Predictive Power of a Risk-Assessment Questionnaire Across Different Disease States: Results in an Elderly Managed Care Enrolled Population

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Objective: To examine the predictive power of self-reported assessment questionnaire data to explain changes in healthcare service utilization and expenditures of a population of Medicare health maintenance organization enrollees during a 2-year period.

Study Design: A prospective cohort study with a 2-year postenrollment follow-up period. Multiple robust regression analyses were conducted to examine associations among self-reported health status variables obtained from responses to the questionnaire.

Sample and Methods: Participants were administered a voluntary comprehensive questionnaire at enrollment that collected self-reported information on morbidity, health status, perceptions of health, and healthcare service utilization during the preenrollment year. Questionnaire responses were combined with actual 2-year postenrollment claims data. For the complete follow-up period, 4128 patients were available.

Results: Participants with such chronic conditions as depression and diabetes were likelier than the average enrollee to have higher healthcare service utilization. Self-reported health status predictors examined in this study explained a larger percentage of the variance (as much as 20%) in such chronic conditions as cancer and depression. Despite evidence of underreporting of preenrollment healthcare service utilization, these variables were highly predictive of actual postenrollment utilization patterns.

Conclusions: Self-reported health status information collected at baseline is as predictive of postenrollment risk as are currently used traditional approaches that require archival healthcare service utilization data. In addition, this approach is sensitive to changes in healthcare service utilization across differing morbidity states in older adults.

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The problems associated with the aging population of the United States are matters of increasing concern to the country's policymakers. People who live to age 65 years today have a life expectancy of nearly 18 more years, but chronic diseases, such as arthritis, hypertension, diabetes, cancer, and chronic obstructive pulmonary disease, are prevalent in many noninstitutionalized older adults. Older adults (ie, >65 years old) also are the country's major consumers of healthcare. In 1995, older adults had highest healthcare expenditures for heart disease ($58 billion) and diabetes ($26 billion).[1,2] In 1996, the average older adult had nearly 12 physician visits and 6.5 days of hospital stay.[1,2] Older adults accounted for 36% of all hospital stays and 49% of all day care in hospitals during that year. In 1997, they averaged nearly $2855 in out-of-pocket healthcare expenditures, a 35% increase since 1990.[1,2]

Participation in Medicare health maintenance organizations (HMOs) is increasing among this population. In 1997, more than 4 million people 65 years or older who received Medicare coverage were enrolled in managed care plans, nearly 4 times the

enrollment rate in 1985.[1,2] It therefore is essential to characterize the elderly patient who has the greatest likelihood of having an adverse medical outcome (ie, hospitalization or emergency department [ED] visit), and to target individuals in this category for disease management interventions that will improve outcomes and reduce avoidable healthcare service utilization. In an era of rising healthcare costs and managed care delivery systems, it is important to minimize medical care expenditures by preventing and controlling illness and disability through innovations in care management and coordination of care between specialists and primary care providers. Efforts to control resource consumption have focused on identifying those at risk to optimally use healthcare resources to control future needs for costly services.[3,4]

However, few researchers have investigated the empirical association between a Medicare managed care plan enrollee's self-reported health status and associated healthcare service utilization, especially in the case of those with chronic disease conditions. Nevertheless, this relationship might be especially important in predicting healthcare utilization, and in identifying patients at risk for potentially avoidable medical events in this population. In addition, traditional methods of risk assessment have focused on limited dimensions of risk and are able to explain less than 7% of the variance in healthcare service utilization.[4,5]

Traditionally, "risk" has been defined as the propensity of enrollees to consume healthcare resources during a particular period, usually 1 year. Studies have used 1-year data to predict healthcare service utilization in the subsequent year. This approach has explained as much as 12% of the variance in healthcare service utilization, after inclusion of comorbidity and perceived health status in the models.[6] As a congressionally mandated requirement, all Medicare HMOs in the country use some type of risk-screening strategy. The collection of comprehensive risk-assessment data at the time of enrollment in the Medicare HMO, although typically thought of as relatively more resource- and time-consuming, may actually be equally or more predictive of actual postenrollment risk in elderly patients enrolled in Medicare managed care plans, than use of simple unidimensional screens (eg, using only the Short Form 36 or the Center for Epidemologic Studies Depression Scale[7] (CES-D). The predictive power of this approach must be examined in greater detail.

