The Economic Implications of Self-Care: The Effect of Lifestyle, Functional Adaptations, and Medical Self-Care Among a National Sample of Medicare Beneficiaries

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ABSTRACT

Objectives. Self-care includes actions taken by individuals to promote or ensure their health, to recover from diseases or injuries, or to manage their effects. This study measured associations between self-care practices (lifestyle practices, adaptations to functional limitations, and medical self-care) and Medicare expenditures among a national sample of adults 65 years and older.

Methods. Regression models of Medicare use and expenditures were estimated by using the National Survey of Self-Care and Aging and Medicare claims for 4 years following a baseline interview.

Results. Lifestyle factors (swimming and walking) and functional adaptations (general home modifications) were associated with reductions in monthly Medicare expenditures over a 12-month follow-up period. Expenditure reductions were found over the 48-month follow-up period for participation in active sports, gardening, and medical self-care. Practices associated with increases in expenditures included smoking, physical exercise (possibly of a more strenuous nature), and specific home modifications.

Conclusions. Certain self-care practices appear to have significant implications for Medicare expenditures and presumptively for the health status of older adults. Such practices should be encouraged among older adults as a matter of national health policy. (*Am J Public Health.* 2000;90:1608–1612)

Self-care in health refers to the activities individuals undertake with the intention of improving health, preventing disease, limiting illness, and restoring health after illness or injury.[1,2] An individual who engages in self-care practices may be more likely to detect and treat health conditions on a timely basis. Much of the interest in self-care has focused on the maintenance of functional health and independence among persons with physical or cognitive limitations. The use of self-care practices may also be associated with subsequent reductions in the use or cost of health services. Hence, the potential value of self-care as a means of enhancing the long-term social and health independence of older adults is one of national policy significance.[3]

Much of the self-care literature focuses on incentives or motivations for self-care.[4] Only a limited volume of research has considered how self-care practices can be used as explanatory variables to predict subsequent health care use or expenditures. Grembowski and colleagues[5] found that interventions aimed at improving individuals' assessments of their ability to perform or sustain health-related behaviors may have an indirect, negative effect on physician visits, which may in turn control Medicare costs. Because self-care activities include preventive behaviors, the potential for cost savings may be significant and attainable over the long run.

This study provides results from an estimation of the relationship between selected self-care practices reported by a national sample of community-based older adults and subsequent Medicare expenditures. Self-care practices consist of 3 domains[6]: lifestyle practices, adaptations to functional limitations, and medical self-care. The lifestyle practices included in this study consist of smoking, alcohol consumption, diet, sleep, exercise, and hobbies (hunting, fishing, and gardening). The adaptations to functional limitations include home environmental modifications and the use of equipment or devices to assist with mobility or other functional limitations. Medical self-care includes practices such as monitoring urine, blood pressure, or pulse.

Methods

Data and Study Sample

Data for this analysis come from the National Survey of Self-Care and Aging, a longitudinal, nationally representative survey of 3485 community-dwelling Medicare beneficiaries aged 65 and older in the contiguous United States.[7] The sampling universe consisted of all Medicare beneficiaries in the contiguous United States who were 65 years or older in 1989 and who did not reside in nursing homes or domiciliary care facilities at the time of selection. Baseline in-person interviews were completed in 1990 and 1991. Subjects were selected from the Medicare Beneficiary Files according to a stratified random sampling design, with approximately equal numbers of adults by sex in each of 3 age categories: 65 to 74, 75 to 84, and 85 years and older. The sample was clustered within 50 primary sampling units in 38 urban and 12 rural areas across the United States. The unique aspects of this sample in-

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cluded appropriate representation of rural areas and oversampling of subjects by age and sex to ensure representation of the oldest old (85 years and older).[7,8] The baseline in-person interviews contained detailed self-reported information on demographic measures, health status, and self-care activities. Medicare Part A and Part B claims data from 1989 through 1994 and death records were linked to the survey data. Medicare data were not available for persons who did not match to the Medicare claims files or who were enrolled in Medicare health maintenance organizations (HMOs). The analytic sample therefore consisted of 2921 observations, or 84% of the survey sample of 3485 observations; 9% were excluded as a result of failure to match to Medicare claims data, 6% because of membership in a Medicare HMO only, and less than 1% owing to death within 1 month of the baseline interview. This analysis uses the person-month as the temporal unit of observation.

