

# Changes in Health Care Expenditure Associated with Gaining or Losing Health Insurance

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**Background:** Cross-sectional data suggest that changes in health insurance status are associated with expenditures. No national longitudinal analysis has examined this relationship.

**Objective:** To evaluate the association between changes in health insurance status and expenditures.

**Design:** Cohort analyses using the 2000 to 2003 Medical Expenditure Panel Surveys.

**Setting:** U.S. civilian noninstitutionalized population.

**Participants:** Three 2-year cohorts that included 20 848 adults age 21 to 64 years who were stratified by insurance type (private, public, military, or none): 17 130 participants were insured in both years, 342 participants were insured in year 1 and were uninsured in year 2, 385 participants were uninsured in year 1 and were insured in year 2, and 2991 participants were uninsured in both years. Persons who were insured for longer than 2 months but less than 10 months or who switched insurance type were excluded ( $n = 4039$ ).

**Measurements:** Annual health care expenditures (any or none; amount, contingent on any expenditure; and the difference between year 1 and year 2).

**Results:** Adjusted expenditure probabilities were similar among all participant groups while insured and were higher than those for all participant groups while uninsured: 92.1% (95% CI, 91.4% to 92.7%) in year 1 and 91.8% (CI, 90.9% to 92.5%) in year 2 for persons insured in both years, 74.2% (CI, 71.7% to 76.5%) in year 1 and 74.8% (CI, 72.1% to 77.4%) in year 2 for persons uninsured in both years, and 90.7% (CI, 87.1% to 93.4%) for persons insured in year 1 and 74.6% (CI, 69.4% to 79.2%) for persons uninsured in year 2. The pattern was also consistent for the group that was uninsured in year 1 but insured in year 2. Adjusted annual expenditures among all participant groups with insurance were similar; expenditures among participant groups without insurance were similar but were lower than those among participants with insurance. Consistent differences in expenditures between year 1 and year 2 were observed for all groups.

**Limitation:** Few participants changed insurance status.

**Conclusion:** Changing insurance status is associated with changes in expenditures to levels that are similar to those for persons who are continuously insured or uninsured.

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More than 46 million persons in the United States are uninsured (1). However, this point-in-time estimate may underrepresent health insurance disruptions; 38% of the population younger than 65 years (85 million persons) were uninsured for some time from 1996 to 1999 (2). Cross-sectional studies suggest that lack of health insurance compromises access to health care, utilization of preventive health services, and chronic disease management (3–7). However, the underlying association between health insurance coverage and utilization of services is debatable (8).

Sociodemographic characteristics of uninsured persons are distinct from those of insured persons. Persons most at risk for losing or lacking health insurance coverage are the working poor, ethnic minorities, men, and young adults (2–4, 9). These sociodemographic differences may explain, in part, the reduced utilization of services among un-

insured persons. Other factors (for example, the value placed on health care, the value of future health outcomes, the priority of getting health insurance, or a person's health status) that may confound the relationship between health insurance and utilization of services are difficult to measure in observational studies. To our knowledge, the only randomized study of the relationship between health insurance and utilization of services was conducted by the RAND Corporation in 1971. Higher copayments were associated with lower utilization of appropriate and inappropriate health services (10). Longitudinal observational studies of changing health insurance status are limited to specific groups and narrow interventions. For example, indigent adults in California were found to have a deterioration in access to care and health status 6 months after termination of Medi-Cal benefits (Medicaid insurance) (11). Studies also suggest that gaining Medicare coverage increases utilization of selected health services (9, 12). Although these studies are limited, they suggest that health insurance is an important mediator of access to care that fuels utilization.

Several studies have examined more globally the expenditures and utilization of services by uninsured and intermittently insured persons and compared them with those of insured persons (3, 4, 13, 14). However, because all of the studies are cross-sectional, it is uncertain whether the observed differences in expenditure and utilization of

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services reflect changes that would occur if these persons changed their insurance status. Health economists have suggested that such studies may underestimate the effects of gaining insurance because of the “moral hazard” (15). This term has been used to mean that persons who gain health insurance will utilize services “excessively” because they no longer bear the full cost of that additional utilization.

