Annual Healthcare Spending Attributable to Cigarette Smoking
An Update

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Background: Fifty years after the first Surgeon General's report, tobacco use remains the nation's leading preventable cause of death and disease, despite declines in adult cigarette smoking prevalence. Smoking-attributable healthcare spending is an important part of overall smoking-attributable costs in the U.S.

Purpose: To update annual smoking-attributable healthcare spending in the U.S. and provide smoking-attributable healthcare spending estimates by payer (e.g., Medicare, Medicaid, private insurance) or type of medical services.

Methods: Analyses used data from the 2006–2010 Medical Expenditure Panel Survey linked to the 2004–2009 National Health Interview Survey. Estimates from two-part models were combined to predict the share of annual healthcare spending that could be attributable to cigarette smoking. The analysis was conducted in 2013.

Results: By 2010, 8.7% (95% CI=6.8%, 11.2%) of annual healthcare spending in the U.S. could be attributed to cigarette smoking, amounting to as much as $170 billion per year. More than 60% of the attributable spending was paid by public programs, including Medicare, other federally sponsored programs, or Medicaid.

Conclusions: These findings indicate that comprehensive tobacco control programs and policies are still needed to continue progress toward ending the tobacco epidemic in the U.S. 50 years after the release of the first Surgeon General's report on smoking and health.
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Introduction

January 11, 2014, marked the 50th anniversary of the 1964 release of the first Surgeon General's report on smoking and health.[1] The historic report initiated a decades-long effort around the nation to curb the cigarette smoking epidemic. Recently, Holford and colleagues[2] quantified the historic effect of tobacco prevention and control interventions since the release of that report. They concluded that 8.0 million premature

deaths were averted and 175 million years of life were saved over the past half century as a result of the efforts that began after the report's publication.

Despite declines in adult cigarette smoking prevalence during the past 50 years, tobacco use remains the nation's leading preventable cause of death and disease.[3] The landmark 1964 report and 30 subsequent Surgeon General's reports on tobacco use have synthesized thousands of studies documenting the tremendous public health and financial burdens caused by tobacco use.[4] For example, during 2000–2004, cigarette smoking and secondhand smoke exposure resulted annually in at least 443,000 premature deaths, 5.1 million years of productive life lost, and $96.8 billion in productivity losses in the U.S.[5]

Smoking-attributable healthcare spending is an important component of overall smoking-attributable economic costs, as studies[6,7] have shown that this spending accounts for an estimated 5%–14% of the

annual healthcare expenditure in the U.S. For example, using data from the Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC) system, a previous analysis conducted by CDC concluded that, during 2000–2004, average annual smoking-attributable healthcare expenditures were approximately $96 billion.[5] More recently, an analysis conducted by the Congressional Budget Office (CBO) suggested that smoking accounted for about 7% of total annual healthcare spending for non-institutionalized U.S. adults during 2000–2008.[7]

The objective of this analysis is to present the latest nationally representative estimate of cigarette smoking–attributable fractions and associated healthcare spending for U.S. adults. It also assesses smoking-attributable fractions and associated healthcare spending by payer (Medicare, Medicaid, other federal, private insurance, out of pocket, and others) and type of medical service (inpatient, non-inpatient, and prescriptions). Updated information on the economic consequences of cigarette smoking is necessary to ensure that the data on which policy decisions are based, and that serve as inputs to research, are not stale.

Methods

Data Source

Data came from the 2006–2010 Medical Expenditure Panel Survey (MEPS) linked to the 2004–2009 National Health Interview Survey (NHIS). The MEPS is a nationally representative survey of civilian non-institutionalized families and individuals, their medical providers, and employers that collects information on individual healthcare utilization and medical expenditures. MEPS respondents can be directly linked to the NHIS because they are drawn from the NHIS household samples from the preceding 2 years. The NHIS, a cross-sectional household interview survey that collects information on the health of the civilian non-institutionalized U.S. population, includes questions about respondents' smoking history.

