

SPECIAL ARTICLE

Effect of Cost Sharing on Screening Mammography in Medicare Health Plans

Amal N. Trivedi, M.D., M.P.H., William Rakowski, Ph.D.,
and John Z. Ayanian, M.D., M.P.P.

ABSTRACT

BACKGROUND

Policies that increase patients' share of health care expenses decrease the use of discretionary health services but also may reduce the use of important preventive care such as mammography.

METHODS

We reviewed coverage for mammography within 174 Medicare managed-care plans from 2001 through 2004. Among 550,082 individual-level observations for 366,475 women between the ages of 65 and 69 years, we compared rates of biennial breast-cancer screening in plans requiring cost sharing for mammography with screening rates in plans with full coverage. We also performed a longitudinal analysis of screening rates in plans that changed from full coverage to cost sharing for mammography as compared with rates in matched control plans that did not institute cost sharing.

RESULTS

The number of plans with cost sharing for mammography, which we defined as requiring a copayment of more than \$10 or coinsurance of more than 10% for screening mammography, increased from 3 in 2001 (representing 0.5% of women) to 21 in 2004 (11.4% of women). Biennial screening rates were 8.3 percentage points lower in cost-sharing plans than in plans with full coverage, a difference that persisted in adjusted analyses ($P < 0.001$). The effect of cost sharing was magnified among women residing in areas of lower income or educational levels ($P < 0.001$ for each interaction). Screening rates decreased by 5.5 percentage points in plans that instituted cost sharing and increased by 3.4 percentage points in matched control plans that retained full coverage ($P < 0.001$ for the adjusted analysis).

CONCLUSIONS

Relatively small copayments were associated with significantly lower mammography rates among women who should undergo screening mammography according to accepted clinical guidelines. For effective preventive services such as mammography, exempting elderly adults from cost sharing may be warranted.

From the Department of Community Health, Warren Alpert Medical School of Brown University (A.N.T., W.R.), and the Target Research Enhancement Program, Providence Veterans Affairs Medical Center (A.N.T.) — both in Providence, RI; and the Division of General Medicine, Brigham and Women's Hospital; the Department of Health Care Policy, Harvard Medical School; and the Department of Health Policy and Management, Harvard School of Public Health — all in Boston (J.Z.A.). Address reprint requests to Dr. Trivedi at the Department of Community Health, Warren Alpert Medical School of Brown University, Box G-S121, Providence, RI 02912, or at amal_trivedi@brown.edu.

N Engl J Med 2008;358:375-83.

Copyright © 2008 Massachusetts Medical Society.

MOST AMERICANS WITH HEALTH INSURANCE are required to pay part of the cost of a physician visit, hospitalization, or other health service as an out-of-pocket expense. This financial responsibility, known as patient cost sharing, is designed to control health care spending because persons tend to use fewer health services when they are required to bear higher portions of the cost.¹⁻³

Payers and insurers have increased cost-sharing requirements in recent years.⁴ Since 2001, the average deductible in employer-based plans has increased by 60%, and the most common copayment for an office visit has doubled.⁵ A growing number of employers offer “consumer-driven” health plans that require enrollees to exceed a high deductible before receiving coverage for health benefits.⁵ For elderly Americans, cost sharing is a prominent feature of the Medicare program, including its recently enacted prescription-drug benefit.

Persons who are subject to cost sharing use fewer health services and have lower total health care spending than do persons with full coverage.⁶⁻¹¹ Cost sharing through deductibles and copayments may result in more prudent use of medical care and avoidance of low-value services for which the expected benefit is outweighed by a patient’s financial contribution. Such requirements, however, also may reduce the use of appropriate care,¹² especially for vulnerable groups such as low-income patients or those who are chronically ill. Therefore, it is crucial to understand the effect of copayments on the use of specific preventive services that are known to improve health, particularly among elderly adults, who may have greater adverse health effects from forgoing medical care and may be more sensitive to price, given their typically fixed incomes.¹³ If patients consider preventive care to be discretionary or if they simply cannot afford out-of-pocket payments, then even modest cost sharing may lead patients to reduce their use of effective preventive services, with potentially negative effects on health.

