

How Costly Are Smokers To Other People? Longitudinal Evidence on the Near Elderly

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Abstract: Many studies have estimated the cost of smoking. In recent years, such estimates have been widely used in litigation against the tobacco companies. Both longitudinal and cross sectional methods have been used. On balance, the longitudinal approach, the one used in this study, is much preferable since one can account for the effects of smoking on the pool of eligibles rather than just conditioning expenditures on being eligible. We used data from four waves of the Health and Retirement Study to assess the impact of smoking on use of hospital and physicians' services and nursing home care. The analysis is limited to utilization among persons aged 51 to 67 ("near elderly"). During this phase of the life cycle, many adverse effects of smoking, measured in terms of mortality and morbidity, first occur. In contrast to past studies, we computed the health expenditure burden of smoking by type of health insurer. The net effect of smoking on expenditures on health care services was positive for this age cohort. We found substantial differences in the burden that smoking imposes on various payers. The largest impact was on other government payers, which includes the Veterans Administration, followed by the impacts on Medicare and Medicaid. By contrast, impacts of smoking on private insurers' cost were negligible.

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I. Introduction

Cigarette smoking is the largest single source of preventable source of mortality and morbidity in the United States (Bartecchi et al. 1994). In 1990, for example, about one-fifth of all deaths are attributable to smoking (MMWR 1993). Effects on morbidity, especially on certain types of cancer, heart disease, stroke, and nonmalignant lung disease, have been documented (Peto 1994).

Several negative externalities are attributable to cigarette smoking and provide the rationale for various forms of public regulation of cigarettes. One type of externality is financial. Because of various forms of insurance, including public health insurance coverage, private group health insurance, public disability coverage, and public annuities, in the form of Social Security benefits, smokers may not pay for the total cost of harm they cause. Second, environmental smoke may cause harm to others. Some deleterious effects of environmental smoke on birth weight and incidence of cancer have been documented, although as with the first externality, there is ongoing debate about magnitudes of effect (Manning et al. 1989; U.S. Environmental Protection Agency 1994). In addition, there is the annoyance experienced by nonsmokers to smoky environments, but this cost has not been quantified. Third, cigarette smoking is highly addictive and the habit is almost always acquired during childhood (see e.g., U.S. Department of Health and Human Services 2000, p. 121). Under the doctrine of consumer sovereignty, private consumption decisions are ordinarily considered to be an internal matter and certainly not a source of external costs. However, in view of the young age at which this form of addiction is acquired, it seems difficult to presume that these are informed judgments by

rational actors, or that the parents of youths would make decisions consistent with those of their children. In this sense, actions by tobacco manufacturers to make their products more attractive to youths may be considered to have external costs, providing still another reason for public regulation. In fact, one group of economists concluded that this is, on balance, the strongest rationale for such regulation of the three sources of negative externalities (Warner et al. 1995).

Public regulation of cigarette smoking takes many forms: excise taxes on cigarettes; restricted availability of cigarettes at the point of sales; bans restricting where it is legal for cigarettes to be smoked (e.g., in restaurants, and public buildings); cigarette advertising bans; and imposition of tort liability on cigarette manufacturers for prior harm caused by smoking (Hanson and Logue 1997; Jacobson and Warner 1999). Plaintiffs' success in litigation against tobacco companies is relatively recent, that is, has taken place since 1992 (Rabin 1993). Probably the most notable success is the settlement between some tobacco manufacturers and 46 state attorneys general reached in November 1998. This settlement provided for major indemnity payments by manufacturers as well as an agreement to abide by various restraints on their behavior, such as in advertising.

An important characteristic of smoking is the long latency period between time of initiation and the onset of adverse effects. Relatively few adverse health effects occur before this age. To illustrate, at age 35, the cumulative probability of survival is the same for never smokers and smokers. At age 45, the ratio of such probabilities, never smokers to smokers, is 1.02 for males and 1.00 for females. At age 55, the corresponding ratios are 1.06 for males and 1.02 for females, and at age 65, the ratios are 1.18 and 1.08. By

age 85, the ratios are 2.11 for males and 1.57 for females (Hodgson 1992, p. 91). Excess morbidity and consequent elevated cost occurs earlier; however, for some smoking-related diseases, such as lung cancer, the lag between initial treatment and death, is less than a year on average (Fry et al. 1999; Ramalingam et al. 1998).