Study Sample

The final data set was restricted to non-pregnant adults aged ≥18 years at the time of the interview, because information about smoking-attributable maternal and child healthcare expenditures is available elsewhere.[8] After linking the data from the 2004–2009 NHIS, about 41,000 MEPS respondents were identified with complete data on the post-stratification weights to account for the complex survey design of the MEPS.

MEPS respondents were classified into four categories based on the smoking history information from the NHIS: never cigarette smokers; current cigarette smokers (respondents who smoked 100 cigarettes in their lifetime and smoked some days or every day at the time of the interview); former cigarette smokers who quit smoking within the last 5 years; and former cigarette smokers who quit smoking >5 years ago. Former smokers were considered

separately by how long ago they had quit, as studies[9–11] have found that recent quitters have higher medical expenditures because smoking cessation may have been prompted by the onset of symptoms or the diagnosis of a disease. The MEPS also asked about current cigarette use in the survey and was used to capture possible relapse or misreporting, but the NHIS smoking questions were needed to classify former smoking status.

Statistical Analysis

This analysis focuses on all-cause healthcare spending because smoking damages every organ in the body and causes or exacerbates a wide range of health conditions.[3] A two-part model was used for the analysis[7,12]:

$$DHCExp_{ijt} = \alpha_j + \gamma_t + \beta SmokingStatus_{ijt} + \delta SocialDemo_{ijt} + \pi HlthBeh_{ijt} + \varepsilon$$

$$HCExp_{ijt} = \alpha'_j + \gamma'_t + \beta' SmokingStatus_{ijt} + \delta' SocialDemo_{ijt} + \pi' HlthBeh_{ijt} + \varepsilon'$$

In each part of the model, annual healthcare spending depends on respondents' smoking status (SmokingStatus); sociodemographic characteristics (SocialDemo), including gender (male or female), age group (18–24, 25–44, 45–64, 65–74, or ≥75 years), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or non-Hispanic other), education (less than high school, high school, some college, or college and above), marital status (married or cohabitating, never married and not cohabitating, or divorced/separated/widowed), annual household income as a percentage of federal poverty level (<100%, 100%–124%, 125%–200%, 200%–399%, or ≥400%); and health-related behaviors or attitudes (HlthBeh), including alcohol consumption (excessive drinking, binge or heavy drinker; non-excessive drinking, current drinker; or non-drinkers, former or lifetime abstainer and unknown), self-reported BMI (underweight, BMI<18.5; normal weight, BMI 18.5–<25; overweight, BMI 25–<30; or obese, BMI >30), health insurance coverage (yes or no), self-reported receipt of influenza vaccine in the past 12 months (yes or no), self-reported seatbelt use (always/nearly always or sometimes/never), self-reported taking more risks than average person (agree somewhat/strongly or uncertain/strongly disagree), self-reported belief in own ability to overcome illness without medical help (agree somewhat/strongly or uncertain/strongly disagree). Health-related behavior or attitudes factors were used as controls for confounding factors that may be associated with both health expenditures and cigarette smoking. More information on these variables can be found in the Appendix (available online).

A logit model was used in the first part to estimate the probability of having any positive healthcare spending for respondent i in region j during year t ($DHCExp_{ijt}$, an indicator of positive healthcare spending). In the second part of the model, based on the specification tests,[13] a generalized linear model with a log link and gamma distribution was used to estimate annual attributable spending conditional on having positive healthcare expenditures ($HCExp_{ijt}$). The estimates from both parts were then combined to predict the share of the annual healthcare spending (smoking-attributable fraction) that would be reduced if current and former smokers had been never smokers. The attributable fraction was calculated by dividing the total smoking-attributable

healthcare spending by the total predicted spending for the entire population. The former was projected by subtracting the predicted healthcare spending for current smokers or former smokers from their predicted spending had they been never smokers.

