The influence of comorbidity and other health measures on dental and medical care use among Medicare beneficiaries 2002

Haiyan Chen, MD, PhD; John Moeller, PhD; Richard J. Manski, DDS, MBA, PhD

Division of Health Services Research Department of Health Promotion and Policy Dental School, University of Maryland at Baltimore, Baltimore, MD

Keywords

comorbidity; dental; hospital; visits; Medicare.

Correspondence

Dr. Haiyan Chen, Division of Health Services Research Department of Health Promotion and Policy Dental School, University of Maryland, Baltimore, MD. Tel.: 410-706-6677; Fax: 410-706-0431; e-mail: hchen@umaryland.edu. John Moeller and Richard J. Manski are with the Division of Health Services Research Department of Health Promotion and Policy Dental School, University of Maryland, Baltimore, MD.

Received: 1/25/2010; accepted: 1/23/2011.

doi: 10.1111/j.1752-7325.2011.00251.x

Abstract

Objective: To assess the impact of comorbidity and other health measures on the use of dental and medical care services among the community-based Medicare population with data from the 2002 Medicare Current Beneficiary Survey.

Methods: A comorbidity index is the main independent variable of our study. It includes oral cancer as a comorbidity condition and was developed from Medicare claims data. The two outcome variables indicate whether a beneficiary had a dental visit during the year and whether the beneficiary had an inpatient hospital stay during the year. Logistic regressions estimated the relationship between the outcome variables and comorbidity after controlling for other explanatory variables.

Results: High scores on the comorbidity index, high numbers of self-reported physical limitations, and fair or poor self-reported health status were correlated with higher hospital use and lower dental care utilization. Similar results were found for other types of medical care including medical provider visits, outpatient care, and prescription drugs. A multiple imputation technique was used for the approximate 20 percent of the sample with missing claims, but the resulting comorbidity index performed no differently than the index constructed without imputation.

Conclusions: Comorbidities and other health status measures are theorized to play either a predisposing or need role in determining health care utilization. The study's findings confirm the dominant role of these measures as predisposing factors limiting access to dental care for Medicare beneficiaries and as need factors producing higher levels of inpatient hospital and other medical care for Medicare beneficiaries.

Introduction

The influence of comorbidity on dental and medical care utilization of the Medicare population is the main focus of our study. Comorbidity is a coexisting medical condition distinct from a condition causing the patient to seek health care (1-5). Following Andersen's theoretical model of health behavior, personal characteristics determining this behavior are separated into predisposing, enabling resources, or need classes. (6). Comorbidities related to oral conditions are need factors and are expected to have a positive influence on dental use. Oral conditions may exist as a manifestation of potentially lethal systemic diseases such as AIDS, leukemia, and Paget's disease, or as a secondary consequence or complication of medical conditions such as diabetic-related periodontal disease or drug-induced gingival hyperplasia (7,8). Recent research findings have pointed to possible associations between chronic oral infections and diabetes, heart and lung diseases, stroke, low-birth weight, and premature births showing that oral health is important to general health and well-being (7). Other comorbid conditions may have a significant impact on a patient's capacity to engage in activities needed to maintain good oral health or an ability to seek dental care and thus serve as predisposing determinants of dental care use that may limit access to care. Similarly, comorbidities may serve as either need or predisposing factors determining medical care utilization. Examples of other predisposing factors include age, gender, race/ethnicity, education, and marital status.

Financial considerations are enabling factors that can influence the role comorbidities serve in dental and medical utilization models for the Medicare population. Apart from dental services related to and performed at the same time as a covered primary service, Medicare does not cover dental care (9). There is some limited dental coverage for those in Medicare Advantage programs and for those low income dual Medicare/Medicaid beneficiaries. Beneficiaries receive Medicare Part A hospital coverage and can opt into Medicare Part B physician coverage (10,11).

Without Medicare coverage for dental care, beneficiaries are less likely to visit the dentist because of their health conditions. Beneficiaries with health conditions are less likely to be discouraged from visiting a medical provider because Medicare covers their medical care. In addition, co-pays needed for medical care can reduce the resources Medicare beneficiaries have available to finance needed dental care not covered by Medicare. Accordingly, we hypothesize that beneficiaries with multiple and/or severe morbidities will have high levels of medical care use and low levels of dental care use.

A second focus of our study is to demonstrate the usefulness of measuring comorbidities with an index rather than by counts of the number of morbidities or by separate variables indicating the presence of a specific morbidity. Counts of the number of morbidities fail to distinguish the severity of the health conditions. Separate variables for each condition make it difficult to isolate the impact of specific morbidities because of potential collinearity estimation problems with other measures of health status and limitations. As a result, analysts have developed indices of medical conditions to better represent the many conditions that summarize health status and to provide more accurate and precise measurements of the effect of medical conditions on dental care and medical care use.

In general, a comorbidity index attempts to account for the number and severity of medical conditions present in a given individual. Charlson et al. (12) developed a weighted index measure to predict 1-year all-cause mortality among hospitalized cancer patients. The index is comprised of 19 conditions, each of which was assigned a weight according to its potential for influencing mortality. Klabunde et al. (1-3) further adapted the Charlson index by including outpatient claims. Although the Charlson and Klabunde indices were primarily developed and used to assess the impact of comorbid conditions when modeling for cancer treatment, we have adapted and applied their technique to other more general types of medical care and to dental care. Our study investigates and contrasts the relative impact of a comorbidity index of the Klabunde/Charlson type on dental and medical care use in models containing self-assessed health status and other self-reported health measures using data from the 2002 Medicare Current Beneficiary Survey (MCBS) (1,12).