Breast cancer is the second leading cause of cancer-related death among women and most commonly occurs among older women.¹⁴ Because regular screening can reduce morbidity from breast cancer, clinical guidelines developed by the U.S. Preventive Services Task Force and the American Cancer Society recommend regular screening mammography for women over 40 years of age.^{15,16}

Although rates of breast-cancer screening increased substantially during the 1990s, two recent studies reported a decline in the use of mammography from 2000 to 2005.^{17,18} Our study assessed the extent to which elderly women forgo this recommended preventive service when faced with cost sharing.

METHODS

DATA SOURCES AND STUDY POPULATION

We obtained data from the Medicare Health Plan Employer Data and Information Set (HEDIS) from 2001 through 2004 through the Centers for Medicare and Medicaid Services (CMS), which contained 24,468,528 observations for enrollees in Medicare managed-care plans. Each observation included an enrollee’s health plan and variables designating adherence to HEDIS quality indicators. Information about data collection, measure specifications, and CMS-sponsored audits has been published previously.^{19,20} Brown University’s Human Research Protections Office and the CMS Privacy Board approved the study protocol; informed consent from the patients was not required.

We matched 97% of the observations in the HEDIS data set to the Medicare enrollment file to determine enrollees’ demographic characteristics. We excluded observations from enrollees who were male, who were not between the ages of 65 and 69 years, or who had died during the measurement year.

To obtain information on health plan characteristics, we linked data from 2002 through 2004 (2,189,983 observations from 178 health plans) to the Interstudy Competitive Edge database.²¹ For 17 health plans that could not be matched to this database, we ascertained these characteristics by contacting the plans directly. We excluded 4 plans for which we were unable to obtain this information, yielding 2,143,566 observations from 174 plans. Our final study sample included 550,082 of these observations that were assessed for the HEDIS mammography measure, representing 366,475 enrollees.

We obtained monthly information on health-plan benefits from 2001 through 2004 from the CMS, including each plan’s required copayment or coinsurance for a screening mammogram. ZIP Code-level data on income and education were obtained from the 2000 U.S. Census.

VARIABLES

Our dependent variable was a screening mammogram during the previous 2 years (yes or no). This variable was assessed annually, with more than one observation for enrollees who were included in the sample in multiple years. The primary independent variable was enrollment in a Medicare plan with cost sharing for screening mammography (yes or no). We designated plans requiring copayments of more than \$10 or coinsurance of more than 10% for screening mammography as cost-sharing plans. Three plans with copayments of \$10 or less or coinsurance of 10% or less for mammography were grouped with full-coverage plans. Assuming an average price of \$100 to \$150 for a screening mammogram,²²⁻²⁴ we calculated that 10% coinsurance represents an out-of-pocket cost of \$10 to \$15. For three plans that provided a range of copayments, we designated the plan's required copayment as the median value. Other covariates included year, race, and the proportions of women who were 65 years of age or older in the patient's ZIP Code who had an income below the federal poverty level or who attended college. Plan-level covariates were Census region, model type (staff or group model, independent practice association, network, or mixed model), average yearly Medicare enrollment, the age of the plan in years, and tax status (for-profit or not-for-profit).

STATISTICAL ANALYSIS

We assessed the characteristics of the women who were eligible for screening mammography and rates of biennial screening in full-coverage and cost-sharing plans. We constructed linear regression models with generalized estimating equations that adjusted for race, ZIP Code-level income and education, Census region, number of Medicare enrollees in the plan, age of the plan, tax status, model type, measurement year, clustering of observations within plans, and repeated measurements among enrollees. We determined whether the effect of cost sharing varied according to income, education, and race by assessing two-way interactions of these variables with cost sharing. For these cross-sectional analyses, the cost-sharing status of a health plan was defined according to the plan's benefit policy in January of the measurement year.

We identified seven health plans that instituted mammography copayments of more than \$10 or coinsurance of more than 10% during the 2003 calendar year. For each of these plans, we ran-

domly selected two matched control plans with continuous Medicare participation from 2002 through 2004 that did not institute copayments. Plans were matched on the basis of Census region, tax status, and model type. We compared the change in rates of mammography among the seven cost-sharing plans with the corresponding change among the 14 matched control plans after adjusting for income, education, and race. There were no plans that eliminated mammography cost sharing during the study period.

All analyses were performed with the use of SAS statistical software (version 9.1), and the results are reported with either two-tailed P values or 95% confidence intervals.

