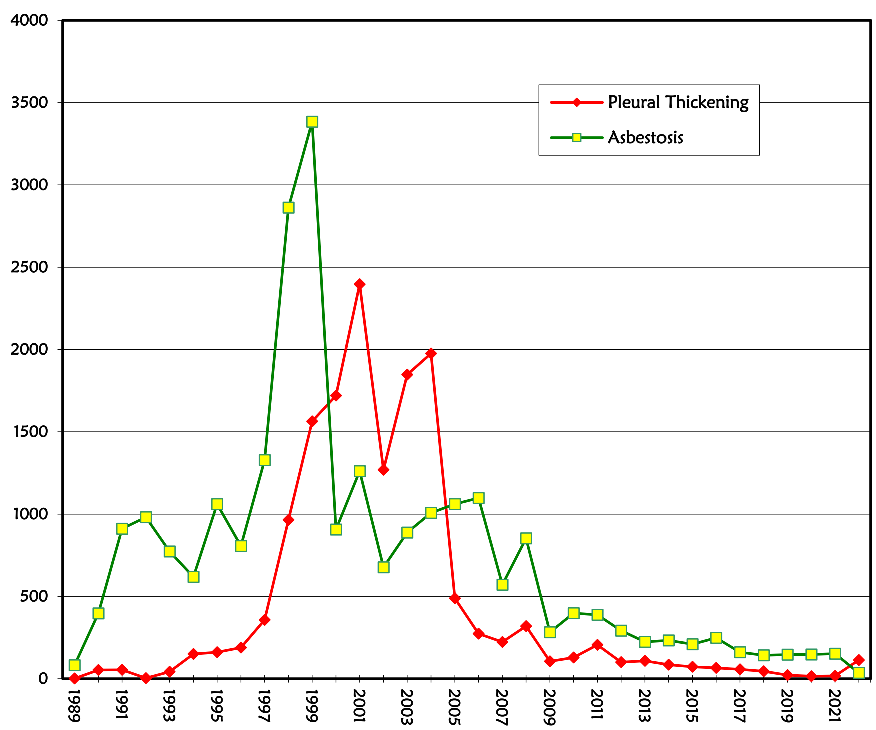


TABLE 8 Results of Annual Survey* of B-Readers in Michigan: 1995-2022

| YEAR | # B- Readers | Pleural Changes Only | Parenchymal Changes- W/ & W/out Pleural Changes | Pleural or Parenchymal Changes | Total X-Rays Reviewed | % of Total w/ any Changes |
|---|---|---|---|---|---|---|
| 1995 | 16 | -- | -- | 1,406 | 8,165 | 17 |
| 1996 | 16 | -- | -- | 837 | 4,825 | 17 |
| 1997 | 16 | 446 | 522 | 968 | 6,652 | 15 |
| 1998 | 16 | -- | -- | 3,111 | -- | -- |
| 1999 | 18 | 1,045 | 2,595 | 3,640 | 10,575 | 34 |
| 2000 | 16 | 532 | 297 | 829 | 10,591 | 8 |
| 2001 | 17 | 1,211 | 1,316 | 2,527 | 11,149 | 23 |
| 2002 | 16 | 683 | 905 | 1.588 | 7,189 | 22 |
| 2003 | 11 | 1,440 | 1,289 | 2,729 | 10,589 | 26 |
| 2004** | -- | -- | -- | -- | -- | -- |
| 2005 | 9 | 502 | 343 | 845 | 3,060 | 28 |
| 2006 | 10 | 391 | 127 | 518 | 5,382 | 10 |
| 2007 | 9 | 201 | 130 | 331 | 3,661 | 9 |
| 2008 | 10 | 337 | 320 | 657 | 4,757 | 14 |
| 2009 | 9 | 247 | 66 | 313 | 4,170 | 8 |
| 2010 | 6 | 202 | 45 | 247 | 2,804 | 9 |
| 2011 | 6 | 183 | 46 | 229 | 2,862 | 8 |
| 2012 | 6 | 139 | 52 | 191 | 4,419 | 4 |
| 2013 | 6 | 130 | 46 | 176 | 2,802 | 6 |
| 2014 | 6 | 127 | 56 | 183 | 3,765 | 5 |
| 2015 | 6 | 67 | 43 | 110 | 3,572 | 3 |
| 2016 | 5 | 112 | 39 | 151 | 2,247 | 7 |
| 2017 | 5 | 75 | 28 | 103 | 2,600 | 4 |
| 2018 | 5 | 65 | 31 | 96 | 3,841 | 3 |
| 2019 | 6 (5 active) | 70 | 24 | 94 | 2,034 | 5 |
| 2020 | 6 (5 active) | 21 | 14 | 35 | 1,184 | 3 |
| 2021 | 6 (5 active) | 36 | 29 | 65 | 2,362 | 3 |
| 2022 | 5 | 5 | 18 | 23 | 1,590 | 1.4 |

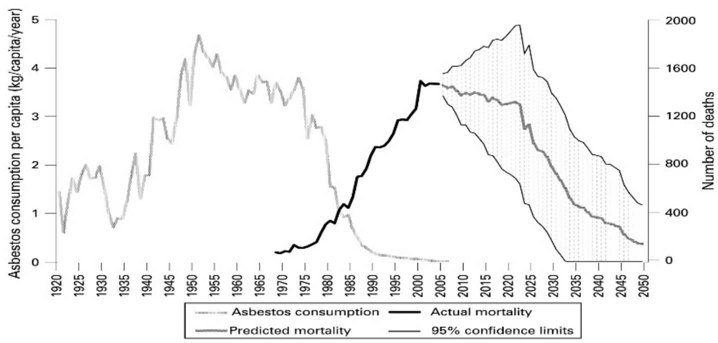
*Actual chest radiograph interpretations were not submitted with the surveys.
**There was no survey in 2004.