To address these questions, we used nationally representative data to examine what happens to individual health care expenditures as people gain or lose health insurance coverage over time. We used data from the Medical Expenditure Panel Survey (MEPS) to assemble a series of overlapping 2-year cohorts from 2000 to 2003. Because the MEPS follows cohorts for 2 years, we could measure the changes in health care expenditures associated with year-to-year gains or losses of health insurance. We compared 4 groups: continuously uninsured persons, who were uninsured for both years; persons with interrupted insurance, who were insured in year 1 and uninsured in year 2 or uninsured in year 1 and insured in year 2; and continuously insured persons, who were insured for both years (military, public, or private insurance). We hypothesized that 1) adjusted expenditures for persons with interrupted insurance during the year in which they were uninsured would be similar to those of continuously uninsured persons, 2) adjusted expenditures for persons with interrupted insurance during the year in which they were insured would be similar to those of persons continuously insured, and 3) the differences in expenditures between year 1 and year 2 would be consistent. That is, the differences would be statistically nonsignificant for continuously insured and uninsured persons (because their actual expenditures would be similar in both years), but the absolute differences in expenditures would be statistically significant and similar in both groups with interrupted coverage.

## METHODS

### Data Source

We used data from the 2000 to 2003 MEPS. The MEPS is designed to collect annual estimates of socio-demographic characteristics, employment status, health status and disability, health care utilization, spending, and insurance coverage for the U.S. civilian noninstitutionalized population. The household component of the MEPS collects data from individual participants, including 5 interviews over 2 years and an annual self-administered questionnaire. We matched persons from each yearly consolidated file from their first-year and second-year data by using a unique identifier. The response rate was approximately 65% for the 3 cohorts (16–18). We used data on 24 887 adults who were age 21 years or older in year 1 and age 64 years or younger in year 2 and who had private, public, or military insurance or were uninsured.

### Context

Health economists hypothesize that persons who gain health insurance after being uninsured may use care at a higher level after receipt of insurance than do those who are continuously insured.

### Contribution

This study examined health care expenditures during 2 years for 3 groups: continuously uninsured persons, continuously insured persons, and persons in transition from no insurance to insurance or vice versa between the first and second year. Expenditures were higher during insured than during uninsured years. However, expenditures for newly insured persons were similar to those for continuously insured persons.

### Implication

Among uninsured persons who become insured, health care expenditures do not seem to increase above those of continuously insured persons.

—The Editors

## Study Variables

### Expenditures

The household component of the MEPS collects information on expenditures for office-based and hospital-based events, home health care, dental care, vision aids, and prescription medications. The expenditure data are totaled and annualized for each year. Expenditure variables are the amount paid by patients and payors for health services. Total expenses include the sum of direct payments for care in a given year, including out-of-pocket payments and payments from insurance sources (19). Expenditures are based on medical events reported by persons who were surveyed in the MEPS household component when matched to events reported in the MEPS medical provider component. Expenditures also include care provided under capitated reimbursement arrangements in which expenditures were not initiated by a single medical event and were adjusted for systematic reporting error by households that were unaware of insurance payments for health care (20). Expenditures do not include payments for over-the-counter drugs or alternative health care services, such as acupuncture and chiropractic services.

Missing expenditure data are imputed in the publicly available MEPS data. Expenditures are defined as the amount paid for health services by all sources, including individuals, private insurance, and public insurance. Expenditure data for each health care event (prescription drugs, medical visits, or hospitalizations) were collected from study participants in the household component of the MEPS and from a sample of providers in the medical provider component of the MEPS. Expense data were missing from at least 1 component for approximately one third of health care events (for example, when participants were in

capitated arrangements, no “expenses” were generated). A weighted hot-deck approach was used to impute missing expenditure data. This approach uses other reported events to complete missing data and incorporates weights to reflect the overall weighted distribution of the available data and the imputed data (21).

### Insurance Categories

We assigned persons to 1 of 4 mutually exclusive insurance categories, depending on their insurance status each year (as determined by examining their monthly insurance status for each year). Continuously insured persons reported holding military, public, or private insurance for 10 months or more in both years ( $n = 17\,130$  [82.2%]). Among continuously insured persons, 133 had military insurance, 1142 had public health insurance, and 15 855 had private health insurance. The 2 groups with interrupted insurance were defined as follows. A person was categorized as insured in year 1 if he or she had military, public, or private insurance for 10 months or more of the year and uninsured in year 2 if he or she lacked coverage for 10 months or more months of the year ( $n = 385$  [1.8%]). A person was categorized as uninsured in year 1 if he or she lacked coverage for 10 months or more of the year and insured in year 2 if he or she had military, public, or private insurance for 10 months or more of the year ( $n = 342$  [1.6%]). Continuously uninsured persons reported holding no health insurance for 10 months or more in both years ( $n = 2991$  [14.3%]). Persons who reported having more than 1 type of insurance were preferentially assigned to private health insurance, if held, or to military insurance if they did not hold private insurance.

We excluded 15.2% of the total sample (4039 persons). Excluded persons were those who held insurance for more than 3 months but less than 10 months in a year or those who changed insurance type from 1 year to the next. The final sample for analysis includes 20 848 persons.

