The Relationship Between a Dementia Diagnosis, Chronic Illness, Medicare Expenditures, and Hospital Use

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OBJECTIVES: To determine whether dementia increases medical expenditures, the probability of hospitalization, and potentially preventable hospitalization, controlling for variables including age and comorbidity.

DESIGN: Cross-sectional analysis of 1 year of claims data comparing usage by patients with claims for dementia with usage by those without dementia.

SETTING: A nationally representative 5% random sample of Medicare beneficiaries in 1999.

PARTICIPANTS: Medicare beneficiaries aged 65 and older with fee-for-service Medicare Parts A and B coverage for 1999 (N = 1,238,895; dementia patients n = 103,512).

MEASUREMENTS: Per capita expenditures, rate of all-cause hospitalization, rate of preventable hospitalization as defined using ambulatory-care sensitive condition (ACSC) admissions, and dementia identified using International Classification of Diseases, 9th Edition, codes 290, 294, and 331.

RESULTS: Prevalence of dementia was 8.3%. In a model of expenditures in those who survived the year adjusting for age, sex, race, and comorbidity, dementia was associated with an incremental cost of $6,927, or 3.3 times greater total expenditures than in nondementia patients (P < .001), with higher expenditures for each specific type of Medicare service. Hospitalization accounted for 54% of adjusted costs. The adjusted odds of hospitalization associated with dementia were 3.68 (95% confidence interval (CI) = 3.62–3.73) and adjusted odds of ACSC hospitalization were 2.40 (95% CI = 2.35–2.46). In those who died, the associations were positive but of smaller magnitude.

CONCLUSION: In a nationally representative sample, higher Medicare expenditures associated with a diagnosis of dementia are in large part due to increased hospitalization. Further study is needed into the factors associated with high rates of hospitalization in dementia patients including aspects of ambulatory management that may be improved. **J Am Geriatr Soc 52:187–194, 2004.**

Key words: dementia; comorbid illness; utilization; hospitalization

Alzheimer's disease (AD) and other dementias are common in later life and are a source of significant morbidity for the patient. Recent studies have demonstrated that dementia is also associated with disproportionate healthcare costs.[1–3] Although long-term care has been recognized as one source of increased expense, the influence of dementia on medical costs is less clearly established. Better understanding this relationship might offer ways to reduce morbidity and lower healthcare costs.

Despite earlier controversy,[2–7] recent data suggest that patients with dementia experience higher medical costs, primarily due to hospitalization,[8–11] but it is unclear whether the increased expenditure is a direct result of dementia-associated morbidity or is primarily due to comorbid conditions. This distinction is important, because efforts to reduce morbidity or costs would differ depending on the source of the higher costs.

It was once argued that patients with AD, the most common type of dementia, are healthier than age-matched individuals,[12] but current evidence reveals a higher level of comorbidity in demented patients than in the nondemented population.[8,10,11,13,14] Management of these comorbid conditions is more challenging in the presence of dementia, because clinicians need to coordinate medical care through a surrogate because the patient may not report symptoms accurately[15] or adhere to treatment recommendations. The higher burden of comorbid conditions and the difficulty of treating those conditions lead to the hypothesis that expenditures and hospital use may be higher for dementia

patients in part because of the failure of ambulatory management of chronic illness.

The objective of this study was to explore the relationship between (1) dementia and comorbidity and (2) expenditures, the likelihood of hospitalization, and the likelihood of potentially preventable hospitalization in a nationally representative fee-for-service Medicare population. It was hypothesized that expenditures independent of other covariates would be higher for dementia patients, mostly due to inpatient hospital costs. Patients with dementia would be more likely to be hospitalized than nondemented patients with similar levels of comorbidity, and those with dementia and specific diseases that require self-management would have the highest likelihood of hospitalization. Additionally, it was hypothesized that dementia patients experience higher rates of admissions that might be prevented by appropriate ambulatory management.

METHODS

Sample

A cross-sectional analysis of claims data from a 5% sample of fee-for-service Medicare beneficiaries in 1999 was performed using the Standard Analytic File (SAF). The SAF is a public access file generated for the purpose of research and contains demographic and utilization data at the level of the individual. A 5% sample resulted in 1,238,895 Medicare beneficiaries.