Harm from smoking and the various public interventions to deal with it are vast topics. The objective of this paper is far more limited—to assess the costs of smoking measured in terms of spending on personal health care services for a defined age group of individuals—persons aged 51 to 67, to estimate the incidence of such costs by source of payment for health expenditures. Our primary data source for this study is the first four waves of the Health and Retirement Study. This national survey interviewed persons aged 51-61 in 1992 and their spouses who could be of any age. By the fourth wave, which was conducted in 1998, the 61-year olds were 67.

Our analytical approach represents an improvement over past cost of smoking studies in these respects. First, unlike most cost of smoking studies, especially those done in the United States (Warner et al. 1999), we used a life cycle approach. We explain the advantages of this approach below. Second, the HRS provides longitudinal data on survival, source of payment for health services, and health services use. Having data on many relevant covariates allowed for development of a more accurate life table than has been available previously. Smokers differ from nonsmokers in many other respects. In this study, we were able to observe types of heterogeneity not often measured in past work, e.g., risk preferences (Hersch and Viscusi 1998). Third, since the HRS provides data on source of payment, we were able to distribute the cost burden of smoking across payers. In the past, no study, to our knowledge, has explicitly considered effects of

smoking on payer status and has explicitly incorporated this information in analysis of the cost burden of smoking. Since smoking decreases health, which in turn influences employment status and income and payer status, which in the United States is employment-related, this is an important adjustment to perform. Fourth, in previous work, it has not been possible to incorporate changes in smoking status and their effects. In fact, during middle age, cessation is quite common, and this change should affect the trajectory of health care cost. Fifth, unlike most studies, we did not limit our analysis to smoking-related diseases. Smoking causes other diseases than the major “smoking-related” diseases. Also, it affects the course of recovery from various diseases, irrespective of whether or not the diseases are “smoking related.” The effect of smoking on recovery is complex and does not always work to the disadvantage of smokers (see, e.g., Hasdai et al. 1999).

Our estimates of the increased cost of smoking overall are in line with estimates from previous studies, especially for the United States. However, we found appreciable differences in the burden of smoking cost borne by different health insurers. Thus, if the policy goal is to compensate for losses incurred as a consequence of smoking, adjustment by payer status is critical for aligning costs incurred with compensatory payments from tobacco companies.

In Section II, we discuss some conceptual issues in measuring cost of smoking. Section III reviews the previous literature on smoking cost. Section IV describes our methodology. In Section V, we present our findings. Section VI places the findings in a larger context and concludes the study.

II. Conceptual Issues

Choosing the Right Analytical Approach: Life Cycle versus Cross Sectional

Analysis. The cost of personal health services attributable to smoking can be measured over the life cycle of the smoker or for a single period, such as a year. Higher medical care use and higher mortality attributable to smoking have opposite impacts on lifetime expenditures. Higher medical care use increases lifetime expenditures associated with smoking. Offsetting this increase, at least in part, is the decrease in survival of smokers relative to nonsmokers. Medical care use patterns of smokers and nonsmokers are affected by the various demand determinants, including health status, price of health services, state of the underlying technology for diagnosing and treating disease, care standards, and other factors. None of these factors can be known with any degree of certainty at the time smoking is initiated. Both mortality and cost per year are partly affected by cessation, which occurs throughout the life cycle and, for many individuals, only occurs after a health shock has been experienced (Ho 1998; Jones 1996; Wray et al. 1998).

During any year, persons who are alive and smoke are potentially subject to higher expenditures on health care. Most individuals survive the year, but those near death experience elevated health care expenditures on average (Lubitz and Riley 1993).

In the life cycle approach (sometimes called the “incidence approach”), analytically, one needs to document inflows—insurance premiums and excise taxes, and outflows, excess expenditures on personal health services. These cash flows are brought to present value at some base year, say when the person is a teenager, by discounting. Premiums do not vary by smoking status. Neither private group insurers nor Medicare

varies contributions on this basis. The extent to which individual insurers do this is unknown. Outflows, both those borne by individuals out-of-pocket, and others vary systematically by smoking status.

In analyzing a particular cross section (sometimes called the “prevalence approach”), the researcher typically finds a smoking-attributable fraction (SAF), that is, the increase in expenditures on personal health services attributable to smoking. Typically, in obtaining the SAF, other explanatory variables than those for smoking behavior are included to control for other determinants of spending. The SAF then is applied to other data on expenditures, such as for Medicaid in a given state in a particular year, to derive the cost of smoking to a that payer.