We therefore examined the predictive power of a comprehensive risk-assessment questionnaire administered to older adults (age 65 years or older) at the time of enrollment in a Medicare HMO across 5 commonly occurring conditions (ie, diabetes, cardiovascular [CV] problems, arthritis, cancer, and depression). Specifically, we examined the associations between preenrollment self-reported health status variables and actual postenrollment annual healthcare service utilization (ie, hospitalizations, physician visits, and ED visits) and total healthcare charges across different disease states in older adults enrolled in a Medicare HMO.

··· METHODS ···

Study Design and Population

This study was a prospective cohort study begun in 1996 with annual follow-up for 2 years postenrollment. The study design is outlined in the **Figure**. The study population consisted of older adults enrolled in a Medicare managed care plan located in the southeastern United States. This managed care plan has been operational since late 1996 and is the sole provider of medical care to the enrollees (ie, it is a "lock-in" risk-benefit plan). After enrolling in the plan, each enrollee was mailed a questionnaire (created by the authors in 1996) that asked questions about demographics, clinical conditions, healthcare service utilization in the year preceding plan enrollment, lifestyle, depression, and quality of life. In addition, the questionnaire collected data on alcohol and tobacco use, physical activities, and activities of daily living (ADLs). Since its creation, this questionnaire has received a response rate of more than 80%. Questions from the Short Form 12 (SF-12) were used to assess quality of life,[8] and the CES-D was used to assess depression.

We followed up a cohort of patients consisting of individuals who responded to the questionnaire, and for whom complete healthcare service utilization data were available for at least 2 years postenrollment. We examined patterns of healthcare service use in patients who reported having any of the following 5 conditions: (1) diabetes; (2) cancer; (3) CV problems (ie, angina, chronic heart failure, stroke, or moderate to severe hypertension); (4) depression; or (5) arthritis. Positive responses to questions on whether the respondent had ever been diagnosed with a condition, was currently taking medications for the condition, and was receiving medical treatment for it constituted confirmation of all the conditions with the exception of depression. Positive responses to the 3 questions *and* a score of 16 or higher on the CES-D scale confirmed depression.