Subjects in the SAF were included if they were alive at the beginning of 1999 and had Medicare Parts A and B coverage. Subjects were excluded if they were younger than 65 or were enrolled in a managed Medicare plan.

Diagnoses in the SAF are identified by International Classification of Diseases, 9th Edition (ICD-9) codes and then grouped into unique disease categories according to the Clinical Classifications Software (CCS; Agency for Healthcare Research and Quality, Rockville, MD). CCS codes that reflect chronic conditions were selected through a consensus process.[16] Individuals were classified as having one of these conditions if they had one Part A or two Part B claims, a common practice to avoid rule-out diagnoses.[9] However, for dementia, this technique is not sensitive and significantly underestimates the true prevalence, a problem stemming from the historical financial disincentives to code the diagnosis.[17,18] To increase identification of dementia cases, only one claim was required to qualify as a case of dementia, a methodology suggested by a group investigators after analyzing the claims data of a clinically well-defined population.[19] Dementia was identified by ICD-9 codes 290, 294, and 331.

Variables

The primary outcome measures in these analyses were total expenditures and expenditures for inpatient hospital, outpatient hospital, skilled nursing facility (SNF), home health, and physician services. Expenditures reflect actual payments made by the Medicare program for all covered services in the year. Copayments and deductibles paid by beneficiaries and services provided but not covered by Medicare were not included in the data and therefore did not contribute to the expenditure estimates.

The probability of hospitalization for any cause and probability of a potentially preventable hospital admission also served as outcome variables. Preventable admissions were defined as admissions for ambulatory-care sensitive conditions (ACSCs). These are conditions that can be prevented altogether or whose course can be mitigated through optimal outpatient management, thereby preventing hospitalization.[20–23] Diagnoses included as ACSC admissions were those used in a study for persons aged 65 and older.[22,23]

The presence or absence of dementia was the main independent variable, with the following covariates: age (10-year intervals), sex, race (Caucasian, black, other), comorbidity, and occurrence of death within the year (dummy variable for quarter of death). Comorbid illness can be assessed many ways, including weighted indices (e.g., Charlson Comorbidity Index), counts, or by examining specific diseases. To obtain a more complete understanding, all three approaches were used. When seeking a summary measure of an outcome, the Charlson Comorbidity Index (adapted for administrative data[24] using claims during the previous year) was used as a covariate to adjust for comorbidity. To examine the interaction between burden of chronic illness and dementia, the sample was stratified by number of chronic conditions. Finally, to evaluate the influence of specific conditions, the sample was stratified by presence of the condition in question then adjusted for further comorbid conditions using the Charlson Comorbidity Index.

Analysis

Demographic features were compared using t tests for continuous variables and chi-square for categorical variables. Expenditures were modeled using multiple linear regression controlling for age, sex, race, the occurrence of death within the year, and level of comorbidity. Log-transformed models were also used because expenditure data typically do not conform to a normal distribution,[25] but because this did not change the level of statistical significance or direction of effects, the untransformed data in dollars are presented for ease of interpretation.

Length of hospital stay is known to be prolonged in dementia patients,[8,13,26] which contributes to hospital expenditures, but the effect of dementia on the probability of hospitalization has been difficult to study because of the confounding effects of age and burden of chronic illness in this population. Multiple logistic regression was used to analyze the effect of dementia on the likelihood of hospitalization while controlling for these and other potential confounding factors. The likelihood of hospitalization for the whole sample was modeled, including as independent variables the presence of dementia, age, sex, race, occurrence of death, and comorbidity.

To examine specifically the interaction between dementia and number of chronic conditions, the probability of admission was analyzed stratified by number of chronic conditions. Using the SAF for 1999, the 13 chronic conditions with the highest costs were chosen (hypertension, coronary artery disease, congestive heart failure,

cardiac dysrhythmias, diabetes mellitus, chronic obstructive pulmonary disease, hyperlipidemia, osteoarthritis, peripheral artery disease, cardiac valve disease, thyroid disease, depression, cataract), and subjects were stratified by number of these conditions. Separate logistic regression models for each stratum included dementia, age, sex, race and occurrence of death as independent variables.

