Mesothelioma among Employees with Likely Contact with in-Place Asbestos-Containing Building Materials[a]

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When construction workers completed their tasks, care of new buildings became the responsibility of maintenance employees. Sometimes obviously, and at other times insidiously, asbestos-containing building material (ACBM) deteriorated or was physically damaged, necessitating repair or replacement. Not identified as a public health priority, such maintenance was often deferred when it was not cosmetically necessary.

Although the health hazard of asbestos exposure from thermal asbestos insulation during building maintenance work was recognized as early as 1932,[2] and concerns were raised about the potential health hazard of spray-applied ACBM in 1932[3] and 1953,[4] quantitative industrial hygiene assessment of exposure circumstances was not begun until the 1970s.[5,6] Health investigations have begun describing asbestos-associated diseases among workers exposed to ACBM during the course of their usual work.[7-12]

In 1984 the United States Environmental Protection Agency (EPA) conducted a national survey of buildings to estimate the extent of friable ACBM in existing structures. They concluded that approximately 31,000 schools and 733,000 public and commercial buildings were likely to contain such materials.[13] Priority has been placed upon addressing the ACBM in schools.

The Wisconsin Division of Health (WDOH) within the Wisconsin Department of Health and Social Services (WDHSS) has served as the lead agency for the U.S. Environmental Protection Agency's (EPA) School Asbestos Programs since 1979.

Wisconsin has 429 public-school districts containing 1,923 schools with a total of 2,230 buildings. There are an additional 986 private-school districts containing 1,014 schools with 1,142 buildings, and 18 government-school districts (state, county) with 28 schools and 107 buildings. All these schools are regulated under the Asbestos Hazard Emergency Response Act (AHERA).

Under AHERA regulations, all school districts were required to submit asbestos management plans to WDOH for review by October 1988. The WDOH developed and maintains a computerized database program for storing data abstracted

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TABLE 1. Asbestos-Conta
1989 AHERA Plan Reviews

	Thermal	
	Friable	Da
Public-school districts (n = 411)	326 (79%)	153
Private-school districts (n = 872)	424 (49%)	130

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TABLE 9. Mesothelioma Deaths among School Teachers Identified by Usual Occupation and Industry on Death Certificate (DC)

Case 1	
Type: Peritoneum	Sex: Female Age: 78 Year of death: 1968 DC Occupation: Teacher DC Industry: Teacher
Lifetime Occupational History	
1908–1910	Grade school teacher in North Dakota
1911–1920	Teachers College; taught elementary school teacher-training courses
1920–1959	Teacher at 2-year teacher preparatory college
Comments:	Father was a farmer; unmarried; no neighborhood exposures; sister of Case 2. Laparotomy identified normal ovaries and no primary tumor site; surgical tissue diagnosed as mesothelioma. Status of any ACBM in schools unknown.
Case 2	
Type: Peritoneum	Sex: Female Age: 68 Year of death: 1970 DC Occupation: Teacher DC Industry: Public Schools
Lifetime Occupational History	
1923–1962	High school home economics teacher
Comments:	Father was a farmer; husband was a menswear salesman; no neighborhood exposures; sister of Case 1; diagnosis confirmed at autopsy. 1989 AHERA inspection found significantly damaged friable thermal insulation and friable surfacing material in the school.
Case 3	
Type: Pleura	Sex: Female Age: 63 Year of death: 1980 DC Occupation: Waitress trainer DC Industry: Vocational school
Lifetime Occupational History	
1932–1976	Hotel and restaurant waitress
1962–1976	Part-time teacher in vocational school; traveled 2–3 times a week to state vocational schools throughout Northeastern Wisconsin to conduct waitress/restaurant training courses
1977–1980	City parking ramp cashier
Comments:	Father was a farmer and part-time carpenter; unmarried; no factories near home; status of any ACBM in schools unknown.
Case 4	
Type: Pleura	Sex: Male Age: 65 Year of death: 1980 DC Occupation: Music professor DC Industry: University
Lifetime Occupational History	
1935–1942	Drove taxi; played piano in bands while in college
1942–1946	Traveled with armed services bands entertaining throughout Europe
1947–1953	Completed college; obtained Masters in Music; played piano in bands
1953–1978	Professor of music at a university
Comments:	Father a history teacher; wife a teacher; no factories near home. Music practice rooms reported to have acoustical asbestos surfacing material; back of stage used surfacing ACBM; asbestos stage curtain

(TABLE 9. *Continued*)

Case 5

Type: Pleura Sex: Female Age: 66 Year of death: 1980 DC Occupation: Teacher DC Industry: School district

Lifetime Occupational History

1937–1942	Elementary school teacher
1943–1946	Office; secretarial work
1946–1955	Taught all grades in rural school
1955–1977	Elementary school teacher in different district
Comments:	Father was a farmer; husband ran a mink farm. Mastectomy in 1959; received radiation therapy. Mesothelioma on opposite side from mastectomy. 1989 AHERA inspections found friable thermal insulation and friable surfacing material in the schools she taught in in 1955–1977. Earlier school's ACBM status unknown.

