Smoking Among Medicaid Insured Mothers: What are the Neonatal Expenses?

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Approximately 13 percent of all pregnant women smoke during pregnancy despite known adverse health effects. Medicaid Programs pay for an estimated 27-53 percent of all births, yet little is known about smoking prevalence nor resulting expenses in this population. Findings indicate that pregnant women with deliveries paid by Medicaid are more than twice as likely to smoke as privately insured women; two-thirds of the estimated $366 million in 1996 neonatal expenses attributable to maternal smoking accrues to Medicaid Programs and these estimates vary widely across States. In light of these estimates, States should carefully consider targeted interventions and appropriate policies.

INTRODUCTION

To meet the *Healthy People 2010* goal that 30 percent of pregnant women who smoke will quit (this rate was 14 percent in 1998), public and private insurers need to implement evidence-based, cost-effective cessation programs (U.S. Department of Health and Human Services, 2000). Maternal smoking exerts immediate harmful effects on the health outcomes of both mother and infant while increasing their costs. Even so, third-party payers may decline to reimburse for smoking cessation programs if they are unaware of the magnitude of the immediate savings that can be obtained with effective interventions.

During the 107th Congress, legislation was introduced (the Medicare, Medicaid, and Maternal and Child Health Smoking Cessation Promotion Act of 2001) to amend the Social Security Act to mandate coverage of counseling for cessation of tobacco use under the Maternal and Child Health Services, Medicare, and Medicaid programs. Although this bill did not pass, advocacy groups are lobbying to reintroduce it and States have taken voluntary actions. For example, in a recent survey 36 States reported providing health insurance coverage for smoking cessation interventions (such as counseling, pharmacotherapy, or both) for all Medicaid recipients in 2002 (Halpin et al., 2004). In addition, CDC and George Washington University have developed model purchasing specifications for public and private sector payers that incorporate evidence-based recommendations to treat tobacco dependence (www.gwhealthpolicy.org/newsps/tobacco).

Standard elements of these recommendations include the use of two counseling protocols, the five A's (ask, advise, assess, assist, and arrange) for those who are willing to try to quit and the five R's (relevance, risks, rewards, roadblocks, and

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repetition), for those who are unwilling.[1] We note that clinicians must carefully weigh the risks and benefits of continued smoking versus pharmacotherapy before prescribing medications for pregnant women (Fiore et al., 2000).

If such interventions are successful, however, savings should accrue from reduced use of the newborn intensive care unit (NICU), shorter lengths of stay (LOS), and decreased service intensity. An example is based on the data presented here. We estimate that if 25 percent of maternal smokers on Medicaid are reached and the demonstrated 30-70 percent (as Melvin et al. [2000] have shown can be achieved with counseling), over a baseline quit rate of 14 percent, some 13,500-18,000 women on Medicaid would quit smoking during pregnancy. At an average savings of $738 per birth, this would result in around $10 to $13 million in excess Medicaid-covered neonatal expenses averted nationally.

Potential savings are important to Medicaid as the percentage of births financed by this program increased significantly, from 17 percent in 1985 to 35 percent in 1998, with the mandated eligibility expansions (The Alan Guttmacher Institute, 1987; National Governors' Association 2001). Medicaid insured from as little as 20 percent to as much as 58 percent of States' total live births in 1997/1998 (National Governors' Association, 2001). Reimbursements for cessation programs and procedures offered through the traditional Medicaid Program would be matched by Federal dollars at an average rate of almost 60 percent making it easier to achieve net savings for State taxpayers. As noted, many States offer some Medicaid coverage, but only New Jersey and Oregon currently offer coverage for all treatment options recommended by the U.S. Public Health Service guidelines (Halpin et al., 2004).

The primary purpose of this article is to present national and State-specific estimates of the smoking-attributable expenditures for newborns (during hospital stay at birth) of women with Medicaid coverage at delivery. By State, we present estimates of prenatal smoking prevalence (overall, privately insured, and Medicaid) for 1997, and estimated smoking-attributable neonatal expenditures in 1996 dollars by State and for the U.S. overall. In addition, we use data on the costs and efficacy of counseling-based interventions to discuss the potential net savings of these interventions and other types of State policies (e.g., increases in excise taxes) that could encourage cessation for the Medicaid population.

BACKGROUND

Smoking during pregnancy is known to retard intrauterine growth, increase the odds of pre-term delivery, and decrease birth weight (U.S. Department of Health and Human Services, 2001). Despite these and numerous other known adverse effects according to birth certificate data, around 13 percent of U.S. pregnant women reported smoking in 1997, the time period for which our data is presented, varying from 5-25 percent across the States (Ventura et al., 1999). However, more recent estimates report the prevalence of smoking during pregnancy for all U.S. women at 12 percent in 2001 (Martin et al., 2002). Although this rate represents a decline from the 1989 level of 19.5 percent, it is still far from the *Healthy People 2010* goal of no more than 1 percent. Furthermore, teenagers were the one group for which smoking

[1] The latter includes two 90-day courses of medications approved by the U.S. Food and Drug Administration and two 90-day courses of counseling per year including individual, group, or telephone sessions.

during pregnancy increased from 1994 to 1998 (Ventura et al., 2000). These young mothers are at risk for a lifetime of smoking and, thus, a host of adverse health outcomes.