# Mesothelioma

Mesothelioma is a rare condition, strongly associated with asbestos exposure. The association between exposure to asbestos and the risk of developing mesothelioma was first reported in the medical literature in 1943 [7]. Mesothelioma is almost always caused by exposure to asbestos [8]. Sometimes the exposure has occurred indirectly; handling/washing the clothes of someone who works with asbestos or being a bystander at a location where asbestos was applied or disturbed by another worker. Eighty-one percent of 759 cases of mesothelioma in Australia where no asbestos exposure was identified by history, had elevated levels of asbestos in their lung tissue [9]. The only other exposure associated with the risk of developing mesothelioma has been the therapeutic, not diagnostic, use of x-rays. The percentage of patients with mesothelioma who have a history of occupational asbestos exposure is lower in studies that are based on review of medical records compared to studies based on a complete work history where 90% of mesothelioma has been attributed to asbestos exposure [10]. Among cohorts of asbestos-exposed workers, up to 10% of deaths have been attributed to mesothelioma. Lung cancer is the most common cancer among asbestos exposed workers. Unlike lung cancer, there is no additional risk of mesothelioma among current or ex-cigarette smokers.

The use of asbestos in the United States peaked in the 1950s (Figure 10). Given that mesothelioma typically occurs 30-40 years after first exposure to asbestos, one would expect the number of cases of mesothelioma in the U.S. to be peaking now, approximately 40 years after the 1980s when asbestos use began to markedly decrease. However, there are large amounts of asbestos still in place from past use as insulation and in products such as asbestos cement, floor tiles and outdoor siding that can cause more recent exposure during renovation or demolition operations. Mortality from asbestos shows how the long latency period of adverse health effects from asbestos causes disease long after its use has decreased (Figure 10).

**FIGURE 10**
**US Asbestos Consumption per Capita (1920-2006), Actual (1968-2004) and Projected (2005-2049) Deaths from Asbestos**




The Michigan Cancer Registry collects data on the demographics of mesothelioma in Michigan. The number of patients with mesothelioma by year in Michigan since 1985 is shown in Figure 11. In 2020 the most recent year with data compiled, there were 80 new cases (48 men and 32 women). The age range was 23-95 years, with an average age of 72. The peak year was in 2000, with 136 new cases. New cases per year ranged from 92-130 in subsequent years.

Approximately 25% of the individuals with mesothelioma were women. In 2020, of the 80 cases, 89% were white, 4% were Black, 3% were American Indian, and 4% were other.

Figure 12 shows the age at diagnosis separately for men and women. Consistent with latency from first exposure to asbestos, the number of mesothelioma cases increased with age. The peak age of occurrence of mesothelioma was for individuals 65 years and older for men and women.