Methods

The MCBS is a continuous, multipurpose survey of a nationally representative sample of aged, disabled, and

institutionalized Medicare beneficiaries. MCBS, which is sponsored by the Centers for Medicare and Medicaid Services (CMS), is the only comprehensive source of information on the health status, health-care use, health insurance coverage, and socioeconomic and demographic characteristics of the entire spectrum of Medicare beneficiaries (13). MCBS sampled persons are interviewed three times a year over 4 years to form a continuous profile of their health care experience. Sample weights we used to project from the sample to the population reflect the probability of sample selection and have been adjusted for nonresponse and under-coverage. The general purpose cross section weight that we used was also post- stratified for age, sex, region, metropolitan residence, and year of entry into the sample. Interviews are conducted regardless of whether the sampled person resides at home or in a long- term care facility, using the version of the questionnaire appropriate to the setting (13). We restricted our sample to the Medicare population residing in the community throughout 2002.

Dependent variables

The outcome variables for our study include: a) whether a beneficiary had a dental visit during the year; and b) whether a beneficiary had at least one inpatient hospital stay during the year. Dental visit data in the MCBS are self-reported while inpatient data combine survey reports with Medicare claims and other data from administrative files. We also investigated other medical care utilization models including medical provider visits, outpatient hospital visits, home health visits, and prescription drugs.

Comorbidity

Claims-based comorbidity data for doctor-diagnosed medical conditions present during the year were the primary source of condition data for our comorbidity index. These MCBS data were derived from "Explanation of Benefit" claim forms from Medicare linked to each MCBS beneficiary in association with medical events recorded on calendars by the respondent. The claims-based comorbidity data were verified by receipts and statements from private health insurers and by the consistency of self-reported condition responses to survey questions asking whether a doctor has ever told the sampled person that they have had a medical condition from a list of conditions.

Following Klabunde *et al.* (1-3), dichotomized indicators were defined by searching Medicare Part A or B claims for one of 20 comorbid conditions, the original 19 Charlson (12) conditions plus a 20th condition added by Klabunde splitting myocardial infarction into two categories. The comorbid indicators were multiplied by their corresponding Charlson integer weights (1, 2, 3, or 6) and summed to

produce a comorbidity index score. Index scores were then categorized into four ordinal groups: 0 for those with an index score of zero, i.e., no comorbidities, 1 for those with an index score of 1, 2 for those with an index score of 2, and 3 for those with an index score of 3 or higher.

Missing claims data

If no information on any of the 19 Charlson comorbid conditions for an observation was available by searching Medicare Part A Hospital or Part B physician claims, then the comorbid index score for the observation was coded as missing. Claims data used to construct our comorbidity index were missing for approximately 20 percent of our sample. Missing data are a common problem and various statistical methods have been or are being developed to address it (14,15). The common approaches for inference with missing covariate data are: inclusion of missing data as a separate domain; multiple imputation; maximum likelihood; fully Bayesian; and weighted estimating equations (14-19). In this study, we chose the first two approaches and found that both led to almost identical results, so we only report findings with missing data as a separate domain.

Other explanatory variables

Other covariates included a core set of characteristics comprised of predisposing factors for age, gender, race/ethnicity, education, marital status, and household size; enabling factors for income and supplementary medical insurance; and a need factor for health status (6,20). Additional need variables included smoking behavior, teeth problems with eating, and physical limitations. Preliminary model testing showed that the comorbidity index did make a statistically significant contribution to the core model although variables for self-reported conditions and difficulties with activities of daily living (ADLs) and instrumental ADLs did not. (20). For comparative purposes, the same set of explanatory variables, including the comorbidity index, was used for the hospital inpatient utilization model.

Statistical analysis

All analyses used SAS/SAS callable SUDAAN software (21,22). Logistic regression was used to estimate the effect of the comorbidity index and other explanatory variables on dental and inpatient hospital utilization. Multiple imputation was conducted using SAS PROC MI, PROC MIANALYZE, and SAS callable SUDAAN PROC MULTILOG the MI_COUNT option (23). All estimates are based on weighted data and account for the complex sample design of the MCBS data. Unless otherwise stated, all results discussed in the text are statistically significant at least at the 5 percent level.

Results

Sample

There were 10,582 total participants in the 2002 MCBS representing 33,725,756 Medicare beneficiaries who were in the community-based population. Our study's sample size was reduced to 9,184 representing 29,573,790 beneficiaries after omitting 836 observations with missing data on one or more of the explanatory variables other than claims data and 562 beneficiaries who were part year community residents during the year. Claims data for 79 percent (7,274/9,184 beneficiaries) of our sample were available to construct the comorbidity index. Sample means for the claims-based conditions used to construct the index, in addition to the index values without imputation and with and without missing values, are shown in Table 1. Sample means for the other explanatory variables in the study appear in Appendix 1. Results for the comorbidity index and other health-related covariates were similar across each type of medical care so we only show the results from the inpatient hospital use model in our paper.