### Covariates

Covariates were selected on the basis of the Andersen behavioral model of health care utilization (22). In this model, 3 general domains are posited to influence health care access: predisposing variables, such as demographic characteristics, social structures, and health beliefs; enabling resources, such as personal, family, and community infrastructure; and health care need. Thus, the covariates that we analyzed were age, sex, marital status (married or unmarried), language of interview (English or Spanish), race or ethnicity (white, black, Hispanic, or other), household income (<100%, <125%, <200%, <400%, or  $\geq 400\%$  of the federal poverty level), education (less than high school, high school, some college, or college or higher), employment status (employed or unemployed), residence (metropolitan or nonmetropolitan census area), geographic region (Midwest, South, and West or North-

east), dependents in a household (yes or no), smoking status (yes or no), body mass index (underweight [ $<18.5$  kg/m<sup>2</sup>], normal [ $>18.5$  kg/m<sup>2</sup> to  $<25$  kg/m<sup>2</sup>], overweight [ $25$  kg/m<sup>2</sup> to  $<30$  kg/m<sup>2</sup>], or obese [ $>30$  kg/m<sup>2</sup>]) (23), health care attitudes (skepticism score based on responses to 4 statements about the value of health care and insurance [for example, “Health insurance is worth the cost.”], with responses in the form of a 5-point Likert scale [“strongly agree” to “strongly disagree”]) (24), health status (Short Form-12 scores included as a summary mental health component and a summary physical health component) (25), and disease burden (a count of responses to prompts for 9 chronic diseases [diabetes, hypertension, angina, coronary artery disease, heart attack, stroke, asthma, emphysema, or joint pain]). Also, we adjusted for a cohort effect by using the panel variable, which accounts for the year and panel when a participant enters the MEPS study.

### Statistical Analysis

Data were analyzed by using Stata, version 9.2 (Stata Corp., College Station, Texas). We adjusted for the complex design of the MEPS. Data were weighted by using longitudinal strata, primary sampling units, and weights to derive estimates that were representative of the U.S. civilian noninstitutionalized adult population.

We first examined the univariate relationships between the 4 insurance categories and all other variables. We used 2-stage models to examine the adjusted associations between annual health care expenditures in each year and insurance category (by using continuously uninsured persons as the reference category) (26). The first stage modeled any annual expenditure versus no expenditure by using logistic regression. To facilitate interpretation, results are presented as adjusted probabilities of any utilization (27). The second stage modeled the amount of annual expenditures among persons with any expenditure by using the logarithm of total annual expenditures to normalize the distribution. Formal testing verified the normal distribution of the log-transformed expenditure data. To facilitate interpretation of the linear regression coefficients, results are presented as the exponentiated parameter estimates for each insurance category, relative to the reference category (continuously uninsured), to avoid retransformation bias. The year 1 and year 2 analyses were conducted by using covariates for their respective year as appropriate. We used Wald tests to examine the statistical significance of differences in expenditures among the 4 groups.

The reported regression analyses used only observations in persons for whom data were complete; data were missing for 402 (1.9%) persons. In particular, the reported analyses do not adjust for medical skepticism, smoking status, and mental and physical component summary scores of the Short Form-12 (because as many as 8.5% of these data were missing). The effect of this decision was examined in 2 ways. First, we conducted analyses including these variables but without imputation. Second, we con-

ducted regression analyses by using imputed data for key missing covariates implemented with the method of multiple imputation by chained equations (28). Both of the aforementioned approaches produced results that were consistent (in terms of direction, size, and statistical significance) with the results presented.

We also used a differencing approach to examine the

associations between changes in insurance and changes in expenditure. A linear regression model was implemented, in which the differences in individual participants' expenditures between year 1 and year 2 were used as the dependent variable and the 4 insurance categories were used as the independent variables. This analysis excluded persons with extreme expenditure differences (values below the 1st