We would expect smoking rates among women whose deliveries are paid by Medicaid to be higher than for all women because individuals with low incomes are more likely to smoke (Warner et al., 1995). Indeed, Schauffler et al. (2001) reported a 50 percent differential in smoking prevalence between the Medicaid and general U.S. populations. Based on data from the 1998 Pregnancy Risk Assessment Monitoring System (PRAMS)—representing all live births in 14 States—the percentage of women who smoked and were on Medicaid during pregnancy was 2.6 times that of women who smoked and were not insured by Medicaid (Lipscomb et al., 2000).

Although the smoking attributable health care expenses for chronic, long-term conditions have been studied extensively, little was known about expenses for poor health outcomes that occur in the short run (Adams and Melvin, 1998; Adams and Young, 1999) until recently. These short-run expenses include those attributable to smoking during pregnancy or the exposure of children to secondhand smoke in their homes or other environments.

In two recent publications (Fellows et al., 2002; Adams et al., 2002), national estimates of smoking-attributable neonatal expenditures due to prenatal maternal smoking were reported. These are also reported in the National Center for Chronic Disease Prevention and Health Promotion, CDC's Web-based software, Smoking-Attributable Mortality, Morbidity and Economic Costs (SAMMEC) that is now available at http://apps.nccd.cdc.gov/sammec in the Maternal and Child Health (MCH-SAMMEC) module. Prenatal smoking was found to be associated with an estimated $366 million in excess neonatal expenses for infants of mothers who smoke (1996 dollars), or $704 per maternal smoker. In this software, expenses are measured by amounts actually reimbursed for health care services.

A recent study of almost 8,000 infants and their mothers (Miller et al., 2001) provided estimates of smoking-attributable costs for both mothers and infants; an earlier study by Lightwood, Phibbs, and Glantz (1999) gave estimates for infants only. In Miller et al., the authors report costs for 11 infant or maternal conditions affected by maternal smoking; their estimates of the excess costs through the first year of the infant's life (for mother and infant combined) range from $1,142 to $1,358 per pregnant woman who smokes. Costs were measured by amounts reimbursed in a sample of privately insured claims. The Lightwood et al. study provides a national estimate of $263 million in smoking attributable neonatal costs (1995 dollars); authors use cost-to-charge ratios to derive estimates of actual hospital costs and then add in estimated professional fees. Although both of these estimates are consistent with those presented in Adams et al. (2002) and used in developing the MCH-SAMMEC software, neither of the other studies presented estimates by State or expenses specific to the Medicaid Program, as done here.

Methods

This article is preceded by another in which we report the full methods used to derive estimates of the neonatal expenditures attributable to maternal smoking (Adams et al., 2002). In this earlier work, we first estimated the relationship of maternal smoking to the probability that

an infant was admitted to a NICU and, in turn, infant LOS whether in an NICU or a regular nursery bed using the PRAMS data on over 16,000 mothers in 13 States (Alabama, Alaska, California, Florida, Georgia, Indiana, Maine, Michigan, New York [excluding New York City], Oklahoma, South Carolina, Washington, and West Virginia). This was the first study to directly test for the relationship of maternal smoking to NICU admission/LOS rather than make an assumption that infants of smokers will cost more due to the use of such services.

The PRAMS uses random sample mailings of a self-administered questionnaire with telephone followup for non-respondents and, for large, high-risk populations in defined geographical areas, hospital-based surveillance. The sample is drawn from participating States' birth certificate records, and survey weights are provided to researchers in those States where a 70 percent or greater response rate is achieved. PRAMS includes questions on individual mother's demographics, health status, smoking history, obstetrical history, and pregnancy outcomes. PRAMS data are augmented with selected variables from the Natality data set of the National Center for Health Statistics for the corresponding birth.

Given the richness of the PRAMS data on each mother surveyed, these models included individual non-smoking risk factors (age, race, parity, initiation of prenatal care, alcohol use) and other sociodemographics (region, education, marital status, insurance) known to affect birth outcomes and, hence, resource utilization. Mothers who reported that they smoked during the last trimester of pregnancy or, if they did not answer this question but said "yes" to being a current smoker, were flagged as a smoker in the analytic models. Since we were primarily interested in deriving a national estimate of these smoking attributable expenditures, the models were used with States' full birth certificate records to extrapolate smoking attributable expenditures to the States and, in turn, to the Nation.

The only variable on mothers included in the PRAMS modeling, but not available in birth certificate records is insurance status. We again used the mothers' individual PRAMS data to derive a model to predict whether the birth was paid by Medicaid or private insurers. The PRAMS records indicate whether the woman was covered by Medicaid before pregnancy, during pregnancy, and at delivery. To impute insurance status, we first estimated multinomial logit models using the previously stated variables (age, race, parity, education, region, initiation of prenatal care, smoking, and alcohol usage) on individual mothers to predict Medicaid or private versus uninsured status at delivery in the 13 PRAMS States; these States are geographically diverse and vary significantly in terms of Medicaid eligibility policies. The usual test of such a model is the concordance between the predicted and actual likelihood of individuals being in each insurance category; our model achieved an 84.5 percent concordance for the over 16,000 observations of delivering mothers in these 13 States. The coefficients from this equation were then used to impute insurance category to each birth certificate record.