Comorbidity index

From Table 1, the most common morbidities among all Medicare beneficiaries in the Charlson/Klabunde index were diabetes, chronic obstructive pulmonary disease, congestive heart failure, and solid cancer. Four percent or more of all beneficiaries had verified claims for each of these conditions in 2002. There are nine conditions in Table 1 with significant differences between the incidence of the particular condition for dental care users and nonusers. In all but one case, nonusers had higher rates of a specific health condition than users. For example, 3.1 percent of beneficiaries with a dental visit have congestive heart failure as verified by Medicare claims data compared with 5.4 percent of those without a dental visit. However, 5.4 percent of beneficiaries with a dental visit had solid cancer compared with 4.3 percent of those without a dental visit. Oral cancer can be included in either solid or secondary cancer morbidities. There are 17 conditions in Table 1 with significant differences between condition rates of hospital inpatient users and nonusers. In each case, hospital users always had a higher rate for a specific health condition than nonusers. For example, 21.6 percent of beneficiaries with a hospital visit have diabetes compared with 9.6 percent of those without a hospital visit.

From the second panel of Table 1, about one-fifth of beneficiaries were missing claims data on the MCBS. Among the beneficiary population with nonmissing claims data in the bottom panel of Table 1, 63.9 percent had no Charlson comorbid conditions present, 18.4 percent had an index value of one, 10.6 percent had an index value of two, and 7.1 percent had an index value of three or more. Not surprisingly in the
 Table 1
 Sample Means for Health Conditions and Comorbidity Index for Full-Year Community-Dwelling Medicare Beneficiaries by Use of Dental and

 Hospital Inpatient Care, 2002
 Community-Dwelling Medicare Beneficiaries

		Dental visit in 2002		Hospital inpatient stay in 2002	
	Full-year beneficiaries	Yes	No	Yes	No
Number of beneficiaries	29,573,790	13,814,192	15,759,598	5,108,617	24,465,173
Condition estimate (SE), %					
Diabetes	11.71 (0.51)	9.27 (0.53)*	13.85 (0.65)	21.56 (1.23)*	9.65 (0.51)
Chronic obstructive pulmonary disease	7.13 (0.29)	5.58 (0.35)*	8.49 (0.43)	21.44 (1.11)*	4.15 (0.27)
Solid cancer	4.92 (0.24)	5.66 (0.35)*	4.27 (0.31)	10.08 (0.77)*	3.84 (0.25)
Congestive heart failure	4.33 (0.20)	3.07 (0.27)*	5.43 (0.32)	17.03 (0.93)*	1.68 (0.16)
Cerebral-vascular disease	2.61 (0.18)	2.67 (0.24)	2.55 (0.24)	9.33 (0.68)*	1.21 (0.12)
Peripheral vascular disease (Dx+Surg)	2.46 (0.18)	1.89 (0.22)*	2.95 (0.25)	7.44 (0.71)*	1.42 (0.14)
Diabetes with sequelae	2.22 (0.18)	1.55 (0.21)*	2.80 (0.25)	5.88 (0.58)*	1.45 (0.17)
Rheumatologic disease	1.70 (0.12)	1.74 (0.20)	1.65 (0.18)	3.27 (0.34)*	1.37 (0.12)
Chronic renal failure	1.42 (0.14)	1.12 (0.15)*	1.68 (0.22)	4.24 (0.61)*	0.83 (0.09)
Old myocardial infarction	1.29 (0.12)	1.14 (0.16)	1.43 (0.20)	6.92 (0.70)*	0.12 (0.04)
Myocardial infarction	0.66 (0.08)	0.63 (0.14)	0.68 (0.09)	3.55 (0.48)*	0.06 (0.03)
Ulcers1+ Ulcers2	0.68 (0.09)	0.61 (0.13)	0.74 (0.11)	2.70 (0.46)*	0.26 (0.06)
Lymphoma	0.43 (0.07)	0.49 (0.13)	0.37 (0.09)	0.80 (0.23)	0.35 (0.07)
Secondary cancer	0.41 (0.07)	0.36 (0.09)*	1.16 (0.18)	1.90 (0.35)*	0.10 (0.03)
Dementia	0.35 (0.06)	0.29 (0.09)	0.41 (0.08)	0.78 (0.25)*	0.27 (0.06)
Leukemia	0.26 (0.06)	0.31 (0.09)	0.21 (0.07)	0.55 (0.21)	0.20 (0.05)
Paralysis	0.23 (0.05)	0.20 (0.07)	0.26 (0.08)	1.23 (0.29)*	0.02 (0.02)
Various cirrhosis	0.21 (0.06)	0.14 (0.06)	0.26 (0.08)	0.76 (0.24)*	0.10 (0.05)
Moderate-severe liver disease	0.16 (0.05)	0.12 (0.06)	0.19 (0.08)	0.76 (0.26)*	0.01 (0.01)
AIDS	0.09 (0.03)	0.03 (0.02)*	0.15 (0.06)	0.14 (0.09)	0.08 (0.04)
Comorbidity index: no imputation, including missing, estimate (SE), %					
Zero	49.71 (0.77)	53.68 (0.98)*	46.23 (0.83)	26.97 (1.16)*	54.46 (0.85)
One	14.32 (0.38)	13.41 (0.58)*	15.11 (0.48)	20.20 (0.97)*	13.09 (0.46)
Тwo	8.29 (0.34)	8.15 (0.48)	8.40 (0.46)	16.97 (0.89)*	6.47 (0.37)
Three or higher	5.53 (0.26)	4.28 (0.30)*	6.61 (0.38)	22.03 (1.03)*	2.08 (0.18)
Missing	22.16 (0.67)	20.46 (0.83)*	23.65 (0.85)	13.83 (1.02)*	23.99 (0.72)
Comorbidity index: no imputation, excluding missing,					
	63 87 (0 74)	67 50 (0.86)*	60 55 (0 92)	31 30 (1 30)*	71 57 (0.82)
One	18 39 (0 50)	16.86 (0.76)*	19 78 (0.52)	23 44 (1 11)*	17 20 (0.60)
Two	10.64 (0.44)	10.25 (0.60)	11 00 (0 59)	19.69 (0.99)*	8 50 (0.48)
Three or higher	7.10 (0.32)	5.39 (0.37)*	8.66 (0.47)	25.57 (1.13)*	2.73 (0.23)