To test the hypothesis that diseases requiring significant patient self-management would create disproportionate risk of hospitalization for patients with dementia, we modeled the probability of hospital admission within specific disease groups. The specific conditions chosen for analysis were the 13 most expensive as described above and five additional conditions that are expensive, prevalent, and clinically important among the dementia patients but were not found with such frequency or expense among the nondemented patients (psychosis (not schizophrenia), osteoporosis, late effects of cerebrovascular disease, anxiety, Parkinson's disease). Subjects were stratified by these conditions, and the probability of hospitalization was modeled for each stratum using multiple logistic regression. It was possible for a subject to appear in more than one stratum. The independent variables in the models were dementia, age, sex, race, occurrence of death, and comorbidity.

To explore whether increased hospitalization rates could be attributed to higher likelihood of failed outpatient management, ACSC admissions were analyzed. As with the previous analysis of all-cause hospitalization, multiple logistic regression was used to model the likelihood of an ACSC admission for the entire sample, for each stratum by number of chronic conditions, and for each stratum by specific condition. The independent variables in each model were the same as those in the analyses to predict the probability of any admission.

Because death is strongly associated with use, each analysis was performed stratified by the occurrence of death. In the models of subjects who died, dummy variables for the quarter of death were created to approximate time at risk. These approximations were necessary because date of death was not available. All analyses were performed using SAS, version 8.02 (SAS Institute, Inc., Cary, NC).

RESULTS

Prevalence

The sample of all 1999 SAF subjects included 103,512 patients with a claim for dementia out of a total sample of 1,238,895, for a prevalence of dementia of 8.3%. The prevalence by age group was 3.0% for age 65 to 74; 10.1% for age 75 to 84; 23.6% for age 85 to 94; and 32.0% for age 95 and older. These figures are comparable with or lower than population prevalence estimates[27] although higher than claims-based estimates.[9,10] The higher prevalence is in part due to using one rather than two claims. The effect of using one dementia claim rather than two was the identification of 30,932 subjects who would otherwise have been classified as nondemented. Mortality using either definition was 20%. This 1-year mortality rate is higher than one would expect based on an average life expectancy of 7 to 10 years, indicating that the people who were identified likely had moderate to severe dementia.

Compared with subjects without dementia, those with dementia were older, were more likely to be female, had a higher number of chronic conditions, and were more likely to die during the year (Table 1). Although statistically significant, there was no meaningful difference in the distribution of race. Subjects with dementia were significantly older than subjects without dementia; 38% of dementia patients were aged 85 and older, compared with 11% of those without dementia. In the sample, the group in this age range was well represented, with 161,812 subjects. Dementia patients were three times more likely to be diagnosed with more than four of the selected chronic conditions (19.7% vs 6.7%). The percentage of patients with claims for specific chronic conditions in the two groups is shown in Table 1.

Expenditures

The mortality differential between the patients with dementia and those without was large, and it is known

Table 1. Characteristics of Fee-for-Service Medicare Patients with and without a Claim for Dementia in 1999

Characteristic	Dementia Patients (n = 103,512)	Nondemented Patients (n = 1,135,383)
Female, %	68	59
Age, mean	81.9	74.9
Age distribution, %		
65–74	18	54
75–84	44	36
85–94	34	10
≥95	4	1
Race, %		
White	87	89
Black	10	7
Other	3	4
Mortality, %	20	4
Chronic conditions, mean	4.24	1.85
Types of chronic conditions, %		
Hypertension	60.1	47.6
Coronary artery disease	29.7	19.2
Congestive heart failure	27.8	11.3
Cardiac dysrhythmias	24.7	12.7
Diabetes mellitus	21.2	16.5
Chronic obstructive pulmonary disease	17.3	10.1
Hyperlipidemia	12.8	24.9
Osteoarthritis	25.6	19.6
Peripheral vascular disease	18.5	7.0
Heart valve disease	8.8	5.5
Thyroid disease	16.4	10.9
Depression	17.8	4.9
Cataract	9.3	11.3
Psychoses	10.3	1.3
Osteoporosis	9.5	5.7
Late effects of cerebrovascular disease	9.5	2.1
Anxiety	7.4	2.7
Parkinson's	7.2	1.5

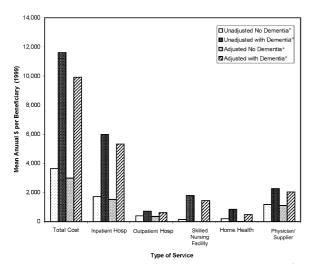*Note:* P-values all <.001 dementia vs no dementia.