Study Variables

The responses to the questions in the patient questionnaire formed the basis for the demographic and health status variables in the study. The demographic variables were age, sex, and whether the enrollee lived alone (as opposed to living with caregivers, spouses, relatives, or others). The health status variables consisted of a sedentary status dummy (from questions examining physical activity and whether the enrollee walked for at least 30 minutes per week), whether the enrollee had more than 1 fall during the year preceding enrollment, dummies for whether the enrollee was a heavy smoker (ie, more than 10 cigarettes per day) and had high alcohol consumption (ie, more than 3 drinks per day), the number of ADLs that the enrollee had problems performing, the number of instrumental activities of daily living (IADLs) that the enrollee had problems performing, the number of comorbid conditions (excluding the condition of primary interest and depression), a dummy for a response on whether the patient perceived that health status worsened during the year preceding enrollment, the general health score (out of a possible 100 points) on the SF-12, the presence of the depression dummy (as indicated by a score of 16 or higher on the CES-D), the number of conditions reported as untreated before enrollment, and reported healthcare service utilization (ie, physician office visits, ED visits, hospitalizations, and number of prescriptions) during the preenrollment year.
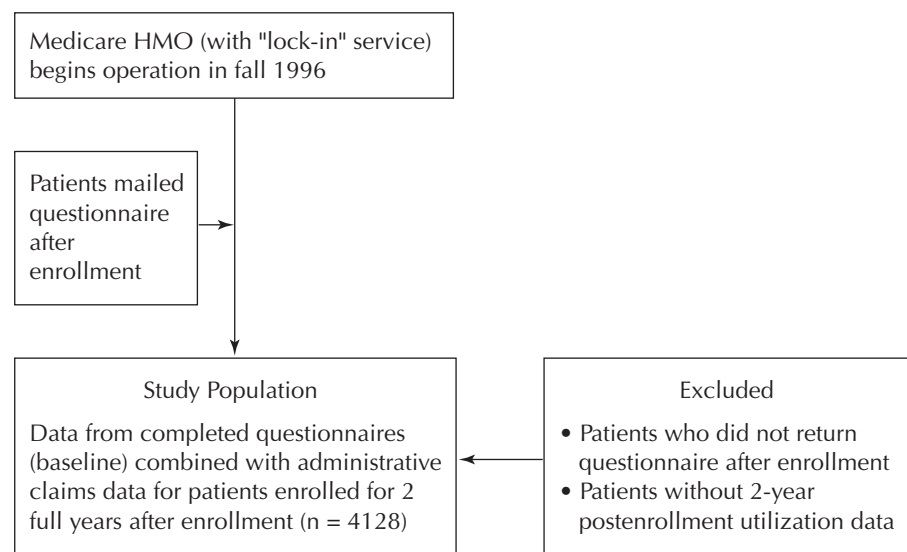
The utilization variables were obtained from the patient claims data that the HMO collected. These variables were the number of hospitalizations per year, the number of ED visits per year, and healthcare charges per year during the 2-year postenrollment follow-up period. Total healthcare charges were all the healthcare service utilization and prescription charges for which the HMO reimbursed the participant.

The regressions, which were in the form of a panel with 2 annual observations per patient, contained a dummy variable for time (year) that took on a value of 1 for the second year, and a value of 0 otherwise. These variables were included to measure periodicity effects. Age splines were used in the regressions, because of the possible nonlinear effects of age. In contrast to step functions or continuous linear variables, splined variables result in a piecewise linear graph. The coefficient for a category indicates the marginal effects of increasing age by 1 year in that group. To make a prediction, one would have to use all the coefficients of the younger age groups.[9]

Statistical Methodology

Multiple ordinary least squares regression analyses were conducted to examine the associations between the predictor variables (ie, the measures of self-reported health status collected in the risk-assessment questionnaire) and postenrollment annual healthcare service utilization (ED visits and hospitalizations) and annual healthcare charges. We additionally compared self-reported healthcare service utilization in year preceding enrollment with actual means of healthcare service use in the years postenrollment from the claims data using bivariate analysis of variance (results not shown). Because the distributions of healthcare service use and charges were skewed, the natural logarithms of

Figure. Description of the Study Design

Medicare HMO (with "lock-in" service) begins operation in fall 1996

Patients mailed questionnaire after enrollment

Study Population

Data from completed questionnaires (baseline) combined with administrative claims data for patients enrolled for 2 full years after enrollment (n = 4128)

Excluded
• Patients who did not return questionnaire after enrollment
• Patients without 2-year postenrollment utilization data

HMO = health maintenance organization.

annual healthcare services and charges were used as the dependent variables for the analyses. The regressions also were checked for the presence of multicollinearity (ie, a linear relationship among predictor variables), autocorrelation (ie, correlation between sequential values, in this case, yearly values, of variables), and heteroskedasticity (ie, variance of the error terms correlated with 1 or more explanatory variables). None of the correlation coefficients (ρ^2) between the predictor variables were greater than 0.4, indicating that multicollinearity was unlikely. Results of the Durbin-Watson test performed on the regressions were around 2 for all the regressions, indicating that no autocorrelation problem was associated with the data. Heteroskedasticity (as indicated by results of the Cook and Weisberg test[10] and White test[11]) was corrected with robust standard error regressions.