RESULTS**CHARACTERISTICS OF PATIENTS AND PLANS**

As compared with enrollees in plans with full coverage, enrollees in plans with cost sharing for mammography were more likely to be black and living in ZIP Code areas characterized by lower income and education levels (Table 1). Enrollees in cost-sharing plans were also more likely to be located in the Northeast and South and to be enrolled in non-staff-model or non-group-model plans with for-profit tax status, smaller numbers of Medicare enrollees, and fewer years of operation.

The number of Medicare plans with cost sharing for mammography as defined by the plan's benefit policy in January of the measurement year was 3 in 2001, 9 in 2002, 10 in 2003, and 21 in 2004. The proportion of women between the ages of 65 and 69 years who were enrolled in these cost-sharing plans was 0.5% in 2001, 4.3% in 2002, 4.8% in 2003, and 11.4% in 2004. Copayments in cost-sharing plans ranged from \$12.50 to \$35, with a median of \$20. Five plans required coinsurance of 20%.

SCREENING RATES

Rates of breast-cancer screening were 77.5% in plans with full coverage and 69.2% in plans with cost sharing. Annual differences in screening rates between cost-sharing plans and full-coverage plans ranged from 8 to 11 percentage points (Fig. 1).

In multivariate analyses, the presence of cost sharing was associated with a rate of screening that was 7.2 percentage points lower (95% confidence interval [CI], 4.7 to 9.8) than the rate in the

Table 1. Characteristics of Enrollees and Health Plans According to Cost-Sharing Status, 2002–2004.*

Variable	Cost-Sharing Plans (N=31,970)	Full-Coverage Plans (N=518,112)
Enrollees		
Mean age (yr)	66.8	66.8
Race (%) †		
White	73	85
Black	22	9
Other	5	6
Below poverty level (%) ‡	11	9
Attended college (%) §	32	36
Region (%)		
Northeast	28	26
South	36	16
Midwest	15	18
West	21	41
Plans		
Type of managed-care plan (%)		
Staff or group model	7	18
Independent practice association	26	32
Network	6	8
Mixed	61	43
No. of Medicare enrollees in plan (%)		
<10,000	4	4
10,000–25,000	19	14
>25,000	78	82
Tax status (%)		
For-profit	73	56
Not-for-profit	27	44
Age of plan (%)		
<8 yr	12	9
8–25 yr	59	56
>25 yr	30	35

* Percentages may not total 100 because of rounding. All estimates are weighted by the ratio of the number of women in the Medicare plan between the ages of 65 and 69 years to the number of women in the Medicare plan who were sampled for the breast-cancer-screening indicator in the Medicare Health Plan Employer Data and Information Set. N denotes the number of observations.

† Race was derived from the Medicare enrollment file.

‡ This category denotes the mean percentage of persons living in the enrollees' ZIP Code area who were 65 years of age or older and had an income below the federal poverty level.

§ This category denotes the mean percentage of persons living in the enrollees' ZIP Code area who were 65 years of age or older and who had attended college.

absence of cost sharing. This effect was greater in magnitude than that of all other covariates in the model (Table 2). Western and for-profit plans had lower mammography rates than did plans in

other regions and not-for-profit plans, respectively. The age, size, and type of health plan were not significant predictors of biennial screening. The effect of cost sharing was greater for women residing in areas with lower income and educational levels than for women in areas with higher levels of income and education (Table 3). The effect of cost sharing was also greater among white women and women in other racial groups than among black women.

From 2002 through 2004, mammography rates decreased by 5.5 percentage points in 7 plans that instituted cost sharing in 2003, as compared with an increase of 3.4 percentage points in the control group of 14 plans that did not institute cost sharing. These changes yielded an unadjusted absolute difference of 8.9 percentage points and an adjusted absolute difference of 9.0 percentage points (95% CI, 4.3 to 13.8) (Table 4).