Figure 1. Mean annual Medicare expenditure per beneficiary who survived the year by dementia status, unadjusted and adjusted for age, sex, ethnicity, and comorbidity. *P<.001 for dementia versus no dementia.

that death is closely related to expenditures.[28] Therefore, expenditure analyses were stratified by the occurrence of death within the year. For those who survived, unadjusted and adjusted expenditures by type of service are presented in Figure 1. In the adjusted model, total mean annual per-beneficiary payments for dementia patients were $9,922, compared with $2,995 for nondemented patients when all other covariates were set to the reference group (Caucasian men aged 65–69 who scored 0 on Charlson Comorbidity Index)—three times as high for individuals with dementia than for those without. Dementia was associated with higher payments for each type of expenditure (inpatient hospital, outpatient hospital, SNF, home health, and physician/supplier). Adjusted inpatient hospitalization expenditures for dementia patients who survived the year were $5,335, or approximately 54% of total expenditures, compared with $1,523 and 51% of total for nondemented patients.

A sensitivity analysis was performed to assess the degree to which ICD-9 diagnostic codes chosen to define

dementia affected expenditures. One concern was that the less specific codes would be more prone to be improperly used for delirium, a costly illness that would bias costs upward. For those who survived the entire year, there was little variability in unadjusted expenditures when ICD-9 331 was compared with 290 and 294 or all three codes together. For those who died, expenditures were more sensitive to the ICD-9 codes chosen, with as much as a $2,000 difference.

The unadjusted total mean annual expenditures for those who died were $15,953 without dementia and $19,159 with dementia. In the adjusted models, although dementia was still associated with increased expenditure, the relative difference was reduced to 1.3 times the expenditures for the nondemented.

Hospitalization

In the setting of chronic conditions, dementia was independently associated with likelihood of hospitalization. The presence of dementia was associated with 3.68 (95% confidence interval (CI) = 3.62–3.73) times higher odds of hospitalization in the adjusted model. The association between dementia and hospitalization was stronger in those who survived (odds ratio (OR) = 3.92, 95% CI = 3.86–3.98) than in those who died (OR = 2.15, 95% CI = 2.07–2.24). When stratified by number of chronic conditions, there was a consistent association between dementia and increased odds of hospitalization across all strata from 0 to 5 conditions (OR = 2.56–5.92) (Table 2). Irrespective of which specific disease stratum was examined, the addition of dementia was associated with an increased probability of hospitalization (OR = 1.96–4.08) (Table 3), but there were not large differences in odds of hospitalization between the conditions to suggest that the addition of dementia to any specific condition posed a greater burden than its addition to any other.

Dementia was also associated with an independent increase in ACSC (i.e., potentially preventable) hospitalization. The adjusted OR for an ACSC hospitalization associated with dementia was 2.40 (95% CI = 2.35–2.46) for the whole sample, 2.72 (95% CI = 2.65–2.79) for those

Table 2. Effect of Dementia on All-Cause Hospitalization and Ambulatory-Care Sensitive Condition (ACSC) Hospitalization, Crude Rate per 1,000 Beneficiaries and Adjusted Odds Ratio (OR) with 95% Confidence Intervals (CI)

Stratum by Number of Chronic Conditions	All-Cause Hospitalization			ACSC Hospitalization		
	Crude Rate	Crude Rate Adding Dementia	Adjusted OR Associated with Dementia (95% CI)*	Crude Rate	Crude Rate Adding Dementia	Adjusted OR Associated with Dementia (95% CI)*
0	9.0	100.2	5.92 (5.60–6.27)	0.9	18.2	6.58 (5.73–7.54)
1	43.8	193.8	3.36 (3.24–3.49)	5.3	31.2	2.89 (2.66–3.15)
2	75.8	303.3	3.33 (3.22–3.44)	10.7	54.7	2.77 (2.30–2.95)
3	136.9	437.7	3.38 (3.27–3.50)	24.4	72.5	2.19 (2.07–2.31)
4	250.0	646.1	3.10 (2.97–3.23)	52.6	113.0	1.68 (1.59–1.78)
5	584.7	1,104.0	2.87 (2.71–3.04)	128.0	189.0	1.49 (1.41–1.58)

* Adjusted for age, sex, ethnicity, and occurrence of death.