Table 1. Summary Statistics for Study Population (n = 4128)

Characteristic	Mean (Standard Deviation)	Median (Range)
At enrollment		
Age (y)	74.20 (6.14)*	73 (65–91)
Sex (% male)	31.61	
Heavy smoker (%)	12.82	
High alcohol consumption (%)	9.74	
Sedentary (%)	37.01	
Lives alone (%)	28.50	
>1 fall (%)	7.16	
CV problem (%)	62.78	
Diabetes (%)	12.91	
Arthritis (%)	47.03	
Cancer (%)	12.52	
Depression (%)	20.11	
Health worse than previous year (%)	15.08	
SF-12 general health score	61.99 (23.89)	60 (25–100)
No. of ADLs causing problems	0.19 (0.81)	0 (0–8)
No. of IADLs causing problems	0.47 (1.23)	0 (0–7)
Medications in preenrollment year (n)	2.09 (1.45)	2 (0–10)
Physician visits in preenrollment year (n)	3.68 (2.67)	2 (0–10)
ED visits year in preenrollment year (n)	0.28 (0.64)	0 (0–3)
Hospitalizations in preenrollment year (n)	0.21 (0.56)	0 (0–4)
Conditions not treated preenrollment	1.04 (1.20)	1 (0–10)
Postenrollment		
ED visit (% with 1 per year)	20.75	
Inpatient admission (% with 1 per year)	77.77	
Physician visits per year (n)	10.8 (10.2)	5 (0–36)
ED visits per year (n)	0.95 (2.43)	0 (0–12)
Inpatient admissions per year (n)	7.26 (10.97)	4 (0–27)
Total annual charges ($)	3441.35 (7889.88)	828.07 (40–36,896)

ADL = activity of daily living; CV = cardiovascular; ED = emergency department; IADL = instrumental activity of daily living; SF-12 = Short Form 12.

··· RESULTS ···

The descriptive statistics for the study population are identified in **Table 1.** The average enrollee age was nearly 74 years. Women comprised more than two thirds of the population. In addition, 12.8% and 9.7% of the population, respectively, reported consuming large amounts of cigarettes and alcohol, and, based on a response to the physical activity question indicating fewer than 30 minutes per week of exercise of some type, including walking, 37% could be classified as sedentary. During the year preceding enrollment, 7% had more than 1 fall, and 15% reported that their health had worsened. At the time of responding to the questionnaire, 28% lived alone. The most prevalent health conditions were some type of CV problem (63%) and arthritis (47%). The average score on the SF-12 was 62 out of a maximum of 100. Fewer than 50% of the patients reported difficulties in performing ADLs. Comparison with actual postenrollment healthcare service utilization suggested

considerable underreporting of healthcare service utilization during the preenrollment year. The average annual charges were approximately $3441 but varied considerably.

The study population's healthcare service utilization during the period from 1997 through 1999 and the average utilization of all the HMO enrollees during that time did not differ significantly (data not shown). In addition, the incidence of certain conditions was lower in the male patients in the study population than in the female patients. For example, only 27% of the enrollees with depression and arthritis were male, relative to the percentage with such conditions as cancer and diabetes, whereas nearly 40% of the study population was male. Patients with depression were more likely than those without the condition to report problems with ADLs and IADLs (they had problems with an average of 0.49 ADLs and 0.96 IADLs [ADI range, 0.23-0.37; IADL range 0.59-0.79]). Patients with diabetes had the lowest average SF-12 general health scores (49.61, compared with 50.86 to 62.31 for patients with any of the other conditions). Although the distributions of self-reported preenrollment and actual postenrollment healthcare service utilization were similar across different conditions, they were the highest for patients with diabetes (nearly 2 ED visits, 9 hospitalizations, and $5012 in annual paid charges).