Separate two-part models and projections were also conducted by payer (Medicare, Medicaid, other federal insurance, private insurance, out of pocket, and others) and type of medical service (inpatient; non-inpatient, which includes outpatient services, physician and clinical services, and other professional services; and prescription drugs).

Additionally, a set of sensitivity analyses was conducted to assess the robustness of primary estimates. Specifically, a two-part model was conducted separately by including smoking intensity (0–14 cigarettes per day, 15–24 cigarettes per day, and ≥25 cigarettes per day) for the current smokers to investigate the potential impact of smoking intensity. Another analysis was run by limiting final samples to those aged 18–65 years to investigate the possible impact of smoking-attributable premature deaths. Finally, a dichotomous alcohol variable (current drinker, nondrinker) was used to explore the potential influence of the specification of alcohol use, which is a risky behavior that is closely correlated with cigarette smoking. These results of sensitivity analyses are reported in the online Appendix.

All models were estimated using Stata, version 12.0, in 2013 and SEs were calculated based on the bootstrap method. All monetary amounts were adjusted to 2010 dollars using the regional Consumer Price Index for All Urban Consumers: Medical Care, provided by the U.S. Bureau of Labor Statistics.[14]

The annual personal healthcare expenditure in the National Health Expenditure Accounts (NHEA) administered by the Centers for Medicare & Medicaid Services (CMS), which is usually considered to be the gold standard for aggregated healthcare spending data in the U.S.,[15] is much higher than that in the MEPS because the latter does not include healthcare spending for the institutionalized, for long-term care >45 days, or for certain healthcare spending such as over-the-counter medications. The MEPS healthcare expenditure estimates can be up to 38% lower than comparable estimates from the personal healthcare expenditures reported by CMS.[16–18] Therefore, the estimated smoking-attributable healthcare spending based on MEPS sometimes can be underestimated. To address this issue, this analysis followed earlier studies,[12,19] multiplying the smoking-attributable fractions estimated from the MEPS data by corresponding annual healthcare spending reported in the 2010 NHEA. Specifically, medical care spending related to dental services (approximately 4.0% of the 2011 NHE) or expenditures for persons aged ≤18 years were excluded.[19] Because this approach relies on the assumption that the smoking-attributable fractions for the non-institutionalized population were comparable to those for the institutionalized population, the annual smoking-attributable spending estimates based on total U.S. healthcare spending in the 2010 MEPS are also reported in the Appendix (available online).

Results

Table 1 presents the characteristics of respondents from the 2006–2010 MEPS linked to the 2004–2009 NHIS, by current cigarette smoking status. In the final sample, 21.5% of adult respondents were current smokers, 22.6% were former smokers (6.0% quit within the last 5 years and

16.6% quit >5 years ago), and 56.0% were never smokers. Compared to never smokers, current smokers were more likely to be younger, non-Hispanic white, or poor, but were less likely to be female, have a college education or higher, or be married or cohabitating. They were also more likely to have other markers of risk for increased health expenditures, including being excessive drinkers, more inclined to take risks, more likely to believe in overcoming illness without medicine, less likely to have health insurance, and less likely to wear a seat belt.

Table 2 presents the share of annual healthcare spending attributable to cigarette smoking. An estimated 3.2% (95% CI=2.2%, 4.4%) of annual healthcare spending among non-pregnant U.S. adults was contributed by current smokers in the population; 1.5% (95% CI=0.7%, 2.2%) was contributed by former smokers who quit within the last 5 years; and another 4.0% (95% CI=2.2%, 5.9%) was contributed by former smokers who quit >5 years ago. As a result, a total of 8.7% (95% CI=6.8%, 11.2%) of annual healthcare spending was attributed to smoking between 2006 and 2010. Appendix Tables 1–3 present the results from the sensitivity analyses, which were generally consistent with findings from the primary model, indicating that the estimated total smoking-attributable fraction was robust.