**FIGURE 11**
**Number of Men and Women in Michigan Diagnosed with Mesothelioma: 1985-2020**

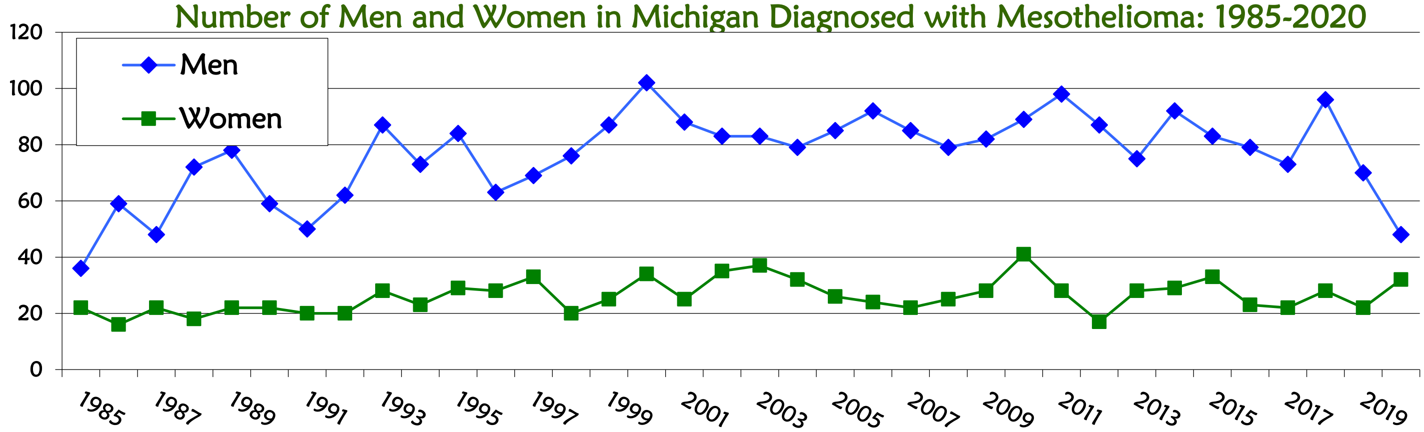
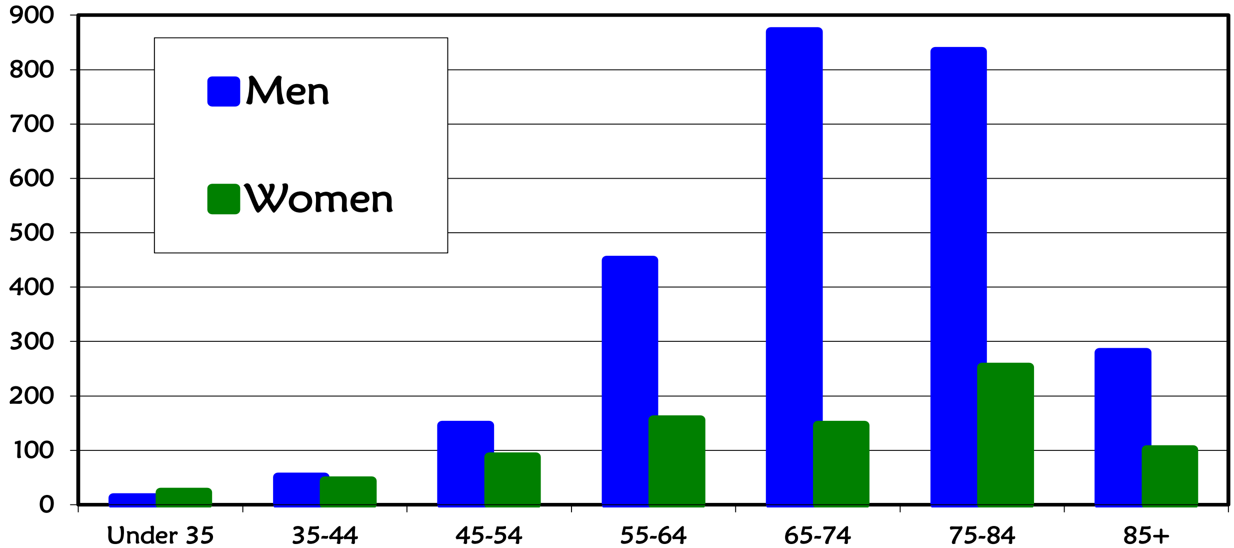


**FIGURE 12**
**Cases of Mesothelioma in Michigan by Gender and Age at Diagnosis: 1985-2020**




There were 4-5 times more men than women with mesothelioma, reflecting the likelihood of more men than women working in an occupation/industry with asbestos exposure. Table 9 shows the distribution of industry and occupation for men and women, based on death certificate data from 2016-2019. Construction, shipbuilding, and certain industrial facilities where asbestos insulation was used on piping, reaction kettles, furnaces and to make asbestos-containing products were the most frequently reported industries on death certificates. Given that the information on occupation and industry comes from death certificates from the Michigan Vital Records Division, the occupation and industry reported is the person's usual occupation and industry and may differ from what they did 30-40 years prior to their diagnosis and death when they were exposed to asbestos. Coastal states, which had a large shipbuilding and repairing industry generally have the highest incidence of mesothelioma, while the incidence in industrial states like Michigan have the next highest rates [11,12].

