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State Estimates of Total Medical Expenditures Attributable to Cigarette Smoking, 1993

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SYNOPSIS

Objective. To estimate state-by-state totals of medical expenditures attributable to cigarette smoking for calendar year 1993.

Methods. The smoking-attributable fractions (SAFs) of total state medical expenditures, by type of expenditure, were estimated using a national model that describes the relationship between smoking and medical expenditures, controlling for a variety of sociodemographic, economic, and behavioral factors. Employing data from the Behavioral Risk Factor Surveillance System, the authors used the national model to estimate SAFs for the 50 states and the District of Columbia, then applied these SAFs to published state medical expenditures, by type of expenditures, to estimate total 1993 state medical expenditures attributable to smoking. National estimates are the sums of state estimates.

Results. In 1993, the estimated proportion of total medical expenditures attributable to smoking for the U.S. as a whole was 11.8%, with a range across states from 6.6% to 14.1%. By type of expenditure, SAFs ranged from a low of 8.0% for home health expenditures to a high of 15.9% for nursing home expenditures for the nation as a whole. Total U.S. medical expenditures attributable to smoking amounted to an estimated $72.7 billion in 1993 (95% interval estimate $48.0–$97.4 billion). Estimates of total smoking-attributable state medical expenditures (SAEs) ranged from $79.6 million to $8.72 billion.

Conclusions. Cigarette smoking accounted for a substantial portion of state and national medical expenditures in 1993, with considerable variation among states. The range across states was due to differences in smoking prevalence, health status, other socioeconomic variables used in the model, and the magnitude and patterns of state medical expenditures.

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Cigarette smoking is a major cause of illness, disability, and premature death in the United States.[1] According to the Centers for Disease Control and Prevention (CDC), in 1996 the median prevalence of current smokers among adults in the 49 states not including Hawaii was 23.6%, with a range from 15.9% in Utah to 31.6% in Kentucky.[2] One way to assess the effect of smoking is to translate the associated medical care burden into economic terms. Estimating smoking-attributable expenditures (SAEs) on a state-by-state basis translates the adverse health effects into dollar terms, the universal language of decision makers. Such estimates can be used by states in many ways: to define the impact of cigarette smoking on the delivery and financing of medical care services, to justify economic interventions such as increases in cigarette taxes, to guide health policy and planning relative to smoking control initiatives, and to provide an economic framework for program evaluation.[3]

CDC has published estimates of total medical care costs in 1990 attributable to smoking by state.[4] The present report updates SAE estimates by state to 1993, reporting them by type of medical expenditures.

METHODS

In a previous issue of this journal,[5] we reported estimates of state Medicaid expenditures attributable to cigarette smoking for fiscal year 1993, which were based on a national model that: (a) relates smoking to health and health to medical expenditures, controlling for a variety of sociodemographic, economic, and behavioral factors (causative relationship); and (b) relates smoking to medical expenditures, controlling for health (associative relationship). A general description of the model was also reported in that article. We used data from the National Medical Expenditure Survey (NMES)[6] to develop the quantitative relationships for the national model. To estimate state Medicaid expenditures attributable to cigarette smoking, we used the national model with data on poor and low-income respondents in each state, drawn from each state's 1993 Behavioral Risk Factor Surveillance System (BRFSS).[7]

Estimating SAEs. In the present article, we report estimates for calendar year 1993 of total state medical expenditures attributable to smoking, by type of expenditure: ambulatory care, prescription drugs, hospital care, home health services, and nursing home care. For this study, we employed the same equations for the national model as in the previous study,[5] but in the present study we defined two smoking history categories: (a) current smokers and (b) a combined category of former smokers and respondents with missing smoking information. The means and variances of the expenditure equations in the present model are functions of these smoking history categories. (A detailed description of the present model, including regression equations, is available from the authors).

We based estimates of total medical expenditures attributable to cigarette smoking, by type of expenditure, on each state's full 1993 BRFSS sample. The national model required estimates of three measures absent from the BRFSS state datasets: respondent's income level (poor, low-income, middle-income, or high-income), likelihood of having private insurance, and likelihood of being Medicaid funded. We based expected values for these variables on probit and ordered probability models[8] estimated with state data from the 1993 Current Population Survey (CPS).[9]

As in the previous study, we assumed that BRFSS had no sample selection problems. Technically this means that the coefficients on the inverse Mills ratio variables in each equation were set to zero.