While this method of imputing Medicaid coverage may under or overstate the actual percentage, our range of 27 to 58 percent State Medicaid financed births is similar to the range reported by the NGA for 1997/1998 although they report a low of 20-21 percent (New Hampshire) (National Governors' Association, 2001). Also, for the great majority of States our estimated Medicaid percentage does not differ by more than 5 percentage points from the

National Governors' Association estimate. We note in our tables the nine States (Delaware, Maryland, New Hampshire, New Mexico, Nevada, New York, Pennsylvania, Washington, and Wyoming) for which we differ by more than 5 points from NGA estimates; for New Mexico, New York, Washington, and Wyoming, our estimates are lower and hence, our estimate of smoking-related expenses is conservative for these States.

We estimated smoking attributable expenditures (SAE) by using the models to predict two values of neonatal expenditures for births to smokers as illustrated:

SAE neonatal expenditures=(Predicted $ "as is" – Predicted $ "as if" not smoking) (1)

where the first predicted expenditures uses the model's coefficients and the actual reported smoking status and the second set of predicted dollars also uses the model's coefficients but sets the reported smoking status to "no" for all smokers. Column break: The difference in these two predicted values is our estimate of SAEs. A second measure, the smoking attributable fraction (SAF), is then derived as shown:

SAF = (Predicted $ "as is" – Predicted $ "as if" for births to smokers)÷(Predicted $ "as is" for all births). (2)

Similar methods were used in estimates for adult smoking and conditions (Fellows et al., 2002). Further detail is provided in Adams et al. (2002) and the help pages in the MCH SAMMEC software (Centers for Disease Control and Prevention, 2004)

As part of the estimation process, measures of resource utilization contained in the PRAMS data (NICU admission and infant nights in hospital) had to be assigned dollar costs. The Medstat MarketScan® Database was used to derive these estimates from the private sector since these data allow us to identify NICU usage, follow individual infants throughout their stay, and measure LOS as well as medical expenses. For 1996, these data indicate that an infant admitted to an NICU cost $2,496 per night while in the unit and $1,796 while in a regular nursery bed versus only $748 per night for infants not admitted to an NICU. On average, infants included in this data set who were admitted to an NICU spent only 62 percent of their total birth hospital stay there; we used this to derive a weighted average of the NICU ($2,496) and regular nursery costs ($1,796) per night for infants with an NICU admission.

RESULTS

In Table 1, we show data on the number of total births and estimates of Medicaid-covered births, percent Medicaid, and smoking prevalence among Medicaid births. Our estimated percentage Medicaid births ranges from a low of 27 percent in several States (Hawaii, Massachusetts, Minnesota, New Hampshire, and Utah) to a high of 58 percent in the District of Columbia. The next highest, 53 percent, is found in Mississippi, a State with historically high levels of poverty. Based on these data, Medicaid appears to finance at least 40 percent of all births in a total of 17 States (including the District of Columbia).

The data in Table 1 highlight that smoking cessation programs aimed at the Medicaid population are warranted. Whereas, smoking prevalence among all women with live births ranges from 5 percent (District of Columbia) to 27 percent (Indiana), smoking prevalence among women whose deliveries are covered by Medicaid ranges from 7 percent (District of Columbia) to as high as 39 percent (Indiana). Averaging across all States, the

Table 1

Total Births, Estimated Medicaid Births, and Smoking Prevalence Among Privately Insured and Medicaid Births, by State: Calendar Year 1997