Table 3 combines the estimated smoking-attributable fractions from the MEPS with the aggregated personal healthcare spending from the 2010 NHEA to demonstrate annual smoking-attributable healthcare spending by payer.[20] An estimated 9.6% (95% CI=4.4%, 15.6%) of Medicare spending; 32.8% (95% CI=21.3%, 46.3%) of spending from other federal government–sponsored insurance programs (Tricare, Veterans Affairs health benefits, Indian Health Service, military treatment facilities, and other care provided by the federal government); and 15.2% (95% CI=6.2%, 27.4%) of Medicaid were attributable to cigarette smoking. In addition, 5.4% (95% CI=1.0%, 9.9%) of healthcare spending reimbursed by private insurance programs; 3.4% (95% CI=0.6%, 6.0%) of spending paid by patients themselves; and 11.8% (95% CI=0.0%, 23.9%) of payments made by other insurance programs (including other state and local sources, state and local health departments, state programs other than Medicaid, or other unclassified sources) were attributable to cigarette smoking.

The total estimated smoking-attributable healthcare spending of adults aged ≥18 years in 2010 was approximately $167.5 (95% CI=$166.4, $168.7) billion based on personal healthcare spending of those aged ≥19 years in the NHEA. Among them, Medicare spent $45.0 (95% CI=$39.0, $40.2) billion; other federal programs spent $23.8 (95% CI=$23.7, $24.0) billion; and Medicaid spent an additional $39.6 (95% CI=$39.0, $40.2) billion on smoking-related medical services. These estimates show

Table 1. Weighted descriptive statistics of study sample, adults 18 years or older, by smoking status, 2006–2010