Table 3. Effect of Dementia on All-Cause Hospitalization and Ambulatory-Care Sensitive Condition (ACSC) Hospitalization by Specific Condition Stratum, Crude Rates per 1,000 Beneficiaries and Adjusted Odds Ratio (OR) with 95% Confidence Intervals (CI)

Chronic Condition Stratum	All-Cause Hospitalization			Preventable Hospitalization		
	Crude Rate	Crude Rate Adding Dementia	Adjusted OR Associated with Dementia (95% CI)*	Crude Rate	Crude Rate Adding Dementia	Adjusted OR Associated with Dementia (95% CI)*
Psychoses	1,571.0	1,728.1	1.76 (1.28–2.43)	191.6	211.0	—†
Congestive heart failure	1,384.4	1885.4	1.96 (1.61–2.38)	211.8	280.6	1.74 (1.24–2.44)
Cerebrovascular disease	1,736.7	2,137.5	1.97 (1.44–2.69)	243.3	295.3	1.74 (0.88–3.46)
Osteoarthritis	693.4	1,532.6	2.19 (1.88–2.56)	82.2	191.4	3.55 (2.36–5.35)
Chronic obstructive pulmonary disease	1,084.2	2,018.0	2.34 (1.95–2.79)	178.8	305.6	1.82 (1.36–2.44)
Depression	1,235.6	1,699.0	2.34 (1.86–2.93)	149.6	202.5	1.70 (0.95–3.03)
Anxiety	1,153.5	1,754.5	2.35 (1.56–3.53)	138.7	193.1	2.30 (0.78–6.79)
Cardiac dysrhythmia	1,129.3	1,856.3	2.42 (1.99–2.95)	155.5	246.3	3.35 (2.18–5.25)
Peripheral vascular disease	1,076.2	1,508.2	2.42 (1.94–3.01)	150.0	202.1	2.05 (1.15–3.67)
Heart valve disease	1,305.1	2,277.5	2.59 (1.65–4.07)	184.6	298.7	1.79 (0.069–4.68)
Coronary artery disease	991.9	1,829.4	2.6 (2.14–3.16)	170.6	265.8	2.58 (1.66–4.01)
Thyroid disease	611.5	1,334.5	2.65 (2.17–3.24)	80.4	174.5	2.50 (1.48–4.21)
Parkinson's disease	922.0	1,342.6	2.70 (2.09–3.48)	116.5	167.2	2.16 (1.27–3.65)
Osteoporosis	733.9	1,547.9	2.85 (2.19–3.70)	83.5	179.6	1.51 (0.69–3.31)
Hypertension	613.6	1,462.3	3.04 (2.79–3.32)	95.1	205.8	2.60 (2.16–3.12)
Diabetes mellitus	697.7	1,583.6	3.27 (2.71–3.95)	103.4	213.4	3.61 (2.32–5.63)
Hyperlipidemia	392.4	1,344.0	3.6 (2.72–4.79)	67.0	188.1	4.81 (2.14–10.77)
Cataract	392.1	1,154.0	4.08 (3.1–5.37)	54.6	150.6	4.37 (2.22–8.69)

* Adjusted for age, sex, race, occurrence of death, and comorbidity.
† Event number too small to model.

who survived, and 1.62 (95% CI = 1.55–1.69) for those who died. Whereas dementia was observed to be consistently associated with all-cause hospitalization as number of chronic conditions increased, the OR of an ACSC admission in association with dementia decreased as more chronic conditions were added (Table 2). In fact, with more than seven conditions, the OR became nonsignificant. The pattern observed in the disease-specific analysis for ACSC admission was similar to that seen for all hospitalizations, but event numbers were much lower, leading to several nonsignificant results (Table 3).

DISCUSSION

In this nationally representative sample of Medicare beneficiaries, dementia as identified by claims was associated with more than three times the expenditures, three times the odds of hospitalization, and more than twice the odds of an ACSC admission in the fee-for-service arena. People with dementia are older and have a higher burden of chronic illness than nondemented groups, and the most important finding is that dementia is associated with higher usage independent of these other variables. Prior studies have been limited in the ability to make these assessments because of sample size or have been limited to managed-care populations.