State	Births				Prenatal Smoking Prevalence		
					Percent		
	All	Percent Medicaid	Medicaid Births	*N* of Pregnant Medicaid Smokers	All	Privately Insured	Medicaid
Total	3,878,657	—	1,481,298	—	—	—	—
Alabama	60,873	47	28,452	483,684	12.4	7.9	17.0
Alaska	9,901	32	3,211	95,367	18.4	12.0	29.7
Arizona	75,638	38	28,974	365,072	8.4	5.6	12.6
Arkansas	36,422	49	17,797	430,687	18.2	11.5	24.2
California	524,848	38	201,816	3,208,874	11.5	9.0	15.9
Colorado	56,492	30	17,222	322,051	10.9	7.0	18.7
Connecticut	43,065	28	12,001	201,617	9.1	5.9	16.8
Delaware[1]	10,232	44	4,545	90,900	14.1	9.0	20.0
District of Columbia	7,900	58	4,586	33,936	5.1	1.8	7.4
Florida	192,326	45	87,364	1,406,560	11.3	6.9	16.1
Georgia	118,169	46	54,208	758,912	9.8	5.8	14.0
Hawaii	17,348	27	4,660	69,900	7.8	4.4	15.0
Idaho	18,531	31	5,689	129,140	12.4	7.4	22.7
Illinois	180,739	35	63,806	1,244,217	12.1	7.7	19.5
Indiana	83,439	36	29,890	1,159,732	27.4	18.7	38.8
Iowa	36,605	30	11,041	346,687	17.7	11.3	31.4
Kansas	37,242	32	11,851	267,833	13.2	8.2	22.6
Kentucky	53,156	45	23,656	820,863	23.8	14.5	34.7
Louisiana	65,987	51	33,963	455,104	10.2	6.4	13.4
Maine	13,646	30	4,045	138,339	18.7	11.8	34.2
Maryland[1]	70,148	38	26,813	461,184	10.3	5.7	17.2
Massachusetts	80,317	27	21,632	508,352	12.3	7.9	23.5
Michigan	133,642	34	45,978	1,301,177	17.3	10.9	28.3
Minnesota	64,427	27	17,678	417,201	12.3	7.7	23.6
Mississippi	41,498	53	21,863	332,318	12.4	9.0	15.2
Missouri	73,982	35	25,858	817,113	19.4	12.2	31.6
Montana	10,802	31	3,311	105,952	17.7	10.4	32.0
Nebraska	23,282	30	7,048	196,639	16.5	11.0	27.9
Nevada[1]	26,859	38	10,174	194,323	13.1	0.09	19.1
New Hampshire[1]	14,285	27	3,803	124,738	17.0	10.9	32.8
New Jersey	113,233	30	33,562	654,459	11.2	7.5	19.5
New Mexico[1]	26,806	40	10,756	152,735	9.7	6.6	14.2
New York[1]	257,174	33	85,686	1,807,975	12.6	8.2	21.1
North Carolina	106,958	45	47,759	1,036,370	15.0	9.1	21.7
North Dakota	8,328	28	2,325	80,445	19.5	13.0	34.6
Ohio	151,971	35	53,763	1,709,663	19.5	12.3	31.8
Oklahoma	48,164	45	21,630	547,239	17.0	9.6	25.3
Oregon	43,772	33	14,609	392,982	15.9	9.7	26.9
Pennsylvania[1]	144,157	33	47,343	1,391,884	17.5	11.4	29.4
Rhode Island	12,405	30	3,715	104,392	15.9	10.5	28.1
South Carolina	52,160	48	25,055	468,529	13.8	8.8	18.7
South Dakota	10,204	36	3,704	107,786	19.9	12.7	29.1
Tennessee	74,425	47	34,816	839,066	17.2	10.4	24.1
Texas	333,905	47	156,158	1,577,196	7.2	4.4	10.1
Utah	43,019	27	11,805	213,671	8.6	4.7	18.1
Vermont	6,590	28	1,853	61,149	17.0	10.6	33.0
Virginia	91,810	41	37,191	662,000	11.2	6.4	17.8
Washington[1]	78,214	31	24,216	615,086	14.5	9.1	25.4
West Virginia	20,690	45	9,306	335,947	24.5	14.0	36.1
Wisconsin	66,507	32	21,099	637,190	17.7	11.1	30.2
Wyoming[1]	6,364	32	2,012	67,201	20.3	13.7	33.4

[1] Estimate of percentage Medicaid births differs from National Governors' Association estimate by 5 percentage points or more. Delaware, Maryland, New Hampshire, Nevada, and Pennsylvania are above National Governors' Association estimate while New Mexico, New York, Washington, and Wyoming are below.

NOTE: *N* is number.

SOURCES: National Center for Health Statistics: Data from the Natality data set; Centers for Disease Control and Prevention: Data from the Maternal and Child Health Smoking-Attributable Mortality, Morbidity, and Economic Costs Web site, http://apps.nccd.cdc.gov/sammec/; and the California Department of Public Health: Data from the Maternal and Infant Health Assessment Files,1997.

prevalence is 13.4 percent for all women with live births versus 20.2 percent for those with a delivery paid for by Medicaid.

The average prevalence of smoking among mothers, 13.4 percent, masks the large differences in prevalence between the privately versus Medicaid insured. Indeed, the prevalence of smoking among women who are Medicaid insured is a multiple of that for mothers who are privately insured. Across all States, the rate of smoking among Medicaid insured is 1.5 times that of privately insured (20.2 versus 9.0) and in eight States, the prevalence of smoking among Medicaid insured is at least three times greater (in the District of Columbia, it is four times). Yet, if a State has a relatively higher prevalence of smoking among women with live births, this applies to both insured groups. This may reflect State-specific factors such as State cigarette taxes, bans in public settings or widespread media campaigns that affect the prevalence of smoking among pregnant women in a given State whether privately or publicly insured.

Estimated neonatal SAEs for infants of mothers who deliver while on Medicaid are shown in Table 2 by State. The total estimated amount (State and federally funded) for births paid by Medicaid is $228 million, or about two-thirds of estimated neonatal SAEs for all births ($366 million). Estimated smoking-attributable neonatal expenditures vary widely across the States with the higher amounts largely driven by State population size. In eight States (California, Florida, Illinois, Michigan, New York, Ohio, Pennsylvania, and Texas), estimated expenditures for Medicaid births exceeds $10 million. Only in Michigan, Ohio, and Pennsylvania, however, is the prevalence of smoking among mothers on Medicaid higher than the national average for this group shown in Table 1.