As noted by Eppig and Chulis,[9] survey and claims data often differ in their reports of health care use. The disease measures take advantage of combined information from survey and claims data. The health care use and expenditure variables come solely from the claims file. As such, they exclude all non-Medicare-covered services and therefore understate total health care use.

Modeling Issues

Our basic model for individual *i* in time *t* is

$$\begin{aligned}\text{EXPEND}_{it} = {} & \alpha_0 + \alpha_1 \text{SELFCARE}_i \\ & + \alpha_2 \text{DEMO}_i + \alpha_3 \text{HEALTH}_{it} \\ & + \alpha_4 \text{OTHER}_{it} + e_{it},\end{aligned}$$

where EXPEND represents Medicare expenditures; SELFCARE is baseline survey variables representing self-care practices; DEMO is baseline survey variables for age, sex, marital status, income, and insurance; HEALTH is survey data on health status and survey/claims data on disease status; and OTHER is measures of hospital and physician supply and dummy variables for geographic, time, and seasonal effects.

The key explanatory variables of interest include 3 categories of self-care: lifestyle practices, adaptations to functional limitations, and medical self-care. Assessment of the impact of self-care practices on health care expenditures is complicated by the lack of randomized trials and possible bias from self-selection in the use of self-care. For example, healthier people may find it easier to adopt a pattern of regular exercise, resulting in lower costs attributable to their selection rather than to exercise itself. Similarly, people who undertake certain types of self-care (e.g., taking their blood pressure regularly) may do so because of an existing health problem and therefore may be sicker than average. Such selection could result in differences in costs not truly attributable to self-care practices in a cross-sectional analysis of a general population at a single point in time. Two aspects of the analysis should mitigate these selection effects. First, although the National Survey of Self-Care and Aging does not randomize subjects to different self-care practices, it does provide extensive measures of health and functional status. Use of a comprehensive set of controls for health status should reduce bias from selection in the parameters. Second, by estimating the effects of self-care practices on Medicare expenditures longitudinally, we may minimize the confounding from selective use of self-care practices. Estimations are done for both a 12-month and a 48-month follow-up period.

Decisions pertaining to definitions of specific self-care measures were made on the basis of correlations in preliminary analyses. Separate indicators were included for different types of exercise (active sports, swimming or walking, and physical exercise) and hobbies (hunting or fishing and gardening). Home modifications were classified as general (rearranging furniture or objects, removing throw rugs or using nonslip tape, or putting things on lower shelves or within easy reach) or specific (installing additional telephones or more lighting on stairs).

The baseline health measures included survey indicators of functional status and an index of predicted expenditures developed by Ellis et al.[10] Indicators of the baseline presence or subsequent onset of selected chronic disease were created from survey and Medicare claims data. Dummy variables for each disease were initially set to 1 if the person reported the disease at baseline and 0 otherwise. A given variable was changed to 1 (and remained at 1 for all subsequent months) if a Medicare claim with that disease diagnosis appeared in a month. As noted by Newcomer et al.,[11] Medicare claims data understate true disease incidence, especially for diseases such as Alzheimer disease. Therefore, the disease indicators understate the true prevalence of disease over time.

An important qualification pertaining to the model is that it treats the health (or disease) indicators as exogenous variables that are not affected by the self-care practices. In theory, these health indicators should be outcome variables in a more complex simultaneous model of both health outcomes and expenditures, although this point is most relevant for the time-varying disease indicators. The model estimated, therefore, is a simpler model that focuses on the relationship between baseline reports of self-care practices and expenditures over a longitudinal follow-up period.