The cross sectional approach has one major advantage. It is simpler to implement since, to obtain the SAF, one only needs a single cross section on individuals with data on expenditures and determinants of such expenditures, including smoking behavior. The SAF is then readily applied to publically-available data bases from insurers.

The cross sectional approach, however, has one important flaw. Outlays from a payer, for example Medicaid, depend on the number of enrollees and outlays per enrollee. To the extent that smoking results in premature deaths of persons who would otherwise have been enrollees, expenditures are correspondingly diminished. Also, even for persons who survive, persons change in insurers. The cost of smoking may have more to do with numbers of people enrolled in a particular program than with spending attributable to smoking, conditional the number of persons covered by the program. The life cycle method conceptually links the cause (smoking) with the effect (future medical expense) much more directly (see e.g., Miller et al. 1997).

From the standpoint of setting the charge on potential injurers to achieve optimal deterrence by some form of ex ante regulation, including imposing excise taxes on cigarettes, the life cycle approach is preferable. This approach allows one to identify the cash flows associated with another person starting the habit and the cash flows from quitting or continuing to smoke but reducing one's level of cigarette consumption. One can compute the benefit from a particular action to discourage initiation and encourage cessation which certainly has consequences over several years at set cigarette excise taxes, adjust insurance premiums, or impose penalties per smoker on manufacturers according to the quantitative estimates of harm attributable to the activity.

Risk Classification. For purposes of developing an actuarially fair premium to reflect the added external cost of smoking, it is necessary to answer the counterfactual question. What cost would a nonsmoking person with smoker-like characteristics impose? For purposes of establishing an actuarially fair premium for insurance purposes, just knowing that the person is a smoker or not might be sufficient to achieve some characteristics of an optimal risk classification system, such as separation in expected loss (see Abraham 1986), but risk classes should also provide loss prevention incentives. To craft an adequate disincentive to smoke, one must reward but not under- or overreward such behavior. Demographic characteristics affect medical spending levels and are correlated with smoking. To the extent that smokers differ on demographic characteristics that are clearly exogenous to the smoking decision, adjustment is straightforward. Also, individual tastes, for example, risk preferences may not be affected by smoking status.

On the other hand, how other health behaviors, such as diet and exercise, and alcohol use, are properly treated in the analysis is more controversial. Such activities may

be complements or substitutes for smoking, complements if persons who smoke also are inactive, perhaps due to shortness of breath, or are more likely to consume excess amounts of alcohol, substitutes if reductions in smoking lead to offsetting increases in other unhealthy behaviors. One should gauge the sensitivity of estimates effects of smoking on cost, controlling and not controlling for these other activities.

Another issue is whether the comparison group is between current smokers and never smokers or between smokers and some category of former smokers. The appropriate choice depends on the question being asked. Comparing current and former smokers would be relevant for assessing benefits of smoking cessation interventions, but not for assessing benefits of preventing initiation for which never smokers are the appropriate reference group.

III. Previous Studies

Life Cycle Approach. Empirical implementation of the life cycle approach is illustrated by a recent article by Barendregt et al. (1997), which applied the approach for the Netherlands. For their calculations, the authors used data on age- and gender-specific incidence and prevalence of five major diseases, heart disease, stroke, lung cancer, a heterogeneous group of other cancers, and chronic obstructive pulmonary disease (COPD). They obtained data on the per capita cost of each of these diseases. The residual category was all other diseases, which accounted for the difference between total costs of health care and the cost of the five diseases, expressed per capita population. Unlike the five diseases, frequency of the residual disease category varied by age and gender, but not by smoking status. The authors used three life tables, one for a mixed population of smokers and nonsmokers, one for a population of smokers, and one for a population of

nonsmokers. Expected cost was discounted at alternative rates, ranging from zero to 10 percent.

Per capita costs rose sharply with age, increasing 10-fold between the base age 40-44 years of age to 85-80 years of age. At age 65-74, per capita cost was 40 percent higher for male smokers and 25 percent higher for female smokers. However, considering the number of smokers alive and alive by age, the total cost of care for various age cohorts of male smokers peaked at about age 65-69 . For male nonsmokers, the total cost of care peaked about age 75-79. Far more (over three times) was spent on behalf of male nonsmokers aged 85-89 than on male smokers of the same age. The authors simulated changes in total health costs for the male population after smoking cessation. Irrespective of the discount rate used, smoking cessation caused an initial drop in spending. However, as the population aged, spending increased. Thus, for example, using the most plausible discount rate of three percent, 31 years after cessation, encouraging people to stop smoking actually increased spending. Using a lower discount rate decreased the breakeven year; with a higher rate, the breakeven year was greater than 31 years.