Mesothelioma Encasing Lung on Autopsy Specimen

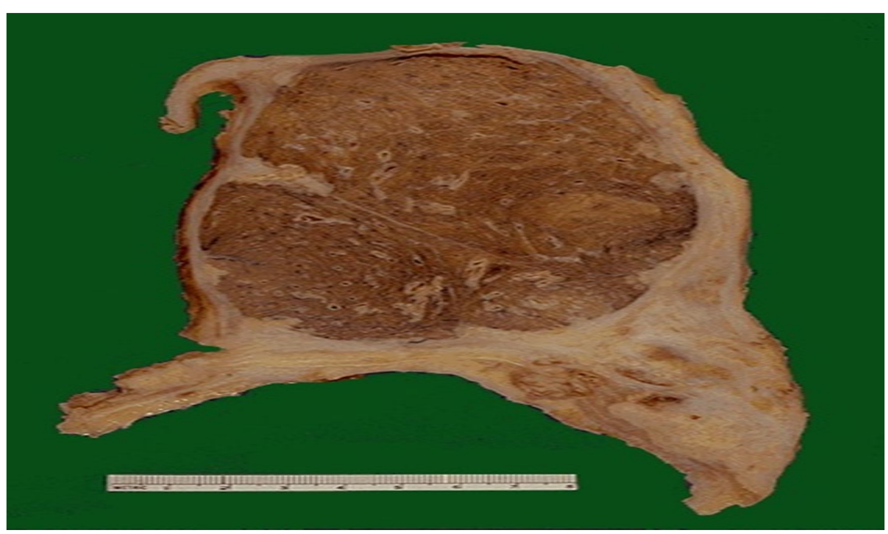


TABLE 9
Industry and Occupation of Mesothelioma Patients, Michigan, 2016-2022

| **INDUSTRY** (men/women)<br>Occupation | # | % |
|---|---|---|
| **AGRICULTURE** (5/1) | 6 | 1.8 |
| Farmer (6) | | |
| **MINING** (2/0) | 2 | 0.6 |
| Engineer (1), Miner (1) | | |
| **UTILITIES** (7/0) | 7 | 2.1 |
| Engineer (2), Janitor (2), Utility worker (3) | | |
| **CONSTRUCTION** (61/1) | 62 | 18.7 |
| Carpenter (9), Electrician (5), Engineer (2), General laborer (29), Office worker (1), Plumber/pipefitter (7), Supervisor (8) | | |
| **MANUFACTURING** (111/8) | 119 | 36.0 |
| Engineer (12), Factory worker (50), Janitor (2), Professional/office (19), Skilled trades (30), Transportation/driver (6) | | |
| **RETAIL TRADE** (12/2) | 14 | 4.2 |
| Professional/office (5), Retail trade worker (9) | | |
| **TRANSPORTATION & WAREHOUSING** (17/0) | 17 | 5.1 |
| Engineer (1), Professional/office (1), Transportation worker (6), Truck driver (7), Water transport worker (2) | | |
| **INFORMATION** (4/2) | 6 | 1.8 |
| Professional/office (3), Technician (3) | | |
| **FINANCE** (4/3) | 7 | 2.1 |
| Professional/office (7) | | |
| **PROFESSIONAL, SCIENTIFIC & TECHNICAL SERVICES** (1/5) | 6 | 1.8 |
| Engineer (1), Professional/office (5) | | |
| **ADMINISTRATIVE & SUPPORT & WASTE MGT SERVICES** (2/1) | 3 | 0.9 |
| Grounds maintenance (2), Office worker (1) | | |
| **EDUCATIONAL SERVICES** (10/7) | 17 | 5.1 |
| Administration (1), Janitor (3), Teacher (13) | | |
| **HEALTH CARE & SOCIAL ASSISTANCE** (6/17) | 23 | 6.9 |
| Health care worker (10), Janitor (2), Nurse/aid (6), Professional/office (5) | | |
| **ARTS, ENTERTAINMENT & RECREATION** (2/2) | 4 | 1.2 |
| Artist (3), Coach (1) | | |
| **ACCOMMODATION & FOOD SERVICES** (2/3) | 5 | 1.5 |
| Food service worker (3), Professional/office (2) | | |
| **OTHER SERVICES** (5/1) | 6 | 1.8 |
| Mechanic (2), Janitor (1), Pesticide Applicator (1), Minister (1), Cosmetologist (1) | | |
| **PUBLIC ADMINISTRATION** (16/1) | 17 | 5.1 |
| Judge (1), Mail carrier (1), Maintenance (2), Professional/office (6), Public safety (7) | | |
| Not Employed (1/9) | 10 | 3.0 |
| Total<br>*One additional listed unknown (male) | 331* | |

Figure 13 shows the distribution of the number of cases of mesothelioma among Michigan residents by county. The southeast and central region of Michigan has the highest number of cases of mesothelioma. Increased cases of mesothelioma in Marquette County in the Upper Peninsula are thought to be from asbestos exposure on equipment used in paper mills, and mining operations where asbestos was a contaminant during ore mining as well as exposure from asbestos insulation during ore processing. Increased cases in Bay and Saginaw counties are thought to be from asbestos exposure used in the largest shipyard that was in Michigan, and foundries in Saginaw County. In Muskegon and Kent counties as well as the Detroit metropolitan area, asbestos exposure occurred within the numerous industrial facilities located in these regions. Figure 14 shows the average annual incidence rates of mesothelioma among Michigan residents by county. The counties with the highest rates are: Clare (2.3 per 100,000); Marquette (2.2 per 100,000); Bay and Delta (each with 1.8 per 100,000); and Midland and St. Clair (each with 1.7 per 100,000). The annual average mesothelioma incidence rate for 2001-2020 in Michigan was 1.0 cases per 100,000.

Mesothelioma has a poor prognosis. Data from the 18 cancer registries in the CDC Surveillance, Epidemiology, and End Results Program (SEER) reported 91.4% mortality with a median of seven months from diagnosis [13]. The best treatment results are found for patients receiving multimodality therapy, usually consisting of neoadjuvant chemotherapy, followed by surgery and adjuvant radiotherapy. Combining these modalities, a median survival of 17-38 months for patients with tumor Stage I, to 7-24 months for patients with tumor Stage IV has been reported [14]. One aspect of mesothelioma management that can be overlooked by physicians is the availability of compensation to cover medical care and funeral costs and support of family dependents. Patients with mesothelioma and their dependents should be encouraged to seek legal advice regarding the potential to receive compensation.