**Table 1. Sample Characteristics for the First Year of the Survey\***

Variable	Continuously Uninsured Persons	Persons with Interrupted Insurance		Continuously Insured Persons		
		Uninsured in Year 1	Insured in Year 1	Military Insurance	Public Insurance	Private Insurance
Sample size, <i>n</i>	2991	385	342	133	1142	15 855
Participants	14.3 ± 0.4	1.8 ± 0.1	1.6 ± 0.1	0.6 ± 0.1	5.5 ± 0.3	76.1 ± 0.5
Age†						
21–24 y	14.6 ± 0.8	16.6 ± 2.2	20.9 ± 2.8	5.0 ± 2.0	9.9 ± 1.1	5.3 ± 0.3
25–34 y	28.7 ± 1.0	31.1 ± 2.6	26.7 ± 3.5	13.3 ± 3.1	19.6 ± 1.4	21.4 ± 0.6
35–44 y	25.3 ± 0.9	25.0 ± 2.6	25.3 ± 3.0	22.5 ± 4.0	24.4 ± 1.5	29.6 ± 0.5
45–54 y	20.1 ± 1.0	18.7 ± 2.4	16.3 ± 2.7	31.4 ± 4.8	25.3 ± 1.3	27.6 ± 0.6
55–64 y	11.3 ± 0.7	8.6 ± 1.5	10.9 ± 2.1	28.0 ± 4.2	20.9 ± 1.9	16.0 ± 0.4
Men†	56.8 ± 0.9	49.8 ± 2.3	53.7 ± 2.8	42.7 ± 3.5	39.2 ± 1.4	48.9 ± 0.3
Married†	47.8 ± 1.4	50.1 ± 3.1	55.2 ± 4.3	74.3 ± 4.4	36.3 ± 1.7	71.6 ± 0.6
Spanish-speaking†	21.3 ± 1.3	10.5 ± 1.8	6.0 ± 1.1	0	7.4 ± 0.9	2.4 ± 0.2
Race†						
White	66.1 ± 1.7	57.0 ± 3.2	60.0 ± 3.6	64.1 ± 4.7	53.0 ± 2.9	59.5 ± 1.7
Black	14.1 ± 0.9	14.3 ± 2.3	12.1 ± 2.1	5.0 ± 1.7	25.6 ± 1.3	9.4 ± 0.5
Hispanic	15.5 ± 1.4	21.2 ± 2.8	22.8 ± 3.6	17.9 ± 3.9	16.3 ± 2.0	26.5 ± 1.8
Other	4.3 ± 0.6	7.5 ± 1.6	5.2 ± 1.5	13.0 ± 4.3	5.2 ± 1.0	4.6 ± 0.3
Family income†						
<100% of federal poverty level	19.8 ± 0.8	15.5 ± 2.0	8.2 ± 1.6	7.4 ± 2.0	51.4 ± 1.7	2.2 ± 0.2
100%–124% of federal poverty level	7.9 ± 0.5	6.9 ± 1.5	5.0 ± 1.1	1.5 ± 0.8	10.9 ± 1.0	1.2 ± 0.1
125%–199% of federal poverty level	24.0 ± 0.9	23.5 ± 2.8	20.8 ± 2.7	11.0 ± 3.1	19.2 ± 1.3	6.6 ± 0.3
200%–399% of federal poverty level	32.1 ± 1.1	33.2 ± 3.3	35.7 ± 3.7	35.2 ± 5.2	13.4 ± 1.2	33.3 ± 0.7
≥400% of federal poverty level	16.3 ± 1.0	21.0 ± 2.8	30.3 ± 3.4	44.8 ± 5.1	5.1 ± 0.7	56.9 ± 0.7
Education†						
Some high school	36.1 ± 1.1	22.5 ± 2.5	24.5 ± 3.2	8.3 ± 2.1	44.1 ± 1.5	7.6 ± 0.3
High school	36.2 ± 1.1	33.6 ± 2.8	33.1 ± 2.9	38.9 ± 5.3	37.7 ± 1.5	31.7 ± 0.5
Some college	17.1 ± 0.9	24.5 ± 2.5	23.5 ± 2.5	29.0 ± 4.3	13.7 ± 1.1	25.4 ± 0.5
College or higher	10.6 ± 0.8	19.4 ± 2.7	18.3 ± 3.1	23.8 ± 4.5	4.5 ± 0.6	35.3 ± 0.7
Employed†	73.1 ± 0.8	74.9 ± 2.5	85.1 ± 2.1	61.1 ± 4.7	25.9 ± 1.5	88.1 ± 0.3
Urban residence‡	80.2 ± 1.5	88.0 ± 1.9	80.0 ± 2.7	72.3 ± 4.7	78.1 ± 1.9	83.5 ± 1.0
Region†						
Midwest	16.4 ± 1.2	19.4 ± 2.3	18.1 ± 2.9	18.2 ± 4.5	19.2 ± 1.9	25.2 ± 1.5
South	44.4 ± 2.2	38.8 ± 3.4	39.9 ± 3.9	57.3 ± 5.9	29.4 ± 2.3	32.8 ± 1.9
West	25.5 ± 2.1	26.0 ± 2.9	28.5 ± 3.5	22.1 ± 4.9	24.9 ± 2.8	21.5 ± 1.8
Northeast	13.6 ± 1.1	15.8 ± 2.8	13.5 ± 2.7	2.4 ± 1.3	26.5 ± 2.2	20.6 ± 1.4
Persons with usual source of care†	46.3 ± 1.3	47.7 ± 3.1	73.9 ± 2.9	90.8 ± 2.8	86.7 ± 0.9	83.2 ± 0.5
Persons with dependents†	22.8 ± 0.8	27.5 ± 2.6	29.5 ± 2.7	24.0 ± 3.4	19.9 ± 1.3	28.9 ± 0.4
Disease burden†						
No disease	64.6 ± 1.1	64.2 ± 2.9	61.0 ± 3.0	43.2 ± 5.3	35.9 ± 1.8	53.6 ± 0.6
1 disease	25.1 ± 0.9	25.9 ± 2.6	25.5 ± 2.7	28.6 ± 4.1	25.3 ± 1.5	31.3 ± 0.5
≥2 diseases	10.3 ± 0.6	64.2 ± 2.9	13.6 ± 1.9	28.2 ± 4.4	38.8 ± 1.8	15.1 ± 0.4
Health status†						
Excellent	16.0 ± 0.9	17.8 ± 2.3	20.3 ± 2.8	13.3 ± 3.1	6.7 ± 0.8	20.4 ± 0.5
Very good	32.2 ± 1.2	37.1 ± 3.2	36.1 ± 3.5	41.0 ± 4.5	18.8 ± 1.6	44.5 ± 0.6
Good	33.5 ± 1.1	29.9 ± 2.9	34.1 ± 3.5	34.5 ± 4.1	28.9 ± 1.5	28.1 ± 0.5
Fair or poor	18.4 ± 0.8	15.2 ± 2.5	9.6 ± 2.0	11.2 ± 2.7	45.6 ± 1.9	6.7 ± 0.3
Any expenditure for year 1, %†	58.0 ± 1.1	65.8 ± 3.1	82.4 ± 2.3	91.7 ± 2.4	92.4 ± 0.8	89.7 ± 0.4
Any expenditure for year 2, %†	56.5 ± 1.1	79.4 ± 2.6	64.5 ± 2.8	94.9 ± 2.0	91.0 ± 0.8	89.0 ± 0.3
Mean total expenditure for year 1, \$†	447 ± 1.0	453 ± 1.1	798 ± 1.1	1314 ± 1.2	2248 ± 1.1	1051 ± 1.0
Mean total expenditure for year 2, \$†	469 ± 1.1	985 ± 1.1	605 ± 1.1	1194 ± 1.1	2160 ± 1.1	1006 ± 1.0