Case 6

Type: Pleura Sex: Male Age: 81 Year of death: 1981 DC Occupation: School teacher DC Industry: Education

Lifetime Occupational History

1920–1974	Teacher at parochial schools in Texas, Oklahoma, South Dakota, Illinois, Minnesota, Wisconsin (history, math, Bible classes)
1920–1974	Carpenter during summers working on renovation, remodeling and new residential jobs
Comments:	Father was a farmer; wife a teacher; no military service; no neighborhood exposures. Status of any ACBM in schools unknown.

Case 7

Type: Pleura Sex: Male Age: 48 Year of death: 1981 DC Occupation: Professor of architecture DC Industry: University

Lifetime Occupational History

1950–1952	Summer construction work; driving wood pilings at dam sites
1953–1961	University degree program; part-time work at a cement plant and electrical supplies wholesaler
1961–1981	University professor of architecture; research on urban renewal
Comments:	Father was an engineer; commercial building, federal government projects in the Tennessee valley. While at cement company, subject helped with the cleaning of an old closed cement plant. Wife is an architect; home not near factories. University office contained asbestos covered pipes—since removed as part of an asbestos abatement project.

Case 8

Type: Pleura Sex: Male Age: 50 Year of death: 1984 DC Occupation: Teacher DC Industry: Public schools

Lifetime Occupational History

1953–1954	Seaman on iron ore boats; coal passer
1954–1955	Paper mill machine operator (Idaho)
1956–1958	U.S. Army medic; EKG technician at Hawaii hospital
1959–1966	College; part-time/full-time work for power plant; worked outside with coal piles and coal transport system. Cut up scrap metal with welding torch for short time
1966–1968	Teacher corps in Texas; training in special education
1968–1984	Teacher; special education classes; football coach
Comments:	Father ran shoe repair store. Wife reports the coach's room/office was in the basement of the school, had many pipes running through it from the boiler room nearby. Taught in same school as Case 10. 1989 AHERA inspection identified significantly damaged friable thermal insulation in all schools subject taught in.

1954–1955	Paper mill machine operator (Idaho)
1956–1958	U.S. Army medic; EKG technician at Hawaii hospital
1959–1966	College; part-time/full-time work for power plant; worked outside with coa' and coal transport system. Cut up scrap metal with welding torch for short time
1966–1968	Teacher corps in Texas; training in special education
1968–1984	Teacher; special education classes; football coach
Comments:	Father ran shoe repair store. Wife reports the coach's room/office was in the basement of the school, had many pipes running through it from the boiler room nearby. Taught in same school as Case 10. 1989 AHERA inspection identified significantly damaged friable thermal insulation in all schools subject taught in.

Case 9

Type: Pleura Sex: Female Age: 80 Year of death: 1985 DC Occupation: Teacher DC Industry: Secondary school

Lifetime Occupational History

1925–1946	High school teacher (Latin)
1947–1956	Homemaker
1957–1960	Part-time Latin & history high school teacher
1960–1967	Full-time Latin & history high school teacher
Comments:	Father ran a retail store; family lived in apartment on 2nd floor above store, basement unused but did have boiler and pipes which may have been covered with asbestos; husband was a high school teacher; no factories near residence. Taught in same school as Case 10. 1989 AHERA inspection found significantly damaged thermal insulation and surfacing material in school

Case 10

Type: Pleura Sex: Female Age: 49 Year of death: 1986 DC Occupation: Home economics teacher DC Industry: Education

Lifetime Occupational History

1958–1959	North Dakota high school teacher (home economics)
1960–1961	Interior decorator
1962–1963	Wisconsin high school teacher (home economics)
1964–1966	Part-time Wisconsin high school teacher (home economics)
1966–1984	Full-time Wisconsin high school teacher (home economics)
Comments:	Father was a railroad depot agent; husband a teacher; no environmental exposure. 1989 AHERA inspection identified friable thermal insulation in all schools subject taught in and significantly damaged surfacing material in one. Taught in the same school as Case 9 (1962–63) and Case 8 (1964–66).

Case 11

Type: Pleura Sex: Male Age: 91 Year of death: 1987 DC Occupation: Professor emeritus DC Industry: University

Lifetime Occupational History

1920–1925	Waiter in restaurant while in school
1925–1965	Electrical engineer; professor of mathematics at University
Comments:	No military service; father a farmer; no neighborhood industry. Status of ACBM in university unknown.

Case 12

Type: Pleura Sex: Male Age: 43 Year of death: 1987 DC Occupation: Teacher DC Industry: Elementary & high school

Lifetime Occupational History

1964–1969	6th grade teacher
1970–1972	U.S. Army meteorologist in Vietnam and Germany
1972–1972	Returned to school for reading specialist certificate
1973–1986	Special education teacher traveling to all district schools
Comments:	Father a farmer; no neighborhood factories. 1989 AHERA inspections found friable thermal insulation in all schools subject taught in. Friable surfacing material in one school he began teaching at in 1973.