Other longitudinal studies have yielded different results. Several studies have found smoking to result in higher medical cost, but the amount of the increase depended on the discount rate used and other underlying assumptions (Oster et al. 1994; Leu and Schaub 1985; Manning et al. 1991; and Hodgson 1992). Leu and Schaub (1985), a study of Swiss males, found higher expenditures for nonsmokers than smokers, a result consistent with above study from the Netherlands. However, according to Miller et al. (1997), “there is some evidence that Leu and Schaub underestimated the level of excess medical care associated with smokers” (p. 5).

The prevalence approach has been widely used in studies by experts for plaintiffs in tobacco litigation (see e.g., Harris 1997; Max 1997). The general methodology is to derive smoking-attributable fractions for particular health services, such as for hospital care, and apply these fractions to data on expenditures. The smoking-attributable fractions consistently imply excess spending on behalf of smokers (see e.g., Miller et al. 1997, 1999) and therefore are favorable to plaintiffs in such litigation. Thus, smoking-related cost is always positive as well. These studies have been criticized by experts for the defense on such grounds that they underadjust for behaviors other than smoking and fail to account for premature death due to smoking (see e.g., Rubin 1997). Quoting Viscusi (1999), “there are no damages to the state in terms of higher Medicaid costs once smokers are dead” (p. 590).

Several studies have extended analysis of the consequences of smoking to include a larger number of types of costs—sick leave, group life insurance, retirement pensions, and fire (see, in particular, Atkinson and Townsend 1977; Manning et al. 1989 and 1991, Viscusi 1995 and 1999). The largest addition to cost from smoking is medical care cost, excluding cost of nursing home care. The largest savings from smoking are in terms of reduced pension cost, and in the cost of nursing home care.

IV. Methods and Empirical Specification

The HRS was conducted in 2-year intervals. We defined explanatory variables for the preceding wave. Thus, utilization of health care services between the waves was made to depend on levels of variables in the previous wave. For this reason, our panel used Waves 2-4, with Wave 1 used exclusively for information on explanatory variables.

Our measures of personal health services were the number of nights in the hospital, number of visits to physicians, and whether or not the person was admitted to a nursing home during the two years before the survey. In this age cohort, very few persons are admitted to nursing homes.

The key explanatory variables related to smoking behavior. We defined binary variables for current smokers, former smokers who quit smoking from 5-10, 11-19, and 20+ years before the preceding interview with never smokers, the omitted reference group. We combined persons who quit less than five years before the preceding interview with current smokers because (1) such persons are much more likely to relapse, and (2) short-term quitting is often motivated by an adverse health event.

Other explanatory variables were either time-varying or time-invariant. Time-varying explanatory variables were household income, marital status, self-reported health, body mass index (for height in relationship to weight), and insurance status. The insurance categories were Medicare disabled, Medicare elderly, Medicaid, other government, private individual, and private group coverage. Some sample persons had more than one type of coverage. We distinguished between Medicare disabled and elderly based on the person's age. If under age 65 at the interview, the Medicare enrollee was classified in the former group. To develop mutually exclusive health insurance

categories, we developed a hierarchy of types. For example, if a person had both Medicare and Medicaid, we considered the person to be covered by Medicare. A person was only considered to be uninsured if s/he had no other source of coverage.

Time-invariant variables were alcohol consumption, including self-identified problem drinkers, a risk tolerance measure (see Barsky et al. 1995), gender, education, age, and race. We also included a variable for year.

To assess the effect of smoking behavior on numbers of hospital nights and physician visits, we estimated a random effects negative binomial model (Hausman et al. 1984). A random effects negative binomial has several appealing features. First, it explicitly deals with count data. Second, it allows for inclusion of covariates. Third, it accounts for the large proportion of zeros in our utilization measures and the skewed distribution of positive values. Fourth, it allows for overdispersion (variance greater than the mean) unlike the Poisson model. Fifth, it takes advantage of the panel feature of our data by accounting for persistent individual random effects. To gauge effects of smoking on nursing home use, we estimated a random effect logit model.