DISCUSSION

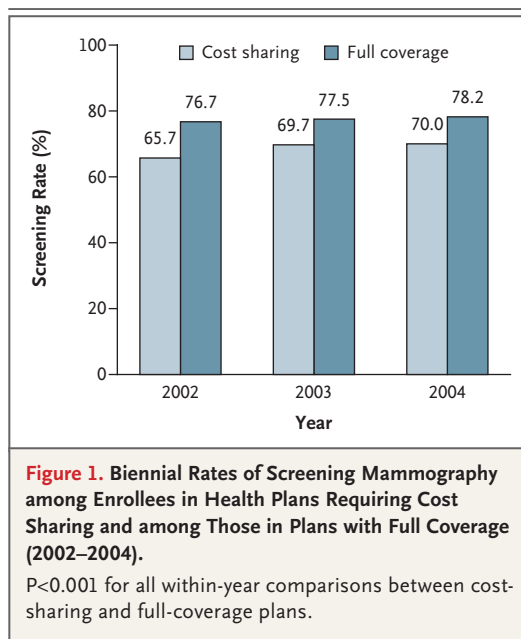
Cost sharing at the point of service encourages patients to consider costs before seeking medical care and relies on their ability to distinguish between essential and nonessential services. In this nationally representative study of Medicare managed-care enrollees, a copayment of more than \$10 or coinsurance of more than 10% was associated with significantly reduced rates of mammography among women who should receive regular screening mammography, according to accepted clinical guidelines. The association of copayments with mammography rates was strong, persisted after adjustment for individual and health-plan covariates, and was consistent both in cross-sectional analyses of all Medicare health plans and in longitudinal analyses of matched health plans that did or did not add copayment requirements over time.

Cost-sharing policies disproportionately affected vulnerable population groups. Black enrollees and those from communities with lower income and educational levels were more likely to enroll in plans requiring copayments for mammography. Moreover, the effect of cost sharing was magnified for enrollees living in communities with lower levels of education and income. However, although the magnitude of cost-sharing effects differed according to socioeconomic factors, we observed a significant negative effect on mammography rates for every demographic group we analyzed.

The prevalence of cost sharing for mammography increased substantially during the years of our study. These trends mirror those described for commercial insurance plans.⁵ Managed-care organizations have traditionally used provider-focused mechanisms such as capitation, utilization review, and regulated networks to contain costs while providing a generous benefit structure with full coverage of preventive care. In recent years, however, increasing numbers of managed-care plans, including those that participate in Medicare, have instituted patient-directed mechanisms, such as greater cost sharing at the point of service, to reduce costs.^{25,26}

Why would modest copayments discourage the use of a service with substantial acceptance among patients and clinicians? First, as compared with insured adults under the age of 65 years, adults 65 years of age or older often have increased out-of-pocket health care expenses associated with chronic medical conditions.^{27,28} Therefore, even a small copayment may represent a substantial financial deterrent to seeking routine medical care, including mammography.^{29,30} Second, patients may be particularly sensitive to the price of preventive services because such offerings may be viewed as less essential than health care for symptomatic conditions. For example, studies of the effect of cost sharing on emergency care have shown that copayments did not delay use of emergency care for persons with acute coronary syndromes or reduce such care for patients with severe conditions.^{9,31} In contrast, in the RAND Health Insurance Experiment, cost sharing decreased the use of preventive care and resulted in adverse outcomes in visual acuity and blood-pressure control in a low-income subgroup.³²⁻³⁴ A direct comparison of the effect of cost sharing on mammography with the effect on other services for Medicare enrollees was beyond the scope of this study and should be further evaluated.

The design of benefits for Medicare enrollees is an area of considerable policy debate. The goal of such policies is to ensure that Medicare enrollees have access to appropriate health services and are protected from financial risk while providing incentives to curb the inappropriate use of services. For its first two decades, Medicare did not provide coverage for cancer screening. Because insurance coverage for effective preventive services can promote their use, Medicare instituted coverage for mammography, Papanicolaou tests, fe-



cal occult-blood tests, and colonoscopy during the 1990s.³⁵ However, the Medicare fee-for-service program still requires a copayment for most preventive services, and we found that an increasing number of Medicare managed-care plans also have implemented such copayments for screening mammography.

The economic rationale for maintaining copayments is that first-dollar coverage of health services leads to overuse by shielding enrollees from the costs of care and providing an incentive to use services of marginal value or to use them excessively — a problem known as moral hazard.³⁶ However, first-dollar coverage for mammography would be unlikely to foster this problem for several reasons. First, for most preventive services covered by Medicare, including screening for breast cancer, colon cancer, and osteoporosis, the appropriate frequency and population for these services have been established in clinical guidelines based on extensive evidence. Indeed, the benefit policies we reviewed typically limited coverage to one annual screening mammogram. In addition, preventive care is generally underused. Only three quarters of the eligible women in our study underwent biennial mammography. Rates of breast-cancer screening are even lower in the Medicare fee-for-service program: only 63% of women between the ages of 65 and 69 years underwent biennial mammography in 2003 or 2004.³⁷ Finally, mammography is a service of high value to women in this age group.³⁸ The cost-effectiveness of such

