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Silicosis prevalence and incidence among Medicare beneficiaries

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Abstract

Introduction: Existing epidemiologic information on silicosis relies on mortality data.

Methods: We analyzed health insurance claims and enrollment information from 49 923 987 fee-for-service (FFS) Medicare beneficiaries aged ≥65 from 1999 to 2014. Three different definitions were developed to identify silicosis cases and results are presented as ranges of values for the three definitions.

Results: Among FFS beneficiaries, 10 026–19 696 fit the silicosis case definitions (16-year prevalence: 20.1–39.5 per 100 000) with the highest prevalence among North American Natives (87.2–213.6 per 100 000) and those in New Mexico (83.9–203.4 per 100 000). The annual average prevalence had a significant (P <0.05) 2–5% annual decline from 2005 to 2014. The average annual number of incident cases had a significant 3–16% annual decline from 2007 to 2014.

Conclusions: Silicosis is a prevalent disease among Medicare beneficiaries aged ≥65, with variation across the country. Morbidity data from health insurance claims can provide a more complete picture of silicosis burden.

Keywords

insurance; Medicare; silicosis

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AUTHORS' CONTRIBUTIONS

MLC is the principal investigator for this research and was responsible for the design of the work, as well as the acquisition and analysis of the data. JMM contributed to the design and interpretation of the data. All authors contributed to the manuscript preparation and approved its contents.

ETHICS APPROVAL AND INFORMED CONSENT

The analysis was determined not to be human research by the National Institute for Occupational Safety and Health (NIOSH) Institutional Review Board and did not require additional review.

DISCLOSURE (AUTHORS)

The authors declare no conflicts of interest.

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DISCLAIMER

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health. Mention of product names does not imply endorsement by NIOSH/CDC.

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1 | INTRODUCTION

Silicosis is a preventable occupational respiratory disease caused by exposure to respirable crystalline silica.[1–3] Chronic silicosis, the most common form of the disease, develops 10 or more years after exposure to relatively low levels of respirable crystalline silica.[2] The disease may develop or progress even after occupational exposure has stopped.[4–6] Because of the long latency period from the first exposure to disease development, some silicosis cases may not be diagnosed until late in their life.

An estimated 2.3 million U. S. workers are potentially exposed to respirable crystalline silica.[7] Exposure is a recognized risk in mining, quarrying, sandblasting, pottery making, rock drilling, road construction, stone masonry, tunneling, and other operations.[7] In addition, newer manufactured processes and industries have been documented to place workers at risk for silicosis, including workers that handle engineered stone products containing quartz, dental laboratory technicians, and workers employed in natural gas extraction using hydraulic fracturing.[8–10]

No national information is available on silicosis incidence and prevalence. National silicosis mortality data come from vital statistics records collected by the National Center for Health Statistics. During 1999–2014, a total of 2163 decedents had silicosis listed as the underlying or contributing cause of death. Among these deaths, 1764 (81.6%) occurred among persons aged ≥65 years.[11] In the United States, Medicare is the primary insurance of people aged ≥65 years, and Medicare claims may offer insight into silicosis morbidity. To determine the prevalence and incidence of silicosis among Medicare beneficiaries aged ≥65 years, health insurance claims and enrollment information from 1999 to 2014 were analyzed.

2 | METHODS

2.1 | Data source

The U. S. Centers for Medicare and Medicaid Services (CMS) is the primary insurer of U.S. citizens and permanent legal residents aged ≥65 years through its Medicare program.[12] De-identified information from beneficiary enrollment and from medical claims can be purchased for analysis through the Research Data Assistance Center.[13] The Medicare enrollment data include beneficiary's date of birth, date of death, sex, race or ethnic origin, state of residence, the original, and current reasons for Medicare enrollment as well as the type of enrollment such as Part A, Part B, or enrollment in a health management organization (HMO). Medicare claims include the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis, and procedure codes, Current Procedural Terminology 4 (CPT-4) procedure codes, Healthcare Common Procedure Coding System (HCPCS) procedure codes, dates of service, financial data such as charges and payments as well as other information.[13]

For this study, data on beneficiaries aged ≥65 years who were enrolled in Medicare during 1999–2014 were examined. Those who were enrolled in Medicare due to disability or end-stage renal disease were excluded. Medicare data do not include claims for beneficiaries who receive their Medicare benefits through a managed care provider (Medicare Part C).[14]

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Including these individuals in rate calculations would likely underestimate silicosis since not all of their medical claims are found in the Medicare data.[14] To address this limitation, the analysis was restricted to fee-for-service (FFS) beneficiaries (Medicare Parts A&B) and excluded individuals ever enrolled in a managed care plan (Medicare Part C) from 1999 to 2014. Final, reimbursed claims for beneficiaries were identified and included claims for inpatient, outpatient, skilled nursing facility, hospice, and home health services as well as durable medical equipment. The analysis was determined not to be human research by an Institutional Review Board and did not require additional review. To assure consistency of the analysis, data from 2015 to 2016 were not included due to the change from ICD-9 to ICD-10.