The SAF of total neonatal Medicaid expenditures (Table 2) is generally high in these latter three States (Michigan, Ohio, and Pennsylvania) averaging 4.75 percent, versus the overall fraction (not shown in table) of 3.3 percent. The highest SAFs, however, are in the States with the two highest smoking prevalence rates (Table 1) for Medicaid-covered births: Indiana and West Virginia. In Indiana, where this rate is estimated to be 39 percent, 6 percent of total Medicaid neonatal expenditures are attributable to smoking; similarly, in West Virginia, where the smoking rate is estimated at 36 percent for Medicaid-covered births, the estimated SAF is 5.77 percent.

Since efforts aimed at cessation will focus only on those women who smoke during pregnancy, States will be interested in the SAF specific to mothers whose deliveries are covered by Medicaid and who smoke. For that group, the SAF is much higher (Table 2), averaging 14.5 percent across the States with a narrow range (the lowest is 13.33 percent in South Dakota and the highest values are 15.95 percent for the District of Columbia and 14.95 percent in Maryland). Thus, while factors other than smoking may increase or decrease the relative expense of care for infants of prenatal smokers, the risk imposed by smoking itself accounts for a larger portion of their total neonatal expenses.

As States consider interventions for Medicaid women who smoke, they will want to know the expense per birth generated by newborns if exposed. In Table 2, we show SAE—smoking attributable neonatal expenditures—both per Medicaid birth and per birth to smokers on Medicaid. In general, the States with higher estimated expenditures per Medicaid birth have higher values for prenatal smoking prevalence, with Indiana, Kentucky, and West Virginia (the States that

Table 2

Estimated Smoking Attributable Neonatal Expenditures to Medicaid from Maternal Smoking, by State: Calendar Year 1996

State	Smoking Attributable Neonatal Costs	Percent		Smoking Attributable Neonatal Costs/Medicaid Birth	Smoking Attributable Neonatal Costs/Medicaid Smoker
		Smoking Attributable Fraction (SAF)	SAF Among Medicaid Smokers		
Total	$227,661,823	—	—	—	[1]738
Alabama	3,643,633	2.47	14.43	$59.86	$753
Alaska	522,357	4.59	13.91	52.76	548
Arizona	2,351,205	2.25	14.70	31.08	644
Arkansas	3,255,399	3.72	14.49	89.38	756
California	21,832,758	3.01	14.77	41.60	680
Colorado	2,022,506	3.24	14.63	35.80	628
Connecticut	1,634,815	2.67	13.85	37.96	811
Delaware	785,224	3.39	14.89	76.74	864
District of Columbia	452,299	1.52	15.95	57.25	1,333
Florida	11,008,323	2.54	14.60	57.24	783
Georgia	6,087,771	2.16	14.62	51.52	802
Hawaii	371,660	2.37	13.63	21.42	532
Idaho	762,936	3.92	14.44	41.17	591
Illinois	10,483,247	3.39	14.81	58.00	843
Indiana	8,602,347	5.91	14.46	103.10	742
Iowa	2,423,712	5.15	14.29	66.21	699
Kansas	1,892,662	3.69	14.29	50.82	707
Kentucky	5,926,420	5.47	14.32	111.49	722
Louisiana	3,744,853	2.03	14.70	56.75	823
Maine	981,710	5.16	13.39	71.94	710
Maryland	4,079,095	2.91	14.95	58.15	884
Massachusetts	3,890,388	3.59	13.65	48.44	765
Michigan	10,127,394	4.58	14.57	75.78	778
Minnesota	2,985,488	3.98	14.34	46.34	716
Mississippi	2,715,440	2.25	14.66	65.44	817
Missouri	6,064,018	4.97	14.43	81.97	742
Montana	612,150	5.22	14.22	56.67	578
Nebraska	1,375,419	4.54	14.28	59.08	699
Nevada	1,307,914	3.36	14.83	48.70	673
New Hampshire	889,616	4.97	13.42	62.28	713
New Jersey	6,192,636	3.39	14.35	54.69	946
New Mexico	965,736	2.51	14.65	36.03	632
New York	15,496,293	3.31	14.08	60.26	857
North Carolina	8,396,204	3.47	14.64	78.50	810
North Dakota	520,891	5.41	13.91	62.55	648
Ohio	13,018,792	5.04	14.53	85.67	761
Oklahoma	3,906,974	3.99	14.22	81.12	714
Oregon	2,417,700	4.59	14.57	55.23	615
Pennsylvania	11,584,801	4.63	13.96	80.36	832
Rhode Island	805,981	4.38	13.65	64.97	772
South Carolina	3,789,951	2.83	14.66	72.66	809
South Dakota	626,638	4.37	13.33	61.41	581
Tennessee	6,546,140	3.75	14.56	87.96	780
Texas	12,007,549	1.71	14.48	35.96	761
Utah	1,259,547	3.17	14.41	29.28	589
Vermont	438,365	5.04	13.43	66.52	717
Virginia	5,516,067	2.94	14.76	60.08	833
Washington	3,767,526	4.32	14.54	48.17	613
West Virginia	2,395,233	5.77	14.29	115.77	713
Wisconsin	4,777,631	4.98	14.46	71.84	750
Wyoming	398,409	5.49	14.41	62.60	593

[1] Smoking attributable expenditures across all States' Medicaid births to smokers.