Source: 2002 Medicare Current Beneficiary Survey.

* P value of two-sided z-test of dental visit compared with no dental visit, or hospital visit compared with no hospital visit is less than or equal to 0.05.

second panel of Table 1, nearly 54 percent of beneficiaries who use dental care have index values of zero compared with 46.2 percent of those without any dental care. In the same panel of Table 1, 54.5 percent of those without hospital inpatient care have an index value of zero whereas only 27 percent of those using hospital inpatient care have an index value of zero. For beneficiaries with values of the index of 1 or 3 or higher, the percentage of those not using dental care exceeds the percentage using dental care.

On the contrary, for those beneficiaries with nonzero index values, the percentage of those with hospital inpatient care exceeds the percentage not using hospital care at each level of the index.

Dental visit regressions

Table 2 provides the unadjusted and adjusted odds ratios and confidence interval estimates from the logistic regressions for the likelihood of a dental visit using the 2002 MCBS data. The unadjusted estimates do not include controls for other explanatory variables in the model. We only discuss the adjusted results. Differences between the two sets of estimates are attributed to correlation between explanatory variables excluded from the unadjusted models but included in the adjusted model.

The odds of a dental visit were higher for beneficiaries with index scores below 3 or missing compared with those with

Table 2	Logistic Estimates	of the Likelihood of a Den	tal Visit from the 200	2 Medicare Current	t Beneficiary Survey	for Community	/-Dwelling Beneficiaries
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Population characteristic	Unadjusted odds ratios (95% confidence interval)	Adjusted odds ratios (95% confidence interval)
Need covariates		
Comorbidity index zero	1.793 (1.502, 2.140)**	1.336 (1.097, 1.627)**
One	1.371 (1.130, 1.662)**	1.235 (0.980, 1.557)
Two	1.499 (1.175, 1.912)**	1.394 (1.072, 1.811)*
Missing	1.336 (1.075, 1.660)**	1.255 (0.983, 1.602)
Three	(1.0) -	(1.0) –
Health status fair/poor	0.443 (0.394, 0.498)**	0.795 (0.674, 0.937)**
Good	0.750 (0.679, 0.828)**	0.985 (0.875, 1.110)
Excellent/verv good	(1.0) –	(1.0) –
Teeth problems eating solid foods	0.702 (0.601, 0.820)**	1.178 (1.005, 1.382)*
Does not have problems	(1.0) -	(1.0) –
Three or more physical limitationst	0.545 (0.482 0.616)**	0 777 (0 659 0 917)**
Two limitations	0.855 (0.728 1.004)	0.938 (0.785 1.121)
One limitation	1 096 (0 954 1 258)	1 033 (0.888, 1.200)
None	(1 0) -	(1 0) -
Current smoker	0 469 (0 402 0 546)**	0 539 (0 455 0 640)**
Former smoker	0.965 (0.872, 1.067)	0.884 (0.783, 0.999)*
Never smoked	(1 0) -	(1 0) -
Enabling covariates	(1.0)	(1.0)
Person income < \$10,000	0 125 (0 106 0 147)**	0 294 (0 240 0 361)**
\$10,000-20,000	0.204 (0.175, 0.237)**	0.355(0.300 0.421)**
\$20,000-35,000	0.204 (0.175, 0.257)	0.535 (0.454 0.630)**
Sec. 000-55,000	(1.0)	(1 0)
Public supplementary coverage	0.594 (0.506 0.697)**	(1.0) = 1 000 (0.814 1.230)
Private supplementary coverage	2 109 (1 990 - 2 252)**	1 E10 (1 220 1 72E)**
No supplementary coverage	2.106 (1.869, 2.555)	(1.0)
Prodisposing covariates	(1.0) -	(1.0) -
A go loss than 6E	0.746 /0.622 0.870**	1 278 /1 102 1 722**
Age less than 65	0.740 (0.055, 0.878)***	0.005 (0.875 1.121)
05 (0 09 70 to 74	1.221 (1.095, 1.504)***	0.995 (0.875, 1.151)
70 10 74	1.259 (1.132, 1.400)^^	0.958 (0.851, 1.079)
75 (0 79 80 and above	(1.0)	1.143 (1.002, 1.304)^
SU driu above	(1.0) =	(1.0) = 0.022 (0.724 + 0.020) * *
Iviale	1.004 (0.903, 1.117)	(1.0)
Female Rischer aus Llienenia	(1.0) -	
Black, non-Hispanic	$0.279(0.228, 0.341)^{**}$	0.525 (0.425, 0.650)^^
Hispanic	0.533 (0.441, 0.644)^^	1.045 (0.848, 1.289)
Other, non-Hispanic	0.618 (0.493, 0.775)**	0.795 (0.642, 0.984)*
White non-Hispanic	(1.0) -	(1.0) -
Some or no high school	0.129 (0.110, 0.152)**	0.261 (0.21/, 0.314)**
High school graduate	0.376 (0.326, 0.434)**	0.515 (0.442, 0.600)**
College graduate	(1.0) –	(1.0) –
Widowed, divorced	0.578 (0.530, 0.630)**	0.838 (0.719, 0.976)*
Never married	0.635 (0.527, 0.765)**	1.113 (0.894, 1.385)
Married	(1.0) -	(1.0) -
Household size one	1.319 (1.151, 1.511)**	1.274 (1.046, 1.552)*
Size two	1.918 (1.690, 2.177)**	1.151 (0.984, 1.347)
Size three or more	(1.0) -	(1.0) -

