Articles

Effects of Cost Sharing on Physiological Health, Health Practices, and Worry

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In a randomized trial of the effects of medical insurance on spending and the health status of the nonaged, we previously reported that patients with limited cost sharing had approximately one-third less use of medical services, similar general self-assessed health, and worse blood pressure, functional far vision, and dental health than those with free care. Of the 20 additional measures of physiological health studied here on 3,565 adults, people with cost sharing scored better on 12 measures and significantly worse only for functional near vision. People with cost sharing had less worry and pain from physiological conditions on 33 of 44 comparisons. There were no significant differences between plans in nine health practices, but those with cost sharing fared worse on three types of cancer screening and better on weight, exercise, and drinking. Overall, except for patients with hypertension or vision problems, the effects of cost sharing on health were minor.

Although the United States does not have universal National Health Insurance, insurance coverage has increased remarkably in the last 30

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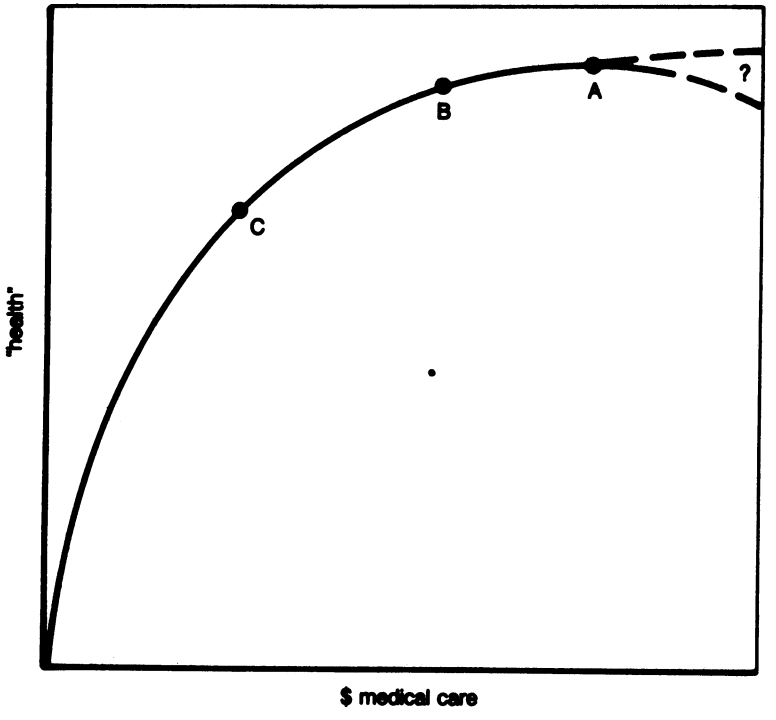
years [1]. Improved longevity and health have accompanied this increase, but national spending on medical care has risen to an all-time high. The resulting concern over the latter has inspired such cost-containment activities as prospective payment. Another way to reduce health care expenditures has been an expansion of cost sharing—causing an increase in the proportion of costs borne by patients. This approach reduces expenditures by decreasing use of health care; its opponents argue that it causes people to cut back on needed care and that their health suffers as a result.

The issue is one of the magnitude of the returns; both opponents and supporters of cost sharing would agree that spending some money on medical care is worthwhile but that there is a limit to how much can profitably be spent. A hypothetical relationship that shows diminishing returns between money spent on medical care and "health" is shown in Figure 1. The line presumably represents the effect of spending on the health of an individual. It also could represent an average effect over

Figure 1: Resources Spent on Medical Care and Health



many groups of people, of whom some (the treatably sick) get more benefit from care than others. The figure holds even for healthy people, reflecting diminishing returns in future health for investments in preventive care. With respect to increases in cost sharing, the issue is to what degree we are on "the flat of the curve."

To examine the effects of cost sharing on health care costs and on the health status of the nonaged, the federal government sponsored a randomized, controlled trial, the RAND Health Insurance Experiment (HIE). We randomly assigned a sample of families to various insurance plans. One group received all medical care free of charge, but others paid a share of their costs up to an income-related maximum amount. We have already reported that those given access to free care used more medical services and spent about 40 percent more on health care than persons sharing in the cost of their medical care [2].

Results on use by insurance plan from two papers on the RAND HIE are shown in Table 1. Free care increases use of all kinds of services. Outpatient use declines steadily with higher coinsurance rates, but the biggest difference is between plans with any cost sharing and those with free care. The individual deductible plan (a special plan with a $150 deductible on outpatient care and free inpatient care) had a rate of inpatient admission between the free-plan rate and the cost-sharing plan rates. Differences in expenses across plans were proportional to differences in use and differences in episode rates. This confirms that prices for services and the amount of care consumed per episode were not affected by cost sharing.

The random assignment of subjects to insurance plans permits a

Table 1: Health Services Use by Insurance Plan

Insurance Plan	*Visits*	*Admissions*	*Adjusted Expenses**	*Outpatient Episodes†*	*Well-Care Episodes†*	*Person-Years (N)*
Free	4.55	0.128	750	3.77	0.79	6,822
25 percent coinsurance	3.33	0.105	617	2.96	0.64	4,065
50 percent coinsurance	3.03	0.092	573	2.83	0.72	1,401
95 percent coinsurance	2.73	0.099	504	2.42	0.51	3,727
Individual deductible	3.02	0.115‡	630	2.61	0.53	4,175

*Adjusted for imbalance of plans across sites, see [17]; 1984 dollars.

†An episode comprises all the services in a year related to a particular illness; for more detail see [18].

‡Inpatient care was free for this plan.

simple test of the effects of cost sharing on health. Because of the large differences in use between those assigned to cost-sharing plans and those who had free care, it also permits a test of the marginal benefits of that additional use. In most observational studies of the effects of medical use, it is hard to untangle the benefits of additional use from the fact that sick people use more care than well people do. For instance, even those who receive optimal treatment for their lung cancer are worse off on average than those people who do not need to visit an oncologist because they are well. However, because of the study's random assignment to a plan, we know that the higher use on the free plan is due to generosity of insurance and not to sickness. This allows an unbiased test of the effects of insurance on health.