The prevalence of dementia and demographic characteristics of the dementia patients in the sample were similar to those from epidemiological studies.[27] The

identification of dementia cases in population-based research is challenging for several reasons. Clinically, the syndrome has an insidious onset, and there is no confirmatory diagnostic test. There is the potential for underreporting of dementia in claims data because, before the spring of 2002, there was a financial disincentive to code dementia.[17,18] To address these methodological issues, an inclusive definition was used that captured most types of dementia and required only one claim during the year, rather than two, as used in other outcomes studies. To the authors' knowledge, this is the first study using claims data to obtain rates of dementia close to epidemiological estimates, although the resulting diagnosis of dementia may be less precise. However, this prevalence probably remains an underestimate. Based on the high observed mortality in the dementia subjects and work by others assessing the sensitivity of claims for the diagnosis of dementia,[29] patients with mild dementia are likely underrepresented in this sample.

The SAF, which was the source of data for this study, provides a nationally representative sample that is large enough to adjust for multiple factors with sufficient numbers of subjects at the extremes of age and chronic illness burden. Adjustment for multiple confounders revealed that Medicare costs are 3.3 times higher for people with dementia than for those of similar age and level of comorbidity but without dementia. Nonrepresentative samples or inability to control for confounding factors may have limited previous attempts to determine the effect

of dementia on direct medical expenditures. Studies that did not adjust for age or for comorbidity found costs 1.6 to 1.9 times higher for AD or dementia patients,[9,10,30] but one study set in a regional managed-care organization found that dementia patients had significantly lower costs,[14] and in one geographically limited study, the presence of dementia did not affect acute care costs.[31]

As noted earlier, the reliance on claims diagnoses likely leads to identification of individuals with later-stage dementia, which may lead to inflated expenditure estimates. To test the degree to which misclassification of mild dementia occurred in this study, the highest age-specific prevalence rates of dementia from epidemiological studies were applied to the sample.[32] Using this method, 76,000 cases could be misclassified. Assuming no additional cost, the reclassification of these subjects into the dementia group would reduce the estimate of total mean annual per-beneficiary expenditure in dementia patients to $6,734. This exploratory calculation suggests that the expenditure estimate based on dementia identified by claims may overestimate costs by as much as $3,000. Even taking into account potentially misclassified cases, the expenditures associated with dementia would remain 2.3 times higher than without dementia.

The study showed that expenditures for all specific services covered by Medicare, in particular hospital, physician, home health, and postacute nursing facility care, were higher for people with dementia. The findings corroborate those of others—that dementia increases home health and SNF expenditures[7,10,11]—but also showed that dementia is independently associated with higher inpatient hospital and physician expenditures in fee-for-service Medicare. Studies of patients in managed-care organizations have found that dementia is associated with higher hospital, SNF, and home-health expenditures but lower physician costs.[10,11] Two retrospective case-control studies also from managed-care settings found that number of physician visits may decrease in the setting of AD or dementia.[14,33] One of these studies specifically reported that physician expenditures were reduced in congestive heart failure or diabetes mellitus patients when dementia was also present, and the authors raised concern that less outpatient care with comorbid medical illness may lead to higher hospitalization.[11] It was hypothesized that the current study would find a similar association between dementia and lower physician expenditures, but it did not. It is possible that, in fee-for-service Medicare, healthcare-seeking behavior of patients and caregivers and referral practices of physicians differ from those in managed care.

Along with higher hospital costs, a strong association was found between the presence of dementia and an increased probability of all-cause hospitalization. This relationship held at all levels of chronic disease burden and across all disease pairings. This finding suggests that dementia itself leads to hospitalization by some as-yet-undelineated mechanism or that its presence worsens the course of comorbid illnesses. The hospital offers no specific therapies for dementia that would explain the increased use, unlike other diseases such as coronary artery disease or chronic obstructive pulmonary disease. Potential reasons for increased hospital use by dementia patients include high rates of trauma or falls, high rates of infections and pressure

wounds in the late stages of dementia, and the need for palliative care. One group of investigators reported that expenditures and hospitalization rates increase as the dementia progresses for community-dwelling dementia patients.[34] Another plausible reason that dementia patients are hospitalized more might be failures in management of their other chronic illnesses. This failure might result from patients' inability to coordinate their own care, inability to participate actively in disease management, or inability to report symptoms accurately. Alternatively, if a caregiver is involved, inadequate communication with the caregiver, inadequate education of the caregiver, or caregiver burnout could lead to uncontrolled exacerbations of chronic illness. Finally, clinicians may have difficulty managing several important chronic conditions simultaneously.[35] It was hoped that subgroups of patients would be identified for whom the addition of dementia was particularly likely to lead to hospitalization, to give clinicians some guidance on where to focus efforts, but the odds of hospitalization were increased within a similar range for all conditions studied.