The sample consists of 9,184 observations. Logistic estimates incorporated adjustments for the sample weights and the sample design. Pseudo $R^2 = 0.141$ in adjusted regression.

* Significant at 0.05; ** significant at 0.01.

+ Physical limitations include any difficulty stooping/crouching, kneeling, lifting/carrying 10 lbs, extending arms above shoulders, writing/handling object, and walking 0.25 mi or two to three blocks.

Note: Odds ratio point estimate = estimate of [probability of dental visit/probability of no dental visit] for persons with row characteristic divided by [probability of dental visit/probability of no dental visit] for omitted category. Unadjusted estimates do not control for other characteristics of the individual. Adjusted estimates include controls for other explanatory variables in the logistic equation.

index scores of 3 or higher, but were only statistically significant differences for those with index scores of zero or two. Beneficiaries with either missing claims data or with an index score of 1 were no more likely to have a dental visit than beneficiaries with index scores of 3 or higher.

Medicare beneficiaries under age 65 and those ages 75 to 79 years were more likely to visit the dentist than those in the oldest age group 80 years and above. Males were less likely to visit the dentist than females, as were black and other non-Hispanics compared with white non-Hispanics. Hispanics had use rates no different from white non-Hispanics in the adjusted model. Lower income and education beneficiaries were less likely to visit the dentist than those in the highest income and education categories. Widowed and divorced individuals were less likely to have dental visits than married persons, while beneficiaries in single households were more likely to visit the dentist's office than those in 3 or more person household units.

Beneficiaries who are in poor or fair health status, are current or former smokers, or who have 3 or more physical limitations are less likely to visit the dentist than those who are in very good or excellent health, never smoked, or who have no physical limitations, respectively. Beneficiaries with private supplementary medical insurance are more likely to visit the dentist than those without any supplemental insurance to their Medicare. Finally, beneficiaries with difficulties eating solid food because of teeth problems are more likely to visit the dentist than those who have no such problems.

Hospital inpatient regressions

Table 3 provides estimates of the odds ratios and confidence intervals from the logistic regression equations for the likelihood of a hospital inpatient stay. Unlike dental visit results, beneficiaries without any health conditions in Table 1 were less likely to be hospitalized than those with index scores of 3 or higher. Also unlike the dental results, beneficiaries with index scores of 1 or 2 were in each case less likely to have an inpatient stay than those with scores of 3 or higher. We note that this relationship was somewhat lessened for those with scores of 2 compared with those of index scores of 1, but in each case beneficiaries with an index score of 3 were more likely to be hospitalized than those with lower index scores.

Only Medicare beneficiaries in the 65-to-69 age group are less likely than those 80 years and older to become hospitalized. We also found that Hispanics are less likely to have an inpatient stay compared with white non-Hispanics. Otherwise, beneficiaries in good, fair, or poor health status, and with two or more physical limitations are more likely to have an inpatient stay compared with those in very good or excellent health, and with no physical limitations, respectively. Curiously, current smokers are less likely to be hospitalized compared with those Medicare beneficiaries who have never smoked. Unlike the dental visit results, there were no significant marital status, income, education, gender, teeth problem, supplementary medical insurance, or household size effects found in the hospital inpatient utilization results.

Discussion

Overview

The main result from our study is that Medicare beneficiaries treated for health conditions such as congestive heart failure, peripheral vascular disease, chronic obstructive pulmonary disease, chronic renal failure, diabetes, and secondary cancer are less likely than not to visit the dentist, but are more likely than not to have a hospital inpatient stay, during the year. Only beneficiaries treated for solid cancer were more likely than not to visit the dentist during the year. We also find with our comorbidity index that the greater the number and severity of such conditions a beneficiary has, the less likely the beneficiary will visit the dentist and the more likely they will have at least one hospital inpatient stay during the year.