Referring back to Figure 1, we can use the information on health of subjects at the end of the experiment to determine whether free care is at point A on the graph and cost sharing at B, or whether they are on a steeper part of the curve at B and C, respectively. Indeed, some have argued that those with generous insurance may be past the top of the curve, that they consume so much medical care that the iatrogenic illness created by the extra care exceeds its benefit.

To judge whether the increased use of medical services with free care led to improved health in adults, 11 health status indicators were compared previously between the free-care and cost-sharing groups [3]. Free care improved two of these measures: functional far vision and blood pressure, with the effects being greater for the poor than for the nonpoor. Subsequent analyses showed a positive effect on dental health as well [4]. These initial findings from the experiment have been criticized for their lack of completeness and their reliance on self-assessed general health measures [5].

In this article, we report on 20 additional measures of physiologic health in the HIE; they include: lung function, shortness of breath, phlegm production, hay fever, angina, ECG abnormalities, ulcer, dyspepsia, varicose veins, chronic joint disorders, walking speed, grip strength, near vision, hearing in each ear, glucose intolerance, thyroid abnormalities, anemia, urinary tract infection, and acne (Table 2). We selected these measures because of their ability to respond to medical intervention.

We also report on nine measures of health practices: weight, smoking, exercise, alcohol consumption, use of relaxants, seatbelt use, frequency of rectal examinations, frequency of Papanicolaou smears, and breast self-examination (Table 2). The additional visits among those receiving free care (see Table 1), especially for well-care appointments, provided an opportunity for providers to counsel their patients

Table 2: Definition of Health Status and Health Practice Measures

Health Status Measure	*Definition*
FEV_1 percent of predicted	Forced expiratory volume in 1 second from spirometric testing, expressed as a percentage of predicted FEV_1 based on equation from Ref. [19]; best of three tries
Shortness of breath scale	Self-reported measure based on dyspnea questionnaire, ranging from 0 = no shortness of breath, to 4 = severe shortness of breath [20]
Chronic phlegm production	Self-reported phlegm production on most days during at least three months of the previous year; 1 = present, 0 = absent
Hay fever scale	Self-reported amount of time per year bothered by hay fever on a natural log scale, ranging from 0 = none, to 6.4 = 6 months or more
Modified Rose scale	Severity scale of self-reported symptoms characteristic of angina [21]; 0 = angina not present, 1.5 = angina present with mild impairment, 2.5 = angina present with moderate impairment
ECG abnormalities	Presence of one or more of the following findings: intraventricular conduction abnormalities, ventricular enlargement (including LVH), atrial fibrillation, ST-segment and T-wave changes, Q-wave abnormalities, ventricular dysrhythmias, artificial pacemaker rhythm; 1 = present, 0 = absent
Varicose vein scale	Severity of varicose veins based on physical exam; 1 = absent, 2 = spider angiomata, 3 = minimal, 4 = moderate, 5 = severe
Diastolic blood pressure	Measured in mm Hg [10]
Cholesterol	Measured in mg/dl [10]
Chronic joint symptoms	Self-reported symptoms characteristic of mild to moderate joint disorders or reported diagnosis of gout by physician; 1 = present, 0 = absent

Continued

Table 2: Continued

Health Status Measure	*Definition*
Walking speed	Number of seconds required to walk 50 feet
Grip strength	Measured in mm Hg three times in each hand using a dynamometer; best try of weaker hand
Active ulcer	Stomach pain or ache in past three months with previous history of physician diagnosis and x-ray-confirmed ulcer, or presence of symptom pattern characteristic of ulcer; 1 = present, 0 = absent
Dyspepsia	Self-reported episodes or attacks of stomach pain or ache in past three months; those with active ulcer are classified as having no dyspepsia 1 = present, 0 = absent
Functional far and near vision	Measured in number of Snellen lines; "functional" means with whatever correction (if any) used by the person to improve vision; Line 2 = 20/20; higher numbers worse
Average hearing threshold level	Simple average of the thresholds at 500, 1000, and 2000 Hz, calculated for right and left ears, separately
Glucose	Measured in mg/dl; random glucose at exit
Abnormal thyroid level	T7 outside the normal range for Seattle, Massachusetts, and South Carolina at enrollment and all sites at exit; T4 outside the normal range for Dayton only at enrollment, excluding values of women with elevated T4 who are pregnant or on birth control pills
Hemoglobin	Measured in g/100 ml automatically by the Coulter Model S machine
Positive urine culture	Growth greater than or equal to 100,000/ml of one or more pathogens, and patient not taking medication for urinary tract infection; 1 = present, 0 = absent

Continued

Table 2: Continued

Health Status Measure	*Definition*
Severity of acne	Scale based on reading of facial photo by a dermatologist; 0 = no acne, 1 = one comedo or papule, 2 = extensive comedos or papules, 3 = pustules, 4 = inflammatory cysts, 5 = acne conglobata
Weight-height measure	Standard Z score for weight/(height squared) for men and weight/(height to the 1.5 power) for women
Smoking scale	Value based on overall mortality ratio relative to never-smokers; ranging from 1.00 = never-smoker or ex-smoker, to 2.20 = current cigarette smoker: more than two packs a day
Monthly alcohol consumption	Ounces of ethanol consumed per month
Use of relaxants	Sum of days per month sleeping pills are taken, and days per month tranquilizers are taken
Seat belt use	Self-reported frequency of seat belt use, ranging from 0 to 100 percent
Level of physical activity	Self-reported measure of overall physical activity; ranging from 1 = not very active physically, to 4 = strenuous activity most days
Most recent rectal examination	"When did you last have a rectal examination by a doctor?" 1 = within the past two years, 0 = more than two years ago, or never had a rectal examination
Most recent Papanicolaou smear	"When did you last have a routine female examination with a Pap smear?" 1 = within the past 12 months, 0 = one or more years ago, or never had one
Frequency of breast self-examination	"How often do you check your own breasts for lumps?" 1 = every month or almost every month, 0 = several times a year or less or never

about their health practices, if they so chose. As advocates of preventive medicine point out, these practices together with current physiologic health can have strong effects on future morbidity and mortality [6]. Finally, based on the results reported here and in other papers, we arrive at a general conclusion of the effect of cost sharing on health.