Variance in Annual Charges

The log-transformed value of the parameters in the regression analyses were estimated

Table 2. Predictors of Annual Charges Across Different Disease States in Cohort of Patients Followed Up for 2 Years (Dependent Variable: Logarithm of Annual Charges per Patient)*

Predictor[†]	Diabetes (n = 528)	Cancer (n =539)	CV Problems (n = 2533)	Arthritis (n =1891)	Depression (n = 672)
Age at enrollment	-.47[‡] (0.22)	NS	NS	NS	NS
Age at enrollment squared	.0031[‡] (.0014)	NS	NS	NS	NS
Sedentary	.38[‡] (0.17)	NS	NS	NS	NS
High alcohol use	-.56[‡] (0.29)	NS	NS	NS	NS
SF-12 general health score	NS	0.006[§] (.0033)	-.006[‖] (.0016)	-.004[‡] (.0016)	-.0095[‖] (.0028)
No. of ADLs causing problems	.19[‡] (0.096)	NS	NS	NS	NS
No. of IADLS causing problems	NS	NS	NS	NS	.10[§] (.052)
Conditions not treated preenrollment	-.10[‡] (.050)	-.11[§] (.059)	-.10[‖] (0.026)	-.066[‡] (.027)	-.20[‖] (.046)
ED visits in preenrollment year	.25[‡] (.094)	NS	17[‖] (0.055)	NS	-.15[§] (.087)
Hospital visits in preenrollment year	.28[‡] (0.13)	.38[‡] (0.14)	0.31[‖] (0.068)	.41[‖] (0.069)	.53[‖] (.097)
Physician visits in preenrollment year	NS	.052[§] (.028)	.043[‖] (.012)	.062[‖] (.014)	NS
Total number of comorbidities	.16[‖] (.040)	.096[§] (.055)	.18[‖] (.022)	.16[‖] (.024)	.18[‖] (.036)
Year	NS	NS	-.11[§] (.059)	NS	-.20[§] (0.11)
Adjusted R^2	0.16	0.17	0.13	0.14	0.20

ADL = activity of daily living; CV = cardiovascular; ED = emergency department; IADL = instrumental activity of daily living; NS = not significant; SF-12 = Short Form 12.
*The unit of observation was the person-year (2 observations per patient). Parameter estimates shown with standard errors are indicated in parentheses.
[†]NS across all disease categories: lives alone, male sex, heavy smoker, >1 fall, health worse than previous year, depression.
[‡]Significance at the 0.05 level.
[§]Significance at the 0.10 level.
[‖]Significance at the 0.005 level.

Table 3. Predictors of Annual Outpatient Visits Across Different Disease States in Cohort of Patients Followed Up for 2 Years (Dependent Variable: Logarithm of Annual Outpatient Visits per Patient)*

Predictor[†]	Diabetes (n = 527)	Cancer (n =536)	CV Problems (n =2527)	Arthritis (n =1887)	Depression (n = 667)
Age at enrollment	NS	.46‡ (.13)	.10§ (.050)	.15§ (.061)	.28‡ (.10)
Age at enrollment squared	NS	-.003‡ (.0008)	-.00067§ (.00033)	-.00094§ (.0003)	-.0019‡ (.00067)
Male sex	NS	-.14‖ (0.73)	NS	-.095§ (.039)	-.23‡ (.079)
Heavy smoker	NS	NS	-.090‖ (0.48)	-.10‖ (.060)	NS
High alcohol use	NS	NS	.14§ (.051)	.12§ (.059)	NS
Sedentary	.16§ (.074)	NS	NS	.080§ (.038)	NS
Lives alone	NS	NS	NS	NS	-.10‖ (.060)
> 1 fall	NS	NS	NS	NS	.13‖ (.076)
SF-12 general health score	NS	-.003‖ (0.017)	-.002§ (0.0071)	NS	-.0023‖ (.0014)
No. of ADLs causing problems	NS	-.080§ (.029)	-.052§ (.021)	-.065‡ (.022)	NS
No. of IADLs causing problems	NS	NS	-.036§ (.015)	NS	-.055§ (.023)
Conditions not treated preenrollment	-.060§ (.022)	-.059‖ (.028)	-.040‖ (.012)	-.039‡ (.013)	-.050§ (.025)
ED visits in preenrollment year	.13‡ (.042)	NS	.059§ (.024)	NS	NS
Hospital visits in preenrollment year	NS	.15‡ (.046)	.086‡ (.028)	.12‡ (.032)	.14‡ (.051)
Physician visits in preenrollment year	.043‡ (.011)	.046‡ (.012)	.055‡ (.0056)	.060‡ (.0064)	.051‡ (.012)
Total number of comorbidities	.042§ (.019)	.070§ (.025)	.072‡ (.010)	.071‡ (.011)	.086‡ (.018)
Year	NS	NS	-.064§ (.027)	NS	NS
Adjusted R^2	.14	.20	.14	.16	.22