2.2 | Definitions

Three case definitions were used to identify beneficiaries with silicosis and to calculate silicosis prevalence and incidence (Supplemental Figure S1). A broad prevalent silicosis definition identified Medicare beneficiaries with any claim that included ICD-9-CM code 502, pneumoconiosis due to other silica or silicates, listed in any position during 1999–2014. Among cases identified by this broad definition, a more specific, intermediate prevalent silicosis case definition, based on CMS algorithms was applied (there is no CMS algorithm available to identify beneficiaries with silicosis).[15] This intermediate prevalent silicosis case definition identified Medicare beneficiaries with i) at least one inpatient, skilled nursing or home health agency claim, or ii) at least two outpatient provider claims within 365 days of each other. Among those identified by the intermediate definition,a narrow prevalence case definition, using procedure codes for chest X-rays, and computerized tomography (CT) scans was developed. This definition required that cases have a chest X-ray or CT scan 30 days before or 30 days after a silicosis claim. Procedure codes for chest X-ray included CPT-4 codes 71010, 71015, 71020–71022, 71030, and ICD-9-CM codes 87.44 and 87.49. Procedure codes for CT scan of the thorax included CPT-4 codes 71250, 71260, 71270, and ICD-9-CM code 87.41.

Incident silicosis cases were a subset of prevalent cases who had at least 3 years of continuous Medicare enrollment without any claims listing the silicosis diagnosis code (ICD-9-CM 502) prior to their first silicosis claim. The 3-year continuous enrollment period was selected as individuals exposed to silica are recommended to have regular medical check-ups every 3 years to evaluate radiographic changes in the lung and pulmonary function.[16]

2.3 | Statistical analysis

Medicare beneficiaries that met the silicosis case definition were considered prevalent from their first claim listing silicosis ICD-9-CM code 502 and were counted until they died or were otherwise not enrolled in Medicare. This methodology was based off of previous studies analyzing Medicare and other administrative claim dataset.[17,18] Cumulative annual number of prevalent silicosis cases for 1999–2014 was calculated by summing the number of prevalent silicosis cases for a given year.[17,18] An annual prevalence per 100 000 Medicare beneficiaries was calculated by taking the total number of identified prevalent silicosis cases in a specific year and dividing it by the total number of enrolled FFS Medicare beneficiaries

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aged ≥65 years for that year. Since Medicare claim data were available starting in 1999, prevalent cases would not be counted until they sought medical care. Thus, calculations of annual cumulative prevalence at the beginning of the analysis are likely incomplete. Prevalence during the entire 16-year period was calculated by summing all prevalent cases and dividing by the number of all FFS Medicare beneficiaries enrolled during 1999–2014.

Annual silicosis incidence was calculated for 2002–2014 using the total number of incident silicosis cases for a given year, starting with the year of their first silicosis claim. An annual incidence (per 100 000 FFS Medicare beneficiaries) was calculated by taking the total number of incident silicosis cases in a specific year and dividing it by the total number of enrolled Medicare beneficiaries aged ≥65 years who were continuously enrolled for at least 3 years prior to that year. A limitation of this methodology is that silicosis cases that had disease onset prior to 1999 may erroneously be counted as new (incident) cases despite the 3 year incident observation period. Thus, calculations of annual incidence at the beginning of the analysis may be artificially high. Cumulative incidence over the entire 16 year period is presented by summing all incident cases and dividing by all FFS Medicare beneficiaries enrolled during 1999–2014 who had at least 3 years of continuous enrollment.

Demographic information (age, sex, race/ethnic origin, and state of residence) was determined at the end of the year for the beneficiary's first silicosis claim or the first year of enrollment, starting in 1999. Race and ethnic origin is combined in Medicare data. Cell sizes of less than 11 were suppressed and were not used to generate rates or frequencies. Chi-square tests were used to evaluate statistically significannt (P <0.05) differences among demographic groups and case definitions. Time-trends, in log-transformed rates, were evaluated using joinpoint regression and conducted in Joinpoint Trend Analysis Software.[19] Annual percent change (APC) with corresponding 95% confidence intervals (CI) were calculated. Time points, expressed in years, where there was a statistically significant change in trend (P < 0.05) were also identified.[20] All other statistical analyses were conducted in SAS Enterprise Guide 7.1 (SAS Institute, Cary, NC). Results are presented as ranges of values for the three definitions.

3 | RESULTS

During 1999–2014, 49 923 987 beneficiaries aged ≥65 years were enrolled in Medicare due to their age (Table 1). Most beneficiaries were aged 65–74 years (73%) and white (85%). Over 4.7 million (9%) were originally enrolled in Medicare due to disability.

3.1 | Prevalence

During 1999–2014,10 026–19 696 (16-year prevalence 20.1–39.5 per 100 000 beneficiaries) beneficiaries had silicosis.(Table 1) The cumulative silicosis prevalence was highest among those aged 7584 years for all three case definitions (43.4–78.5 per 100 000 beneficiaries). Most prevalent silicosis cases were males (81–90%, 40–66 per 100 000) and white (84–85%, 20–36 per 100 000). The prevalence rate among males was 5.3–11.5 times greater than that of females. Beneficiaries identifying as North American Natives had the highest prevalence of silicosis among all other race/ethnicity categories with 87.2–213.6 cases per 100 000 beneficiaries. Significant differences (P <0.05) were found within all demographic

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categories and between all three case definitions. By state, beneficiaries in New Mexico (83.8–203.4 per 100 000), West Virginia (99.5–162.0), and Utah (59.2–112.6) had the highest 16-year prevalence rates during 1999–2014 for all three prevalence definitions. States categorized in the highest quartile of prevalence were similar among all three case definitions.(Figure 1).