METHODS

DATA COLLECTION METHODS

The HIE sample represents the general nonaged population of the United States; excluded were those eligible for Medicare (elderly and disabled), military personnel, the institutionalized, and families with income exceeding $61,000 in 1985 dollars. Medicare recipients were not used because varying cost sharing for them was of less interest at the time the study was planned. Families were sampled from six sites: Dayton, Ohio; Seattle, Washington; Fitchburg, Massachusetts; Franklin County, Massachusetts; Charleston, South Carolina; and Georgetown County, South Carolina.

Participants were randomly assigned to one of several health insurance plans by a technique that made the distribution of over 25 sociodemographic and health characteristics as similar as possible across plans. The plans varied by the amount of coinsurance and maximum dollar expenditure. In these analyses, we have grouped the cost-sharing plans and compared them with the one-third of the sample for whom all care was free. This was done for two reasons. First, the differences in use among the cost-sharing plans were smaller than was the difference between the cost-sharing plans and free care. Second, preliminary analysis failed to show any large or consistent pattern of differences within the cost-sharing plans in the general measures of self-reported health status or the few physiologic impairments that were common enough to make such comparisons feasible [3].

A random 70 percent of participants were enrolled for a period of three years, the others for five years. The experiment enrolled 3,958 people between the ages of 14 and 61; we study here the 3,565 who completed the experiment. The sample, sampling techniques, and insurance plans are described in detail elsewhere [7]. Included in the overall experiment, but not in this analysis, were children under age 14 and a group of families in a prepaid group practice; they are the subject of separate analyses [8, 9].

Information on health practices, and on the history of physician

diagnosis, treatment, severity, and impact of selected conditions was collected from a self-administered medical history questionnaire given at the beginning and end of each person's participation in the study. The impact (amount of worry and pain) of each reported physiologic condition was assessed from the response to such questions on worry and pain as: "During the past three months, how much has your hay fever worried you?" (Not at all = 0, a little = 1, somewhat = 2, a great deal = 3). Physiologic measurements were collected as part of a screening examination administered at the beginning of participation to a 60 percent random sample, and at the end to the entire sample. The purpose of the random sample in the study design was to estimate the effect of the examination itself on the use of medical services and subsequent health status.

STATISTICAL METHODS

The objective of the analysis was to compare specific measures of physiologic health practices at the end of the study among persons enrolled on different health insurance plans, after controlling for differences at enrollment. We used regression methods to estimate an equation relating the physiologic measure or health practice at the end of the study (dependent variable) to insurance plan and to initial values of other characteristics expected to affect the final measure (independent variables). For the continuous measures, we used linear regression. For those conditions classified simply as present or absent, for example, dyspepsia, we used logistic regression to estimate the effect of health insurance generosity on the probability of having the condition at the end of the study.

The variables included in the equations were: type of insurance plan, initial physiologic measure or initial health practice, age, sex, race, study site, length of participation in the study (three or five years), family income, and other disease-specific information obtained from the initial medical history questionnaire.

Medical care should be most beneficial to those with health problems. For each physiologic measure, we used regression methods to predict those most likely to have an abnormal measure at the end of the study, on the basis of their characteristics at the beginning of the study. For measures from the screening examination, we made separate predictions for those who did or did not have an initial screening examination. (See Appendix F in [10].) Those most likely to have an abnormal measure are referred to as being at elevated risk—that is, at elevated risk of having an abnormal value for a particular physiologic measure

at the end of the study. For each measure, the elevated-risk group was defined as the predicted top or bottom quartile, depending on whether a high or low value is abnormal.

Cost sharing might affect those with a high income and those with a low income differently; therefore, interactions between risk category, income, and insurance plan were investigated. Low income was defined as the lowest one-fifth of the income distribution of the sample (a mean of $8,100 for a family of four in 1985 dollars) and high income was defined as the highest two-fifths of the income distribution (a mean of $44,600).

Regression equations were used to predict values of the health status measures at the end of the study for an average-risk person on each plan, an elevated-risk person on each plan, an elevated-risk person with low income on each plan, and an elevated-risk person with high income on each plan. The results for elevated-risk individuals of low or high income are presented only for the more common conditions due to sample size limitations. Elevated-risk groups were not defined for health practices.

The predicted values from the screened and unscreened group were combined in the analysis. We used the Dagenais procedure to down-weight properly the 40 percent of the sample without initial screening values [11]. (For this group, predicted values were based only on initial questionnaire information and, therefore, were less accurate.)

There are plan comparisons for each of the 23 conditions for each sample studied. Because we want to assess overall effects on health status, we did not correct for multiple comparisons. The usual corrections are designed to prevent significant differences from appearing by chance when numerous comparisons are made. Particularly given the possibility of concluding that cost sharing does not result in worse health status than free care, it is important that we not use the very conservative standards that lead inevitably to that conclusion. Instead, we will look at the overall pattern of results, using sign tests [12]. These are based on a count of the number of conditions for which free care is better (not necessarily significantly so). Under the assumptions of independent changes in these conditions, and null effects of insurance, we would have 17 or more of the 23 favoring free care 1.74 percent of the time (two-sided $p < .035$). (For 16 of the 23 conditions the percent is 4.7; two-sided $p < .094$.)