ADL = activity of daily living; CV = cardiovascular; ED = emergency department; IADL = instrumental activity of daily living; NS = not significant; SF-12 = Short Form 12.
*See the first footnote in Table 2 for an explanation.
[†]NS across all disease categories: depression.
[‡§‖]See the third through fifth footnotes in Table 2 for an explanation.

using the correction by Halverson and Palmquist,[12] with a modification by Kennedy.[13] The predictors included in the regressions examining annual charges explained between 13% and 20% of the variance in annual charges (**Table 2**). Sedentary status and high alcohol consumption were associated with, respectively, a 42% significant increase and a 42% significant decrease in healthcare charges in diabetic patients. An increase of 10% in the SF-12 score was associated with a significant decrease of 6% to 10% in healthcare charges across all conditions with the exception of diabetes. One additional self-reported condition for which the enrollee had not sought treatment before plan enrollment decreased charges significantly from 7% to 19% across all conditions. One additional ADL difficulty was associated with a 21% increase in charges for patients with depression, and 1 additional IADL difficulty was associated with a 10% increase in charges for patients with depression.

As expected, despite significant underreporting of preenrollment healthcare service utilization, increases in this utilization were significantly associated with increased costs. Additional ED visits during the preenrollment year increased charges from 14% to 28% during the postenrollment period for patients with all conditions with the exception of cancer and arthritis. Additional preenrollment hospitalizations were associated with increases of 31% to 69% across all conditions, and additional physician visits with increases of 4% to 6% for all conditions with the exception

of diabetes and depression. Additional self-reported comorbidities were associated with increases of 10% to 20% across all conditions. The second year was associated with decreases in charges by 10% and 20% in patients with cardiovascular problems and in patients with depression, respectively.

Variance in Physician Visits

The trends were similar in the prediction of postenrollment outpatient physician visits, although the magnitudes of the effects of individual predictors were smaller. The predictors in the regressions explained between 14% and 22% of the variance in postenrollment physician visit utilization (**Table 3**). Male patients with arthritis, cancer, or depression were significantly likely to have 10% to 23% fewer physician visits than male patients with depression or diabetes. Although heavy smoking was associated with roughly 10% fewer physician visits in patients with CV problems and arthritis, high alcohol intake in patients with the same conditions was associated with a nearly 15% increase in these visits. In patients with depression, living alone and more than 1 fall were associated with a 10% decrease and 13% increase in physician visits, respectively.

Increases in the number of ADLs and IADLs with which a patient had difficulty were associated with a 5% to 8% decrease in physician visits across many conditions, with the exception of diabetes. Having conditions that were untreated before enrollment was associated with 4% to 6% decreases in postenrollment physician visits. As expected, preenrollment healthcare service utilization was associated with increases in postenrollment physician visit utilization of nearly 5% to 15%. An increase in the number of comorbid conditions was associated with increases of 5% to

10% in the number of physician visits. In patients with CV problems there was a 7% decrease in physician visits.