NOTES: Neonatal expenditures include both Federal and State funding. Amounts are in 1996 dollars.

SOURCES: National Center for Health Statistics; Data from the Natality data set; Centers for Disease Control and Prevention: Data from the Maternal and Child Health Smoking-Attributable Mortality, Morbidity, and Economic Costs Web site, http://apps.nccd.cdc.gov/sammec/; and the California Department of Public Health: Data from the Maternal and Infant Health Assessment Files, 1996.

rank first, third, and second respectively, for smoking rates among Medicaid mothers) having the highest values.

When we examine only smokers insured by Medicaid (Table 2), the average SAE per smoker equals $738, with a range from $548 (Alaska) to $946 (New Jersey) across the 50 States and a high of $1,333 in the District of Columbia. Variation in these values are related to the SAF among smokers which, in turn, is driven by the individual characteristics (including non-smoking risk factors) among Medicaid smokers in each State as well as the medical practice patterns that prevail across the States. Hospital LOS, for example, is generally higher in the Northeast (Placek, 1986) and thus, infants born to smokers in this area of the country may have longer NICU stays than in other parts of the country.

Mothers who quit smoking early in pregnancy can achieve birth outcomes similar to those of non-smokers (U.S. Department of Health and Human Services, 2001). Correspondingly, reaching Medicaid-eligible women early in their pregnancy is critical to the ability of the State to improve outcomes and lower expenses. In Table 3, we compare estimated smoking attributable expenditures in total and per births to smokers for women who received prenatal care in the first/second trimester versus those who either received care only in the third trimester or none at all. These estimates represent the differences in expenditures between smokers and non-smokers in these groups adjusted for (that is, holding constant) the factors in the neonatal model described earlier (age, race, parity, alcohol use, etc.) known to affect variation in expenses.

While the proportion of all women on Medicaid who receive only third trimester or no care is low, ranging from 3 to 15 percent (data not shown), estimated smoking attributable neonatal expenditures per birth to women in this group is markedly higher than for those receiving earlier prenatal care. In 11 States, smoking attributable neonatal expenditures for those who smoke are twice those of women receiving earlier prenatal care; the highest difference occurs in Indiana where expenditures per birth for those with late or no prenatal care are 2.3 times those with earlier care. Again, there is wide variation across States with expenses ranging from $497 to $1,118 per birth for those receiving first/second trimester care and $740 to $2,129 per birth for those starting later or not at all.

Limitations

We note several limitations to this study. The first is that the modeling on which the software estimates are based used PRAMS data from only 13 States. While PRAMS data are drawn to be representative of live births within each State, these 13 States are not necessarily representative of the Nation as a whole. Work is underway to update the modeling and estimates using the more current PRAMS data (2001) in which many more States participated. Data from these States was also used to derive models to impute Medicaid insurance. While our estimates of percent Medicaid births are consistent with those of the NGA, we may have substantially under- or overestimated Medicaid-covered births in some States. We note, in Table 1, States for which our estimates differ by 5 percentage points or more from the NGA estimates. We would expect more accuracy among the original 13 study States and, indeed, New York is the only one with a discrepancy of 5 percentage points or more.

We also note that both the birth certificate and the PRAMS data are believed to underestimate the true levels of prenatal smoking (Dietz et al., 1998) although PRAMS does ask about smoking through

Table 3

Estimated Smoking Attributable Neonatal Medicaid Expenditures All Medicaid, and Trimester of Prenatal Care, by State: Calendar Year 1996