**FIGURE 13**
**Distribution of MI Residents Diagnosed with Mesothelioma by County: 2001-2020**

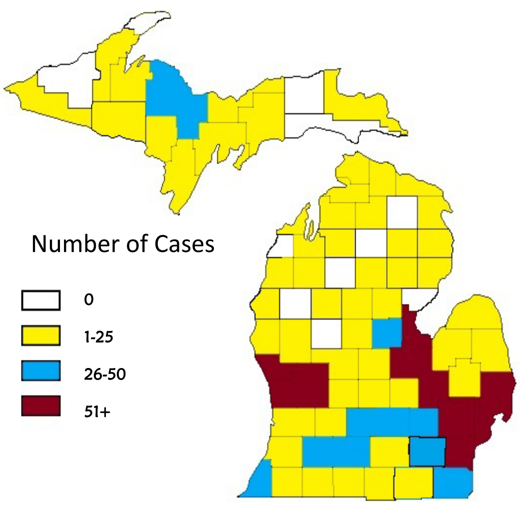
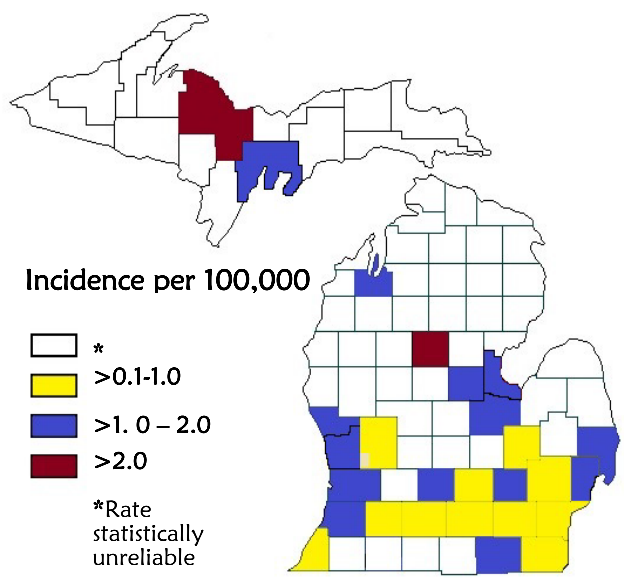



**FIGURE 14**
**Age-Adjusted Incidence Rates of Mesothelioma among MI Residents, by County: 2001-2020**




# *Other Work-Related Lung Diseases (OLDs)*

2011 was the first year of data collection for other work-related lung diseases (OLDs). Other lung diseases from exposures in the workplace include breathing problems that are not necessarily chronic in nature, in addition to those that are chronic. Conditions that we have identified since beginning OLDs surveillance include acute conditions such as chemical irritation/irritative bronchitis where an acute exposure results in a health provider visit and treatment, with resolution of symptoms. Other conditions covered include smoke inhalation from fires or burning material, infectious agents from exposures at work, and chemical pneumonitis. Chronic conditions are also included in this grouping, with other pneumoconiosis such as hard metal lung disease and coal workers' pneumoconiosis. A physician board-certified in internal and occupational medicine reviews all medical records to determine first, whether the condition is work-related and secondly, the nature of the illness and classification into general categories of disease.

In cases where the work-relatedness of the exposure is unclear, additional medical records may be obtained and/or a patient interview completed.

Table 10 shows the distribution of diseases reported by year, from 2017-2022. 2011-2016 data can be found in prior annual reports. Over all the years, chemical irritation/irritative bronchitis and chemical pneumonitis were the most common conditions.

Each year varies slightly in the types of conditions reported, in part related to the reporting sources within a given year. In 2011 and 2012, hospitals and Workers' Compensation reported 72% of the 139 cases, and 68% of the 191 cases, respectively. In 2013 and 2014, the Michigan Poison Center (MPC) and hospitals reported 69% of the 162 cases, and 63% of the 150 cases, respectively. In 2015, hospitals reported 59% of the 167 cases, followed by Workers' Compensation reporting 16% of the cases (Table 11). In 2016 through 2022 the MPC and hospitals, respectively, reported the greatest percentages of cases.

*The following statistics are based on the 193 cases of other lung diseases confirmed from 2022.*

Similar to delays in reporting cases of silicosis, OLDs reports are incomplete from delays in hospital reporting. Table 11 shows the primary reporting source of the 193 persons confirmed with OLDs in 2022. In 2022, the MPC reported 59% of the 193 cases, hospitals reported 16% of the cases, death certificates reported 4% of the cases, Workers' Compensation reported 12% of the cases, the MI Emergency Medical Services (EMS) system reported 7% of the cases, and physicians reported 2% of the cases. In 2022, there were no reports from laboratories.

One hundred thirty-nine of the OLDs cases were classified as chemical irritation/irritative bronchitis, 12 had asbestos-related disease, six had hypersensitivity pneumonitis, three each had chemical pneumonitis or metal fume fever, two each had smoke inhalation, COPD, a lung infection, COVID or legionnaires disease, and one each had coal workers' pneumoconiosis or histoplasmosis. An additional 16 had a definite work-related respiratory illness that could not be classified more specifically (Table 10).