Characteristics	Current smokers[a] n=9,886 (21.5%)	Former smokers who quit within the last 5 years 2,587 (6.0%)	Former smokers who quit >5 years ago 7,060 (16.6%)	Never smokers 27,021 (55.9%)
Age group (years)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
18–24	6.9 (6.1, 7.9)	4.6 (3.6, 5.9)	0.2 (0.1, 0.7)	7.8 (7.2, 8.5)
25–44	43.0 (41.3, 44.6)	49.5 (46.2, 52.8)	11.9 (10.7, 13.2)	39.8 (38.7, 41.0)
45–64	39.5 (37.8, 41.2)	31.0 (28.2, 34.0)	43.6 (41.6, 45.7)	32.9 (31.9, 33.8)
65–74	7.4 (6.7, 8.2)	9.3 (7.8, 11.2)	22.0 (20.5, 23.6)	8.8 (8.3, 9.4)
≥75	3.2 (2.6, 3.8)	5.5 (4.3, 7.0)	22.2 (20.5, 24.1)	10.7 (10.0, 11.4)
Gender				
Male	53.4 (51.7, 55.1)	50.8 (47.6, 54.0)	51.8 (49.9, 53.6)	40.7 (39.7, 41.7)
Female	46.6 (44.9, 48.3)	49.2 (46.0, 52.4)	48.2 (46.4, 50.1)	59.3 (58.3, 60.3)
Race/ethnicity				
White, non-Hispanic	76.8 (75.2, 78.4)	77.8 (75.1, 80.2)	83.4 (82.0, 84.8)	66.8 (65.3, 68.3)
Black, non-Hispanic	11.8 (10.6, 13.1)	8.1 (6.7, 9.7)	7.5 (6.7, 8.4)	13.4 (12.3, 14.6)
Hispanics	8.6 (7.6, 9.8)	11.2 (9.5, 13.2)	6.4 (5.5, 7.5)	13.8 (12.7, 15.0)
Others	2.7 (2.3, 3.3)	2.9 (2.2, 4.0)	2.7 (2.1, 3.4)	5.9 (5.3, 6.7)
Education				
Less than high school	18.9 (17.6, 20.2)	12.9 (11.1, 14.9)	12.9 (11.8, 14.0)	12.8 (12.1, 13.5)
High school	33.9 (32.4, 35.5)	25.5 (23.0, 28.1)	28.0 (26.4, 29.6)	23.5 (22.4, 24.6)
Some college	31.9 (30.2, 33.6)	34.3 (31.2, 37.6)	30.6 (29.0, 32.3)	28.1 (27.1, 29.1)
College graduate or higher	15.3 (14.0, 16.8)	27.3 (24.1, 30.8)	28.5 (26.7, 30.3)	35.7 (34.3, 37.1)
Marital Status				
Married or cohabitating	35.7 (34.1, 37.4)	44.5 (41.3, 47.7)	53.3 (51.2, 55.3)	48.6 (47.4, 49.9)
Never married, not cohabitating	30.3 (28.8, 31.9)	27.1 (24.3, 30.2)	8.4 (7.4, 9.5)	26.4 (25.3, 27.5)
Divorced/separated/widowed	33.9 (32.3, 35.6)	28.4 (25.7, 31.3)	38.3 (36.5, 40.2)	25.0 (24.1, 26.0)
Family income as % of poverty level				
Poor (<100%)	18.2 (17.1, 19.3)	12.3 (10.7, 14.0)	8.0 (7.3, 8.8)	10.9 (10.4, 11.5)
Near poor (100% to <125%)	6.0 (5.4, 6.6)	5.0 (4.1, 6.1)	4.3 (3.7, 4.9)	4.5 (4.2, 4.8)
Low income (125% to <200%)	15.4 (14.5, 16.4)	14.0 (12.5, 15.5)	12.9 (11.9, 14.0)	13.1 (12.6, 13.6)
Middle income (200% to <400%)	32.4 (31.2, 33.7)	32.8 (30.5, 35.1)	29.1 (27.7, 30.5)	29.5 (28.7, 30.4)
High income (≥400%)	28.0 (26.5, 29.5)	36.0 (33.0, 39.1)	45.7 (44.0, 47.5)	42.0 (40.8, 43.2)
Alcohol use[b]				
Non-drinkers	23.8 (22.2, 25.4)	23.6 (21.1, 26.2)	32.6 (30.7, 34.5)	41.0 (39.3, 42.6)
Non-excessive drinkers	34.3 (32.8, 35.8)	40.4 (37.3, 43.6)	47.1 (45.1, 49.1)	40.4 (39.0, 41.8)
				(continued on next page)

Table 1. Weighted descriptive statistics of study sample, adults 18 years or older, by smoking status, 2006–2010 (continued)