Using data on mortality between the waves, we estimated Weibull hazard models for males and females to analyze determinants of survival, particularly, the effects of smoking. We used the same explanatory variables used to assess determinants of utilization. All such variables were measured at Wave 1. With parameter estimates from these models, we constructed life tables for current smokers, former smokers, nonsmoking smokers, nonsmoking former smokers, and never smokers. A nonsmoking smoker is a person with the characteristics of smokers except that the person does not smoke.

We created 13 categories for 13 representative individuals: current smoker; former smoker who quit (1) two years ago, (2) seven years ago, (3) 13 years ago, (4) 18 years ago, and (5) 23 years ago; never smoker, nonsmoking smoker, and five nonsmoking former smokers. The total number of hospital nights and physician visits for persons between the ages of 51 and 67 were estimated as follows. First, we created life tables for 51-year old male and female representative individuals based on estimates from the hazard models. Second, we created eight two-year periods. Third, for each period, we simulated survival for each period. Fourth, using coefficients from the negative binomial model, we simulated the number of hospital nights and physician visits that a representative individual had in that period. If, according to the simulation, the individual survived period, we used this simulated amount for health services utilization. But if the individual died during the period, we assumed that the person used 3.5 times as much care. Fifth, if the individual was predicted to have died, this was the final utilization level. If the individual was predicted to have survived, we updated the characteristics of the representative individuals by (1) updating the period (to account for trends in medical utilization), (2) updating the number of years since quitting for former smokers, and (3) we forced 10 percent of the current smokers to become former smokers. We did not allow for relapsing, but relapsing was uncommon in our sample, especially after smokers had quit for a number of years. Sixth, we repeated the fourth and fifth steps until the individual was predicted to die or the eighth period was reached.

We used alternative discount rates of zero and three percent. We simulated utilization for 1,000 representative smokers, never smoker smokers, and never smokers

100 times. We computed means from each sample of 1,000 representative individuals and report the means and standard deviations based on the 100 samples.

Finally, to study effects of smoking on insurance status, we estimated a multinomial logit model. Mutually-exclusive categories for the dependent variable were being uninsured, on Medicare, Medicaid, having other public coverage, or private individual coverage. The omitted reference group was private group coverage. We used the same explanatory variables as in the previous multivariate analyses (except, of course, insurance status). All variables were measured for Wave 1.

Simulated changes in utilization for all individuals were obtained in the following way. First, we calculated the weighted average of utilization of smokers, former smokers who quit 2, 7, 13, 18, and 23 years ago, and never smokers. Second, we calculated the weighted average of utilization for nonsmoking smokers, nonsmoking former smokers who quit 2, 7, 13, 18, and 23 years ago, and never smokers. Third, we calculated the percentage difference between the two amounts. To calculate simulated changes in utilization for each payer, we adjusted the weights based on the likelihood of each individual using a particular payer.

To translate utilization differences in cost to each payer, we used data on cost per hospital day (U.S Department of Commerce, 1999, Table 203), adjusted for price-cost margins paid by each payer (U.S. Prospective Payment Assessment Commission 1995, p. 21) and prices per physician encounter (U.S. Department of Commerce, 1999, Tables 184 and 198), also adjusted for payer payment differentials (U.S. Physician Payment Review Commission, pp. 77-84).

V. Results

Longitudinal Smoking Patterns. Once a person quit smoking, restarting was relatively unusual (Table 1). Among persons who reported smoking at Wave 1, the propensity to smoke at subsequent waves fell monotonically. At Wave 2, 83 percent continued to smoke, but at Wave 3, only 79 percent of Wave 1 current smokers did. By Wave 4, only 70 percent of these individuals said they were current smokers. Among persons who said that quit between one to four years before the Wave 1 interview, nearly six percent had restarted by Wave 2; the proportion of these persons who restarted by Waves 3 and 4 were even higher. Thus, for a nontrivial subset of such individuals, not smoking at Wave 1 was only temporary. For this reason, in our empirical analysis, we combined current smokers and those who had quit within five years of the interview into a single category for our analysis of mortality, utilization of personal health care services, and choice of health insurance type.

Between two and three percent of persons who had quit for five to nine years at the baseline survey, resumed smoking subsequently. For former smokers who had quit 10 to 19 years earlier, 20 years earlier, or had never smoking, restarting occurred in one percent of cases or less. Overall the percent of smokers declined from 28 percent Wave 1 to slightly less than 20 percent by Wave 4 (Fig. 1). In part, the decline reflected higher mortality rates among smokers, but most of the change is attributable to high smoking cessation rates among persons in this age cohort.