The following case narratives describe exposures and symptoms related to OLDs cases reported in 2022:

**Chemical Irritation Case 1.** A male in his 40s developed breathing issues after inhaling industrial cleaning agents that were mistakenly opened while working at a package distribution warehouse. The ventilation system caused the exposure to drift to his work area. He was picked up at work by ambulance and treated at a local hospital. He was a cigarette smoker. **Chemical Irritation Case 2.** A female in her 40s developed breathing issues after being exposed to the same industrial cleaning agents as case #1. She was treated at a local occupational health clinic, with follow up at a local hospital.

| TABLE 10<br>Other Work-Related Lung Diseases Reported 2017-2022 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | YEAR REPORTED | | | | | | | | | | | |
| | 2017 | | 2018 | | 2019 | | 2020 | | 2021 | | 2022 | |
| **DISEASE** | **#** | **%** | **#** | **%** | **#** | **%** | **#** | **%** | **#** | **%** | **#** | **%** |
| Chemical Irritation/Irritative Bronchitis | 391 | 71 | 187 | 69 | 174 | 73 | 94 | 58 | 110 | 64 | 139 | 72 |
| Chemical Pneumonitis | 40 | 7 | 13 | 5 | 0 | -- | 2 | 1 | 5 | 3 | 3 | 2 |
| Asbestos-Related | 18 | 3 | 9 | 3 | 3 | 1 | 5 | 3 | 25 | 15 | 12 | 6 |
| Smoke Inhalation | 13 | 2 | 6 | 2 | 7 | 3 | 3 | 2 | 3 | 2 | 2 | 1 |
| COPD | 12 | 2 | 11 | 4 | 10 | 4 | 5 | 3 | 5 | 3 | 2 | 1 |
| Silo-Related Disease | 1 | <1 | 0 | -- | 0 | -- | 1 | 1 | 0 | -- | 0 | -- |
| Acute Respiratory Distress Syndrome | 1 | <1 | 1 | <1 | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| Allergies/Rhinitis/Anaphylactic Reaction | 4 | 1 | 1 | <1 | 1 | <1 | 4 | 2 | 1 | 1 | 2 | 1 |
| Hard Metal Lung Disease | 1 | <1 | 2 | 1 | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| Hypersensitivity Pneumonitis | 23 | 4 | 4 | 1 | 5 | 2 | 0 | -- | 5 | 3 | 6 | 3 |
| Infectious Agent | 4 | 1 | 6 | 2 | 0 | -- | 3 | 2 | 2 | 1 | 2 | 1 |
| Metal Fume Fever | 8 | 1 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 2 | 3 | 2 |
| Sinus– related | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| Coal Workers' Pneumoconiosis | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 1 | 1 | 1 | 1 |
| Pneumoconiosis NOS | 2 | <1 | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| Lung Trauma | 0 | -- | 1 | <1 | 2 | 1 | 0 | -- | 0 | -- | 0 | -- |
| Respiratory Bronchiolitis | 0 | -- | 0 | -- | 1 | <1 | 0 | -- | 0 | -- | 0 | -- |
| Lung Cancer | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| Pneumothorax | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| Pulmonary Embolism | 0 | -- | 1 | <1 | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| Beryllium Lung Disease | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 1 | 1 | 0 | -- |
| Vocal Cord Dysfunction | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- | 0 | -- |
| Siderosis | 0 | -- | 2 | 1 | 1 | <1 | 0 | -- | 0 | -- | 0 | -- |
| Infectious COVID-19 | | | | | | | 10 | 6 | 2 | 1 | 2 | 1 |
| Histoplasmosis | | | | | | | | | | | 1 | 1 |
| Legionnaires | | | | | | | | | | | 2 | 1 |
| Respiratory Illness NOS | 34 | 6 | 25 | 9 | 32 | 13 | 31 | 19 | 9 | 5 | 16 | 8 |
| **TOTAL** | **552** | | **272** | | **238** | | **161** | | **172** | | **193** | |

| TABLE 11<br>Reporting Source for OLDS Cases: 2022 | | |
|---|---|---|
| **REPORTING SOURCE** | **#** | **%** |
| Michigan Poison Center | 114 | 59 |
| Hospital | 30 | 16 |
| Death Certificate | 8 | 4 |
| EMS (Ambulance) | 14 | 7 |
| Workers' Compensation | 23 | 12 |
| Physician Report | 4 | 2 |
| Laboratory | 0 | -- |
| **TOTAL** | **193** | |

*Demographic Characteristics*
One hundred and thirteen (61%) of the 186 persons with known gender were men; 73 (39%) were women. Gender was unknown for seven cases. The average age of the OLDS cases was 41, ranging from 15 to 91 years of age.

*Type of Industry*

Table 12 shows the primary type of industry where exposure occurred among the OLDS cases. The predominant industry where individuals were exposed was manufacturing with 14 cases (7%), followed by seven cases (4%) in public administration, five cases each (3%) in retail trade and construction, three (2%) in transportation and warehousing, two cases each (1%) in agriculture, health care and accommodation and food services, and one each (1%) in mining, utilities, administrative and support services and arts, entertainment, and recreation. The 44 individuals with a known workplace with OLDS worked at 43 different facilities. The workplace was unknown for 149 individuals.