Statistical Techniques

Self-care practices may affect different components of health service use. For example, appropriate self-care might mean that an elderly person in good health sees a physician at least once a year. Persons with chronic conditions that require ongoing monitoring might see a physician more often. However, appropriate self-care practices should hypothetically reduce the likelihood of seeing a physician in any month. Appropriate self-care may also reduce the probability of hospitalization, or the level of expenditures in a month for those with any health service use.

The empirical framework is a modified version of the 4-part model used by Manning et al.[12] The dependent variable for the first equation is a dichotomous indicator of whether an individual had *any* Medicare-reimbursed services (inpatient or outpatient) during each month following the baseline interview. The second equation uses a dichotomous dependent variable indicating whether an individual had 1 or more hospital admissions during the month, conditional on having some Medicare-reimbursed services that month. The first 2 equations are estimated by probit because of the dichotomous dependent variables. The third and fourth equations are linear regressions. The third equation estimates the level of Medicare expenditures for outpatient services for all months in which an individual had Medicare outpatient expenditures only. The fourth equation estimates, for all months in which an individual had at least 1 hospital admission, the sum of inpatient Medicare expenditures for all admissions in a month plus any outpatient expenditures in that month. Natural log transformations are used for the dependent variables in the third and fourth equations, given the skewed distribution of the data.

Statistical techniques (random-effects models and Huber–White corrections to the standard errors) were used to control for heteroscedasticity since there were multiple observations per individual. Our goal in this analysis is to estimate the relationships between self-care practices and Medicare expenditures, while controlling for as many relevant covariates as possible. Since, as DuMouchel and Duncan[13] argue, adjustment for survey weights is not required in fully specified models, we do not use complex survey adjustments in the regression models.

The 4 components of total expenses (likelihoods of any use and of hospital use, and Medicare expenditures for these 2 types of use among persons with some use) can be combined to yield expected Medicare expenditures per month. The effects of different self-care practices on Medicare expenditures are estimated for the sample for each self-care prac-

tice with the assumption, first, that each sample member undertook the practice and, second, that he or she did not undertake the practice. The fact that these estimates are the product of different components of the probability of use and level of use complicates the calculation of appropriate standard errors. Therefore, stochastic methods involving the estimation of bootstrap replications were used to estimate percentile confidence intervals for the differences.

Results

Table 1 provides descriptive statistics for the explanatory variables from the baseline survey. These measures are presented for the unweighted analytic sample (2921 observations) as well as the national community-based older adult population (3485 observations with use of survey weights) to compare the distribution of the analytic sample with that of the national community-based population. The analytic sample statistics are very close to the community-based population estimates for many characteristics, but not for age, sex, and race (owing in part to oversampling in the survey design). Given the differences in the age distribution, the measures of self-reported health status and impairments in activities of daily living are very similar for the analytic sample and the national community-based population. The lack of difference in these measures may indicate that many of the oldest population (i.e., 85 years and older) still living in noninstitutional settings are relatively healthy.

TABLE 1—Descriptive Statistics of Population at Baseline in Study of Economic Implications of Self-Care