These measures do not apply equally well to all people. All persons between the ages of 14 and 61 at the beginning of the study were included in the analyses of forced expiratory volume in one second

(FEV_1), shortness of breath, chronic phlegm production, hay fever, hypertension, cholesterol, ulcer, dyspepsia, far vision, average hearing threshold level, glucose intolerance, thyroid abnormalities, and hemoglobin count. Persons 35 years of age or older who answered "yes" at exit to the question, "During the past year, have you had pain, aching, swelling, or stiffness in your joints?", were included in the analysis of grip strength and walking speed. The analyses of angina, ECG abnormalities, chronic joint problems, and near vision were limited to those 35 years of age or older. Only women were included in the analyses of varicose veins and urinary tract infection. The analysis of data related to acne was restricted to those under 45 years of age. Analysis of health practices was limited to those over 17 for all practices except recent rectal examinations, which was limited to those 40 and over.

These age and gender restrictions also applied to the analyses of reported impact on daily life (worry and pain). Because the power of the tests as related to rare impacts is so low, we restricted our analyses to those conditions for which more than 250 people reported any impact. (For 250 people, a one-quarter increase in the percent worried, e.g., from 8 to 10 percent, would be significant at the 5 percent level.) We assessed the significance of differences in the percentage of people reporting worry (or pain) by insurance plan, according to the *t*-value of the coefficient of cost sharing in a logistic regression for the report of worry (or pain) at exit. Those who reported not having the condition were assumed to have no worry or pain for the condition in that analysis. Differences by insurance plan in the mean level of worry (or pain) for those who worried at all were assessed by simple *t*-tests.

In all analyses, persons with missing data for the dependent variable were excluded from the analysis of that variable. Most such missing data were for people who did not complete the experiment. Although assignment to plan was randomized, differences by plan in acceptance of the enrollment offer and in the dropout rate could have caused differences by plan in the sample completing the experiment. However, the initial values of those completing the study for age, sex, race, income, level of education, and physiologic measures did not differ by plan [10]. Moreover, a previous analysis of the 393 adults who left the experiment before taking the final screening examination and completing the medical history questionnaire showed that health differences by plan should not be affected by this loss to follow-up. Of those 393 adults, 82 did not complete the experiment because of death or for other health reasons; these were distributed evenly across the plans [10].

RESULTS

At the end of the experiment, for people with average characteristics, free-care enrollees scored significantly better than cost-sharing enrollees on 3 of 23 physiologic measures: functional near vision, and the previously reported functional far vision and diastolic blood pressure. In Tables 3 and 4, note that a higher value denotes better health for 3 of the 23 measures: percent of predicted FEV_1, grip strength, and hemoglobin; a positive difference for these three would mean that those on the free plan did better than those on the cost-sharing plan. The two-sided 95 percent confidence intervals are indicated by $\pm X$ and represent the minimal difference that would have been significant. The last columns in Tables 3 and 4 provide information on the direction and magnitude of the difference between the plans. An uppercase letter followed by ++ means the free (F) or cost-sharing plan (C) was significantly better ($p < .05$); and uppercase letter followed by + means the effect was in the ($.05 < p < .2$) range; and an uppercase letter alone indicates simply "better" results ($.2 < p$). An average person on the free plan fared better on 10 measures and worse on 13. There were no significant differences by plan in the measures of health practices (Table 3). An average person on the free plan fared better on five of nine, including the three practices related to early detection of cancer.

Our focus on the quartile in the sample at elevated risk of having a specific condition at the end of the study yielded two significant differences between those on the cost-sharing and on the free-care plans (Table 4). Among those with low hemoglobin values at the beginning of the study, those on the free plan had significantly higher hemoglobin values at the end of the study than those on the cost-sharing plans. Those on the free plan exhibited a significantly worse uncorrected average hearing threshold level in the left ear than those on the cost-sharing plans. Although uncorrected hearing in the right ear exhibited a difference in the same direction, it was not statistically significant. When the elevated-risk group for vision impairments was expanded to include all of those with impaired natural vision, the free plan was significantly better for both far and near corrected vision (that is, tested with usual glasses). Considering all 23 measures, the free plan was better on 10 and worse on 13.

INCOME

Personal income might be expected to affect the relationship between health status and health insurance; an insurance plan providing free

Table 3: Predicted Exit Values for an Average Person According to Measure and Plan

Health Status Measure	*Cost-Sharing Plan*	*Free Plan*	*Predicted Difference (Free – Cost Sharing)*	*	*Direction and Magnitude of Effect*†	*Raw Mean Difference (Free – Cost Sharing)*	*Sample Size*‡
Respiratory system							
FEV_1 (% of predicted)§	94.8	95.0	0.1	±1.1	F	0.9	3225
Shortness of breath	0.20	0.19	-0.01	±0.04	F	-0.03	3497
Chronic phlegm production (% of sample)	8.5	9.1	0.5	±1.8	C	-0.0	3523
Severity of hay fever	0.16	0.21	0.05	±0.06	C +	0.03	3540
Circulatory system							
Rose scale‖	0.03	0.03	0.004	±0.02	C	0.005	1434
ECG abnormalities (% of sample)‖	10.0	9.3	-0.7	±3	F	-0.4	1360
Severity of varicose veins**	2.21	2.15	-0.06	±0.09	F +	0.01	1624
Diastolic blood pressure (mm Hg)	78.8	78.0	-0.8	±0.7	F ++	-0.9	3495
Cholesterol (mg/dl)	202	203	0.7	±2	C	-1.3	3381
Musculoskeletal system							
Chronic joint symptoms (% of sample)‖	31.6	30.0	-1.6	±5	F	-0.7	1435
Walking speed (seconds)††	10.11	10.05	-0.06	±0.3	F	-0.4	514
Grip strength (mm Hg)§,††	233.8	232.5	-1.3	±5	C	-1.2	516