The annual cumulative silicosis prevalence among beneficiaries aged ≥65 years is shown in Figure 2. The annual number of prevalent silicosis cases identified using the broad definition increased from 1999 to 2005 and remained relatively steady from 2005 to 2014, averaging 7105 cases per year with an APC of 1% (95%CI = 0.7–1.1%, $P = 0.000017$). The annual number of prevalent silicosis cases increased for the intermediate and narrow definitions until 2005 reaching 3929 and 3465 cases, respectively. From 2005 to 2014, the number of prevalent silicosis cases identified by the intermediate definition averaged 3829 cases per year with an APC of −1% (95%CI = −0.7-–0.4%, $P = 0.000051$). During this same time period, the number of prevalent silicosis cases identified by the narrow definition averaged 3260 cases per year with an APC of −2% (95%CI = −2.1-–1.5%, $P = 0.000002$).

The prevalence rate per 100 000 beneficiaries significantly changed in 2005/2006.(Figure 2) The annual prevalence calculated using the broad definition increased from 1999 to 2001 by 42% (95% CI = 27–59%, $P = 0.000088$) and by 8% (95%CI = 6–11%, $P = 0.000063$) from 2001 to 2006. Then, the rate declined (from 29.2 per 100 000 in 2006–25.0 in 2014) by 2% (95%CI = −3-–1%, $P = 0.000190$) annually from 2006 to 2014. The prevalence calculated using the intermediate definition increased 33% annually (95%CI = 20–46%, $P = 0.000173$) from 1999 to 2001, and 8% annually (95%CI =4–12%, $P = 0.002072$) from 2001 to 2005. Then, the rate significantly ($P = 0.000004$) declined (from 16.7 per 100 000 in 2005 to 12.5 in 2014) annually 3% (95% CI = −4-–3) from 2005 to 2014. The annual prevalence calculated using the narrow definition increased by 33% (95%CI = 21–47%, $P = 0.000126$) from 1999 to 2001 and by 5% (95%CI=3–8%, $P = 0.001190$) from 2001 to 2006. Then the rate declined (from 14.7 per 100 000 in 2006 to 10.0 in 2014) annually by 5% from 2006 to 2014 (95%CI = −6-–4%,p =0.000001). The average annual prevalence rate from 2005 to 2014 was 12.9–27.8 per 100 000 beneficiaries while the average annual prevalence over the entire study period (19992014) was 12.4–24.9 per 100 000 beneficiaries.

3.2 | Incidence

During 2002–2014, 5265–10 219 (16-year cumulative incidence of 16.6–32.1 per 100 000 beneficiaries) incident silicosis cases were identified. (Table 1) Nearly half (47–48%, 28.6–54.7 per 100 000) of the incident silicosis cases were aged 75–84 years, most were male (79–89%, 34.3–59.3 per 100 000) and white (85–86%, 16.1–31.3 per 100 000).(Table 1) The incidence rate among males was 5.0–10.4 times greater than that of females. By race/ethnicity, silicosis incidence was highest among North American Natives with 99.0–239.4 cases per 100 000 beneficiaries. Significant differences ($P<0.05$) were found within all demographic categories and between all three case definitions. State-specific silicosis incidence calculated using all three case definitions from 2010 to 2014 are shown on Figure 3. Using each approach, beneficiaries in New Mexico had the highest incidence (88.1–218.1) followed by those in West Virginia (83.7–134.5).

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The annual incidence of silicosis among beneficiaries during 20022014 is shown on Figure 4. The annual average number of incident silicosis cases ranged from 405 beneficiaries using the narrow case definition to 786 beneficiaries using the broad case definition. The number of silicosis cases identified by the broad incidence definition significantly decreased 9% (95%CI = −13-–6%, $P = 0.000384$) from 2002 to 2007, and by 3% (95%CI = −6-–0.4%, $P = 0.030669$) from 2007 to 2014. The number of silicosis cases identified by the intermediate incidence case definition had a similar trend, declining 11% (95% CI = −15-–6%, $P = 0.000510$) from 2002 to 2007, and by 3% (95% CI = −7– 0.4%, $P = 0.073541$) from 2007 to 2014. The number of cases identified by the narrow definition significantly declined by 9% (95% CI = −12-–8%, $P = 0.000039$) from 2002 to 2009, rose slightly from by 2% (95%CI = −15–22%, $P = 0.801836$) from 2009 to 2012 and then declined 16% (95%CI = −32–3%, $P = 0.078031$) from 2012 to 2014.