	Analytic Sample (n = 2921)		Community-Based Population Estimate (n = 3485), %
	Observations	%	
Lifestyle practices			
No alcohol	1716	59.1	61.9
Former smoker	1100	37.9	31.8
Current smoker	310	10.7	12.7
Correct weight for height	1805	62.2	57.7
Gets 6–8 h of sleep	1627	56.1	55.7
Active sports	422	14.5	14.2
Swimming or walking	1540	53.1	54.3
Hunting or fishing	404	13.9	15.5
Physical exercise	1012	34.9	34.9
Gardening	1370	47.2	50.9
Adaptations to functional limitations			
General home modifications	718	24.7	25.6
Specific home modifications	245	8.4	7.8
Uses equipment for mobility/ADL	1400	48.2	43.3
Medical self-care: protects health by testing urine, taking BP or pulse	625	21.5	26.6
Demographics			
Age, y			
65–74	1117	38.5	53.9
75–84	1021	35.2	36.1
≥85	764	26.3	10.0
Male	1506	51.9	40.9
African American	165	5.7	10.1
High school education or above	1677	57.8	60.2
Married	1587	54.7	54.1
Rural	804	27.7	28.7
Supplemental insurance	2058	70.9	69.6
150% of poverty line or higher	1903	65.7	65.1
100%–149% of poverty line	523	18.0	18.7
Health characteristics			
Health status (self-report)			
Poor	310	10.7	9.8
Fair	691	23.8	24.9
Good	846	29.2	29.0
Very good	656	22.6	23.0
Excellent	399	13.8	13.0
2 or more ADL limitations	354	12.2	12.1
2 or more IADL limitations	904	31.2	28.4
2 of more MADL limitations	431	14.9	12.8
Had major physical or emotional illness in last year	557	19.2	17.5
Ever had any other health problem >3 mo	913	31.5	29.1
Had arthritis in past year	1718	59.2	62.1
Behavioral index	2215	76.3	75.4
Mean of DxCG predicted expenses	2921	0.69	0.62
SE for DxCG predicted expenses		0.43	0.43

Note. ADL = activities of daily living; BP = blood pressure. Data for the analytic sample are unweighted. The community-based population estimates were derived with survey weights.

The assessment of lifestyle characteristics shows that 59% of the sample did not consume alcohol and 51% said they had never smoked. More than half the sample had an appropriate weight (scaled for height) and reported getting 6 to 8 hours of sleep per night. The 2 types of exercise reported most frequently were swimming or walking (53%) and working in the garden (47%). Similar proportions (about 14%) of the sample participated in active sports or in hunting or fishing. Twenty-five percent of the sample had undertaken at least 1 of the general home modifications, while approximately 8% had undertaken specific home modifications. Almost half of the sample reported using some sort of equipment to assist with mobility (e.g., walkers) or other functional limitations in activities of daily living (e.g., handgrips or handrails in the bathing area), indicating a proclivity on the part of many individuals to install and/or use assisting devices where appropriate. Only 22% of the sample reported testing their urine or taking their blood pressure or pulse.

Table 2 contains descriptive statistics for the time-varying chronic disease diagnosis indicators. Rates of disease at baseline ranged from 8% for stroke to 43% for hypertension. By the end of the 48-month follow-up period, the least frequently reported diseases (diabetes, myocardial infarction, and stroke) were indicated for approximately 16% of the sample, and the percentage of the sample with congestive heart failure, congestive pulmonary disease, or cancer increased by 8 percentage points or more.

Descriptive statistics pertaining to Medicare use and expenditures during the 48-month follow-up period are as follows. Over 96% of the sample had at least 1 Medicare-reimbursed service, and 54.4% of the sample had at least 1 hospitalization. The monthly probability of a hospitalization in a given month was less than 3%, but the monthly likelihood of any Medicare-reimbursed service was 42%. Average monthly expenditures overall were $365; monthly expenditures among persons with ambulatory expenditures only or with a hospitalization were $422 and $7588, respectively.

TABLE 2—Analytic Sample Descriptive Statistics: Time-Varying Diagnostic Characteristics (n = 2921) in Study of Economic Implications of Self-Care

	Baseline, %	48-Month Follow-Up, %
Persons with Medicare claims or self-reports of—[a]		
Angina	15.0	20.3
Congestive heart failure	20.0	30.7
COPD	14.8	24.9
Diabetes	12.5	15.9
Cancer	21.3	34.7
Hypertension	43.3	51.4
Myocardial infarction	11.4	15.3
Stroke	8.3	16.0

Note. COPD = chronic obstructive pulmonary disease.
[a]Percentages indicate the proportion of the sample with a self-reported diagnosis or a claim with the diagnosis.