All of the maintenance workers were likely to have performed tasks around thermal asbestos materials. It was commonly reported that periodic maintenance of boilers and pipes was performed either by the individuals or in their vicinity. Mention of acoustical or surfacing material was less common.

The patients reported in cases 7 and 10 in TABLE 5 were employed at the same university facility, which was known to have friable thermal and acoustical ACBM. A similar situation was described in the school district in which the patients in cases 2 and 4 in TABLE 5 had both worked. It is unlikely that these clusters are due to chance alone.

An unexpected observation was that four (17%) of the patients had served 4-year enlistments in the U.S. Navy. Two (one a boilerman and the other an engineer) spent time in the engine room and were probably exposed to asbestos aboard ship. The other two served aboard ship and may also have been indirectly exposed. A recent report of the mortality of United Kingdom military serviceman (those with more than 5 years of service) found an excess of mesothelioma among the Royal Navy servicemen (7 cases of mesothelioma).[26] Asbestos diseases have also been reported among long-term merchant seamen.[27,28] It is important to consider military service when investigating possible sources of asbestos exposure when mesothelioma develops.

School Teachers

This is the first report that systematically investigates possible sources of asbestos exposure among school teachers with mesothelioma. In 9 of the 12 cases, the only potential source of asbestos exposure identified was in-place ACBM.

It was unexpected to find two teachers who were sisters. The occurrence of more than one mesothelioma in a family is a very rare event. The world medical literature contains less than 10 reports of family clustering of mesothelioma.[29,30] In each instance, exposure to asbestos (occupational and/or environmental) has been identified. The two sisters in our series fit the pattern described in these reports—sharing a similar tumor site and histology. It was postulated by both Martensson[29] and Lynch[30] that a hereditary predisposing factor may exist which is especially sensitive to induction by asbestos. If such is the case, our sisters probably received their induction dose of asbestos from ACBM within their schools. AHERA reports indicate that friable thermal and surfacing material were present in the school of one of the sisters. The school in which the other sister taught no longer exists and no information is currently available whether ACBM was in the school.

Considering the rarity of mesothelioma and the more than 3,000 schools in the state, it was unexpected to find two school clusters of two cases among the 12 teachers investigated. In both instances significantly damaged thermal and surfacing ACBM was present in 1988–89. The status of ACBM at the time the teachers were in the schools is unknown.

CONCLUSION

Our investigation of mesothelioma cases in Wisconsin with school, residential, commercial and factory maintenance and repair employment identified asbestos exposure in every instance. For most, the opportunities for asbestos exposure came from multiple jobs, including maintenance work. However, in 10 (34%), the only identifiable likely source of asbestos exposure was to in-place ACBM, probably intermittently disturbed while maintenance activities were performed. We

conclude that building maintenance workers are at increased risk to develop mesothelioma from exposure to in-place ACBM.

We report 12 mesothelioma deaths among school teachers. For 9, the only likely source of asbestos exposure was to in-place ACBM. Two teachers, with similar peritoneal mesotheliomas, were sisters. All previous sibling clustering of mesothelioma reports have identified asbestos exposure to the siblings. This suggests that our two teachers must have been exposed to asbestos, most likely during each of their 40+ years of teaching.

Especially for the maintenance staff in the public school buildings, the high prevalence (36%) of significantly damaged friable thermal insulation described in our AHERA plan reviews represents a serious concern and underscores the need for strict operations and maintenance programs including repair and/or removal of such material. Rapid implementation of rigorous operations and maintenance programs is needed to prevent future asbestos exposure to the large existing maintenance work force and the even larger population of building residents whose health may be jeopardized by episodic environmental contamination by inadequate maintenance and operational precautions.

SUMMARY

The occurrence of mesothelioma is a sentinel event in occupational and environmental disease.[1] A mesothelioma surveillance system was established utilizing existing computerized Wisconsin vital statistics data maintained since 1959 and a Cancer Reporting System (CRS) established in 1978.

Review of the death certificate listing of usual occupation and industry from 487 mesothelioma deaths in Wisconsin from 1959 to 1989 led to the investigation of 41 persons with likely exposure to inplace asbestos-containing building materials (ACBM): 12 school teachers, 10 school maintenance employees, 7 public building maintenance workers, 5 private building maintenance workers, and 7 commercial and factory workers performing maintenance activities.

For 10 (34%) of the 29 maintenance workers the only source of asbestos exposure identified was their maintenance work. For five (17%) histories indicated some prior employment in occupations and industries with probable asbestos exposures. Opportunities for indirect occupational exposure were identified for ten who had been employed in the residential construction industry. One maintenance worker was exposed to asbestos in the household and another had neighborhood exposure.

For 9 (75%) of the school teachers, the only identifiable potential source of asbestos exposure was derived from in-place ACBM in schools. One teacher had spent a season in the merchant marine aboard an iron ore–hauling ship and 2 had worked in the residential construction industry. Two of the teachers were sisters, and in two instances, two teachers had taught in the same school facility.

We conclude that individuals occupationally exposed to in-place ACBM are at risk for the subsequent development of mesothelioma.

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