Table 2. Predictors of the Use of Screening Mammography.*

Predictor	Estimated Change (95% CI) <i>percent</i>	P Value
Cost sharing		
Yes	-7.2 (-9.8 to -4.7)	<0.001
No	Reference	
Race†		
White	Reference	
Black	+1.1 (-0.1 to 2.3)	0.07
Other	-0.9 (-3.8 to 2.0)	0.54
Poverty‡		
High	Reference	
Medium	-1.8 (-2.7 to -0.8)	0.001
Low	-3.9 (-5.4 to -2.3)	<0.001
Education§		
High	Reference	
Medium	-2.5 (-3.1 to -1.9)	<0.001
Low	-4.8 (-5.9 to -3.7)	<0.001
Region		
Northeast	+7.2 (2.2 to 12.2)	0.005
South	+6.6 (2.2 to 11.0)	0.003
Midwest	+4.7 (0.5 to 9.0)	0.03
West	Reference	
Type of managed-care plan		
Staff or group model	+2.8 (-1.7 to 7.2)	0.23
Independent practice association	-2.7 (-6.4 to 1.1)	0.16
Network	+0.3 (-3.7 to 4.2)	0.90
Mixed	Reference	
No. of Medicare enrollees in plan		
<10,000	-1.7 (-5.2 to 1.9)	0.35
10,000–25,000	-0.5 (-2.7 to 1.7)	0.66
>25,000	Reference	
Tax status		
Not-for-profit	Reference	
For-profit	-4.6 (-8.6 to -0.6)	0.03
Age of plan		
<8 yr	-2.8 (-8.7 to 3.1)	0.35
8–25 yr	-1.5 (-8.4 to 5.4)	0.67
>25 yr	Reference	

* Estimates have been adjusted for the clustering of observations within health plans, repeated observations of enrollees, and the year of measurement.

† Race was derived from the Medicare enrollment file.

‡ Poverty denotes the percentage of persons in the enrollees' ZIP Code area who were 65 years of age or older and who had an income below the federal poverty level. "High" refers to ZIP Code areas in the lowest quartile of percentage with income below the poverty level, "medium" refers to the middle two quartiles, and "low" refers to the highest quartile.

§ Education denotes the percentage of persons in the enrollees' ZIP Code area who were 65 years of age or older and who had attended college. "High" refers to ZIP Code areas in the top quartile of college attendance, "medium" refers to the middle two quartiles, and "low" refers to the lowest quartile.

screening has been demonstrated in several studies and compares favorably with that of many other medical services covered by Medicare.³⁸⁻⁴¹

Cost sharing for mammography yields two striking policy contradictions. First, in an effort to monitor and improve clinical performance, the CMS has required that health plans report mammography rates in their enrolled populations publicly. Yet the increasing prevalence of copayments in these same plans could reduce mammography use, despite any quality-improvement efforts to increase such use. Second, Medicare provides coverage for its enrollees for expensive treatment of advanced breast cancer, such as mastectomy and chemotherapy. Yet coinsurance could reduce screening and thereby contribute to greater costs arising from delayed diagnoses of disease. Therefore, a key policy implication of our study is that cost sharing should be tailored to the underlying clinical and societal value of the service in question.¹² For certain preventive services of demonstrated benefit, full coverage will promote appropriately greater use.

Our study has a number of strengths. First, we studied women 65 years of age or older, a group that was excluded from the RAND Health Insurance Experiment and other well-known studies of cost sharing.^{6,8,9} Our study analysis was based on data from 174 health plans operating in 38 states rather than data from a single plan or region. Other studies have assessed the association of supplemental insurance coverage with the use of preventive services.^{42,43} However, supplemental coverage is only an indirect estimate of the degree of cost sharing. Our study reviewed specific benefit policies, thereby allowing greater precision in the assessment of cost sharing. Instead of relying solely on a cross-sectional analysis, we also conducted a longitudinal analysis focusing on plans that introduced cost sharing for mammography, as compared with a matched control group of plans that maintained full coverage. We found a similar magnitude of effect with the two analyses. Finally, assessments of both copayment policies and screening mammography were ascertained through administrative data, which are typically more accurate than patients' reports.^{44,45}

The most important limitation of our study is that enrollees were not randomly assigned to cost-sharing plans. Although we adjusted for several individual and health-plan characteristics that could explain the relationship between cost shar-