Characteristics	Current smokers[a] n=9,886 (21.5%)	Former smokers who quit within the last 5 years 2,587 (6.0%)	Former smokers who quit >5 years ago 7,060 (16.6%)	Never smokers 27,021 (55.9%)
Excessive drinkers	39.5 (37.9, 41.3)	33.9 (30.7, 37.2)	18.7 (17.1, 20.4)	17.0 (16.0, 18.0)
Unknown drinking status	2.4 (2.0, 2.9)	2.2 (1.4, 3.3)	1.7 (1.2, 2.4)	1.7 (1.4, 2.1)
Body weight[c]				
Underweight	2.1 (1.8, 2.6)	1.2 (0.8, 1.7)	1.1 (0.8, 1.6)	1.5 (1.3, 1.7)
Normal weight	35.9 (34.6, 37.3)	29.3 (26.7, 32.1)	27.3 (25.8, 28.8)	34.2 (33.3, 35.2)
Overweight	34.1 (32.8, 35.4)	36.6 (34.0, 39.3)	39.2 (37.4, 41.0)	34.9 (34.0, 35.9)
Obese	27.8 (26.4, 29.2)	32.9 (30.3, 35.6)	32.4 (30.7, 34.1)	29.4 (28.5, 30.3)
Health insurance				
Yes	79.3 (77.9, 80.6)	86.1 (83.9, 87.9)	94.0 (93.2, 94.7)	87.9 (87.1, 88.6)
No	20.7 (19.4, 22.1)	13.9 (12.1, 16.1)	6.0 (5.3, 6.8)	12.1 (11.4, 12.9)
Had an influenza vaccine				
Yes	20.5 (19.3, 21.8)	27.0 (24.2, 30.1)	48.9 (47.0, 50.9)	30.3 (29.2, 31.3)
No	79.5 (78.2, 80.7)	73.0 (69.9, 75.8)	51.1 (49.1, 53.0)	69.7 (68.7, 70.8)
Wears a seat belt				
Always/nearly always	87.2 (86.0, 88.3)	90.6 (88.6, 92.3)	94.7 (93.8, 95.5)	94.2 (93.6, 94.6)
Sometimes/never	12.8 (11.7, 14.0)	9.4 (7.7, 11.4)	5.3 (4.5, 6.2)	5.8 (5.4, 6.4)
More likely to take risks				
Agree somewhat/strongly	28.3 (26.9, 29.6)	24.8 (22.5, 27.3)	20.2 (19.0, 21.5)	20.9 (20.1, 21.6)
Uncertain–strongly disagree	71.7 (70.4, 73.1)	75.2 (72.7, 77.5)	79.8 (78.5, 81.0)	79.1 (78.4, 79.9)
Can overcome ills without medicine				
Agree somewhat/strongly	24.7 (23.5, 26.1)	25.9 (23.6, 28.5)	17.8 (16.6, 19.1)	23.0 (22.2, 23.9)
Uncertain–strongly disagree	75.3 (73.9, 76.5)	74.1 (71.5, 76.4)	82.2 (80.9, 83.4)	77.0 (76.1, 77.8)

[a]Current smokers are those who smoked 100 cigarettes in their lifetime and smoked cigarettes some days or every day at the time of the interview.
[b]Non-drinkers consumed no alcohol in the past year; non-excessive drinkers consumed an average of ≤14 drinks per week for men or ≤7 drinks per week for women and never had ≥5 in a single day during the past year; excessive drinkers consumed an average of >14 drinks per week for men or >7 drinks per week for women and/or had ≥5 drinks in a single day once or more during the past year.
[c]Underweight includes those whose BMI was <18.5; normal weight includes those whose BMI was ≥18.5 but <25; overweight includes those whose BMI was ≥25 but <30; obese includes those whose BMI was ≥30.

that >60% of annual healthcare spending associated with cigarette smoking was reimbursed by public funds.

Table 4 presents smoking-attributable annual healthcare fractions and associated spending by type of medical service. An estimated 11.1% (95% CI=4.9%, 17.7%) of inpatient healthcare spending; 10.4% (95% CI=6.3%, 13.6%) of prescription spending; and 5.3% (95% CI=2.1%, 9.0%) of medical spending on non-inpatient services (outpatient, physician and clinical services, and other professional services) were attributable to cigarette smoking. In total, smoking-attributable spending amounted to $169.3 (95% CI=$167.9, $170.7) billion based on personal healthcare spending in the NHEA.

Discussion

Using data from the 2006–2010 MEPS linked to the 2004–2009 NHIS, this analysis reveals that 50 years after

Table 2. Share of total annual health care spending attributable to cigarette smoking, by smoking status, 2006–2010

Smoking status	Percent attributable fraction (95% CI)[a]
Current smokers[b]	3.2 (2.2, 4.4)
Former smokers	
Who quit within the last 5 years	1.5 (0.7, 2.2)
Who quit >5 years ago	4.0 (2.2, 5.9)
Overall (current/former smokers)	8.7 (6.8, 11.2)