Variance in Hospitalizations and ED Visits

The predictors explained a lower percentage of the variance in hospitalizations (between 9% and 15%; **Table 4**) and in ED visits (between 6% and 20%; **Table 5**) than in charges and physician visits. Sedentary status was associated with a 30% increase in hospitalizations in diabetic patients. Male sex was associated with a 30% decrease in ED visits, and high alcohol intake was associated with 42% and 58% increases in ED visits in patients with depression and cancer, respectively. Living alone was associated

Table 4. Predictors of Hospitalization Across Different Disease States in Cohort of Patients Followed Up for 2 Years (Dependent Variable: Logarithm of Annual Hospitalizations per Patient)*

Predictor[†]	Diabetes (n = 402)	Cancer (n = 433)	CV Problems (n = 1956)	Arthritis (n =1492)	Depression (n = 521)
Sedentary	.27[‡] (.13)	NS	NS	NS	NS
No. of ADLs causing problems	NS	-.11[‡] (.054)	NS	NS	NS
No. of IADLs causing problems	NS	NS	NS	NS	-.049[§] (.030)
Conditions not treated preenrollment	NS	NS	-.043[‡] (.020)	-.044[‡] (.021)	-.086[‡] (.033)
Hospital visits in preenrollment year	.415[‖] (.086)	.26[‡] (0.11)	.24[‖] (.053)	.31[‖] (.050)	.32[‖] (.062)
Total number of comorbidities	NS	NS	.092[‖] (.017)	.088[‖] (.018)	.11[‖] (.025)
Year	NS	NS	NS	.11[‡] (.048)	NS
Adjusted R^2	.14	.13	.089	.10	.15

ADL = activity of daily living; CV = cardiovascular; ED = emergency department; IADL = instrumental activity of daily living; NS = not significant; SF-12 = Short Form 12.
*See the first footnote in Table 2 for an explanation.
[†]NS across all disease categories: age at enrollment, sex, heavy smoker, high alcohol use, lives alone, >1 fall, SF-12 general health score, depression, and ED and physician visits during the preenrollment year.
[‡§‖]See the third through fifth footnotes in Table 2 for an explanation.

with a 31% increase in ED visits in cancer patients. An increase in the number of conditions that were not treated before enrollment was associated with a 4% decrease in ED visits in patients with CV problems, with a 4% decrease in hospitalizations in patients with CV problems or arthritis, and with a 9% decrease in hospitalizations in patients with depression. Significant increases in hospitalizations (24% to 42%) were associated with self-reported preenrollment hospitalizations. An increase in comorbidities increased ED visits by 7% in patients with depression and decreased these visits by 6% in diabetic patients. Additional comorbidities were associated with 9% to 11% increases in hospitalizations in patients with CV

problems, arthritis, or depression. Patients with arthritis and cancer had increases in ED visits during the second follow-up year of 17% and 24%, respectively; arthritis was associated with 11% additional hospitalizations during that year.

··· DISCUSSION ···

Self-reported health status information collected at the time of enrollment in a Medicare managed care plan was highly predictive of healthcare service utilization during the postenrollment period. In addition, the variance in postenrollment healthcare service utilization varied across older adults with different conditions. To our knowledge, this study is one of the first to use self-reported archival data to examine the issue of health risk assessment in Medicare HMO enrollees.

Although comparisons with actual postenrollment healthcare service utilization found evidence of considerable underreporting of preenrollment healthcare service utilization, higher preenrollment healthcare service utilization was strongly associated with more postenrollment adverse medical outcomes that required expensive healthcare services, such as ED visits and hospitalizations. Other factors, such as poor quality of life, difficulties performing ADLs, a decrease in the number of conditions that were not treated before enrollment, and an increase in the number of comorbidities, were also associated with higher healthcare service utilization during the postenrollment period in patients with many of the conditions studied. Furthermore, disease-specific self-reported health status predictors, such as female sex in patients with depression and sedentary status in patients with diabetes, were significantly associated with changes in postenrollment healthcare service utilization.