\* There were 20 848 persons in the sample. Values are percentages (±SE) except where noted. The data for the groups with interrupted insurance are pooled for the 3 insurance types.

† *P* < 0.001.

‡ *P* < 0.01.

**Table 2. Adjusted Probability of Any Expenditure versus No Expenditure\***

Insurance Category	Adjusted Probability (95% CI), %	
	Year 1	Year 2
Insured in years 1 and 2	92.1 (91.4–92.7)	91.8 (90.9–92.5)
Insured in year 1, uninsured in year 2	90.7 (87.1–93.4)	74.6 (69.4–79.2)
Uninsured in year 1, insured in year 2	77.7 (71.3–83.0)	88.9 (84.2–92.3)
Uninsured in years 1 and 2	74.2 (71.7–76.5)	74.8 (72.1–77.4)

\* Probabilities are adjusted for age, sex, language of interview, race or ethnicity, household income, education, employment, urban residence, region, number of dependents, disease burden, and cohort year.

percentile and above the 99th percentile) to ensure an acceptably normal distribution of expenditure differences. Results are presented in dollar amounts of expenditure difference to compare expenditures between year 1 and year 2. We used Wald tests to compare the 4 insurance groups.

**Role of the Funding Source**

No external funding was received for the study.

**RESULTS**

Table 1 shows the relationship between insurance categories and other measured characteristics. In general, the characteristics of persons who had interrupted insurance are intermediate between those of persons who had continuous private insurance and those who were continuously uninsured. Characteristics of persons who had continuous public insurance reflect a greater social disadvantage than those of the other groups. For variables that are more sus-