TABLE 3—Change in Monthly Medicare Expenditures (in US Dollars) Expected to Result From Self-Care Practices, 12- and 48-Month Follow-Up Estimates

	12-Month Follow-Up		48-Month Follow-Up	
	Estimate	95% CI	Estimate	95% CI
Lifestyle practices				
No alcohol	142.86	−174, 435	−11.27	−161, 145
Former smoker (vs never)	364.14**	54, 698	166.72	−24, 345
Current smoker (vs never)	−129.23	−526, 348	107.96	−211, 382
Correct weight for height	−11.21	−42, 19	18.55	−7, 50
Gets 6–8 h of sleep	27.02*	−2, 59	4.29	−4, 22
Active sports	−114.95	−616, 444	−241.12*	−508, 9
Swimming or walking	−196.43*	−507, 61	−76.68	−240, 97
Hunting or fishing	29.74	−365, 498	37.69	−189, 306
Physical exercise	356.09**	27, 708	378.80**	183, 562
Gardening	11.15	−295, 329	−162.32**	−339, −3
Adaptations to functional limitations				
General home modifications	−259.24*	−598, 76	47.37	−110, 237
Specific home modifications	404.08*	−64, 925	150.62	−45, 471
Equipment for mobility/ADL	−15.55	−270, 298	−6.61	−183, 151
Medical self-care: tests urine, BP, or pulse	220.22	−128, 608	−122.98*	−317, 62

Note. ADL = activities of daily living; BP = blood pressure. 95% Confidence intervals (CIs) are based on the percentile method, using 1000 bootstrap replications for the 12-month results and 150 replications for the 48-month results.
*$P < .10$; **$P < .05$.

Table 3 contains the expected change in monthly Medicare expenditures (with 95% confidence intervals) for someone who follows the indicated self-care practice vs someone who does not. (Full estimation results from the 4 models used to get these expected changes are available upon request.) Some effects are sizable, demonstrating an important potential effect of self-care practices reported in 1 period on the level of medical services used in subsequent time periods. The confidence intervals are wide for many of the factors, so the precision of some estimates is limited.

Statistically significant *reductions* ($P < .10$) in average monthly Medicare expenditures were detected for persons who reported swimming or walking ($196 in the 12-month follow-up), active sports ($241 in the 48-month follow-up), and gardening ($162 in the 48-month follow-up). The detected effects for gardening may be attributable to psychosocial aspects rather than or in addition to a physical component of the activity. Glass and colleagues[14] showed that activities not oriented toward fitness (such as gardening) lowered the risk of mortality from all causes over a 13-year period to the same extent as did activities with a greater fitness component.

A few self-reported lifestyle variables were significantly associated with higher monthly Medicare expenditures. Being a former smoker (relative to never having smoked) led to an increase of $364 per month in the 12-month follow-up, possibly because these people quit smoking owing to health reasons. Getting 6 to 8 hours of sleep per night was also positively associated with expenditures, but the amount was small ($27) in the 12-month follow-up and negligible in the 48-month follow-up. Surprisingly, reports of physical exercise at baseline were associated with substantially higher monthly Medicare expenditures (approximately $370 during each follow-up period). This association was unexpected and was not due to a small number of outlier cases. An expected finding was that the rate of hospitalization was lower among persons reporting physical exercise than among those not reporting physical exercise. Persons reporting physical exercise who were hospitalized during the follow-up period, however, had significantly higher costs.

General home modifications were associated with an expected reduction in Medicare expenditures of $259 per month during the 12-month follow-up. The reduction over 12 months is interesting because of the likely direction of selection bias in the estimates. If persons undertake home modifications owing to ill health, estimated expenditures might *increase* if the control variables used in the models do not account sufficiently for such selection. Indeed, such confounding may be the reason for the large *increase* of $404 associated with *specific* home modifications in the 12-month follow-up period. (Neither effect was significant in the 48-month follow-up.) It is conceivable that some individuals may undertake modifications for a spouse rather than for themselves, but these effects occurred while marital status was controlled for. Persons who reported monitoring of urine, blood pressure, or pulse at baseline had estimated monthly expenditures that were $123 lower per month over the 48-month follow-up period. It is not surprising that the benefits of such protective activities are realized only in the long run.