Continued

Table 3: Continued

Health Status Measure	*Cost-Sharing Plan*	*Free Plan*	*Predicted Difference (Free – Cost Sharing)*	*	*Direction and Magnitude of Effect*†	*Raw Mean Difference (Free – Cost Sharing)*	*Sample Size*‡
Gastrointestinal system							
Active ulcer (% of sample)	3.0	3.3	0.3	±1	C	0.7	3539
Dyspepsia (% of sample)	7.9	9.9	2.0	±2.1	C+	2.1	3540
Vision/hearing							
Functional far vision (Snellen lines)	2.52	2.42	-0.10	±0.06	F++	-0.13	3465
Functional near vision (Snellen lines)‖	2.44	2.35	-0.09	±0.08	F++	-0.07	1410
AHTL, right ear (db)	12.25	12.28	0.03	±0.5	C	0.03	3267
AHTL, left ear (db)	12.46	12.84	0.38	±0.5	C+	0.07	3270
Endocrine system							
Glucose (mg/dl)	94.2	94.7	0.5	±1.5	C	0.7	3395
Abnormal thyroid level (% of sample)	1.7	2.4	0.7	±1.0	C+	0.9	3373
Other systems							
Hemoglobin (g/100 ml)§	14.45	14.46	0.01	±0.1	F	0.03	3390

Continued

Positive urine culture (% of sample)**	2.9	3.5	0.6	±2	C	0.0	1796
Severity of acne‡‡	0.32	0.37	0.05	±0.07	C+	0.1	2478
Health practices§§							
Weight-height index	0.266	0.271	0.005	±0.04	C	0.005	3087
Level of physical activity§	2.24	2.21	-0.03	±0.06	C	-0.03	3056
Smoking scale	1.293	1.290	-0.002	±0.02	F	-0.01	3037
Monthly alcohol consumption	13.4	13.7	0.03	±2	C	0.3	3062
Use of relaxants	1.69	2.09	0.40	±0.5	C+	0.53	3070
Seat belt use§	28.5	29.2	0.7	±2	F	-0.02	3062
Rectal exam within past two years§§,‖	52.6	56.7	4.1	±6	F+	4.0	1057
Papanicolaou smear within past 12 months§,**	59.7	63.4	3.8	±5	F+	3.4	1679
Breast self-examination almost every month§,**	50.8	53.4	2.6	±5	F	2.6	1679

* Number following predicted difference represents the width of the 95 percent confidence interval, i.e., 1.96 (standard error).

† F++, F+, F represent differences that favor the free plan at $p < 0.05$, $0.05 < p < 0.20$, and $0.20 < p$, respectively; C++, C+, C represent differences that similarly favor the cost-sharing plan.

‡ Numbers of persons included in the analyses vary because of differences in the number of persons with valid data for the health status measures, and restrictions on age and sex.

§ For this condition, a higher value denotes better health.

‖ Limited to persons 35 years of age or older.

** Limited to females.

†† Limited to persons 35 years of age or older who reported joint discomfort.

‡‡ Limited to persons under 45 years of age.

§§ All analyses related to health practices were limited to persons 18 years of age or older.

‖‖ Limited to persons 40 years of age or older.

Table 4: Predicted Exit Values for an Elevated-Risk Person, According to Measure and Plan

Health Status Measure	*Mean Value at Enrollment for Elevated-Risk Group**	*Cost-Sharing Plan*	*Free Plan*	*Predicted Difference (Free – Cost Sharing)*	†	*Direction and Magnitude of Effect‡*
Respiratory system						
FEV_1 (% of predicted)§	78.0	77.0	78.2	1.2	±2	F
Shortness of breath	0.67	0.57	0.53	-0.04	±0.1	F
Chronic phlegm production (% of sample)	33.4	22.5	24.2	1.7	±5	C
Severity of hay fever	0.56	0.5	0.7	0.18	±0.20	C+
Circulatory system						
Rose scale‖	0.16	0.09	0.06	-0.03	±0.07	F
ECG abnormalities (% of sample)‖	68.6	25.0	17.8	-7.3	±8	F+
Severity of varicose veins**	3.1	3.56	3.55	-0.01	±0.2	F
Diastolic blood pressure (mm Hg)	87.2††	88.3	87.6	-0.7	±1.5	F
Cholesterol (mg/dl)	242††	243	244	2	±5	C

Musculoskeletal system						
Chronic joint symptoms (% of sample)‖	90.0	64.7	64.4	-0.3	±10	F
Walking speed (seconds)††	10.7	12.3	12.5	0.3	±1	C
Grip strength (mm Hg)§,††	199.4	206.1	203.3	-2.8	±15	C
Gastrointestinal system						
Active ulcer (% of sample)	12.5	9.6	10.6	1.0	±4	C
Dyspepsia (% of sample)	48.0	17.5	18.4	0.9	±5	C
Vision/hearing						
Functional far vision (Snellen lines)	3.4††	3.36	3.20	-0.16	±0.22	F+
Functional near vision (Snellen lines)‖	4.5	2.99	2.86	-0.12	±0.3	F
AHTL, right ear (db)	23.7	20.6	21.2	0.6	±1.4	C
AHTL, left ear (db)	21.3	20.5	22.0	1.5	±1.4	C++

Continued

Table 4: Continued

Health Status Measure	*Mean Value at Enrollment for Elevated-Risk Group**	*Cost-Sharing Plan*	*Free Plan*	*Predicted Difference (Free – Cost Sharing)*	†	*Direction and Magnitude of Effect*‡
Endocrine system						
Glucose (mg/dl)	125.9	107.0	108.0	1.1	±5	C
Abnormal thyroid level (% of sample)	1.6	4.6	6.6	1.9	±3	C
Other systems						
Hemoglobin (g/100 ml)§	12.3	13.00	13.14	0.14	±0.12	F++
Positive urine culture (% of sample)**	22.6	8.7	9.3	0.6	±6	C
Severity of acne§§	1.76	0.92	1.08	0.16	±0.22	C+

*Elevated-risk groups are the least healthy 25 percent of the sample defined with respect to the individual health measure at enrollment.