Significant declines in the silicosis incidence rate from 2002 to 2014 were noted for the broad case definition (APC = −6%, 95% CI = −7-–5%, $P = 0.000000$) and the narrow case definition (APC = −8, 95%CI = −9-–6%, $P = 0.00000$). The silicosis incidence for the intermediate case definition significantly declined by 10% (95%CI = −14-–5%, $P = 0.001237$) annually from 2002 to 2007 and by 4% annually (95%CI = −8-−1%, $P = 0.029359$) from 2007 to 2014. The average annual incidence rate from 2002 to 2014 ranged from 2.4 to 4.6 per 100000 beneficiaries.

4 | CONCLUSION

To our knowledge, this is the first study reporting on silicosis prevalence and incidence using national data. Depending on the case definition, the 16-year prevalence of silicosis ranged from 20.1 to 39.5 cases per 100000 beneficiaries with an annual average prevalence ranging from 12.4 to 24.9 silicosis cases per 100 000 beneficiaries. During 2005–2014, the incidence over this entire period was 16.6–32.1 per 100 000 beneficiaries with an annual average incidence of 2.4–4.6 cases per 100 000 beneficiaries. While the annual incidence of silicosis has declined from 2002 to 2014, the number of prevalent cases has remained relatively constant from 2005 to 2014 with an annual average ranging between 3260 and 7105 beneficiaries.

Other studies looking at silicosis morbidity in the U.S. have been done at the state level, used capture-recapture methods to estimate national morbidity and used subsets of administrative claims (hospitalizations).[21–24] An analysis of data from sentinel case-based surveillance in Michigan for 1988–2016 reported a cumulative incidence rate of silicosis of 1.7 cases per 100 000 men ≥40 years of age. This analysis found a rate of 34.3–59.3 per 100 000 cases among male Medicare beneficiaries aged>= 65. However, the rates are not directly comparable as the age groups included in the rates are different. Using capture-recapture methods, Rosenman et al[23] estimated the national number of prevalent silicosis cases to be 3600–7300 cases among all adults per year during 1987–1996. Although the methodology, time periods and study populations are significantly different, these national estimates from Rosenman et al are nearly identical to our annual average prevalence results of 3260–7105. The Healthcare Cost and Utilization Project (HCUP) estimated number of silicosis discharges from hospitals in 2014 was 1575, with 68% (1,075) among individuals aged

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≥65.[24] However, it is difficult to directly compare Medicare claims and HCUP data, as HCUP primarily relies on facility claims and our analysis of Medicare data included all claim types. Within the Medicare data, there were 1256 facility header claims that listed silicosis in any position in 2014, but without additional information, the differences between these data sources cannot be fully explained. Yet, this difference provides an example of how counts of medical claims may be very different between administrative systems.

In this study, silicosis cases were predominantly white, non-Hispanic males, a population consistent with reviews of silicosis mortality.[25,26] Individuals identifying as North American Natives had the highest rate of silicosis among all race/ethnicity categories. While no occupational data were available to explain this result, silicosis has been identified as an occupational health concern among Native Americans working in uranium mines.[27,28] In addition, a study of 757 uranium miners, among whom 99% were Native Americans, found 2.5 times more deaths from pneumoconioses (including silicosis) than expected.[29]

States with the highest 16-year prevalence rates of silicosis included New Mexico, West Virginia, and Utah. Many of these states have had historically high rates of silicosis mortality. An analysis of multiple cause-of-death data by state from 1996 to 2005 identified 10 states with age-adjusted silicosis death rates >1.6 million per year: Vermont, Pennsylvania, Ohio, West Virginia, Wisconsin, New Mexico, Colorado, Utah, Idaho, and Montana. With the exception of Idaho, which was in the second-highest quartile, all of these states were identified as having the highest silicosis prevalence rates among FFS Medicare beneficiaries.[30]

There are some limitations to this analysis related to the case definitions, characteristics of Medicare data, exclusions made to identify the study population and the calculation of specific measures. The case definitions in this study were not validated by medical chart review and information on employment history was not available to validate occupational exposure.[15] Using three definitions, the number of identified silicosis cases ranged from 10 026 to 19 696. Each of these definitions produced similar demographic frequencies. Chronic conditions in administrative dataset may be underestimated due to financial considerations, administrative errors, and other factors. However, the extent of underestimation is unknown. For this reason, a range of definitions was used in this analysis to provide estimates of silicosis at varying levels of criteria, each of which has its own benefits and limitations.[14,31] Among the 19 696 beneficiaries identified as having silicosis using the broad definition, 47% have only one claim listing silicosis as a diagnosis with a median of 9 years of observation from 1999 to 2014. By comparison, the percentage of beneficiaries identified by the intermediate and narrow case definitions with only one claim was 22%. While it is possible that the broad definition may identify less-severe cases of silicosis, it is also possible that this definition may identify individuals who do not have silicosis. In addition, cases identified by the narrow definition may be biased because no information was available to determine if the CT or chest X-ray were done as part of silicosis management or diagnosis. Finally, for all three case definitions, there is the risk of silicosis being diagnosed as other lung diseases or for other lung diseases to be diagnosed as silicosis. This may be a particular problem for beneficiaries residing in states with large mining industries where diseases like coal workers' pneumoconiosis is highly prevalent. In this analysis, assessments