We obtained 1993 state medical expenditures from published Health Care Financing Administration (HCFA) data,[10] which we adjusted to exclude amounts spent for people younger than age 19. We calculated the U.S. total by adding the state totals. Based on 1987 NMES data, medical expenditures for adults (people ages 19 years and older) represent the following proportions of total U.S. medical expenditures: ambulatory care—85%, prescription drugs—90.4%, hospital care—86.5%, and home health services—94%. We estimated the proportion of nursing home expenditures for people ages 19 and older as 98% of total nursing home expenditures.[11] We applied these proportions to state expenditures to yield the state totals of medical expenditures shown in Table 1.

Estimating SAFs. To estimate SAFs, we used the national model to estimate the expected expenditures for medical care of smokers and the expected expenditures for medical care of a hypothetical group of people—smokers considered as never smokers. The difference in expected expenditures between the two groups is allocatable to smoking. The ratio of the expenditures allocatable to smoking to total expenditures is the fraction of expenditures attributable to smoking, the SAF.

As described in our previous report, SAFs of state Medicaid expenditures are a function of (conditioned by)

prior treatment for specific tobacco-related diseases and poor health status, both self-reported.[5] Prior treatment and health status are known for smokers. However, since one can't know the treatment status or self-reported health status of smokers considered as never smokers, the estimate for this group must be made without using reported data. When expenditures of smokers are conditioned by self-reported health status and expenditures of smokers considered as never smokers are not conditioned by self-reported health-status, we call the SAFs conditional estimates. When the expenditures for neither smokers nor smokers considered as never smokers are conditioned by self-reported health status, we call the SAFs unconditional estimates.

Feasible state estimates of SAEs are based on unconditional estimates. The range in these unconditional expenditure estimates is narrower than the range in the conditional expenditure estimates. The difference between expenditures for smokers and for smokers considered as never smokers is less when based on unconditional expenditures than when based on conditional expenditures. Hence the unconditional SAFs

undercount the actual SAEs. To correct this error of underestimation, we applied the ratios of the estimated conditional SAFs to the estimated unconditional SAFs—by age, gender, and type of expenditure—to estimated state SAFs. These adjustment ratios are reported in Table 2.

Based on BRFSS data, we made feasible estimates of state SAFs by age, gender, and type of medical expenditure. Only total expenditures, by type, are available for states from the Health Care Financing Administration (HCFA). We estimated the proportions for each age/gender group with proportions derived from the NMES data. Finally, we multiplied each age, gender, and type of medical expenditure SAF by total state expenditures—by age, gender, and type—to estimate the state SAEs. We used the weighted average of SAFs for hospital expenditures to represent the SAFs for nursing home expenditures for people ages 65 and older. This reflects the fact that a large proportion of elderly nursing home residents (39% in 1985[12]) are admitted to nursing homes from short-stay hospitals and that many of these people suffer from smoking-related diseases.

Table 1. Medical expenditures for people ages 19 and older, by state and type of expenditure, calendar year 1993 (in millions)

State	Ambulatory care	Prescription drugs	Hospital care	Home health services	Nursing home	All types
United States.	$200,710	$67,778	$268,682	$21,616	$55,772	$614,559
Alabama	2,926	1,128	4,399	566	611	9,630
Alaska.	388	149	584	5	45	1,170
Arizona.	3,285	1,016	3,313	298	556	8,468
Arkansas.	1,393	618	2,286	136	459	4,893
California	31,899	8,153	29,292	1,542	3,672	74,558
Colorado	2,928	831	3,244	183	598	7,784
Connecticut	3,029	901	3,564	368	1,536	9,397
Delaware	561	194	774	48	187	1,763
District of Columbia	831	158	2,069	42	164	3,264
Florida	12,700	4,024	14,309	2,185	2,839	36,057
Georgia.	5,208	1,914	7,197	686	903	15,908
Hawaii	902	376	1,245	30	171	2,725
Idaho	552	240	751	46	155	1,745
Illinois.	8,228	2,950	13,042	802	2,564	27,587
Indiana	3,864	1,441	5,808	290	1,700	13,103
Iowa	1,669	672	2,611	129	751	5,832
Kansas	1,709	628	2,343	143	602	5,426
Kentucky	2,450	1,081	3,773	336	765	8,405
Louisiana.	2,931	1,147	4,905	386	845	10,213

(Table continues on next page)

Table I. (continued)