†Number following predicted difference represents the width of the 95 percent confidence interval, i.e., 1.96 (standard error).

‡F++, F+, F represent differences that favor the free plan at $p < 0.05$, $0.05 < p < 0.20$, and $0.20 < p$, respectively; C++, C+, C represent differences that similarly favor the cost-sharing plan. These p-values do not account for multiple comparisons.

§For this condition, a higher value denotes better health.

‖Limited to persons 35 years of age or older.

**Limited to females.

††For cholesterol, blood pressure, and functional far vision, these are predicted exit values.

‡‡Limited to persons 35 years of age or older who reported joint discomfort.

§§Limited to persons under 45 years of age.

care might benefit low-income people more than high-income people, who presumably could pay for better care without insurance. Evidence for this was found in the measures initially chosen for analysis—blood pressure and functional far vision—but none of the other measures studied here was significantly better with free care (Table 5). For the elevated-risk, low-income subgroup, persons on the free plan had significantly more severe acne. Still, the low-income group did better with free care on 9 out of the 13 more common measures.

The confidence limits for even these 13 most common measures are quite wide. A comparison of Table 5 with Table 3 shows the confidence intervals for low-income, elevated-risk people to be about five times as wide as those for the overall sample.

People with free care were generally more likely to be worried about the health conditions studied here than those with cost-sharing (Table 6). A positive *t*-test value indicates more worry on the free plan, controlling for initial prevalence of worry and other factors. (For shortness of breath, the *t*-test, which takes initial values into account, shows the free plan to have been worse, even though the raw percentage worried at exit was lower.) Those with free care also had slightly higher levels of worry among those who worried at all about particular conditions (Table 6). The only significant difference in the percentage who worried was for chronic bronchitis, and the mean levels of worry were not significantly different for any of the conditions. People with free care usually reported more pain from their conditions, although there were no significant differences in the percentage reporting pain (Table 7). Of the 44 comparisons on pain and worry that are shown in Tables 6 and 7, free care produced more impact on 33, significant at $p < .01$ by a sign test. However, for vision disorders, which were helped by free care, there was less worry and significantly lower levels of pain with free care.

COMMENTS

One objective of the HIE was to measure the effect of different levels of coinsurance on health status of the nonaged. Though relatively healthy, the nonaged comprise 88 percent of the population, and generate two-thirds of the health care expenditures [13]. Beneficial effects of complete coverage were reported previously for functional far vision and blood pressure, while availability of cost-free medical care did not seem to affect five measures of general self-assessed health status, smoking habits, weight, and cholesterol [3].

Table 5: Differences Between Free and Cost-Sharing Plans in Predicted Exit Values, for an Elevated-Risk Person According to Measure and Income

Health Status Measure	Low Income	*	Direction and Magnitude of Effect†	High Income	*	Direction and Magnitude of Effect†
Respiratory system						
FEV_1 (% of predicted)‡	2.6	±2.9	F+	-0.1	±3.4	C
Shortness of breath	-0.06	±0.2	F	-0.03	±0.2	F
Chronic phlegm production (% of sample)	-4.0	±10	F	4.6	±7	C+
Severity of hay fever	0.19	±0.4	C	0.16	±0.3	C
Circulatory system						
Severity of varicose veins‖	0.02	±0.4	C	-0.03	±0.3	F
Diastolic blood pressure (mm Hg)	-2.3	±2.6	F+	0.1	±2.1	C
Cholesterol (mg/dl)	-0.4	±9	F	2.8	±6	C
Other systems						
Chronic joint symptoms (% of sample)§	3.8	±20	C	-2.0	±12	F
Dyspepsia (% of sample)	-3.5	±9	F	4.0	±8	C
Functional far vision (Snellen lines)	-0.33	±0.35	F+	-0.07	±0.30	F
Functional near vision (Snellen lines)	-0.02	±0.4	F	-0.16	±0.3	F
Hemoglobin (g/100 ml)‡	0.167	±0.169	F+	0.101	±0.185	F
Severity of acne**	0.31	±0.28	C++	-0.05	±0.33	F

Note: Elevated-risk groups are the least healthy 25 percent of the sample defined with respect to the individual health measure. Low-income families are those in the lowest one-fifth of the income distribution in the sample; high-income families are those in the highest two-fifths of the income distribution.

* Number following predicted difference represents the width of the 95 percent confidence interval, i.e., 1.96 (standard error).

† F++, F+, F represent differences that favor the free plan $p < 0.05$, $0.05 < p < 0.20$, and $0.20 < p$, respectively; C++, C+, C represent differences that similarly favor the cost-sharing plan. These p-values do not account for multiple comparisons.

‡ For this condition, a higher value denotes better health.

§ Limited to persons 35 years of age or older.

‖ Limited to females.

** Limited to persons under 45 years of age.

Table 6: Frequency of Reported Worry and Mean Level of Reported Worry for Selected Health Conditions at Exit, According to Plan

Condition	*Percentage of Sample Reporting Worry Due to Condition*			*Mean Level of Worry**		
	Cost-Sharing Plan (%)	*Free Plan (%)*	*t-Test Value†*	*Cost-Sharing Plan*	*Free Plan*	*t-Test Value‡*
Phlegm production, chronic bronchitis, or emphysema	6.8	8.3	2.27	1.23	1.27	0.56
Hay fever	9.6	10.0	1.32	1.35	1.36	0.20
Chest pain§	14.1	15.2	0.19	1.41	1.43	0.18
Varicose veins‖	7.9	10.9	1.55	1.30	1.41	1.17
Chronic joint disorders§	25.9	25.8	-0.42	1.56	1.66	1.22
Dyspepsia	8.9	9.7	0.03	1.50	1.56	0.73
Vision disorders§	36.1	36.4	-0.44	1.36	1.28	-1.52
Kidney disease‖	7.4	10.1	1.12	1.52	1.50	-0.13
Acne**	13.0	14.7	0.52	1.36	1.36	0.06
Shortness of breath, enlarged heart, or heart failure††	16.4	14.7	0.05	1.49	1.40	-0.60
Hemorrhoids	6.6	7.7	1.55	1.21	1.24	0.47

*Mean level of worry is based on those people who reported worrying at least a little about the condition at exit; 1 = a little worry, 2 = some worry, 3 = a great deal of worry.