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of prevalence and incidence were limited to individuals aged 65 and over enrolled in Medicare. Individuals aged less than 65 who had more severe silicosis might have died prematurely and were not captured in this study. A review of death certificates would suggest that our analysis may underestimate national silicosis prevalence and incidence by 20%.[11] However, the most common form of silicosis is chronic silicosis that develops, in general, 10 years after initial exposure to respirable crystalline silica. Most chronic silicosis cases would be diagnosed and receive medical care later in life while enrolled in Medicare. In addition, this study was restricted to Medicare FFS beneficiaries and excluded those ever enrolled in managed care programs. It is likely that some of these beneficiaries had silicosis, thus underestimating our findings. The percentage of Medicare beneficiaries enrolled in managed care programs ranged from 13% in 2003 to 30% in 2014.[32] Finally, this analysis of Medicare beneficiaries would not include individuals who are not eligible for the program because they are not U.S. citizens or permanent legal residents.[12]

Measures of cumulative prevalence and incidence are similar to the analysis of incidence and prevalence of idiopathic pulmonary fibrosis presented by Raghu etal.[17,18] However, there are limitations in this methodology due to data truncation. For example, prevalent cases are not counted until they receive medical care during 1999–2014; making cumulative prevalence at the beginning of the analysis incomplete and results observed toward the end of the study period likely more complete. This is demonstrated by the significant increase in cumulative prevalence from 1999 to 2005. The significant change in trend that occurs in 2005 may be an indicator of a time point when silicosis cases diagnosed before 1999 are less likely to contribute to annual prevalence results. Thus, the annual prevalence results from 2005 to 2014 are likely more accurate than those from 1999 to 2004.

Similarly, beneficiaries with silicosis that had disease onset prior to 1999 may erroneously be counted as new (incident) cases during 1999–2014 despite the 3-year incident observation period. This may explain why the incidence of silicosis is higher in the initial years of the study period. Results observed toward the end of the study period are less likely to include cases that are erroneously identified as new (incident). The significant change in trend observed in 2007 may be an indicator of a time point when these cases are less likely to contribute to annual incidence results. Thus, annual incidence results from 2007 to 2014 maybe more accurate in this respect than results from 1999 to 2006. The 3-year observation period used to determine incident cases was based on the Occupational Safety and Health Administration’s silicosis rule which was notin effect at during the study period, but was recommended by the National Institute for Occupational Safety and Health in 1974 and assumed to be general practice during the study period.[7,16]

Prior studies evaluating silicosis burden rely on mortality data which may represent only a fraction of true silicosis cases. This analysis of Medicare data characterizes silicosis morbidity and demonstrates the prevalence and incidence of silicosis among those aged >65 using national data. Silicosis is a prevalent disease among Medicare beneficiaries aged >65, with variation across the country. This is the first time that silicosis morbidity has been described using a national dataset and confirms other research using different populations and methodologies. Despite limitations, morbidity data from health insurance claims can provide a more complete picture of silicosis burden.

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Supplementary Material

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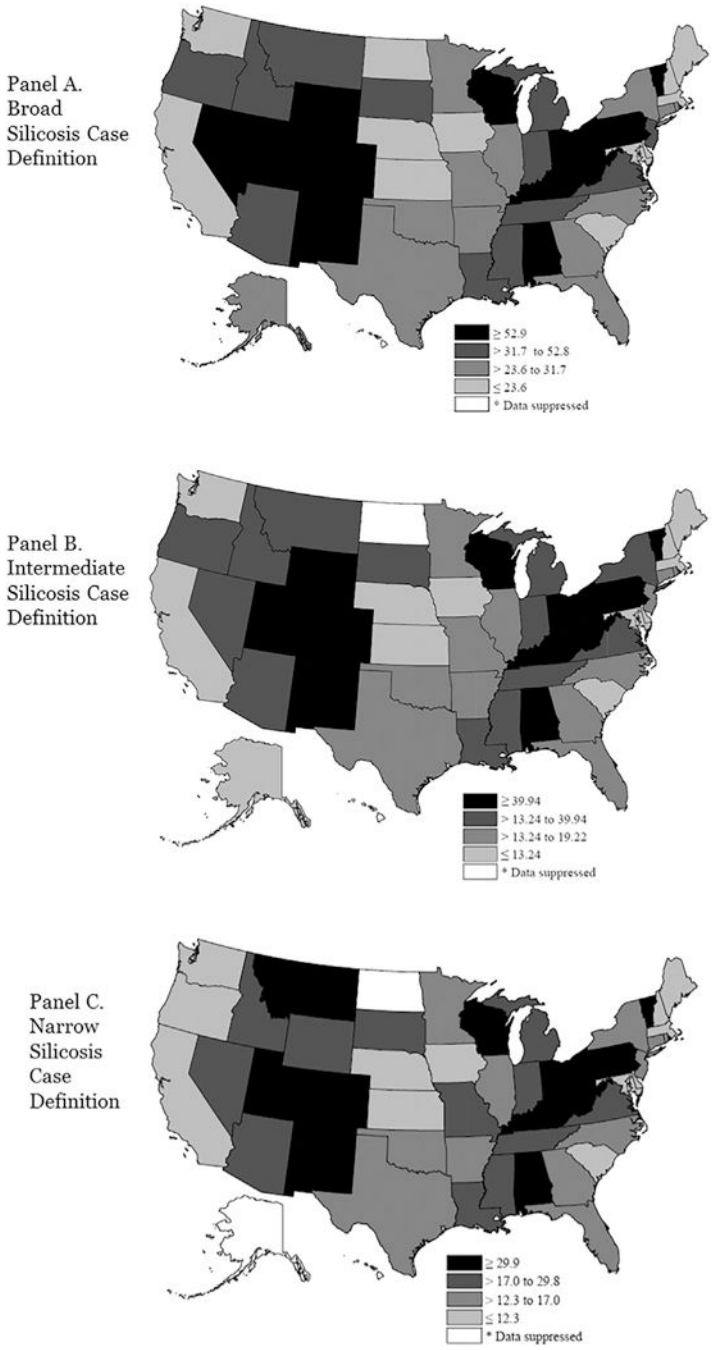