Beneficiaries with problems eating solid foods because of teeth problems are more likely to have a dental visit, but are no more likely to have hospital inpatient use, compared with those with no such problems. In general, adverse health status or physical well-being serves the same role as the presence of morbidities in dental and hospital utilization models. As such, we conclude that comorbidities, poor health status, and physical limitations dominate as theorized predisposing factors limiting access to dental care, and as theorized need factors in determining the utilization of hospital inpatient services and other medical care.

Comorbidity index

Apart from the different directions of influence in the dental and inpatient use models, the relatively strong performance of our comorbidity index in the hospital use equation compared with the dental use equation may be because breast/ prostate cancer and mortality represented the respective primary disease and outcome variable in Charlson's study (12). These are factors more closely related to hospitalizations and other medical care than dental care. Consequently, the set of comorbid conditions that best predict in a dental visit model may be different from that predicting breast/prostate cancer mortality. Indeed, 11 of the 20 conditions in Table 1 do not appear to have an impact on dental care utilization and only one, solid cancer, was positively correlated with dental care utilization. Furthermore, even if a comorbid condition is important to both, the degree of importance (i.e., weight) may be different. Whether specific comorbidities can be found for a revised index that is more highly correlated with dental use would be a subject for a future study.

Table 3	Logistic Estimates of t	the Likelihood of an	Inpatient Hospital	Visit from the 2002	Medicare Cu	urrent Beneficiary S	Survey for C	Community-D [,]	welling
Beneficia	ries								

Population characteristic	Unadjusted odds ratios (95% confidence interval)	Adjusted odds ratios (95% confidence interval)
Need covariates		
Comorbidity index zero	0.047 (0.039, 0.056)**	0.059 (0.048, 0.073)**
One	0.146 (0.115, 0.186)**	0.166 (0.127, 0.216)**
Two	0.248 (0.194, 0.316)**	0.274 (0.213, 0.352)**
Missing	0.055 (0.043, 0.069)**	0.069 (0.052, 0.091)**
Three	(1.0) –	(1.0) –
Health status fair/poor	3.485 (2.982, 4.072)**	1.887 (1.535, 2.319)**
Good	1.780 (1.522, 2.082)**	1.334 (1.132, 1.574)**
Excellent/verv good	(1.0) -	(1.0) –
Teeth problems (eating solid foods)	1.319 (1.125, 1.546)**	0.913 (0.752, 1.108)
Does not have problems	(1.0) =	(1.0) –
Three or more physical limitationst	3 167 (2 616 3 833)**	1 616 (1 305 2 001)**
Two limitations	2 149 (1 723 2 680)**	1 503 (1 186 1 904)**
One limitation	1 373 (1 105 1 706)**	1 138 (0 900 1 440)
None	(1 0) -	(1 0) -
Current smoker	(1.0) 0.893 (0.736 1.084)	0.771 (0.608 0.977)*
Former smoker	1 204 (1 057 1 371)*	1 073 (0 920 1 250)
Never smoked	(1.0) _	(1 0) =
Enabling covariates	(1:0) -	(1.0) -
Porson income $<$ \$10,000	1 277 (1 050 1 552)*	0.008 (0.670 1.216)
\$ 10,000 20,000	1,227 (1,020, 1,233)	1 019 (0 905 1 296)
\$10,000-20,000	1.232 (1.033, 1.408)	0.040 (0.750 1.180)
\$20,000-33,000	(1.0)	(1.0)
	(1.0) -	(1.0) = 0.007 (0.720 + 1.144)
Public supplementary coverage	1.555 (1.294, 1.869)^^	0.907 (0.720, 1.144)
Private supplementary coverage	(1.0)	(1.0)
No supplementary coverage	(1.0) -	(1.0) -
Predisposing covariates		4.045 (0.042, 4.207)
Age less than 65	1.068 (0.894, 1.275)	1.045 (0.842, 1.297)
65 to 69	0.595 (0.482, 0.735)**	0.735 (0.582, 0.928)**
70 to 74	0.581 (0.616, 0.853)**	0.877 (0.726, 1.060)
75 to 79	0.813 (0.703, 0.940)**	0.862 (0.725, 1.025)
80 and above	(1.0) –	(1.0) –
Male	1.034 (0.913, 1.170)	0.976 (0.831, 1.147)
Female	(1.0) –	(1.0) –
Black, non-Hispanic	1.309 (1.107, 1.548)*	0.928 (0.762, 1.131)
Hispanic	0.816 (0.625, 1.064)*	0.679 (0.510, 0.904)**
Other, non-Hispanic	0.796 (0.574, 1.103)	0.711 (0.495, 1.021)
White non-Hispanic	(1.0) -	(1.0) -
Some or no high school	1.208 (1.023, 1.426)*	0.847 (0.679, 1.057)
High school graduate	0.984 (0.840, 1.152)	0.827 (0.675, 1.012)
College graduate	(1.0) -	(1.0) -
Widowed, divorced	1.093 (0.982, 1.218)	0.983 (0.804, 1.203)
Never married	0.886 (0.699, 1.122)	0.854 (0.637, 1.145)
Married	(1.0) -	(1.0) -
Household size one	0.931 (0.784, 1.106)	1.043 (0.844, 1.289)
Size two	0.896 (0.749, 1.071)	0.986 (0.809, 1.201)
Size three or more	(1.0) -	(1.0) -

The sample consists of 9,184 observations. Logistic estimates incorporated adjustments for the sample weights and the sample design. Pseudo $R^2 = 0.159$ in adjusted regression.