[a]Bootstrapped 95% CIs are shown in parentheses. The sum of individual categories may not equal the total because of rounding. For all data, health care spending associated with dental services was excluded.
[b]Current smokers are those who smoked 100 cigarettes in their lifetime and smoked cigarettes some days or every day at the time of the interview.

the first Surgeon General's report on smoking and health was released in 1964, cigarette smoking continues to be a major contributor to annual healthcare spending in the U.S. Across all payers, cigarette smoking was associated with 8.7% of annual aggregated healthcare spending. This finding is consistent with previous cross-sectional studies[21,22] that reported smoking-attributable fractions ranging from 6.5% to 14%. This conclusion also remains fairly stable across the sensitivity analyses. The present finding is also comparable to the results in the CBO's report, which concluded that 7% of total annual spending on health care in the U.S. between 2000 and 2008 was attributable to cigarette smoking.[7]

The updated total attributable fraction amounts to as much as $170 billion each year, based on the non-dental personal healthcare spending of adults aged ≥19 years in the NHEA. Among them, >60% of smoking-attributable healthcare spending was financed through public health insurance programs. Each year, cigarette smoking–related diseases accounted for 9.6% of Medicare expenditures ($45.0 billion); 15.2% of Medicaid expenditures ($39.6 billion); and 32.8% of expenditures from other federal government–sponsored insurance programs ($23.8 billion). Medicare and Medicaid together were responsible for approximately half of the attributable spending, $85 billion annually.

This analysis is subject to limitations. First, although a two-part model is commonly used to model health expenditures, the robustness of the estimates depends on the extent to which all of the factors of healthcare spending are considered. For example, in a recent analysis using a similar approach, the CBO concluded that differences in demographic characteristics accounted for 12% of the gap in annual expenditures between those who ever smoked and those who never smoked in the 45–64 years age group, 26% of the gap in the 65–74 years age group, and 26% of the gap in the ≥75 years age group.[7] However, in this study, an extensive set of factors was considered, including both respondents' sociodemographic characteristics and their attitudes and beliefs related to risky health behaviors. Additionally, sensitivity analyses were conducted to test the robustness of the estimates. The consistency across these analyses supports the specifications used in this analysis.

Second, this analysis may be subject to recall bias arising from self-reported healthcare use. Studies have shown that MEPS respondents are likely to under-report office and emergency room visits but are unlikely to under-report inpatient care.[23] However, as under-reporting

Table 3. Smoking-attributable fractions and annual health care spending attributable to cigarette smoking, by payer, 2006–2010

Payer	Percent attributable fraction (95% CI)[a]	2010 NHEA ($[b] billions, 95% CI)
Medicare	9.6 (4.4, 15.6)	45.0 (39.0, 40.2)
Medicaid[c]	15.2 (6.2, 27.4)	39.6 (39.0, 40.2)
Other federal[d]	32.8 (21.3, 46.3)	23.8 (23.7, 24.0)
Private insurance	5.4 (1.0, 9.9)	33.6 (33.1, 34.2)
Out-of-pocket	3.4 (0.6, 6.0)	7.9 (7.7, 8.1)
Others[e]	11.8 (0.0, 23.9)	17.5 (17.2, 17.8)
Total	—	167.5 (166.4, 168.7)

[a]The sum of individual categories may not equal the total because of rounding. Bootstrapped 95% CIs are shown in parentheses.
[b]Dollar values were adjusted to 2010 using the Consumer Price Index for All Urban Consumers: Medical Care provided by the U.S. Bureau of Labor Statistics.
[c]Medicaid payments reported for persons who were not listed as enrolled in the Medicaid program at any time during the year.
[d]Other federal includes Tricare, VA health benefits, Indian Health Service, military treatment facilities, and other care provided by the federal government.
[e]Others include other state and local sources (community and neighborhood clinics, state and local health departments, and state programs other than Medicaid); other unclassified sources (automobile, homeowner's, liability, and other miscellaneous or unknown sources); and other public resources.
NHEA, National Health Expenditure Accounts.