FIGURE 1.

Silicosis prevalence per 100 000 fee-for-service Medicare beneficiaries by case definition and state, 1999–2014. Shading denotes quartiles of state silicosis prevalence

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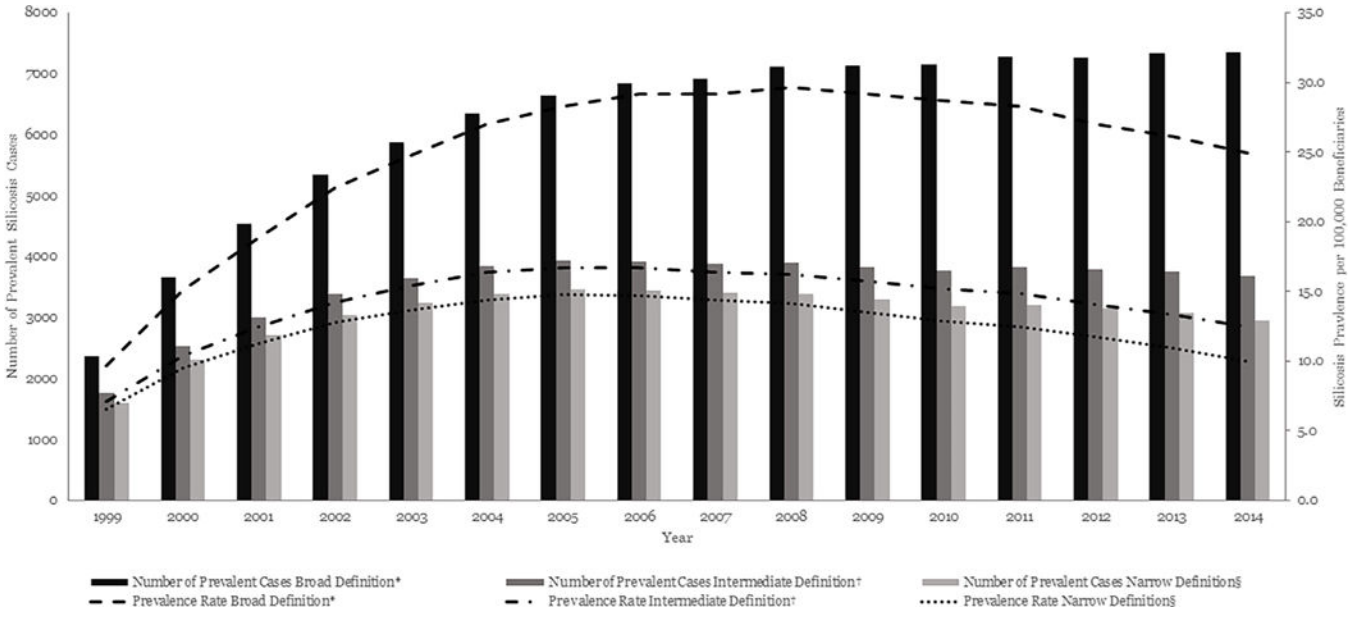

FIGURE 2.

Annual number and rate of prevalent silicosis cases among fee-for-service Medicare beneficiaries, by case definition, 1999–2014