†t-Test value is based on a significance test for the coefficient representing insurance plan (1 = free, 0 = cost sharing) in the multiple logistic equation for report of worry at exit. Because of differences in initial prevalence, this value may be in a different direction than the raw percentages.

‡t-Test value is based on a significance test for the difference between sample means

§Limited to persons 35 years of age or older.

‖Limited to females.

**Limited to persons under 45 years of age.

††Limited to persons 45 years of age or older.

Here we examine the effect of cost sharing on health for 20 more physiologic conditions and 7 more health practices. Except for functional near vision, we found no additional significant differences between an average free-care enrollee and an average cost-sharing enrollee. A person at elevated risk of having a low hemoglobin value had significantly better values at the end of the study on the free plan

Table 7: Frequency of Reported Pain and Mean Level of Reported Pain for Selected Health Conditions at Exit According to Plan

Condition	Percentage of Sample Reporting Pain Due to Condition			Mean Level of Pain*		
	Cost-Sharing Plan (%)	Free Plan (%)	t-Test Value†	Cost-Sharing Plan	Free Plan	t-Test Value‡
Phlegm production, chronic bronchitis, or emphysema	4.0	4.6	1.34	1.25	1.25	0.0
Hay fever	13.2	12.5	0.47	1.37	1.38	0.23
Chest pain§	15.4	14.8	-0.70	1.41	1.34	-0.76
Varicose veins‖	6.6	8.6	1.26	1.30	1.42	1.15
Chronic joint disorders§	30.6	29.4	-0.93	1.75	1.82	0.87
Dyspepsia	10.6	12.8	1.39	1.56	1.60	0.47
Vision disorders§	17.5	19.8	0.82	1.40	1.24	-2.32
Kidney disease‖	7.8	11.3	1.80	1.58	1.60	0.14
Acne**	7.2	8.2	0.13	1.24	1.15	-1.38
Shortness of breath, enlarged heart, or heart failure††	10.6	10.9	0.71	1.51	1.42	-0.56
Hemorrhoids	9.0	10.7	1.90	1.28	1.36	1.38

*Mean level of pain is based on those people who reported at least a little pain from the condition at exit; 1 = a little pain, 2 = some pain, 3 = a great deal of pain.
†t-Test value is based on a significance test for the coefficient representing insurance plan (1 = free, 0 = cost sharing) in the multiple logistic equation for report of pain at exit.
‡t-Test value is based on a significance test for the difference between sample means.
§Limited to persons 35 years of age or older.
‖Limited to females.
**Limited to persons under 45 years of age.
††Limited to persons 45 years of age or older.

than on the cost-sharing plans. This finding is not due to a few cases of severe anemia on the cost-sharing plan, but to a higher rate of mild anemia. Average hearing was significantly worse at the end of the study for a person at elevated risk on the free plan than on the cost-sharing plans.

Of 20 comparisons, one is expected to be significant by chance alone. Thus, among the 66 new comparisons, the four new significant

results (one for the whole sample, two for the elevated-risk sample and one for the low-income elevated risk sample) are about what would be expected if insurance had no true effects on these conditions. Except for vision, blood pressure, and anemia, we were unable to detect that free care offered much benefit to physiologic health over limited cost-sharing insurance plans. Indeed, people receiving free care were more likely to report worry or pain from these conditions. Given the effectiveness of medical care in treating many of these conditions, and the fact that those with free care consumed considerably more care, we may question why more beneficial effects were not found.

One problem is the sample size of the study, particularly for detecting an effect on rare physiologic conditions. The study was designed to test a variety of effects of insurance arrangements in a general, nonaged population. We could not afford the numbers or the case selection necessary to obtain an adequate sample for studying effects on less common conditions in a nonaged population, such as specific cancers or abnormal thyroid levels. For example, hypertension defined as a diastolic blood pressure of 90 mm Hg or over is a relatively common disease. The percent hypertensive at exit on the cost-sharing plan, using this definition, was 16.9 percent compared to 14.1 percent with free care [10]—a 20 percent difference that was significant at the 0.01 level. For positive urine cultures (which had a 3 percent prevalence for women at exit), it appears that free care did worse; however, a 20 percent increase in prevalence with cost sharing is consistent with our data (as any change would be between -74 percent and +40 percent—see Table 3). The power of our experiment to detect a 20 percent increase in a condition that had a 3 percent prevalence among women is only 9 percent.

However, if higher use of medical services with free care improved health relative to the lower levels of use associated with cost sharing, we would expect to see most of the differences between the groups favoring free care even if the individual differences were not significant. For example, if the 23 measures were independent and free care were for each measure, on average, one standard error of the difference better than cost sharing, then we would expect to see 4 measures significantly better, none significantly worse, and 15 more that favored free care but not significantly, with only 4 favoring cost sharing. In fact, however, we observe that 3 measures are significantly better and none are significantly worse, but that free care is better than cost sharing on only 10 of the 23 measures. Thus, looking at the group of measures together, it does not appear that cost sharing has many large deleterious effects. Moreover, using the sign test discussed above, we would have detected

fairly small effects if the differences were also consistent. For most conditions, one standard error of the difference is not large; it is approximately half of the 95 percent confidence intervals shown in Table 3. For example, the standard error represents a 0.9 percent difference in the prevalence of chronic phlegm production or one mg/dl of cholesterol.