State	Ambulatory care	Prescription drugs	Hospital care	Home health services	Nursing home	All types
Maine	732	301	1,121	98	385	2,637
Maryland.	4,199	1,581	4,836	295	1,102	12,014
Massachusetts.	5,323	1,773	8,307	785	2,373	18,562
Michigan	6,713	2,656	9,695	672	1,666	21,401
Minnesota.	4,121	1,036	3,950	389	1,563	11,061
Mississippi.	1,242	651	2,370	282	373	4,919
Missouri	3,599	1,284	6,399	326	1,229	12,837
Montana	507	189	767	47	164	1,675
Nebraska	965	381	1,675	70	439	3,528
Nevada.	1,206	369	1,133	113	134	2,955
New Hampshire	932	288	1,133	67	257	2,678
New Jersey.	6,918	2,217	8,503	675	1,805	20,118
New Mexico.	887	370	1,479	58	169	2,963
New York	14,352	4,594	23,017	3,350	6,913	52,227
North Carolina.	4,343	1,833	6,327	509	1,221	14,233
North Dakota.	483	145	760	15	205	1,607
Ohio.	8,212	2,910	12,026	610	3,242	27,000
Oklahoma.	1,934	790	2,759	257	604	6,344
Oregon.	2,156	689	2,451	115	564	5,975
Pennsylvania	9,462	3,182	16,054	749	3,580	33,026
Rhode Island.	723	280	1,078	97	372	2,550
South Carolina	1,940	884	3,508	203	463	6,999
South Dakota	418	147	790	15	183	1,553
Tennessee.	3,868	1,478	6,063	846	949	13,204
Texas	12,807	4,640	18,015	1,489	2,544	39,495
Utah	1,025	397	1,438	94	210	3,164
Vermont.	351	146	458	49	134	1,137
Virginia	4,298	1,822	5,793	346	811	13,070
Washington	4,324	1,333	4,445	357	1,063	11,522
West Virginia	1,185	519	1,992	141	343	4,180
Wisconsin.	3,822	1,166	4,512	249	1,513	11,264
Wyoming	209	102	321	27	75	735

NOTE: Expenditures were reduced by amounts spent for psychiatric hospital care and mental retardation nursing homes, and were categorized as follows:

This study:		HCFA categories:
Ambulatory care	=	Physician services, other professional services, visual and other medical durable expenditures (Reference 10)
Prescription drugs	=	Drug and other medical non-durable expenditures (Reference 10)
Hospital care	=	Hospital care (Reference 10) minus psychiatric hospital care (Reference 16)
Home health services	=	Home health care (Reference 10)
Nursing homes	=	Nursing homes (Reference 10) minus mental retardation nursing homes (Personal communication, W. Wesley Grover III, Tucker Alan, Inc., Chicago, 1998)

SOURCE OF DATA: Reference 10

"Estimating smoking-attributable expenditures (SAEs) on a state-by-state basis translates the adverse health effects into dollar terms, the universal language of decision makers."

There were no 1993 BRFSS data for Wyoming; each SAF for Wyoming represents the means of the corresponding SAFs of its contiguous states: Colorado, Idaho, Montana, Nebraska, South Dakota, and Utah.

RESULTS

Estimated SAFs. Table 3 presents estimated SAFs of total state medical expenditures by type of medical expenditures for calendar year 1993. SAFs varied across states as a function of sociodemographic characteristics, smoking prevalence and history, expected self-reported health status, and the smoking-related diseases that are included in the model.

Nationally, the SAF for all states and Washington DC was 11.8%. Utah had the lowest total SAF (6.6%) and Nevada the highest (14.1%). By type of expenditure, the lowest SAF (8.0%) was for home health care, while the highest was for nursing home care (15.9%). For each type

of expenditure there was considerable variation among the states. For ambulatory care, the highest ranking state, Rhode Island at 10.7%, had an SAF almost twice that of the lowest, Utah at 5.5%. The state SAFs for prescription drugs ranged from 6.6% in Utah to 14.3% in Nevada. For hospital care, SAFs ranged from 7.3% in Utah to 17.6% in Nevada. The state SAFs for home health services were generally lower than for other expenditure categories, ranging from 4.2% in Utah to 9.9% in Massachusetts. SAFs for nursing home care ranged from 8.0% in Utah to 22.4% in Nevada.