State	Estimated Total Smoking Attributable Neonatal Costs			Estimated Smoking Attributable Neonatal Costs Per Smoker		
	All	First/Second Trimester Prenatal Care	Third Trimester Care/None	All	First/Second Trimester Prenatal Care	Third Trimester Care/None
Total	$227,661,823	$194,695,597	$32,966,227	—	—	—
Alabama	3,643,633	3,250,913	392,721	$753	$716	$1,322
Alaska	522,357	465,697	56,661	548	525	832
Arizona	2,351,205	1,895,721	455,483	644	586	1,047
Arkansas	3,255,399	2,701,393	554,006	756	698	1,246
California	21,832,758	16,763,568	5,069190	680	597	1,252
Colorado	2,022,506	1,745,813	276,693	628	597	956
Connecticut	1,634,815	1,487,655	147,160	811	782	1,313
Delaware	785,224	679,419	105,805	864	804	1,557
District of Columbia	452,299	293,043	159,256	1,333	1,118	2,129
Florida	11,008,323	9,765,491	1,242,832	783	739	1,431
Georgia	6,087,771	5,369,617	718,154	802	753	1,551
Hawaii	371,660	312,415	59,245	532	497	835
Idaho	762,936	667,323	95,613	591	564	886
Illinois	10,483,247	8,572,278	1,910,969	843	760	1,634
Indiana	8,602,347	7,626,497	975,851	742	694	1,596
Iowa	2,423,712	2,226,404	197,308	699	674	1,182
Kansas	1,892,662	1,736,997	155,666	707	681	1,253
Kentucky	5,926,420	5,447,029	479,391	722	697	1,230
Louisiana	3,744,853	3,285,042	459,811	823	774	1,524
Maine	981,710	939,042	42,668	710	697	1,184
Maryland	4,079,095	3,447,325	631,770	884	810	1,801
Massachusetts	3,890,388	3,531,540	358,848	765	737	1,209
Michigan	10,127,394	8,878,580	1,248,813	778	730	1,426
Minnesota	2,985,488	2,704,709	280,779	716	686	1,149
Mississippi	2,715,440	2,384,252	331,188	817	762	1,585
Missouri	6,064,018	5,318,434	745,584	742	696	1,377
Montana	612,150	557,642	54,508	578	560	865
Nebraska	1,375,419	1,226,060	149,359	699	669	1,141
Nevada	1,307,914	1,024,962	282,951	673	601	1,167
New Hampshire	889,616	828,183	61,433	713	692	1,206
New Jersey	6,192,636	4,529,083	1,663,553	946	808	1,785
New Mexico	965,736	777,958	187,778	632	581	974
New York	15,496,293	12,905,231	2,591,062	857	791	1,489
North Carolina	8,396,204	7,414,328	981,875	810	761	1,549
North Dakota	520,891	485,445	35,446	648	633	932
Ohio	13,018,792	11,293,426	1,725,366	761	714	1,404
Oklahoma	3,906,974	3,377,571	529,403	714	674	1,153
Oregon	2,417,700	2,133,093	284,607	615	591	911
Pennsylvania	11,584,801	9,811,534	1,773,267	832	766	1,588
Rhode Island	805,981	729,281	76,700	772	736	1,421
South Carolina	3,789,951	3,294,891	495,060	809	758	1,452
South Dakota	626,638	495,002	131,636	581	550	740
Tennessee	6,546,140	5,664,053	882,087	780	724	1,523
Texas	12,007,549	10,167,084	1,840,465	761	701	1,339
Utah	1,259,547	1,113,832	145,715	589	566	922
Vermont	438,365	405,671	32,694	717	695	1,167
Virginia	5,516,067	4,816,842	699,225	833	776	1,623
Washington	3,767,526	3,399,403	368,123	613	589	979
West Virginia	2,395,233	2,163,531	231,702	713	684	1,164
Wisconsin	4,777,631	4,228,581	549,051	750	711	1,297
Wyoming	398,409	356,713	41,696	593	568	949

NOTES: Neonatal expenditures include both Federal and State funding. Amounts are in 1996 dollars.

SOURCES: National Center for Health Statistics: Data from the Natality data set; Centers for Disease Control and Prevention: Data from the Maternal and Child Health Smoking-Attributable Mortality, Morbidity, and Economic Costs Web site, http://apps.nccd.cdc.gov/sammec/; and the California Department of Public Health: Data from the Maternal and Infant Health Assessment Files, 1996.

the third trimester, which is most predictive of adverse outcomes. The State estimates for smoking presented here are based on the prevalence as self-reported in birth certificate data and, hence, smoking-attributable expenditures are likely underestimated for all women.

Although our methods of estimating neonatal expenditures are more refined than those used in earlier estimates (Oster, Delea, and Colditz, 1988; Marks et al., 1990), our use of private sector data may overestimate Medicaid costs per night because the Medicaid reimbursement level for obstetrical services is usually lower than private. We do note, however, that 10 States increased their Medicaid fees for obstetrical services by at least 30 percent from 1993-1998 (Norton and Zuckerman, 2000). Moreover, women whose deliveries are paid for by Medicaid are generally at higher risk for poor delivery/birth outcomes independent of smoking and, therefore, likely to use more services. Indeed, average pregnancy expenditures for Medicaid women were found to be higher when services used were priced at private sector reimbursement rates (Adams et al., 2001).

Another limitation is that we do not estimate any smoking-attributable maternal expenses. We note that models of mothers' utilization of services before delivery based on the PRAMS data did not find a significant effect from their smoking. This may be due in part to an apparently protective effect found for smoking for an otherwise high-cost condition, pre-eclampsia, among women with a live birth (Adams and Melvin, 1998; Miller et al., 2001). Adams and Melvin, however, found higher expenses over all pregnancies due to a relationship of smoking to ectopic pregnancy and spontaneous abortion. Although the Miller et al. (2001) study included incremental maternal costs for infants born with a low birth weight they were not able to test for a causal relationship of smoking to these maternal costs because their analysis was based on claims data. They further noted that costs for infant conditions attributable to SAE were roughly 10 times those of maternal costs. We focus here on smoking-attributable neonatal expenses for which we did find a statistical relationship of smoking to resource utilization based on multivariate models.