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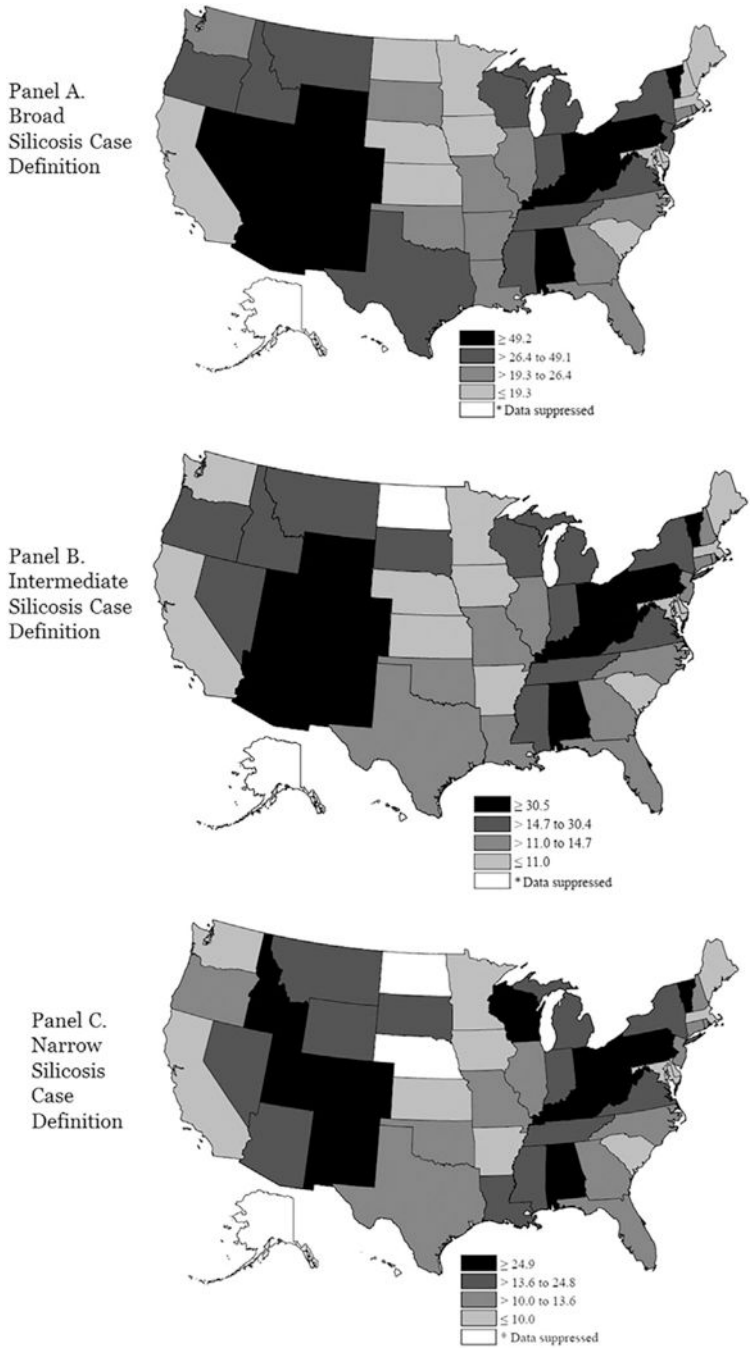

FIGURE 3.

Silicosis incidence per 100 000 fee-for-service Medicare beneficiaries, by case definition and state, 2010–2014. Shading denotes quartiles of state silicosis incidence. Incident cases had at least 3 years of continuous Medicare coverage without a silicosis (ICD-9-CM = "502") claim during that period. The denominator in the incidence rates are FFS beneficiaries who had at least 3 years of continuous enrollment in Medicare

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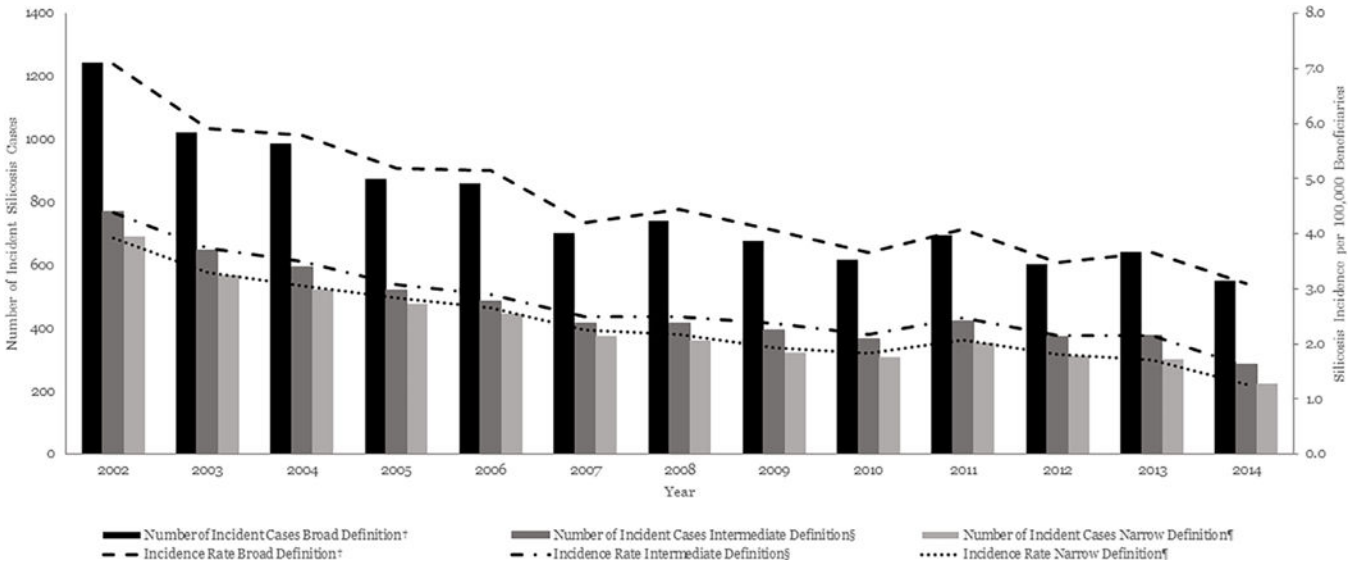

FIGURE 4.