Table 3. Effects of Cost Sharing on Rates of Screening Mammography, According to Income, Education, and Race.*

Variable	Rate of Mammography (95% CI) percent	P Value
Poverty†		<0.001
High	-5.4 (-8.5 to -2.3)	
Medium	-7.7 (-10.5 to -4.9)	
Low	-8.4 (-12.8 to -4.0)	
Education‡		<0.001
High	-4.6 (-7.0 to -2.2)	
Medium	-8.4 (-11.3 to -5.6)	
Low	-12.3 (-16.0 to -8.5)	
Race§		<0.001
White	-7.8 (-10.5 to -5.0)	
Black	-4.3 (-7.4 to -1.3)	
Other	-7.4 (-10.0 to -4.8)	

* Estimates have been adjusted for the clustering of observations within health plans, repeated observations of enrollees, year of measurement, and all characteristics listed in Table 2.

† Poverty denotes the percentage of persons in the enrollees' ZIP Code area who were 65 years of age or older and who had an income below the federal poverty level. "High" refers to ZIP Code areas in the lowest quartile of percentage with income below the poverty level, "medium" refers to the middle two quartiles, and "low" refers to the highest quartile.

‡ Education denotes the percentage of persons in the enrollees' ZIP Code area who were 65 years of age or older and who had attended college. "High" refers to ZIP Code areas in the top quartile of college attendance, "medium" refers to the middle two quartiles, and "low" refers to the lowest quartile.

§ Race was derived from the Medicare enrollment file.

ing and the use of mammography, selection effects or residual confounding may explain some part of our results. For example, women who are more inclined to seek mammography may enroll in plans without cost sharing, or plans without cost sharing may have other mechanisms to promote mammography. We did not have detailed clinical information to determine the effect of copayments on women who are at increased risk for breast cancer or to estimate excess late-stage diagnoses or breast-cancer deaths in cost-sharing plans. We could not analyze differential effects of specific copayment amounts, since there were limited numbers of plans in some cost-sharing ranges. The study used ZIP Code-level measures of income and education, which may underestimate the effects of individual-level socioeconomic measures.⁴⁶ We were unable to identify which enrollees in our study were eligible for Medicaid coverage of Medicare managed-care copayments. Finally, we did not have information regarding physi-

Table 4. Rates of Screening Mammography in Plans That Instituted Cost Sharing in 2003, as Compared with Matched Control Plans without Cost Sharing.

Type of Plan	No. of Observations	Rates of Mammography		Change	Between-Group Difference*	
		2002	2004		Unadjusted	Adjusted (95% CI)†
		percent			percentage points	
Instituted cost sharing	8,732	74.8	69.3	-5.5	8.9	9.0 (4.3-13.8)
Did not institute cost sharing	12,969	71.9	75.3	+3.4		

* This category shows the difference between plans that instituted cost sharing and those that did not institute cost sharing.

† This estimate has been adjusted for clustering within health plans, repeated observations of enrollees, income, education, and race ($P < 0.001$).

cian recommendations or referrals for mammography, which are important determinants of screening.⁴⁷

Ensuring that all eligible women undergo appropriate breast-cancer screening is an important public health goal. We found that a rising proportion of women in the Medicare managed-care program are subject to copayments for screening mammography and that such copayments are associated with significantly reduced rates of screening. For cost-effective preventive services such as

mammography, exempting elderly beneficiaries from cost sharing may increase rates of appropriate use.

Supported by a grant (5T32-HS-000020-20) from the Agency for Healthcare Research and Quality.

Dr. Ayanian reports receiving consulting fees from RTI International and DxCG. No other potential conflict of interest relevant to this article was reported.

We thank Vincent Mor for his helpful comments on a previous version of the manuscript; Kim Elmo, Judy Giles, and Michael McCann of the CMS for their assistance with data acquisition; and the Research Data Assistance Center of the University of Minnesota for advice on obtaining Medicare data.