We have also omitted other short-term expenses related to prenatal smoking such as those related to readmissions and other adverse outcomes that occur for infants after the neonatal period (first 4 weeks of life). For example, researchers have estimated that birth and first-year costs for infants attributable to smoking could be as high as $1,024-$1,225 per maternal smoker (Miller et al., 2001). These estimates would add $387-$587 to our estimates for neonatal expenses per birth for smokers on Medicaid. Work is underway to add a component to MCH-SAMMEC that will provide estimates of first-year expenditures for infants as well as children through age 12 who are exposed to secondhand smoking. As Medicaid covers the health care of newborns throughout the first year of life and has greatly expanded coverage for young children, these additional programatic costs are quite pertinent to deliberations on smoking cessation policies at the State level.

The overriding strength of this study is that SAE measured for all women and within the subgroups are calculated on models that include many individual factors known to affect pregnancy and birth outcomes. However, if unobserved individual factors vary systematically between smokers and non-smokers or between these two groups more within certain subgroups (e.g., those accessing prenatal care later) analyzed here, there could be some mismeasure-

ment. Still, the PRAMS data are more complete than most data on pregnant women, are designed to be representative of all live births in a State, and hence, provide a sound basis for the results presented.

DISCUSSION

The data presented here indicate that many States face a challenge in reducing the prevalence of prenatal smoking in their State to desired levels. Given relatively high prevalence rates, potential improvements in maternal and infant health as well as savings from reducing prenatal smoking among Medicaid enrollees should be of interest. Nationally, there is interest in increasing coverage of smoking cessation services by public payers.

The magnitude of excess expense per prenatal smoker that we present suggests that Medicaid Programs could save money if interventions are effective and not overly expensive. The five A's has been shown to achieve a modest, but clinically significant effect on cessation rates of pregnant women (Melvin et al., 2000), but solid estimates of the costs of implementing it in the Medicaid population are not available. The CDC, however, is doing work to estimate these costs for women in alternative clinical settings. Earlier, counseling-based health education interventions have been estimated to cost $6 per patient (Windsor et al., 1993). We note, however, that it is quite likely that smoking cessation programs aimed at women with multiple risk factors, such as those who start prenatal care in the third trimester, will cost more per successful quit than those aimed at women with fewer risk factors.

Even if smoking cessation services were included in all States' Medicaid benefit package, much more would need to be done to reach the population of low-income women whose deliveries are paid by Medicaid. Specifically, the availability of Medicaid coverage needs to be promoted and early enrollment increased. Low-income women, who are often eligible for Medicaid, frequently delay enrollment in Medicaid and the initiation of prenatal care (Kaestner, 1999); it is during early prenatal care that counseling on cessation is most important. Other data indicate that one-half or more of women whose deliveries are paid for by Medicaid are uninsured pre-pregnancy (Adams et al., 2003; Egerter, Braveman, and Marchi, 2002) and 21 percent were found to be uninsured throughout their first trimester (Egerter, Braveman, and Marchi, 2002). The expense of this delay, and presumably continued smoking, is ultimately borne by the Medicaid Program and thus, by Federal and State taxpayers, as providers enroll eligible women at delivery.

While the data presented here may be helpful to States, they can also use the data in the MCH-SAMMEC software to classify maternal smokers by characteristics such as age, race, and education for further targeting. Here, we focused on data for those receiving early versus late prenatal care. Although seeking early prenatal care and smoking are both individual choices, the estimates presented suggest that further reducing barriers to early prenatal care may go hand in hand with reducing the adverse outcomes and associated expenses of smoking.

We noted earlier that if 25 percent of smokers on Medicaid are reached and some 13,500 to 18,000 women smoking during pregnancy quit, this would result in an estimated $10 to $13 million in excess Medicaid-covered neonatal expenditures averted nationally. If each pregnant smoker reached by this intervention received counseling at an estimated cost of $30, the net savings would be from almost $8 to $11 million, depending on the effectiveness of

usual practice and the intervention. If the mothers remain smoke free, expenses could be reduced and outcomes improved in the short, as well as long, run. If actual interventions prove to be more costly, on the other hand, net savings will be less.

Another effective tool that States may consider is their cigarette excise tax. A recent study indicates that a 10-percent increase in State excise tax rates would lead to a 7-percent reduction in smoking among pregnant women; alternatively, a tax hike of $0.55 would reduce maternal smoking by 22 percent (Ringel and Evans, 2001). Based on the MCH-SAMMEC model, 7 percent reductions in Medicaid maternal smoking would result in a savings of around $15 million across the States; this assumes the tax would affect all women who smoke who we estimate as having Medicaid-covered deliveries. Of course, this policy has the added advantage of raising revenues for the State that could be earmarked for further investment in smoking cessation programs.

States will likely want to take a multipronged approach, however, to the problem of smoking cessation among pregnant women. Pregnancy is an opportune time to help women quit smoking and, while an excise tax may encourage many to quit, explicit interventions targeted to pregnant women may yield incremental quits. These interventions also offer the opportunity to monitor women throughout their pregnancy and postnatal period. Such programs may be more successful in encouraging women to stay quit because many of those who quit during pregnancy return to smoking after their delivery. Intervention programs can provide information regarding the improvement in their health as well as their newborn infant that results from remaining smoke free. Policies need to take this into account as they assist women of reproductive age in quitting permanently.

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