Estimated SAEs. Table 4 presents the estimated national and state total SAEs by type of expenditure for calendar year 1993. We estimated the overall SAE for the U.S. adult population in 1993 to be $72.7 billion, 11.8% of total medical expenditures. Of this total, $18.5 billion was for ambulatory care, $7.7 billion for prescription drugs, $35.9 billion for hospital care, $1.7 billion for

Table 2. Adjustment ratios used to estimate state SAFs due to missing BRFSS information: ratios of conditional to unconditional national SAFs

Category	Ambulatory care	Prescription drugs	Hospital care	Home health services
Males 19–34 (years).....	1.1728	1.4591	1.3442	1.0000
Males 35–64...........	2.5792	2.3434	3.1848	1.1955
Males ≥ 65...........	1.5016	1.9105	1.8090	1.7646
Females 19–34........	1.1203	1.2466	1.0000	1.0735
Females 35–64........	1.3796	2.5831	2.4588	1.1956
Females ≥ 65.........	1.5589	2.5938	.5838	1.1573

NOTE: Conditional SAFs are based on self-reported poor health status; unconditional SAFs are based on unknown health status.

SAF = smoking-attributable fraction

BRFSS = Behavioral Risk Factor Surveillance System

Table 3. Smoking-attributable fractions (SAFs) of medical expenditures by state and type of expenditure, 1993

State	Ambulatory care	Prescription drugs	Hospital care	Home health services	Nursing home	All types
United States.........	**9.23**	**11.33**	**13.37**	**8.02**	**15.91**	**11.84**
Alabama	6.37	8.30	9.76	5.52	10.23	8.33
Alaska................	10.37	12.24	14.87	8.22	18.25	13.15
Arizona...............	7.69	10.35	12.43	6.61	15.70	10.36
Arkansas..............	9.61	11.40	13.80	8.02	15.97	12.35
California	9.29	11.48	13.83	8.06	17.47	11.69
Colorado	9.23	11.82	14.01	7.47	17.14	12.06
Connecticut	8.96	14.00	14.35	8.92	16.82	12.78
Delaware	9.57	11.53	14.34	8.36	17.93	12.73
District of Columbia.....	7.48	9.15	10.43	7.31	12.28	9.67
Florida	10.16	12.30	14.89	9.09	18.04	12.84
Georgia...............	8.38	10.53	12.52	6.73	13.39	10.73
Hawaii	9.12	12.07	13.65	7.69	16.45	12.04
Idaho	8.30	10.01	11.55	6.24	12.71	10.27
Illinois................	8.04	9.98	12.27	6.64	14.00	10.76
Indiana	9.43	11.39	13.23	7.26	14.23	11.92
Iowa.................	8.55	10.37	11.57	6.43	12.56	10.58
Kansas	8.81	11.07	13.19	7.70	15.62	11.69
Kentucky	9.12	11.69	14.01	7.39	15.69	12.17
Louisiana..............	8.07	10.55	12.92	7.24	15.08	11.22
Maine	9.85	12.52	13.94	9.26	16.31	12.82
Maryland..............	8.64	11.84	13.12	7.86	15.52	11.48
Massachusetts..........	10.53	12.32	14.15	9.87	17.93	13.24
Michigan..............	9.48	11.49	13.71	7.88	15.39	12.06
Minnesota.............	9.38	10.48	11.90	7.53	14.05	10.98
Mississippi.............	8.63	10.50	12.68	6.85	14.30	11.16
Missouri	9.28	10.90	12.97	7.05	14.26	11.70
Montana..............	9.42	11.79	13.49	7.89	17.08	12.26
Nebraska	8.99	10.33	12.16	7.08	14.10	11.23
Nevada...............	10.39	14.30	17.56	9.51	22.44	14.14
New Hampshire........	10.41	12.37	14.13	9.64	18.92	12.99
New Jersey............	9.35	12.22	14.85	9.67	18.66	12.84
New Mexico...........	8.73	12.27	14.22	7.64	16.27	12.32
New York	10.35	12.15	13.75	9.07	16.43	12.73
North Carolina.........	9.18	10.90	13.45	7.45	14.88	11.72
North Dakota..........	8.79	10.40	12.30	7.13	13.69	11.21
Ohio.................	9.64	11.63	13.71	8.04	16.71	12.48
Oklahoma.............	9.18	10.97	12.40	6.30	11.77	10.93
Oregon...............	9.47	11.65	13.70	7.78	17.25	12.16
Pennsylvania...........	9.66	11.55	13.05	8.40	15.89	12.14
Rhode Island...........	10.71	12.68	14.74	9.52	18.07	13.67
South Carolina	8.85	10.56	12.24	6.84	12.98	10.98
South Dakota..........	8.89	10.56	12.04	7.12	13.63	11.19
Tennessee.............	7.95	10.30	12.28	6.49	13.71	10.52
Texas	9.02	11.35	14.36	7.92	17.11	12.22
Utah.................	5.54	6.62	7.34	4.23	7.95	6.61
Vermont..............	9.41	12.32	14.26	9.34	18.56	12.80
Virginia...............	8.69	9.95	11.38	6.76	12.82	10.27
Washington	9.09	11.39	13.19	7.36	16.51	11.57
West Virginia	8.95	11.15	13.24	7.44	16.02	11.79
Wisconsin.............	9.89	11.58	13.23	8.05	16.25	12.22
Wyoming[a]............	8.49	10.42	12.07	6.73	14.20	10.84

NOTE: SAFs are expressed as percentages of total medical expenditures, reduced by amounts spent for people younger than 19 years, psychiatric hospital care, and mental retardation nursing homes. SAFs for the United States are means of state and Washington DC SAFs.