REFERENCES

- Zweifel P, Manning WG. Moral hazard and consumer incentives in health care. In: Culyer AJ, Newhouse JP, eds. *Handbook of health economics*. New York: Elsevier, 2000:409-59.
- Rubin RJ, Mendelson DN. Cost sharing in health insurance. *N Engl J Med* 1995;333:733-4.
- Ellis RP, McGuire TG. Supply-side and demand-side cost sharing in health care. *J Econ Perspect* 1993;7:135-51.
- Iglehart JK. Changing health insurance trends. *N Engl J Med* 2002;347:956-62.
- Claxton G, Gabel J, Gil I, et al. Health benefits in 2006: premium increases moderate, enrollment in consumer-directed health plans remains modest. *Health Aff (Millwood)* 2006;25:w476-w485.
- Newhouse JP, Manning WG, Morris CN, et al. Some interim results from a controlled trial of cost sharing in health insurance. *N Engl J Med* 1981;305:1501-7.
- Beck RG, Horne JM. Utilization of publicly insured health services in Saskatchewan before, during and after copayment. *Med Care* 1980;18:787-806.
- Cherkin DC, Grothaus L, Wagner EH. The effect of office visit copayments on utilization in a health maintenance organization. *Med Care* 1989;27:1036-45.
- Selby JV, Fireman BH, Swain BE. Effect of a copayment on use of the emergency department in a health maintenance organization. *N Engl J Med* 1996;334:635-42.
- Brian EW, Gibbens SF. California's Medi-Cal copayment experiment. *Med Care* 1974;12:Suppl:1-56.
- Roddy PC, Wallen J, Meyers SM. Cost-sharing and use of health services: The United Mine Workers of America Health Plan. *Med Care* 1986;24:873-6.
- Chernew ME, Rosen AB, Fendrick AM. Value-based insurance design. *Health Aff (Millwood)* 2007;26:w195-w203.
- Rice T, Matsuoka KY. The impact of cost-sharing on appropriate utilization and health status: a review of the literature on seniors. *Med Care Res Rev* 2004;61:415-52.
- U.S. Cancer Statistics Working Group. United States cancer statistics: 1999-2002 incidence and mortality web-based report version. Atlanta: Centers for Disease Control and Prevention, 2005. (Accessed December 28, 2007, at <http://www.cdc.gov/cancer/npcr/uscs/>)
- Humphrey LL, Helfand M, Chan BK, Woolf SH. Breast cancer screening: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med* 2002;137:347-60.
- Smith RA, Saslow D, Sawyer KA, et al. American Cancer Society guidelines for breast cancer screening: update 2003. *CA Cancer J Clin* 2003;53:141-69.
- Breen N, Cronin KA, Meissner HI, et al. Reported drop in mammography: is this cause for concern? *Cancer* 2007;109:2405-9.
- Use of mammograms among women age ≥ 40 years — United States, 2000–2005. *MMWR Morb Mortal Wkly Rep* 2007;56:49-51.
- Trivedi AN, Zaslavsky AM, Schneider EC, Ayanian JZ. Trends in the quality of care and racial disparities in Medicare managed care. *N Engl J Med* 2005;353:692-700.
- Health Care Financing Administration. Medicare HEDIS 3.0/1998 data audit report. (Accessed December 28, 2007, at <http://permanent.access.gpo.gov/websites/www.hcfa.gov/quality/3i2.htm>.)
- The InterStudy Competitive Edge 12. St. Paul, MN: InterStudy Publications, 2001.
- Hendrick RE, Cutter GR, Berna EA, et al. Community-based mammography practice: services, charges, and interpretation methods. *AJR Am J Roentgenol* 2005;184:433-8.
- Breen N, Brown ML. The price of mammography in the United States: data from the National Survey of Mammography Facilities. *Milbank Q* 1994;72:431-50.
- National Cancer Institute. Screening mammograms: questions and answers. (Accessed December 28, 2007, at <http://www.nationalcancer.org>)