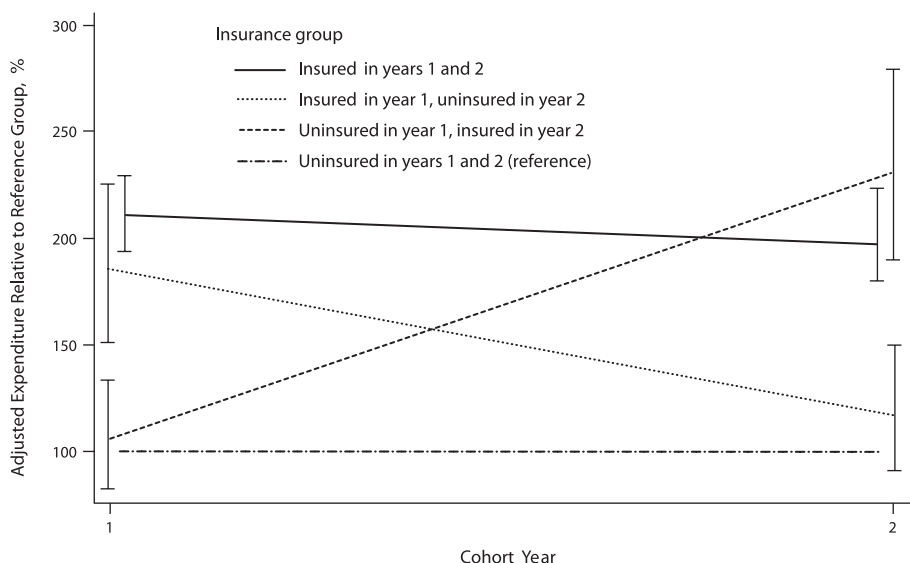
ceptible to the effects of insurance (such as the probability of any expenditures or total health care expenditures), values for persons who had interrupted insurance are closer to those of persons who were continuously insured or those who were continuously uninsured, depending on their insurance status that year. The patterns were consistent for second-year characteristics (data not shown).

Table 2 shows the adjusted probability of any expenditure by year and insurance category. The adjusted probabilities of any expenditure for the 2 groups with interrupted insurance did not statistically significantly differ from those for the continuously insured group for the year in which they were insured, and they were similar to those for the continuously uninsured group for the year in which they were uninsured (Appendix Table 1, available at www.annals.org).

The Figure summarizes the key results of the adjusted analyses of expenditures contingent on any expenditure. The adjusted expenditures for the 2 groups with interrupted insurance did not statistically significantly differ from those for the continuously insured group for the year in which they were insured, and they were similar to those for the continuously uninsured group for the year in which they were uninsured (Appendix Table 2, available at www.annals.org).

Table 3 summarizes the findings of the differencing analysis. The difference in expenditures between the 2 years for the continuously uninsured group did not statistically significantly differ from that of the continuously insured group. For persons who were intermittently insured, there was a statistically significant increase (or decrease) in expenditures with the gain (or loss) of insurance. Wald tests revealed that the mean absolute changes in ex-

**Figure. Adjusted expenditures (95% CIs) of each insurance group.**



penditures for persons who gained or lost insurance did not statistically differ from each other ( $P = 1.00$ ).

## DISCUSSION

Between 2000 and 2003, more than 80% of U.S. adults 21 to 64 years of age had continuous military, public, or private insurance; approximately 15% of adults were continuously uninsured; and 3% of adults had interrupted coverage that included 1 year of no insurance. Persons with interrupted insurance have sociodemographic and health status characteristics that are intermediate between those of persons who are continuously privately insured and those of persons who are continuously uninsured. Despite different individual characteristics, persons who had interrupted insurance, while insured, had health care expenditures similar to those of continuously insured persons; conversely, while uninsured, their expenditures were similar to those of continuously uninsured persons. Our results suggest that expenditures associated with gaining insurance will increase in a predictable manner to levels similar to those of persons who are already insured.

On the basis of an English-language MEDLINE search through 31 January 2007, we believe that ours is the first study to follow a nationally representative cohort to examine how expenditures change as persons gain or lose health insurance. Previous cross-sectional research has shown that uninsured adults are less likely to use health services for preventive care and for chronic disease management (5, 6, 23). Consistent with our findings, those of other studies show that uninsured persons are more likely than those with private insurance to be in minority racial or ethnic groups, poorer, less educated, and non-English speaking (2, 3, 9, 24). Because of these differences, all of which are associated with worse health outcomes, it is uncertain whether lack of insurance, these characteristics, or other characteristics are the primary cause of poorer health care access and outcomes among uninsured persons. Our study confirms the substantial differences in sociodemographic characteristics, disease burden, and health status among groups with different health insurance characteristics. However, our findings show that despite these differences (and possible unmeasured differences), changes in insurance status seem to be associated with predictable changes in total health care expenditures. The findings are also consistent with previous research on specific utilization changes after expansion or reduction in insurance coverage (5, 12, 25, 26, 29).