Table 4. Annual health care spending attributable to cigarette smoking, by type of service, 2006–2010

Type of service	Percent Attributable Fraction (95% CI)[a]	2010 NHEA ($[b] billions, 95% CI)
Inpatient	11.1 (4.9, 17.7)	110.1 (108.9, 111.4)
Non-inpatient[c]	5.3 (2.1, 9.0)	28.2 (27.8, 28.6)
Prescription drug	10.4 (6.3, 13.6)	31.0 (30.8, 31.2)
Total		169.3 (167.9, 170.7)

[a]The sum of individual categories may not equal the total because of rounding. Bootstrapped 95% CIs are shown in parentheses.
[b]Dollar values were adjusted to 2010 using the Consumer Price Index for All Urban Consumers: Medical Care provided by the U.S. Bureau of Labor Statistics.
[c]Non-inpatient includes outpatient services, physician and clinical services, and other professional services.
NHEA, National Health Expenditure Accounts.

was relatively small in magnitude across different sociodemographic groups in the population, such as income, education, health status, and race/ethnicity,[24] it is less likely to be correlated with smoking status and thus less likely to affect the estimated smoking-attributable fractions.

Third, the analysis applied the smoking-attributable fractions estimates from MEPS to the annual personal healthcare spending from NHEA, based on the assumption that smoking-attributable fractions were comparable between the institutionalized and non-institutionalized populations. If smoking prevalence was higher among the institutionalized population,[25] the estimated smoking-attributable fraction and healthcare spending could be underestimated. Finally, although the analysis provides reasonable estimates for all-cause smoking-attributable fractions by payer and type of service, it does not provide attributable fractions by smoking-related disease, estimates for tobacco products other than cigarettes, or benefits of quitting because of emerging value-based insurance products. Thus, the presented figures underestimate the full burden of all forms of tobacco use in the U.S. Future economic cost analyses focusing on all tobacco products or on specific smoking-related diseases would be beneficial.

Although these estimates of smoking-attributable healthcare fractions are subject to limitations, the contribution of cigarette smoking to rising healthcare spending is not subject to debate. These estimates of smoking-attributable healthcare spending are likely to be conservative, as spending related to secondhand smoke, infant and maternal health, or dental services was not considered in this analysis.[26–28] For example, the annual infant's smoking-attributable costs were estimated around $122 million in 2004 dollars, and the annual productivity loss due to exposure to secondhand smoke was estimated around $5.6 billion in 2006 dollars.[28,29] Although the smoking-attributable dental expenditures

are not available, studies have shown that smoking may be responsible for more than half of periodontitis cases among U.S. adults.[30]

Evidence-based tobacco prevention and control interventions or emerging "end game" strategies—including increases in tobacco product prices, comprehensive smoke-free laws, mass media anti-tobacco campaigns, state comprehensive tobacco control programs, a new generation of warning labels, or gradual reduction of cigarette nicotine content to non-addicting levels—are still needed to continue progress toward ending the tobacco epidemic in the U.S. These population-based interventions and strategies can reduce cigarette consumption, prevent smoking initiation, and increase rates of successful quitting.[4,31–38] For example, recent studies have shown that the "Tips from Former Smokers" campaign, the first federally funded national mass media anti-smoking campaign, was effective in increasing population-level quit attempts.[31] The latest federal tobacco excise tax increase was also successful in preventing smoking initiation and smokeless tobacco use among youth.[32] Comprehensive statewide tobacco control programs can significantly accelerate declines in consumption and smoking prevalence as well.[33] Continuing efforts are needed to increase the use of these evidence-based public health interventions, reduce the need for health care aimed at smoking-related diseases, and thereby, shrink smoking-attributable healthcare spending.

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Appendix

Supplementary data

Supplementary data associated with this article can be found at http://dx.doi.org/10.1016/j.amepre.2014.10.012.