TABLE 12
Primary Industrial Exposure for OLDS Cases Reported in 2022

| 2002 North American Industry Classification System | | # | % |
|---|---|---|---|
| 11 | Ag, Forestry, Fishing & Hunting | 2 | 1 |
| 21 | Mining | 1 | 1 |
| 22 | Utilities | 1 | 1 |
| 23 | Construction | 5 | 3 |
| 31-33 | Manufacturing | 14 | 7 |
| 44-45 | Retail Trade | 5 | 3 |
| 48-49 | Transportation & Warehousing | 3 | 2 |
| 51 | Information | 0 | -- |
| 52 | Finance & Insurance | 0 | -- |
| 54 | Veterinary Services | 0 | -- |
| 56 | Administrative & Support & Waste Mgt & Remediation Svcs | 1 | 1 |
| 61 | Educational Services | 0 | -- |
| 62 | Health Care & Social Assistance | 2 | 1 |
| 71 | Arts, Entertainment, & Rec | 1 | 1 |
| 72 | Accommodation & Food Services | 2 | 1 |
| 81 | Auto Repair, Dry Cleaning, etc | 0 | -- |
| 92 | Public Administration | 7 | 4 |
| 00 | Unknown | 149 | 77 |
| TOTAL | | 193 | |

**MIOSHA Inspections-Industrial Hygiene Results**
There was one inspection for an allergic reaction in 2022. The worker was exposed to urethane and other foam products in a facility manufacturing these chemicals. Co-workers were interviewed about their breathing symptoms; eight of 23 co-workers interviewed indicated they experienced daily or weekly shortness of breath, chest tightness, wheezing or had developed asthma since working at the company. The company was fined $7,910 and issued two serious violations; one violation was related to respiratory protection (no medical evaluation or fit testing for the workers wearing respirators) and the other was related to medical services and first aid (no eye wash station and unsanitary conditions).

# Discussion

We have been tracking the occurrence of silicosis since 1988. In the 1990's through 2005, there were 30-70 new cases of silicosis identified each year, from 2006-2015 there were 10-20 and since 2016 under 10 new cases of silicosis per year. Although manufacturing, including foundries, continues to be the most common source of exposure to silica, the percentage of cases of silicosis from exposure to silica in foundries has decreased to 63% while cases from construction have increased to 23% and cases from mining have increased to 11% [4]. The decrease in reports of silicosis can be attributed to downsizing in the foundry industry due to closure of facilities and a decrease in the foundry workforce from increased automation (Figure 6). The Michigan surveillance system has not seen an increase in diagnosed cases since the 2018 Michigan OSHA regulations that first required employers to provide medical screening for silica exposed workers nor from emerging industries with silica exposure including hydraulic fracturing [15], engineered stone countertop fabrication [16] or highway reconstruction. Michigan workers continue to be at risk of developing silicosis because of continued use of silica by approximately a third of the abrasive blasting companies' inadequate controls in the construction industry, and at foundries currently in operation. Further evaluation of exposures and tracking of silicosis in these industries will be important to assure adequate exposure controls. Even without the development of silicosis, silica exposure is a risk factor for the development of lung cancer, connective tissue disease, tuberculosis and chronic obstructive pulmonary disease (COPD) [17,18,19]. These risks justify ongoing assurance of workplace controls for silica even if new cases of silicosis are not identified.

The main characteristics of the individuals reported during Michigan's 35 years of silicosis surveillance are that they are elderly men who mainly worked in foundries in three counties. The age distribution is similar to that reported in the 1960s [20]. The older age of the patient (average year of birth, 1926) is secondary to the chronic nature of the disease and the typical long exposure to silica required to develop the disease (average 27 years of exposure to silica). However, we continue to receive reports of individuals with short-term exposure, who began work in the 1970s, 1980s, 1990s and five in the 2000s. Overall, 100 (8.8%) of 1,134 silicosis cases with known duration worked for less than 10 years. One hundred twenty-nine (11.4%) of the 1,135 individuals with known decade of hire began work in the 1970s, 1980s, 1990s or 2000s; 32 of them had worked for less than ten years. Individuals with silicosis who began working since the 1970s were more likely to have done sandblasting than those who began working with silica before 1970 (51% vs. 34%). Of the 40 people who first were exposed to silica since the 1980s, eight worked in foundries, five worked in auto manufacturing, four worked in construction, three did cement/masonry work, two were buffing and polishing metal, two worked in auto repair, two worked at a tool and die shop, one worked in mineral processing, one worked in a dental laboratory, one was a heavy equipment operator who did excavating, one was a painter, one was a painter/sandblaster, one was a welder/sandblaster, one worked as a miner in gold fields in the Southwest, one welded, one worked in a boiler fabrication shop, one worked for a small sandpaper manufacturing operation, one was an oiler in an iron ore mine, one worked at a bronze foundry, one was a plumber, and one was a truck driver for a sand and gravel mine.