[a]No BRFSS dataset was available for Wyoming. The Wyoming SAFs were computed as the mean of the SAFs of its contiguous states: Montana, Idaho, Utah, Colorado, South Dakota, and Nebraska.

Table 4. Smoking-attributable medical expenditures (SAEs) by state and type of expenditure, calendar year 1993 (in millions)

State	Ambulatory care	Prescription drugs	Hospital care	Home health services	Nursing home	All types
United States........	$18,529.80	$7,677.92	$35,914.36	$1,733.88	$8,876.53	$72,732.49
Alabama	186.38	93.59	429.31	31.25	62.56	803.09
Alaska...............	40.20	18.26	86.87	0.39	8.16	153.88
Arizona..............	252.58	105.19	411.83	19.71	87.24	876.55
Arkansas.............	133.90	70.51	315.42	10.94	73.32	604.08
California	2,963.42	936.01	4,051.04	124.32	641.46	8,716.25
Colorado	270.22	98.22	454.49	13.70	102.51	939.15
Connecticut	271.42	126.09	511.45	32.80	258.30	1200.06
Delaware	53.68	22.31	110.92	4.01	33.46	224.39
District of Columbia.....	62.14	14.48	215.76	3.09	20.10	315.57
Florida	1,290.32	494.93	2,130.67	198.60	512.14	4,626.65
Georgia..............	436.44	201.57	901.00	46.14	120.96	1706.11
Hawaii	82.30	45.40	169.92	2.31	28.19	328.12
Idaho	45.85	23.99	86.75	2.88	19.74	179.20
Illinois..............	661.52	294.46	1,600.24	53.27	358.96	2,968.46
Indiana	364.40	164.17	768.33	21.03	241.91	1,559.84
Iowa................	142.71	69.67	302.09	8.28	94.29	617.05
Kansas	150.59	69.57	309.01	11.01	94.04	634.22
Kentucky	223.47	126.42	528.61	24.81	119.95	1,023.27
Louisiana.............	236.53	121.06	633.67	27.92	127.39	1,146.57
Maine	72.07	37.70	156.30	9.06	62.85	337.98
Maryland.............	362.79	187.25	634.49	23.21	170.99	1,378.73
Massachusetts..........	560.55	218.46	1,175.49	77.51	425.48	2,457.48
Michigan	636.42	305.14	1,329.15	52.92	256.37	2,580.00
Minnesota.............	386.57	108.60	470.11	29.32	219.66	1,214.26
Mississippi............	107.21	68.36	300.48	19.33	53.39	548.77
Missouri	333.96	139.96	829.93	23.01	175.27	1,502.13
Montana	47.77	22.28	103.53	3.71	28.06	205.35
Nebraska	86.73	39.32	203.63	4.93	61.87	396.49
Nevada..............	125.26	52.76	199.01	10.73	30.17	417.93
New Hampshire........	97.06	35.68	160.14	6.44	48.70	348.01
New Jersey............	646.85	270.94	1,262.67	65.30	336.81	2,582.57
New Mexico...........	77.44	45.38	210.31	4.45	27.45	365.04
New York	1,485.44	558.22	3,164.86	303.85	1,135.82	6,648.19
North Carolina.........	398.71	199.78	851.02	37.91	181.61	1,669.03
North Dakota..........	42.48	15.05	93.44	1.07	28.03	180.07
Ohio.................	791.61	338.41	1,648.74	49.07	541.78	3,369.62
Oklahoma.............	177.52	86.70	342.13	16.18	71.04	693.57
Oregon..............	204.15	80.27	335.74	8.93	97.37	726.46
Pennsylvania	913.99	367.52	2,095.08	62.89	568.84	4,008.31
Rhode Island..........	77.45	35.54	158.86	9.22	67.26	348.34
South Carolina	171.67	93.39	429.39	13.90	60.13	768.47
South Dakota	37.12	15.56	95.17	1.07	24.90	173.82
Tennessee.............	307.55	152.28	744.51	54.87	130.04	1,389.25
Texas	1,155.17	526.59	2,587.02	117.91	435.28	4,821.98
Utah................	56.81	26.28	105.52	3.98	16.73	209.31
Vermont..............	33.02	17.94	65.26	4.57	24.88	145.67
Virginia	373.49	181.29	659.24	23.40	104.00	1,341.42
Washington	393.01	151.81	586.31	26.30	175.47	1,332.91
West Virginia	106.06	57.87	263.73	10.50	55.01	493.17
Wisconsin.............	378.03	135.08	596.97	20.06	245.91	1,376.05
Wyoming[a]............	17.76	10.65	38.71	1.84	10.68	79.64