The other self-care practices were not significantly associated with changes in monthly Medicare expenditures, possibly owing to confounding factors. For example, chronically ill persons who take certain medications may be advised not to consume alcohol, but they may also be more likely to have higher expenditures. Persons who still smoke may do so because their health is still good. Also, some of these lifestyle factors, such as smoking, may have a greater impact on *length of life* (which is not modeled explicitly in these analyses), but a lesser impact on *expenditures per month*. The latter argument is consistent with the fact that most people have a period of high expenditures at the end of their life, regardless of whether their death was attributable to smoking or to other illness factors.

Discussion

This study suggests the economic significance of self-care practices among a national sample of older adults. The results from this analysis provide evidence of the potential reduction in Medicare expenditures associated with several types of exercise or hobbies, general home modifications, and medical self-care. Unless people who choose to undertake these simple self-care activities are intrinsically healthier in a way that was not captured by the extensive set of explanatory variables, this analysis suggests that real reductions in Medicare expenditures may be achieved by low-cost self-care interventions. Very simple general home modifications that may easily be undertaken by any individual (e.g., using nonskid rugs and keeping things within easy reach) are associated with reductions in Medicare expenditures. Although more specific home modifications related to additional phones and lighting were associated with an increase in expenditures, these results may be attributable to situations in which caregiving children are stepping in to care for parents whose health is declining. Furthermore, selection effects in which the degree of health or case mix severity affects the likelihood of reporting self-care practices at baseline should dissipate over time, lending credence to the 48-month effects found for active sports, gardening, and medical self-care. The long-run effects for gardening are particularly interesting because of recent evidence of the benefits of such activities[14] and the fact that gardening can be a nonstrenuous activity that can be undertaken by persons with a wide range of modest impairments.

The limitations of the analysis should not be overlooked, but the reported findings appear justified or point to areas that need further research. The analysis uses only a single report of self-care practices at baseline. Updated reports of such practices were not available for each year of the follow-up period, and the potential to change behaviors is not captured in the longitudinal modeling. Although the sample size was relatively large, it was not large enough to allow the use of more interactions to control for differences in the effect of self-care practices in relation to health or functional status. Furthermore, definitions of some activities, such as physical exercise, were part of a series of items and were largely left to the respondent's interpretation. This made comparisons across some preventive practices more difficult and may have caused unintended associations. For example, the finding of an increase in expenditures for persons engaging in physical exercise is counter to the results of exercise intervention trials, which generally show positive benefits and no major adverse effects even in very frail populations. Our finding regarding physical exercise may be due to the proclivity of some respondents to engage in fairly strenuous activity without proper training, to the residual effects of reported physical exercise after other forms of exercise (e.g., swimming or walking) are controlled for, or to some undetected trend, such as an increased tendency to recommend exercise even for persons with existing or incipient health problems. Further investigation of this finding may be warranted, because it is most likely caused by some factor not measured or controlled for in the estimations.

Despite these limitations, several policy implications come from the analysis. This national study underscores the potential importance of interventions to motivate and assist older adults, or those entering these age groups, to engage in simple lifestyle and self-care activities. Health policy regarding programs like Medicare should be enlarged to consider the potential impact of such low-cost interventions for this population. The results suggest the potential value of educational programs designed to motivate the participation of older adults in these activities.

Contributors

S. C. Stearns planned the analysis of Medicare claims data, oversaw the data analysis, and wrote the paper. S. L. Bernard, R. Schwartz, and T. R. Konrad participated in the project design, the data analysis, and the revising of the paper. S. B. Fasick conducted all analyses and contributed to revising the paper. M. G. Ory participated in the approval of the design of the self-care study and review of analyses. G. H. DeFriese was the principal investigator of the National Survey of Self-Care and Aging, and he participated in analysis design and revisions. Both M. G. Ory and G. H. DeFriese provided substantial conceptual reorientation and written revisions for the final manuscript.

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