Health Insurance. Sources of payment for personal health insurance shifted dramatically over the six-year period, probably more so than is typical for other age cohorts (Table 2). For the sample as a whole, the single largest primary source of health

insurance was private group insurance. However, between Waves 1 and 4, the percentage of persons with such coverage dropped from 65 to 48 percent. By Wave 4, Medicare was the second most important payer, consisting about three quarters of persons eligible for Medicare based on age, with the remainder eligible based on disability. Only between three to four percent of persons in this age group had Medicaid was the primary source of health insurance. Less than 10 percent had individual private health insurance coverage. At Wave 1, nearly 17 percent of persons had no health insurance; by Wave 4, only 10 percent of persons fell in this category. The decrease in uninsured individuals was primarily caused by persons becoming age-eligible for Medicare.

At Wave 1, 28 percent of persons smoked or had quit within five years of the interview (Table 3). Such persons were overrepresented among the uninsured, accounting for 36 percent of the uninsured. They also accounted for more than their share of Medicare disabled, Medicaid, and other public programs, and among the uninsured. They were underrepresented among the privately insured, both for group and individual coverage. Although the percentages differed at Wave 4, the conclusion that smokers are disproportionately covered by public programs and are uninsured did not change. However, smokers were underrepresented among the elderly on Medicare (persons between 65 and 67).

Never smokers were 37 percent of the sample at Wave 1 and 38 percent at Wave 4. Relative to the total sample, these persons were more likely to have individual health insurance coverage and less likely to have coverage from government programs other than Medicare or Medicaid.

Adjusting for the influence of other factors using multinomial logit analysis of data from Wave 1 did not alter these findings (Table 4). Current smokers were more likely to have been uninsured or have various forms of government insurance. They were least likely to have private individual insurance, although the difference between this category and private group coverage, the omitted reference group was not statistically significant at conventional levels. Gauged in terms of differences in probabilities predicted from this model, current smokers were 0.0009 more likely to be uninsured, 0.010, 0.0003, and 0.030 more likely to be on Medicare, Medicaid, or have other government coverage, respectively, and 0.006 less likely to have private individual coverage than were never smokers. Although these differences in probability appear to be small, they are sometimes large relative to the proportion of persons in the age cohort with the type of coverage, such as for other government insurance coverage which underlies the large effect of smoking for this payer category to be discussed below.

The difference in the probability of having private group coverage (not shown in Table 4) was 0.049, implying that current smokers were less likely to have group insurance than was the case for never smokers. Although never smokers were less likely to have been uninsured than were current smokers, they were more likely to be uninsured than were persons who had quit, especially persons who had quit 20 or more years before the Wave 1 interview.

Many other parameter estimates, not shown in the table, were plausible. For example, risk averse persons were more likely to have some form of health insurance, a result previously reported by Barsky et al. (1997). Older persons were more likely to be uninsured or have public insurance, including Medicare. Since the analysis was based on

Wave 1, none of the respondents had become age eligible for Medicare. Older persons within the age cohort were least likely to have private group coverage.

Utilization of Personal Health Care Services. We measured the impact of smoking on utilization of health services, controlling and not controlling for self-reported health. In general, the results were quite similar, and we only report results without these controls since not controlling for self-reported health is more conceptually appropriate. (To the extent that smoking affects self-reported health, one should not control for this.)

For hospital care, effects of smoking status on use were positive for current and for all of the former smoking categories (Table 5). Current smokers had the highest rates of use with a relative risk of 1.29, followed by persons who had quit for five to nine years at the prior wave with a relative risk of 1.21; the influence of smoking was less for those who had quit 10-19 years before the prior wave with a relative risk of 1.14. The relative risk for persons who had quit 20 or more years previously was essentially the same as for never smokers, the omitted reference group.

Other relationships, not presented, were plausible. For example, use by the uninsured was the lowest, *cet. par.*, and use by Medicare beneficiaries was the highest, holding age and other factors constant. In general, privately insured individuals had lower rates of hospital use than did those with public insurance.

For number of visits, the effect of smoking status on use was less clear. Current smokers had essentially the same rates of use as never smokers. By contrast, those who quit from five to nine years and 10-19 years before the interview saw physicians more often than did those who never smoked. The relative risk for both groups of quitters was 1.13. When we controlled for self-reported health (not shown), the differential in visit

rates between current smokers and never smokers estimated effect of being a current smoker was even larger, and this difference was statistically significant at better than the five percent level. We controlled for many other factors, including type of health insurance, education, income, and degree of risk aversion. Results for most of the other explanatory variables were plausible.