Table 5. Predictors of ED Use Across Different Disease States in Cohort of Patients Followed Up for 2 Years (Dependent Variable: Logarithm of Annual ED Visits per Patient)*

Predictor[†]	Diabetes (n = 156)	Cancer (n = 132)	CV Problems (n = 667)	Arthritis (n =507)	Depression (n = 202)
Male sex	NS	NS	NS	NS	-.34[‡] (0.13)
High alcohol use	NS	-.58[§] (0.15)	NS	NS	-.42[‡] (0.19)
Lives alone	NS	.31 (0.15)	NS	NS	NS
Conditions not treated preenrollment	NS	NS	-.041[‖] (.024)	NS	NS
ED visits in preenrollment year	NS	NS	.12[‡] (.043)	NS	NS
Hospital visits in preenrollment year	.13[‖] (.074)	NS	NS	NS	NS
Physician visits in preenrollment year	NS	.042 (.025)	NS	NS	NS
Total number of comorbidities	-.056[‖] (.031)	NS	NS	NS	.067[‡] (.034)
Year	NS	.24 (0.13)	NS	.17[‡] (.062)	NS

CV = cardiovascular; ED = emergency department; NS = not significant; SF-12 = Short Form 12.
*See the first footnote in Table 2 for an explanation.
[†]NS across all disease categories: age at enrollment, >1 fall, SF-12 general health score, and depression.
[‡§‖]See the third through fifth footnotes in Table 2 for an explanation.

The comprehensive risk-assessment approach, which incorporates questions about self-reported health status, morbidity history, quality of life, and health perceptions, explained a larger amount of the variance in healthcare service utilization and charges than did an approach that assessed fewer dimensions of self-reported health status. Some might believe that older adults would find it cumbersome to complete a questionnaire that included all these components, thereby leading to lower response rates. In this study, however, response rates were quite high, and a high percentage of the returned questionnaires were complete. The comprehensive health risk assessment was especially predictive of healthcare service utilization in such chronic conditions as diabetes, depression, and cancer, even after controlling for periodicity effects. We believe that the comprehensive risk-assessment approach may be especially useful in identifying elderly patients with chronic disease conditions, especially those at low risk for mortality.

Study Limitations and Generalizability

A limitation of some of these findings is a possible bias in selection. However, we found our population to be representative of national estimates of Medicare managed care plan enrollees, and comparisons with the National Health Interview Survey estimates failed to yield significant differences between the groups. Furthermore, we had a questionnaire response rate of more than 80%, and the respondents' and nonrespondents' healthcare service utilization rates were not statistically different. Therefore, it is unlikely that special groups of patients were excluded from the study. In addition, the study examined total healthcare utilization and charges, as opposed to disease-specific utilization and charges. In this way, we avoided problems inherent in attributing all billings for healthcare service utilization and charges to a specific condition due to miscoding of diagnoses.

These minor limitations do not in any way undermine the potential benefits of a comprehensive risk-assessment approach toward disease management in elderly patients with chronic disease conditions who are enrolled in Medicare managed care plans. We find this approach useful in detecting patients at highest risk for potentially avoidable medical events, and comparable to traditional approaches, such as using 1-year data to predict subsequent risk. We also found this approach to be sensitive to differences in healthcare service utilization resulting from differing health conditions in older adults.

··· CONCLUSIONS ···

This study found self-reported health status information collected at the time of enrollment in a Medicare managed care plan to be highly predictive of subsequent healthcare service utilization. The approach may be especially predictive of healthcare service utilization in populations that maintain enrollment over long periods. The large-scale use of this risk-management approach may help to detect patients at highest risk for avoidable medical events and is comparable to traditional approaches that rely heavily on collection of preliminary healthcare service utilization data to make subsequent-year predictions. Furthermore, this approach is sensitive to healthcare service utilization differences due to differing morbidity in older adults.

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