Annual number and rate of incident silicosis cases among fee-for-service Medicare beneficiaries, by case definition, 2002–2014. Incident cases had at least 3 years of continuous Medicare coverage without a silicosis (ICD-9-CM = “502”) claim during that period. The denominator in the incidence rates are FFS beneficiaries who had at least 3 years of continuous enrollment in Medicare

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TABLE 1

Demographic characteristics of beneficiaries enrolled in fee-for-service Medicare during 1999–2014 by silicosis case definition

		Prevalence									Incidence[g]								
	Fee-for-service beneficiaries (*N* = 49 923 987)	Broad definition[d]			Intermediate definition**			Narrow definition[f]			Broad definition[d]			Intermediate definition[e]			Narrow definition[f]		
Characteristics	N	%	N[h]	%	Rate per 100 000	N	%	Rate per 100 000	N	%	Rate per 100 000	N	%	Rate per 100 000	N	%	Rate per 100 000[d]	N	%	Rate per 100 000
Total	499 23 987	100	19 696	100	39.5	11469	100	23.0	10026	100	20.1	10219	100	32.1	6066	100	19.1	5265	100	16.6
Age group[a]																				
65–74	3 65 54371	73.2	8145	44	22.3	5112	45	14.0	4411	44	12.1	3399	33	17.7	2014	33	10.5	722	14	3.8
75–84	9344202	18.7	7331	40	78.5	4602	40	49.2	4058	40	43.4	4846	47	54.7	2910	48	32.8	2534	48	28.6
85[b]	4025414	8.1	2895	16	71.9	1755	15	43.6	1557	16	38.7	1974	19	52.7	1142	19	30.5	1009	19	26.9
Sex																				
Male	2 2543 512	45.2	14937	81	66.3	10227	89	45.4	9066	90	40.2	8066	79	59.3	5295	87	38.9	4667	89	34.3
Female	2 73 80386	54.8	3434	19	12.5	1242	11	4.5	960	10	3.5	2153	21	11.8	771	13	4.2	598	11	3.3
Race/e thnidty[b]																				
White	42618 098	85.4	15 530	85	36.4	9596	84	22.5	8479	85	19.9	8784	86	31.3	5143	85	18.3	4516	86	16.1
Black	39 60411	7.9	1698	9	42.9	1119	10	28.3	1013	10	25.6	803	8	35.4	504	8	22.2	459	9	20.2
Other	783 348	1.6	128	1	16.3	81	1	10.3	65	1	8.3	65	1	17.9	38	1	10.5	30	1	8.3
Asian	9 28 102	1.9	151	1	16.3	71	1	7.7	59	1	6.4	77	1	17.3	35	1	7.9	29	1	6.5
Hispanic	8 90913	1.8	335	2	37.6	221	2	24.8	196	2	22.0	156	2	35.2	98	2	22.1	92	2	20.7
N.American native	2 27068	0.5	485	3	213.6	356	3	156.8	198	2	87.2	324	3	239.4	242	4	178.8	134	3	99.0
Original entitlement reason[c]																				
Aged 65[b]	4 5138 570	90.4	14439	79	32.0	8743	76	19.4	7622	76	16.9	8,169	80	28.4	4700	77	16.3	4076	77	14.2
Disability	4710437	9.4	3914	21	83.1	2716	24	57.7	2395	24	50.8	2,044	20	68.8	1363	22	45.9	1187	23	40.0

Significant differences ($P < 0.05$) were found within all demographic categories and between all three case definitions.

[a] Age was determined at the year of the beneficiary's first silicosis claim or the first year they were enrolled in Medicare during 1999–2014.

[b] "Hispanic" is considered a separate category in the Medicare data.

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[c] Original reason why a beneficiary was enrolled on Medicare.

[d] The broad silicosis case definition captured any beneficiary with a claim with ICD-9-CM code 502, pneumoconiosis due to other silica or silicates, listed in any position.

[e] The intermediate case definition captured any beneficiary that had at least one inpatient, skilled nursing or home health claim or two outpatient claims within 365 days of each other with ICD-9-CM code 502, pneumoconiosis due to other silica or silicates, listed in any position.

[f] The narrow silicosis case definition captured any beneficiary that had at least one inpatient, skilled nursing or home health claim or two outpatient claims within 365 days of each other with ICD-9-CM code 502, pneumoconiosis due to other silica or silicates, listed in any position AND a chest X-ray or CT scan 30 days before or 30 days after any silicosis claim.

[g] Incidence is calculated from 2002 to 2014. Incident cases had at least 3 years of continuous Medicare coverage without a silicosis (ICD-9-CM = “502”) claim during that period. The denominator in the incidence rates are FFS beneficiaries who had at least 3 years of continuous enrollment in Medicare.

[h] Demographic information was not available for the year of the first silicosis claim for 1325 (7%) of the cases identified by this definition.

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