Another possible explanation for some of the negative results is labeling bias. Seven of the measures are based on self-report, and for only two of these did results favor free care. For some measures, the additional visits made by those on the free plan may have converted what would have been an unspecified set of symptoms into bother from hay fever or a diagnosed ulcer. Even if beneficial treatment were provided, the net reported effect might still be negative if a moderate unspecified illness were replaced by mild hay fever.

However, labeling bias does not fully explain the results on self-reported conditions. If it did, we would expect more people with mild disease to report that they had the disease under free care. The higher prevalence of pain and worry at the end of the experiment might be expected, but not the higher mean levels of pain and worry on the free plan given some pain or worry. Either the conditions became more severe on average with free care, or the additional care provided was counterproductive in reducing the impact of those conditions (at least as measured by pain or worry).

Of the 16 conditions assessed by the screening examination, eight (ECG abnormalities, hearing loss in each ear, abnormal grip strength or walking speed, diabetes, urinary infections, and abnormal thyroid) are rare in a general, nonaged adult population (prevalence less than 5 percent). The small number of cases in our study makes results on such conditions unreliable. For the more common measured conditions, people on free care were better on six of eight: lung function, varicose veins, blood pressure, far and near vision, and anemia. Only acne and cholesterol in this group of measures showed cost sharing ahead, and free care was significantly better for both types of corrected vision, for blood pressure, and for those at high risk of anemia. These results can be interpreted as consistent with a slight positive effect of free care on conditions assessed by examination, and slight negative effects on self-reported illnesses.

The effects of insurance plan on health practices were mixed and, in the aggregate, small. Free care had some benefit for blood pressure control and early detection of cancer, but these improvements were counterbalanced by worse results for cholesterol, weight, exercise, alcohol consumption and pill consumption. The Health Risk Appraisal

model provides a way to combine these factors into an overall predicted risk of mortality [6]. At the end of the experiment, the average appraised mortality risk for people on the free plan was very close to the risk for those with cost sharing. Advocates of preventive medicine would be disappointed by the failure of physicians, given the extra use stimulated by free care, to influence patients in the direction of better health habits.

How do the results answer the question about the effect of cost sharing on health? For an average, reasonably healthy person, having access to medical care free of charge will not lead to greatly improved health, whether measured in general, physiologic, or health habits terms. This result is not altogether surprising, because it is difficult to make a healthy person healthier. More health measures (whatever they may be) or a longer experiment period would not be expected to change this conclusion.

Surprisingly, even when we examined those at elevated risk, the measured values rarely differed between insurance plans. Does this mean that access to free care does not result in improved health, even for those at high risk? This lack of any difference may be explained in part by the low prevalence of clinically significant conditions; not many people even in the quarter at highest risk actually have anemia or diabetes. The analysis cannot be limited to only those few with the diagnosed condition because of the statistical implications of small numbers—but the truly important health changes may occur only in those few.

Analysis of the effects of cost sharing on low-income, elevated-risk people showed no significant negative effects beyond those reported earlier for blood pressure and vision. However, for this sick-poor group, the confidence intervals for even the 13 common conditions were very wide, and therefore we might not have detected clinically important differences. In fact, outcomes for cost-sharing participants were somewhat worse for 9 of 13 common conditions ($p = .28$, assuming independence). Thus, the results reported here do not change our previous conclusions about the poor who were also sick. They did better with free care for those conditions that are easy to diagnose and treat (for example, hypertension and vision problems). For other conditions, the evidence suggests some harmful effects of cost sharing, but is far from conclusive.

For hypertension, we previously reported a detailed investigation of how free care achieved better results than cost sharing [14]. We found the primary mechanism to be better case finding, which accounted for about two-thirds of the difference. The additional visits

shown in Table 1 gave providers a greater opportunity to diagnose hypertension. About one-third of the difference in average diastolic blood pressure was accounted for by the 7 percent of hypertensives on the cost-sharing plans (as opposed to 2 percent on the free plan) who had no physician visits in the study. Blood pressure results for the hypertensives already identified at enrollment were similar at exit across plans. Those hypertensives on the cost-sharing plan who took the initial screening examination (a random 60 percent) had lower blood pressure at exit on average than those who did not. This difference was more than half as large as the average difference between blood pressure of hypertensives on the free and cost-sharing plans at exit. The patterns of treatment and compliance for confirmed hypertensives were similar across plans. These findings suggest that programs targeted at finding conditions may be a more efficient supplement to cost-sharing plans than are additional insurance programs.

Despite the limited gains in health, free care leads to large differences in utilization for the healthy. Because most people are healthy, it is expensive and inefficient to use free care for all as the method to assure the health needs of the few. Caution must be used in extrapolating this conclusion about the inefficiency of free care to populations not included in the study, such as the elderly or institutionalized. Caution must also be used in drawing conclusions regarding the effect of more severe cost sharing on the poor; poor families in the study were protected by an income-related ceiling on their out-of-pocket medical expenses and by the fact that all medical services (prescriptions, appliances, and so on) were covered and paid at customary usual rates (not the case for Medicaid).

Another explanation for the limited effect of free care may be that those who are sick will sacrifice other desires to pay moderate amounts to obtain medical treatment: even the average person on the experimental cost-sharing plan with the least coverage had average medical expenses of $797 per adult per year (1985 dollars), equal to two-thirds of expenses on the free plan. In terms of Figure 1, use under cost sharing may be fairly high up the curve at B, and, for free care, at point A.

Just as the differences in maternity outcomes occur largely between those with no prenatal visits and those with a few, rather than between those with a few and those with an "adequate" number of visits [15], so the big difference in that component of health influenced by medical care may be between those with no insurance and those with some [16]. Moderate increases in cost sharing, as have been recently adopted in many employer group health plans, are unlikely to have

severe effects on health. The challenge then remains to provide adequate care to those now getting little or none.

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