* Significant at 0.05; ** significant at 0.01.

+ Physical limitations include any difficulty stooping/crouching, kneeling, lifting/carrying 10 lbs, extending arms above shoulders, writing/handling object, and walking 0.25 mi or two to three blocks.

Note: Odds ratio point estimate = estimate of [probability of inpatient stay/probability of no inpatient stay] for persons with row characteristic divided by [probability of inpatient stay/probability of no inpatient stay] for omitted category. Unadjusted estimates do not control for other characteristics of the individual. Adjusted estimates include controls for other explanatory variables in the logistic equation.

Nevertheless, we found the comorbidity index to be a useful measure for summarizing the numerous health conditions that the elderly may present and may be advantageous for other researchers to use in similar studies. It avoids the difficulties that may otherwise be encountered in attempting to estimate the effects of each separate condition in medical or dental utilization equations. We also note that our preliminary model testing with the dental use equation demonstrated that the claims-based comorbidity index outperformed measures based solely on self- reported condition data in the MCBS.

Other limitations

Absence of measures of clinical oral health and dentate status, as well as dental insurance coverage, from the MCBS potentially biases our dental utilization model. Unlike our previous analysis of dental use with the Health and Retirement Survey, we were unable to use a measure of dental insurance coverage as an additional enabling variable in our model because the survey did not ask respondents directly if they had dental insurance. (24) We could measure coverage indirectly for dental users reporting third party payments, but this created spurious correlation with the dependent variable for dental use. The MCBS does collect data on private and public medical insurance coverage in addition to Medicare that could serve as a proxy for dental coverage and that we have included in our models. The study's findings regarding the comorbidity index and other health-related covariates were the same in models estimated with and without controls for supplementary medical insurance coverage. To the extent that this coverage proxies for dental insurance, this suggests that our results may not be biased by excluding dental coverage from our model.

Policy implications

Previous studies have emphasized the importance of regular dental care for the elderly population in not only maintaining oral health but in also identifying oral problems that may lead to serious and more expensive medical procedures (7,25,26). Our study suggests that Medicare beneficiaries with the most severe comorbidities, who in turn may be most in need of dental services, tend to not use dental services because of their health situation. The fact that traditional or fee for service Medicare does not offer a dental benefit may also contribute to this finding. Our previous research suggests that adding coverage for preventive dental care might not only provide an incentive for the elderly with severe health conditions to seek dental care, but might also reduce their costs for expensive nonpreventive dental care. (20) The recent health care reform legislation did not add a dental benefit to Medicare and may have even indirectly eliminated some dental benefits under

Medicare Advantage plans through changes to these plans in the legislation. State budgetary pressures make the addition of adult dental benefits to Medicaid highly unlikely in states without such coverage, and increase the possibility of such coverage being cut from state plans where it does currently exist.

The overwhelming adverse health effects on access to dental care in our model suggest that what may be needed is an alternative organizational structure, as suggested by Mertz and O'Neill (27), for delivering dental services to elderly persons whose health status and conditions limit their access to dental care. This would require increased financing for public dental clinics and mobile dental services to reach underserved patients with major medical problems or who lack dental insurance or enough disposable income to purchase services under the current system of private practice, fee for service dentistry. Expanding the practice rights for auxiliary dental staff including hygienists and dental assistants could help alleviate the shortage of dentists participating in Medicaid and in other public settings (27).

Acknowledgments

This investigation was supported by the National Institute of Dental and Craniofacial Research of the National Institutes of Health. (1R03DE016850-01A2, Preventive Dental Care Services and General Health Care) The authors wish to thank Pat Stewart and Diane McNally of the University of Maryland School of Pharmacy's Pharmaceutical Research Computing (PRC) unit for their analytical and programming support.