In this age cohort, being in a nursing home is a very rare event. Although the number of respondents spending time in a nursing home increased for each of the waves, the number was very low: Wave 1—11; Wave 2—14; Wave 3—21; Wave 4—25. Among the users, the overwhelming majority of persons stayed in the nursing home for a month or less, suggesting that most of this utilization was for post-hospital stays. Thus, in our logit analysis of nursing home use, we only distinguished between users and nonusers. Even with this very small sample of users, the coefficient on current users was positive and statistically significant at the 10.3 percent level. Coefficients for the former smokers were also positive, although statistically significant at lower levels than this. Including self-reported health only had a slight influence on the estimated parameters. For all of the categories of current and former smokers, the odds ratios well exceeded 1.0, suggesting that with more statistical power, statistically significant relationships may have been obtained.

Not surprisingly (in results not shown), given the distribution of length of stay, having Medicare increased the number of nights in a nursing home; by contrast, being on Medicaid had no effect.

Mortality. Current smokers a much higher rate of death than never smokers (Table 6). For males, the hazard ratio was 3.68 and for females, 2.41, both parameter estimates

statistically significant at the better than the 0.01 level. For males, hazard ratios for former smokers who quit five to nine years before the interview were around 2.16, for those who quit 10 to 19 years earlier, 2.43, and, for persons who had quit more than 20 years earlier, the hazard ratio was 1.41, but not statistically significant at conventional levels. For females, hazard ratios were consistently lower than for males, and except for current smokers, not statistically significant. Effects of smoking were quite robust to changes in equation specification.

Other results were generally plausible (not shown). For males, the following variables had statistically significant and positive impacts on deaths—age, being on Medicare, Medicaid, and one of the measures of heavy drinking at the baseline interview. Being married reduced the probability of dying. Risk preferences had no impact on mortality. Not accounting for risk preferences has been a criticism of studies used by plaintiffs in tort litigation (see e.g., Hersch and Viscusi 1990 for specific evidence on the link between smoking and other risky behaviors). For females, only age and being on Medicaid had positive and statistically significant effects on mortality at the five percent level or better (other than being a current smoker).

Simulated Utilization by Smoking Status. Simulated utilization by nonsmoking current smokers was far more similar to never smokers than to current smokers, reflecting that the other characteristics had only a minor impact on utilization relative to the effect of being a smoker (Table 7). The same pattern resulted for former smokers. The effect of being a former smoker was far greater than the effect on utilization of the characteristics of former smokers versus those of never smokers. By characteristics, we include characteristics affecting both utilization and mortality.

We show utilization for the 16-year period discounted at three percent. We also simulated utilization using a zero discount rate, not shown. Discounting has the effect of decreasing the utilization differences. Discounting at three percent, male current smokers were predicted to have 2.37 additional nights in the hospital over the 16-year period relative to nonsmoking current smokers, a 20.0 percent increase, and 3.22 nights relative to never smokers, a 37 percent increase. Using a zero discount rate, the differentials were 2.89 or 26.6 percent and 3.95 or 36.7 percent, respectively. For females, the corresponding differentials at a three percent discount were 2.18 nights or 25.8 percent and 2.78 or 33.7 percent, respectively.

Being a former smoker decreased the number of hospital nights relative to current smokers. As the period of quitting increased, the difference between hospitalization of former and never smokers decreased. For male former smokers who quit 18 and 23 years before the interview, use was even lower than for never smokers. For female former smoking, the comparison between former and never smokers was relatively more favorable for former smokers than for males. For some categories, the nonsmoking former smoker adjustment boosts hospital utilization.

The pattern for physician visits is more complex. Utilization over the 16-year period was simulated to be lower for male current than for never smokers, 56.3 versus 57.2 or -1.7 percent lower. Use of visits by male nonsmoking current smokers was 56.8; visit rates among current smokers are -0.9 percent lower than this group. Female use of physician services was uniformly higher than for males. For females, the differential between current and never smokers was 0.9 visits or 1.2 percent. Between current and nonsmoking current smokers, the difference was greater, 1.3 visits or 1.8 percent. This

implies that smokers' characteristics per se decrease demand for physician services. For females, former smokers uniformly had more physician visits compared to never smokers.