Our study has several limitations. The groups with interrupted insurance were relatively small, resulting in wide CIs. In addition, as the groups with interrupted coverage acquire or lose insurance over time, we cannot exclude the possibility that unmeasured characteristics drive the change in health insurance status and the change in health service utilization, so that a similar relationship between insurance change and utilization of services would

**Table 3. Insurance Category and Difference in Total Health Care Expenditures between Year 1 and Year 2\***

Insurance Category	Difference in Total Expenditures (95% CI), \$
Insured in years 1 and 2	52.0 (−13.4 to 117.5)
Insured in year 1, uninsured in year 2	641.9 (195.6 to 1088.2)
Uninsured in year 1, insured in year 2	−977.0 (−1368.2 to −585.8)
Uninsured in years 1 and 2	−30.6 (−132.88 to 71.78)

\* Values below the 1st percentile and above the 99th percentile were excluded. Differences are adjusted for income difference, employment difference, and cohort year.

not be observed in the larger uninsured population if they gained insurance. One might expect, however, that if the decision to obtain insurance was driven by specific needs, utilization (as opposed to nonutilization) would increase above the levels for persons with continuous insurance; we did not observe such an effect. We also cannot exclude the possibility that changes in health care expenditures in persons with interrupted coverage reflect not only changes in insurance status but also utilization that differs in quantity and content from that of continuously insured or continuously uninsured persons. Indeed, some evidence suggests that persons who gain insurance have patterns of utilization that differ from those of persons continuously insured for up to 3 years (9, 25, 30). Because we did not examine outcomes, it is unclear whether changes in service utilization translate into changes in health care outcomes. However, emerging evidence suggests that improved access associated with insurance coverage is associated with potentially beneficial changes in care (3, 12); further analyses are needed to clarify the extent to which these changes are consistent with improved health outcomes.

Despite these limitations, our analysis adds substantively to previous literature. To our knowledge, this is the first study that used nationally representative longitudinal data to measure the changes in expenditures after loss and gain of health insurance. Previous observational studies have used insurance status at 1 point in time, or used highly selected small samples, and narrowly defined insurance changes and utilization measures. To extend our investigation, future studies that query utilization rates of preventive health services relative to longitudinal health insurance status may provide more direct evidence of the role of health insurance in accessing appropriate services. Evaluations of the association between changes in health insurance and hospitalization rates or emergency department use may further clarify the relationship between health insurance and health care.

Our findings suggest that characteristics of persons who have interrupted insurance coverage differ from those of continuously insured or continuously uninsured persons, but changes in insurance status, independent of these individual characteristics, are associated with predictable changes in expenditures. These results are consistent with

the assertion that by increasing access to care, health insurance may improve outcomes. Our study provides further support for efforts to expand health insurance coverage, which is likely to yield relatively cost-effective health benefits to persons in the United States (31).

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**Appendix Table 1. Complete Model of Adjusted Logistic Relationship between Insurance Category and Any Expenditure versus no Expenditure**

Variable	Odds Ratio (95% CI)	
	Year 1	Year 2
Insured in years 1 and 2	4.04 (3.55–4.60)	2.68 (1.81–3.96)
Insured in year 1, uninsured in year 2	3.41 (2.34–4.95)	0.99 (0.75–1.30)
Uninsured in year 1, insured in year 2	1.21 (0.89–1.68)	3.74 (3.28–4.26)
Uninsured in years 1 and 2	1.00 (reference)	1.00 (reference)
Age		
21–24 y	1.00 (reference)	1.00 (reference)
25–34 y	1.06 (0.86–1.31)	0.90 (0.75–1.10)
35–44 y	1.08 (0.88–1.33)	1.00 (0.80–1.25)
45–54 y	1.28 (1.03–1.60)	1.27 (1.00–1.59)
55–64 y	1.57 (1.22–2.02)	1.48 (1.12–2.00)
Women	3.15 (2.80–3.53)	3.26 (2.94–3.62)
Married	1.19 (1.06–1.33)	1.09 (0.98–1.20)
Spanish-speaking	1.85 (1.58–2.17)	1.73 (1.45–2.06)
Race or ethnicity		
White	1.00 (reference)	1.00 (reference)
Black	0.49 (0.41–0.59)	0.52 (0.44–0.63)
Hispanic	1.10 (0.88–1.38)	1.15 (0.94–1.42)
Other	0.48 (0.37–0.60)	0.51 (0.40–0.66)
Income		
<100% of federal poverty level	1.00 (reference)	1.00 (reference)
100%–124% of federal poverty level	1.22 (0.90–1.66)	0.97 (0.71–1.34)
125%–199% of federal poverty level	0.99 (0.82–1.20)	0.94 (0.79–1.13)
200%–399% of federal poverty level	0.93 (0.76–1.13)	1.05 (0.88–1.24)
≥400% of federal poverty level	1.15 (0.94–1.41)	1.36 (1.11–1.66)
Education		
Some high school	1.00 (reference)	1.00 (reference)
High school	1.13 (0.99–1.31)	1.27 (1.10–1.46)
Some college	1.45 (1.21–1.74)	1.70 (1.43–2.03)
College or higher	2.26 (1.86–2.74)	2.31 (1.90–2.79)
Employed	0.95 (0.81–1.10)	0.97 (0.84–1.23)
Urban residence	1.06 (0.91–1.24)	0.85 (0.73–0.98)
Region		
Midwest	0.83 (0.65–1.05)	0.91 (0.76–1.09)
South	0.90 (0.72–1.13)	0.83 (0.70–0.99)
West	0.79 (0.61–1.03)	0.85 (0.70–1.05)
Northeast	1.00 (reference)	1.00 (reference)
Persons with dependents	1.10 (1.00–1.30)	1.26 (1.12–1.42)
Disease burden	2.50 (2.00–3.10)	2.12 (1.82–2.47)
Disease burden squared	1.00 (0.90–1.10)	1.14 (1.01–1.29)
Cohort year	1.10 (1.00–1.20)	1.10 (1.00–1.30)