NOTE: SAEs exclude amounts spent for people younger than 19 years, psychiatric hospital care, and mental retardation nursing homes.

[a]No BRFSS dataset was available for Wyoming. The Wyoming SAFs were computed as the mean of the SAFs of its contiguous states: Montana, Idaho, Utah, Colorado, South Dakota, and Nebraska

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home health care, and $8.9 billion for nursing home care.

Differences in SAEs across states reflected differences in population size, SAFs, and amounts spent by type of medical expenditure. California had the highest estimated overall SAE, $8.7 billion, followed by New York with $6.6 billion. Wyoming had the lowest estimated overall SAE, $80 million.

Interval estimates. Employing the NMES sampling design, we used a "jackknife" estimation of the national model to estimate the standard error of the SAFs (see the Appendix of our previous article for a description of the jackknife estimation method[5]). Table 5 presents the results of this jackknife estimation. The relative error for the ambulatory care SAF (the ratio of the standard error to the mean ambulatory SAF) was 15.7% with interval

estimates ranging from 6.8% to 12.9%. The relative error for prescription drugs was 9.6%, with interval estimates ranging from 10.8% to 15.8%. For the hospital care SAF, the relative error was 25.7%, with interval estimates ranging from 6.8% to 20.8%. For home health services, the relative error of the SAF was 25.4%, which yielded a lower 95% bound of 3.8% and an upper 95% bound of 11.3%. The relative error of the SAF for nursing home care was 22.3%, with a lower 95% bound of 8.4% and an upper 95% bound of 21.6%.

We applied these national interval estimates to each state by type of medical expenditure to derive interval estimates of state SAEs by type of expenditure; we then aggregated these into a total estimated SAE for each state. Table 6 presents the confidence intervals for these estimated state totals. Due to the procedures we

Table 5. Relative errors used to calculate the confidence intervals for estimates of state medical expenditures attributable to smoking (SAEs), by type of medical expenditure, calendar year 1993

Variable	Ambulatory care	Prescription drugs	Hospital care	Home health services	Nursing home[a]	All types
SAF (percent)	9.87	13.30	13.80	7.57	15.01	12.19
Standard error (percent)	1.55	1.28	3.55	1.92	3.35	2.11
Relative error	0.157	0.0958	0.257	0.254	0.223	0.173
t-value	6.374	10.433	3.885	3.944	4.476	5.772
Lower 95% bound (percent)	6.84	10.81	6.84	3.81	8.44	8.05
Upper 95% bound (percent)	12.91	15.80	20.76	11.34	21.58	16.32

NOTE: Relative errors are estimated confidence intervals of SAFs based on 1987 NEMS data.
[a]Nursing homes SAFs are the SAFs for hospital care of people ages 65 and older.
SAF = smoking-attributable fraction

Table 6. Confidence intervals for estimates of total state medical expenditures (SAEs) attributable to smoking, calendar year 1993 (in millions)