Simulated Utilization by Payer. Overall, for males, smoking and having smoked in the past increased hospital utilization and physician visit utilization over the 16-year period starting at age 51 by 9.1 and 2.0 percent, respectively (Table 8). For females, the corresponding increases were 8.3 and 2.5 percent, respectively. These percentage estimates reflect mortality, utilization, and cessation propensities. These differentials compare smoking patterns as of the HRS interviews with a world in which no one smoked.

The differences by payer are striking. The largest differentials were for the other government group, which includes Champus and the Veterans Administration. For males, smoking caused a 55.9 percent increase in hospital use and a 14.1 percent increase in physician visit rates. The hospital differential was about half this for Medicare while, for physicians services, the differential for Medicare is almost as large as for other government. For males on Medicaid, the differentials were somewhat less, but still sizable, 22.7 percent for hospital and 8.5 percent for physician use. By comparison, private payers incurred little loss from smoking or even benefit. This was particularly true of private individual insurance. For females, patterns were the same qualitatively, but with differences in details.

Table 8 was constructed from predicted payer status from the multinomial logit analysis based on data from Wave 1. Thus, underlying the calculations is the assumption that persons stayed with the payer they had initially. In fact, many switched to Medicare

at age 65. Thus, the burden on Medicare is somewhat understated and the burden on other payers, such as Medicaid, slightly overstated, but nevertheless substantial.

For physicians' services use, current smokers had lower visit rates than either of the two comparison groups. Utilization for male never smoker smokers was projected to exceed that for current smokers by 2.83 visits over the 16 years. For females, the corresponding difference was 2.23 visits.

Cost of Smoking by Payer. For males, smoking increases by 5.1 percent in the aggregate (Table 9). The corresponding estimate for females is 5.5 percent. As with utilization, the large impact is for other government, followed by Medicare and Medicaid. Effects of the privately insured and the uninsured were negligible. We obtained no consistent relationship between the estimated impacts for males as contrasted with females. For other government, the males' effect was higher; women were half as likely to be covered by other government insurance as were men. Thus, the impact for this group was fairly imprecise. For Medicare, the cost impact was higher for women than men, and the reverse for Medicaid.

VI. Discussion and Conclusions

For this age group, smoking increased medical utilization and dollar outlays by five to eight percent on average, with substantial variation in incidence by payer. This increase was net of various offsets for mortality and smoking cessation. Accounting for the effects of smoking on payer choice is critical to accurate accounting of smoking-attributable costs.

Several limitations of this study should be noted. Some will be corrected in the final draft of the paper. First, our cost estimates did not include the cost of drugs or nursing home admissions. The latter are small for this age group, but nursing home stays

are typically costly. We made no adjustments for technological change. There have been dramatic decreases in mortality from cardiovascular diseases in particular (Cutler and Meara 1998). To the extent that improvements in treating disease occur, we overestimate the cost of smoking. These improvements will be offset by secular increases in the unit cost of care. Also, changes in payment policy are an unknown. Of course, if smoking becomes less costly, perhaps fewer smokers will decide to quit. Further, more youths may initiate the habit.

We only applied a crude adjustment for the cost of end of life care. In a survey like the Health and Retirement Study, which obtains data on use of health services retrospectively, little information on decedents' use is available. Much more precise estimates of such cost can be obtained from insurance claims data.

We did not include other nonmedical costs of smoking, such as the cost of lost productivity and nonpecuniary losses associated with pain and suffering. Although these losses are important, both from private and social vantage points, our focus in this study was on medical cost and the distribution of such cost by source of payment for personal health services.

In this study, we only examined smoking's influence on the cost of medical care during late middle age. Effects may differ appreciably by age cohort. It is plausible that effects on hospital and nursing home use are smaller for persons younger than age 51. Mortality effects are smaller than for persons 51-67. For persons older than 67, the effect on use of nursing home care is likely to be considerably larger. To the extent that there are more nursing home admissions, it will be possible to obtain more precise estimates of the effect of smoking.

Having acknowledged these caveats, this study has (1) greatly improved the framework for gauging cost impacts of smoking and (2) established that the burdens of this habit are indeed substantial—in fact for this age group, much more substantial than previous studies have reported. In our analysis, we accounted for many of the criticisms of past research on smoking cost used by experts for plaintiffs in tobacco litigation (see e.g., Rubin for a critique of such studies). However, although smoking clearly is a cause of poor health, whether or not tobacco companies caused the damage or the harm is self-inflicted is a larger question that our study has not addressed.

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