**Appendix Table 2. Complete Model of Adjusted Linear Relationship between Insurance Category and Expenditures**

Variable	Expenditures Relative to Reference Group (95% CI)*	
	Year 1	Year 2
Insured in years 1 and 2	2.11 (1.94–2.30)	1.99 (1.78–2.22)
Insured in year 1, uninsured in year 2	1.85 (1.52–2.56)	1.15 (0.89–1.49)
Uninsured in year 1, insured in year 2	1.06 (0.83–1.34)	2.28 (1.87–2.77)
Uninsured in years 1 and 2	1.00 (reference)	1.00 (reference)
Age		
21–24 y	1.00 (reference)	1.00 (reference)
25–34 y	1.06 (0.95–1.19)	1.26 (1.09–1.47)
35–44 y	1.21 (1.07–1.37)	1.32 (1.15–1.52)
45–54 y	1.40 (1.24–1.59)	1.65 (1.40–1.95)
55–64 y	1.66 (1.46–1.88)	1.94 (1.66–2.28)
Women	1.57 (1.49–1.65)	1.58 (1.49–1.67)
Married	0.95 (0.89–1.01)	0.97 (0.91–1.03)
Spanish-speaking	1.44 (1.28–1.62)	1.44 (1.28–1.62)
Race or ethnicity		
White	1.00 (reference)	1.00 (reference)
Black	0.74 (0.68–0.80)	0.73 (0.68–0.79)
Hispanic	0.99 (0.90–1.10)	1.08 (0.98–1.19)
Other	0.79 (0.70–0.90)	0.75 (0.66–0.85)
Income		
<100% of federal poverty level	1.00 (reference)	1.00 (reference)
100%–124% of federal poverty level	0.92 (0.76–1.11)	1.01 (0.83–1.22)
125%–199% of federal poverty level	0.88 (0.78–0.99)	0.97 (0.85–1.11)
200%–399% of federal poverty level	0.94 (0.84–1.04)	0.93 (0.82–1.04)
≥400% of federal poverty level	1.02 (0.91–1.14)	1.01 (0.89–1.15)
Education		
Some high school	1.00 (reference)	1.00 (reference)
High school	1.04 (0.95–1.13)	1.01 (0.93–1.11)
Some college	1.08 (0.99–1.08)	1.06 (0.97–1.15)
College or higher	1.15 (1.06–1.25)	1.11 (1.01–1.22)
Employed	0.74 (0.69–0.80)	0.72 (0.67–0.78)
Urban residence	0.98 (0.91–1.05)	1.04 (0.97–1.12)
Region		
Midwest	1.02 (0.94–1.10)	1.12 (1.02–1.22)
South	0.99 (0.92–1.06)	1.06 (0.98–1.14)
West	0.97 (0.87–1.08)	0.99 (0.89–1.10)
Northeast	1.00 (reference)	1.00 (reference)
Persons with dependents	1.04 (0.98–1.10)	0.98 (0.92–1.04)
Disease burden	1.62 (1.53–1.71)	1.57 (1.50–1.64)
Disease burden squared	0.99 (0.98–1.00)	1.14 (1.01–1.29)
Cohort year	1.22 (1.17–1.28)	1.10 (1.05–1.16)

\* At least some expenditure is assumed. Expenditures refer to the ratio of expenditures for a given insurance category that are greater or less than those of the reference category.  $R^2 = 0.23$  for both years.