Black men are over-represented (37%), reflecting previous hiring practices in foundries [21]. Black workers consistently had higher incidence rates of silicosis than their white counterparts in the counties where rates were compared between these groups (Table 4). Overall, for the state, the average annual incidence of silicosis among Black workers was 6.1 per 100,000 versus 1.2 per 100,000 for white workers (a 5.1-fold greater incidence rate).

The individuals reported generally have advanced disease: 283 (23.3%) with progressive massive fibrosis and another 434 (35.7%) with advanced simple silicosis (category 2 or 3). Only 25% of the reported patients had normal breathing tests [4]. Individuals had both restrictive and obstructive changes. Obstructive changes, although more prevalent among individuals who had smoked cigarettes, were found in half of the individuals who never smoked cigarettes (Table 3). The incidence of TB in the confirmed silicosis cases was 7%; this is 1,000-fold greater than that in the general population in the last decade [4]. Despite the severity of their disease, 68% had not applied for Workers' Compensation.

The reports of Michigan workers with silicosis having obstructive lung changes is consistent with published reports of increased chronic obstructive pulmonary disease (COPD) among workers with silicosis, as well as among individuals without silicosis who have had silica exposure [17]. Individuals with silicosis are at risk of developing pulmonary hypertension, clinically significant bronchitis and chronic obstructive pulmonary disease [22].

Hospitals are the primary reporting source of the patients identified through Michigan's surveillance system. Hospital discharge reporting is a more cost-effective method for identifying silica problem worksites than physician reporting, death certificates or Workers' Compensation data [23]. A comprehensive surveillance system for silicosis that combines all four reporting sources is as good, if not better, return for public health dollars invested as most other existing public health programs [23].

Individuals with silica exposure have an increased morbidity and mortality for malignant and non-malignant respiratory disease [1,18]. The increased risk for death is found both in patients who ever or never smoked cigarettes [1]. Individuals with silica exposure also have an increased risk of developing connective tissue disease, particularly rheumatoid arthritis [24,25] as well as an increased risk of developing chronic renal disease, especially anti-neutrophilic cytoplasmic antibodies (ANCA) positive disease [26,27,28].

The national employer-based surveillance system was not designed to count chronic diseases such as silicosis. We have previously estimated that there were 3,600 to 7,300 newly diagnosed cases of silicosis each year in the United States from 1987–1996. [2] Using the same methodology for the time period 1997–2003 we estimate there were 5,586–11,674 newly diagnosed cases of silicosis per year in the United States. A paper using national Medicare data on hospitalizations estimated 3,260-7,105 cases per year [29]. Using an alternative approach with hospital discharge data, we estimate there were 1,372–2,867 newly diagnosed cases of silicosis per year in the United States. Based on the results of the national Medicare data and our extrapolation from national death certificate data, we believe that the true number of new cases of silicosis is closer to these larger estimates than using the actual number of death certificates that mention silicosis (~150 per year) or the Bureau of Labor Statistics estimate based on employer reporting, which in 1999, the last year available, reported only 2,200 cases for all dust diseases of the lung, including asbestosis and coal worker's pneumoconiosis in addition to silicosis.

Industrial hygiene inspections reveal violations of the exposure standard for silica in 39% of the facilities where sampling was done. However, follow-up inspections of these same companies have shown a significant decrease in silica exposures. Companies not in compliance with the silica standard are requiring their workers to use powered air-purifying respirators or air-line respirators.

Asbestos-related disease, both malignant and non-malignant disease, like silicosis, continues to have a downward trend in reported cases. Unlike silica, there is little use of asbestos in new production, but risk still remains from asbestos still being present, such as in older buildings and automobile brakes. Asbestos-related disease is tracked from a variety of reporting sources in Michigan, including hospital inpatient discharge data, the 3rd Judicial Circuit Court, death certificates, and an annual survey of physicians in Michigan who are certified B-readers.

Targeting smoking cessation programs to individuals who work or used to work with asbestos should be a high priority. Guidelines for lung cancer screening from the U.S. Preventive Services Task Force recommend low-dose CT scans for adults 50 to 80 years of age who have at least a 20-pack-year cigarette smoking history and currently smoke or quit smoking less than 15 years prior [30]. The guidelines do not mention asbestos exposure as a criterion. Given the known synergism between cigarettes and asbestos in increasing the risk of lung cancer for either exposure alone, supports screening individuals 50 to 80 with 20 years of asbestos exposure who ever smoked cigarettes regardless of whether they quit. For more information on the background for including asbestosis and asbestos exposure history in the determination for performing screening for lung cancer, see the PS News Winter 2024 newsletter (V35N1) at: www.oem.msu.edu. Similar data for silicosis and silica exposure is not available, but such screening should also be considered for these individuals.

The 12th year of OLDs surveillance resulted in the identification of a variety of respiratory illnesses from workplace exposures. Future surveillance of OLDs cases will continue to identify workplaces where MIOSHA inspections are warranted. Other activities will focus on characterizing the nature and extent of the OLDs cases, and the identification of areas where education could benefit individuals who develop OLDs and to help prevent OLDs in others with similar workplaces and exposures.

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