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		Dental visit in 2002		Inpatient stay in 2002	
Variable description	Full-year beneficiaries	Yes	No	Yes	No
Number of Beneficiaries	29,573,790	13,814,192	15,759,598	5,108,617	24,465,173
Need covariates					
Health status fair/poor	25.66 (0.55)	18.83 (0.60)*	31.64 (0.89)	42.76 (1.44)*	22.09 (0.57)
Good	32.12 (0.56)	32.27 (0.85)	31.99 (0.76)	31.83 (1.28)	32.18 (0.61)
Excellent/very good	42.22 (0.65)	48.90 (0.88)*	36.37 (0.74)	25.41 (1.30)*	45.73 (0.69)
Teeth problems eating solid foods	11.66 (0.46)	9.75 (0.52)*	13.33 (0.68)	14.18 (0.93)*	11.14 (0.48)
Three or more physical limitations ^a	39.38 (0.74)	31.92 (0.84)*	45.91 (0.95)	55.23 (1.41)*	36.06 (0.79)
Two limitations	17.72 (0.43)	18.55 (0.65)	16.99 (0.60)	18.29 (1.04)	17.60 (0.51)
One limitation	21.25 (0.57)	25.05 (0.81)*	17.91 (0.63)	14.98 (0.92)*	22.55 (0.61)
None	21.66 (0.60)	24.48 (0.80)*	19.18 (0.76)	11.50 (0.97)*	23.78 (0.66)
Current smoker	13.79 (0.45)	9.33 (0.57)*	17.70 (0.58)	11.75 (0.84)*	14.22 (0,50)
Former smoker	47.45 (0.62)	49.49 (0.86)*	45.65 (0.85)	51.87 (1.35)*	46.52 (0.67)
Never smoked	38.76 (0.58)	41.18 (0.77)*	36.64 (0.84)	36.37 (1.32)	39.26 (0.66)
Enabling covariates					
Person income < \$10,000	19.55 (0.47)	10.91 (0.48)*	27.13 (0.78)	21.60 (1.20)	19.12 (0.53)
\$10,000-20,000	29.38 (0.60)	22.97 (0.83)*	35.00 (0.77)	31.53 (1.37)	28.93 (0.60)
\$20,000-35,000	32.92 (0.53)	37.44 (0.90)*	28.96 (0.71)	30.49 (1.27)*	33.43 (0.60)
Over \$35,000	18.14 (0.57)	28.68 (0.95)*	8.90 (0.45)	16.38 (1.11)	18.51 (0.58)
Public supplementary coverage	17.85 (0.54)	10.15 (0.55)*	24.61 (0.76)	22.10 (1.12)*	16.97 (0,56)
Private supplementary coverage	59.26 (0.93)	71.31 (0.99)*	48.70 (1.01)	58.17 (1.52)	59.49 (0.95)
No supplementary coverage	22.89 (0.73)	18.54 (0.86)*	26.70 (0.86)	19.73 (1.24)*	23.55 (0.77)
Predisposing covariates					
Age less than 65	12.56 (0.39)	9.94 (0.52)*	14.88 (0.59)	15.50 (1.03)*	11.95 (0.40)
65 to 69	17.55 (0.44)	18.41 (0.66)	16.79 (0.54)	13.32 (1.02)*	18.43 (0.51)
70 to 74	25.45 (0.39)	27.12 (0.69)*	24.59 (0.58)	22.90 (1.21)*	25.98 (0.49)
75 to 79	21.02 (0.45)	22.46 (0.66)*	19.88 (0.59)	20.82 1.17)	21.07 (0.44)
80 and above	23.42 (0.41)	22.07 (0.51)*	24.59 (0.58)	27.04 (1.03)*	22.57 (0.45)
Male	43.10 (0.53)	43.16 (0.81)	43.05 (0.88)	43.78 (1.43)	42.96 (0.57)
Black, non-Hispanic	9.26 (0.56)	4.46 (0.48)*	13.46 (0.79)	11.47 (0.93)*	8.80 (0.56)
Hispanic	7.77 (0.65)	5.93 (0.50)*	9.37 (0.93)	6.52 (0.95)	8.03 (0.67)
Other non-Hispanic	3.99 (0.29)	3.35 (0.32)*	4.56 (0.40)	3.28 (0.53)	4.14 (0.31)
White, non-Hispanic	78.98 (0.83)	86.25 (0.74)*	72.61 (1.17)	78.73 (1.23)	79.04 (0.87)
Some or no high school	31.23 (0.76)	17.24 (0.62)*	43.50 (0.97)	34.88 (1.28)*	30.47 (0.77)
High school graduate	50.63 (0.70)	54.46 (0.91)*	47.27 (0.85)	47.77 (1.39)*	51.22 (0.69)
College graduate	18.14 (0.57)	28.30 (0.93)*	9.23 (0.49)	17.35 (1.09)	18.31 (0.59)
Widowed, divorced	41.36 (0.53)	34.89 (0.72)*	47.02 (0.70)	43.38 (1.23)	40.93 (0.59)
Never married	5.65 (0.25)	5.04 (0.33)*	6.18 (0.37)	4.97 (0.53)	5.79 (0.28)
Married	53.00 (0.55)	60.07 (0.77)*	46.79 (0.70)	51.65 (1.19)	53.28 (0.60)
Household size one	34.46 (0.54)	31.70 (0.75)*	36.87 (0.79)	34.70 (1.11)	34.41 (0.59)
Size two	50.64 (0.68)	56.69 (0.94)*	45.33 (0.78)	49.38 (1.25)	50.90 (0.77)
Size three or more	14.90 (0.45)	11.60 (0.57)*	17.80 (0.57)	15.92 (0.97)	14.69 (0.51)

Appendix 1	Sample Mean Percentages of	of Covariates for Communi	ty-Dwelling Medicare Beneficiaries b	v Use of Dental and Inpatient Care 2002
reportant i	Sumple Mean refeelinges	r covanates for comman	by by ching medicate beneficialies b	y ose of Defital and inputient care, 2002

Source: 2002 Medicare Current Beneficiary Survey community-based beneficiaries.

Standard errors for percentage estimates appear in parentheses. Sample mean percentages for the comorbidity index appear in Table 1.

^a Physical limitations include any difficulty stooping/crouching, kneeling, lifting/carrying 10 lbs, extending arms above shoulders, writing/handling object, and walking 0.25 mi or two to three blocks.

* P value of two-sided z-test of dental visit compared with no dental visit, or hospital visit compared with no hospital visit is less than or equal to 0.05.

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