- www.cancer.gov/cancertopics/factsheet/Detection/screening-mammograms.)
25. Robinson JC. Reinvention of health insurance in the consumer era. *JAMA* 2004;291:1880-6.
 26. Achman L, Gold M. Trends in Medicare+Choice benefits and premiums, 1999–2002. New York: The Commonwealth Fund, 2002.
 27. Gross DJ, Alecxih L, Gibson MJ, Corea J, Caplan C, Brangan N. Out-of-pocket health spending by poor and near-poor elderly Medicare beneficiaries. *Health Serv Res* 1999;34:241-54.
 28. Goldman DP, Zissimopoulos JM. High out-of-pocket health care spending by the elderly. *Health Aff (Millwood)* 2003;22(3): 194-202.
 29. Chandra A, Gruber J, McKnight R. Patient cost-sharing, hospitalization offsets, and the design of optimal health insurance for the elderly: National Bureau of Economic Research working paper 12972. Cambridge, MA: National Bureau of Economic Research, 2007. (Accessed December 28, 2007, at <http://www.nber.org/papers/w12972.pdf>.)
 30. Kiefe CI, McKay SV, Halevy A, Brody BA. Is cost a barrier to screening mammography for low-income women receiving Medicare benefits? A randomized trial. *Arch Intern Med* 1994;154:1217-24.
 31. Magid DJ, Koepsell TD, Every NR, et al. Absence of association between insurance copayments and delays in seeking emergency care among patients with myocardial infarction. *N Engl J Med* 1997; 336:1722-9.
 32. Lohr KN, Brook RH, Kamberg CJ, et al. Use of medical care in the Rand Health Insurance Experiment: diagnosis- and service-specific analyses in a randomized controlled trial. *Med Care* 1986;24:Suppl: S1-S87.
 33. Lurie N, Kamberg CJ, Brook RH, Keeler EB, Newhouse JP. How free care improved vision in the Health Insurance Experiment. *Am J Public Health* 1989;79: 640-2. [Erratum, *Am J Public Health* 1989; 79:1677.]
 34. Keeler EB, Brook RH, Goldberg GA, Kamberg CJ, Newhouse JP. How free care reduced hypertension in the Health Insurance Experiment. *JAMA* 1985;254: 1926-31.
 35. Medicare preventive services: most beneficiaries receive some but not all recommended services. Washington, DC: General Accounting Office, 2004. (Accessed December 28, 2007, at <http://www.gao.gov/new.items/d041004t.pdf>.)
 36. Pauly MV. The economics of moral hazard: comment. *Am Econ Rev* 1968;58: 531-7.
 37. Centers for Medicare and Medicaid Services. Biennial national and state mammography data by age group, 2003-2004. (Accessed December 28, 2007, at <http://www.cms.hhs.gov/mammography/downloads/biennial%20national%20and%20state%20data%20by%20age%20group%20for%202003-2004.pdf>.)
 38. Neumann PJ, Rosen AB, Weinstein MC. Medicare and cost-effectiveness analysis. *N Engl J Med* 2005;353:1516-22.
 39. Lindfors KK, Rosenquist J. The cost-effectiveness of mammographic screening strategies. *JAMA* 1995;274:881-4. [Erratum, *JAMA* 1996;275:112.]
 40. Levine BS, Neumann PJ. Do HEDIS measures reflect cost-effective practices? *Am J Prev Med* 2002;23:276-89.
 41. Mandelblatt J, Saha S, Teutsch S, et al. The cost-effectiveness of screening mammography beyond age 65 years: a systematic review for the U.S. Preventive Services Task Force. *Ann Intern Med* 2003;139:835-42.
 42. Blustein J. Medicare coverage, supplemental insurance, and the use of mammography by older women. *N Engl J Med* 1995;332:1138-43.
 43. Kelaher M, Stellman JM. The impact of Medicare funding on the use of mammography among older women: implications for improving access to screening. *Prev Med* 2000;31:658-64.
 44. Gordon NP, Hiatt RA, Lampert DI. Concordance of self-reported data and medical record audit for six cancer screening procedures. *J Natl Cancer Inst* 1993; 85:566-70.
 45. Bloom SA, Harris JR, Thompson BL, Ahmed F, Thompson J. Tracking clinical preventive service use: a comparison of the Health Plan Employer Data and Information Set with the Behavioral Risk Factor Surveillance System. *Med Care* 2000; 38:187-94.
 46. Gornick ME, Eggers PW, Reilly TW, et al. Effects of race and income on mortality and use of services among Medicare beneficiaries. *N Engl J Med* 1996;335:791-9.
 47. Fox SA, Murata PJ, Stein JA. The impact of physician compliance on screening mammography for older women. *Arch Intern Med* 1991;151:50-6.

Copyright © 2007 Massachusetts Medical Society.

ELECTRONIC ACCESS TO THE JOURNAL'S CUMULATIVE INDEX

At the *Journal's* site on the World Wide Web (www.nejm.org), you can search an index of all articles published since January 1975 (abstracts 1975–1992, full text 1993–present). You can search by author, key word, title, type of article, and date. The results will include the citations for the articles plus links to the full text of articles published since 1993. For nonsubscribers, time-limited access to single articles and 24-hour site access can also be ordered for a fee through the Internet (www.nejm.org).