State	Total SAE	Lower 95%	Upper 95%
United States	**$72,732.49**	**$48,023.34**	**$97,441.64**
Alabama	803.09	530.30	1,075.87
Alaska	153.88	101.61	206.15
Arizona	876.55	578.81	1,174.28
Arkansas	604.08	398.89	809.27
California	8,716.25	5,755.62	11,676.88
Colorado	939.15	620.15	1,258.15
Connecticut	1,200.06	792.44	1,607.68
Delaware	224.39	148.17	300.61
District of Columbia	315.57	208.38	422.76
Florida	4,626.65	3,055.13	6,198.18
Georgia	1,706.11	1,126.60	2,285.62
Hawaii	328.12	216.67	439.57
Idaho	179.20	118.33	240.07
Illinois	2,968.46	1,960.17	3,976.75
Indiana	1,559.84	1,025.76	2,093.92
Iowa	617.05	407.46	826.64
Kansas	634.22	418.79	849.64
Kentucky	1,023.27	675.70	1,370.84
Louisiana	1,146.57	757.12	1,536.02
Maine	337.98	223.18	452.77
Maryland	1,378.73	910.42	1,847.04
Massachusetts	2,457.48	1,622.75	3,292.21
Michigan	2,580.00	1,703.65	3,456.34
Minnesota	1,214.26	801.81	1,626.70
Mississippi	548.77	362.37	735.16
Missouri	1,502.13	991.90	2,012.35
Montana	205.35	135.60	275.10
Nebraska	396.49	261.81	531.16
Nevada	417.93	275.97	559.89
New Hampshire	348.01	229.80	466.22
New Jersey	2,582.57	1,705.35	3,459.78
New Mexico	365.04	241.05	489.03
New York	6,648.19	4,390.01	8,906.36
North Carolina	1,669.03	1,102.11	2,235.94
North Dakota	180.07	118.90	241.23
Ohio	3,369.62	2,225.07	4,514.17
Oklahoma	693.57	457.99	929.15
Oregon	726.46	479.70	973.21
Pennsylvania	4,008.31	2,646.82	5,369.80
Rhode Island	348.34	230.02	466.66
South Carolina	768.47	507.45	1,029.50
South Dakota	173.82	114.78	232.86
Tennessee	1,389.25	917.37	1,861.13
Texas	4,821.98	3,184.11	6,459.85
Utah	209.31	138.21	280.41
Vermont	145.67	96.19	195.14
Virginia	1,341.42	885.78	1,797.05
Washington	1,332.91	880.16	1,785.65
West Virginia	493.17	325.66	660.69
Wisconsin	1,376.05	908.65	1,843.45
Wyoming	79.64	52.59	106.69

NOTE: SAEs exclude amounts spent for people younger than 19 years, psychiatric hospital care, and mental retardation nursing homes.

"California had the highest estimated overall SAE, $8.7 billion, followed by New York with $6.6 billion. Wyoming had the lowest estimated overall SAE, $80 million."

employed, we believe these interval estimates are likely to be too low. In the estimation of the national model, if a smoking history variable showed a statistically significant difference from zero (*alpha* less than or equal to 0.05), we assumed that the smoking category was statistically significant in every one of the 202 jackknife estimates. If the smoking category was not significant in the estimation of the national model, then in every one of the 202 jackknife estimations we substituted mean values for the smoking category and evaluated the model as if the smoking category had not shown significance. This procedure limits the variation in the smoking-attributable estimates in Tables 5 and 6. Accordingly, these estimates are conservative; more research is needed on this issue.

DISCUSSION

The $72.7 billion figure for U.S. total SAEs for 1993 reported here is 45% more than the $50 billion reported for the same year by three of the present authors and another researcher in a study published in the *Morbidity and Mortality Weekly Report* (*MMWR*).[13] This disparity is due to several important technical differences, as follows: (a) the *MMWR* model used five different tobacco-related disease equations; the national model used in the present study has one tobacco-related disease equation. *MMWR*'s multiple equations each estimate the probability of having been diagnosed with a different tobacco-related disease; the single equation reflects any of five tobacco related diseases. The *MMWR* study employed five expected linear disease probability models; the present study uses one probit probability model, an approach preferred by researchers. (b) For the present study, we estimated the constants and interval boundary values for self-reported poor health status using LIMDEP[8] to correct errors in the SAS procedure. (c) The *MMWR* expenditure equations

were specified as a function of a latent (unobserved) index[14] of self-reported poor health. In the model used in the present study, expenditures are also a function of this latent index, but the latent index is now conditioned by reported poor health status. The relationship between poor health and expenditures is stronger and more consistent with this specification, but it requires the application of an adjustment, as noted above. (d) In the *MMWR* model, the variances were assumed to be the same across smoking status categories. In the present study, we assumed the variances differ by smoking status (with the exception of the likelihood of previous tobacco-related diseases and the likelihood of expenditures by type). Several reviewers of the *MMWR* model suggested that this specification might improve the model. (e) The smearing coefficients[15] in the *MMWR* model did not differentiate among respondents with different smoking histories; the smearing coefficients in the model used in the present study do make this differentiation. Again, several reviewers of the *MMWR* model suggested that making this distinction would be an improvement in the model histories.

Table 7 compares the estimated 1993 state total SAEs with the estimated 1993 state Medicaid SAEs that we published in the March/April issue of *Public Health Reports*.[5] In that earlier study, we reported that for the United States as a whole, Medicaid SAEs comprised 17.7% of total SAEs in 1993, with a range across the states from 10.2% in Delaware to 36.8% in Louisiana. These state variations resulted from differences in Medicaid programs, differences between states in smoking prevalence for the Medicaid population as a proportion of smoking prevalence for the total population, differences between states in the proportions of people with self-reported poor health status, and differences in the distribution of sociodemographic variables such as income level. The Medicaid populations in all states had a higher

Table 7. Comparison of smoking-attributable Medicaid expenditures and total smoking-attributable medical expenditures, by state, 1993

State	Estimated Medicaid SAEs, fiscal year 1993[a] (millions)	Estimated total medical SAEs, calendar year 1993 (millions)	Column one as percent of column two
United States	$12,892.51	$72,732.49	17.73
Alabama	107.30	803.09	13.36
Alaska	23.62	153.88	15.35
Arizona	121.85	876.55	13.90
Arkansas	78.46	604.08	12.99
California	1,732.75	8,716.25	19.88
Colorado	151.50	939.15	16.13
Connecticut	181.76	1,200.06	15.15
Delaware	22.85	224.39	10.18
District of Columbia	35.83	315.57	11.35
Florida	516.98	4,626.65	11.17
Georgia	251.94	1,706.11	14.77
Hawaii	44.06	328.12	13.43
Idaho	25.34	179.20	14.14
Illinois	560.63	2,968.46	18.89
Indiana	254.89	1,559.84	16.34
Iowa	79.38	617.05	12.87
Kansas	72.30	634.22	11.40
Kentucky	200.74	1,023.27	19.62
Louisiana	417.03	1,146.57	36.37
Maine	95.86	337.98	28.36
Maryland	212.30	1,378.73	15.40
Massachusetts	405.94	2,457.48	16.52
Michigan	532.58	2,580.00	20.64
Minnesota	186.85	1,214.26	15.39
Mississippi	111.13	548.77	20.25
Missouri	206.92	1,502.13	13.78
Montana	28.07	205.35	13.67
Nebraska	43.43	396.49	10.95
Nevada	50.14	417.93	12.00
New Hampshire	94.53	348.01	27.16
New Jersey	544.71	2,582.57	21.09
New Mexico	48.31	365.04	13.24
New York	1,850.69	6,648.19	27.84
North Carolina	205.60	1,669.03	12.32
North Dakota	19.06	180.07	10.58
Ohio	597.22	3,369.62	17.72
Oklahoma	80.11	693.57	11.55
Oregon	89.23	726.46	12.28
Pennsylvania	605.52	4,008.31	15.11
Rhode Island	96.88	348.34	27.81
South Carolina	142.04	768.47	18.48
South Dakota	20.74	173.82	11.93
Tennessee	299.88	1,389.25	21.59
Texas	654.00	4,821.98	13.56
Utah	34.21	209.31	16.34
Vermont	29.03	145.67	19.93
Virginia	162.56	1,341.42	12.12
Washington	237.16	1,332.91	17.79
West Virginia	119.24	493.17	24.18
Wisconsin	197.93	1,376.05	14.38
Wyoming	11.45	79.64	14.38

NOTE: Estimates of SAEs exclude amounts spent for people younger than 19 years, psychiatric hospital care, and mental retardation nursing homes.
[a]Reference 1
SAE = smoking-attributable expenditure

"The estimates reported here clearly show that cigarette smoking accounts for a substantial portion of annual state and national medical expenditures."

proportion of people diagnosed with smoking-related diseases and used more medical care services than the general population.[5]

All of the limitations discussed in our previous report[5] apply here as well.

In conclusion, these estimates of total medical expenditures attributable to smoking are improvements over previous national estimates. These estimates could be further refined by: (a) basing nursing home estimates on direct studies of the effect of smoking on nursing home expenditures; (b) developing interval estimates that incorporate all the uncertainties associated with the estimated SAFs; and (c) if more disaggregated expenditure data could be made available, improving the model by differentiating between people who were and were not under

treatment for different tobacco-related diseases. Such disaggregated data were used to estimate the claims for the state of Minnesota and Blue Cross/Blue Shield in their lawsuit against the tobacco industry.

The estimates reported here clearly show that cigarette smoking accounts for a substantial portion of annual state and national medical expenditures. There is considerable variation among states in both the proportions of Medicaid expenditures attributable to smoking and the proportions of total medical expenditures attributable to smoking. The range in SAEs across states is due to differences in smoking prevalence, health status, other socioeconomic variables used in the model, and the magnitude and patterns of medical expenditures in each state.

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