The finding of increased probability of ACSC admissions of dementia patients suggests deficiencies in ambulatory management. ACSC admissions reflect multiple aspects of care, including access, quality of evaluation and management, timeliness, self-management and coordination. Because all subjects in this sample had similar financial access to care, this cannot be the entire explanation for the observed difference, but any of the other aspects of care might plausibly deteriorate in the presence of dementia. Evaluation by physicians is more difficult when a patient is cognitively impaired, and self-management is unreliable. In addition, individuals with dementia are less able to participate in care or to communicate information across multiple providers. It was not possible in this study to determine which of these factors might have been contributing to the association between dementia and a higher likelihood of ACSC hospitalization, yet the increased likelihood of these admissions in dementia patients suggests that they are part of an at-risk population that may need improvement in its ambulatory care.

The independent effect of dementia on ACSC admissions was observed to weaken as a patient's number of chronic conditions increased. This finding suggests that, once people have a sufficiently high number of chronic conditions, the effect of the addition of dementia is less pronounced. Similarly, the association between dementia and hospitalization was weaker in those who died than in those who survived. For a person with many chronic conditions or end-of-life needs, the issues of treatment and coordination of care may already be so complex that dementia becomes just one of the many conditions that put the person at risk.

This study had some limitations. The use of a claims database results in some inaccuracy of diagnosis in addition to underrepresentation of mild dementia, as already stated. For example, some ICD-9 codes do not reflect current diagnostic categories for dementia (e.g., use of senile dementia). The inclusive definition of dementia therefore reflects what clinicians might generally recognize as cognitive impairment. There may also be misclassification of other diagnoses such as delirium or depression, diagnoses

themselves associated with high utilization. Aside from diagnostic inaccuracy, using claims data may create bias based on the likelihood of coding dementia. Dementia may be identified and coded more readily in hospital or SNF settings and in the presence of more severe dementia, which would lead to underrepresentation of mild dementia in the sample, as mentioned earlier. This could have the effect of skewing the data toward higher utilization and mortality. Using one claim increases the proportion of dementia patients who are only labeled with dementia in the hospital setting by 4%, which might contribute to the overrepresentation of severe dementia or misclassified delirium, but expenditures were only $136 higher when using one claim than when using two, and mortality was similar (20%). Although it is likely that there is some misclassification related to the lower likelihood of physicians coding for mild dementia, the definitions used to identify dementia in this study created no systematic bias. The biases created by false-negative and -positive diagnoses of dementia may have inflated the expenditure estimates.

Another limitation was that some useful variables were unavailable or not optimally coded. Although comorbidity was adjusted for using the Charlson Comorbidity Index, severity of illness and functional status were not coded, so this adjustment was likely to be incomplete. Also, death was recorded quarterly, limiting how this variable could be analyzed, which the authors attempted to address with the analysis stratified by death. The direction of bias created by death in dementia patients may depend on location of residence, and this variable was unavailable in the data set. With worsening stage of dementia, cost and hospitalization may decrease for nursing home residents but increase for community dwellers.[34,36] The authors attempted to identify long-term SNF residence using Current Procedural Terminology and point-of-service codes, but the rates were too low to be reliable. Medicare SNF claims could not be used as a proxy, because it could not be determined who went on to a long-term stay posthospitalization. The subgroup of patients with late-stage dementia living in a nursing home may have lower costs than nondemented patients, but in the present study, this interaction could not be studied.

This investigation demonstrates the association between dementia and increased healthcare usage, independent of other chronic illnesses, age, and death. One implication for clinicians, policy makers, payors, and researchers is that ambulatory management is a potential area for improvement. When patients have multiple chronic illnesses, clinicians need guidance regarding identification of high-risk groups, such as people with dementia. When caring for people with dementia, clinicians need to maintain ongoing communication with caregivers, other medical providers, and agencies. These efforts need support and investment from policymakers and payors to improve coordination of care. Further research, particularly prospective studies, is needed to allow a more sophisticated approach to understanding what increases a dementia patient's risk of hospitalization. Information from these studies could ultimately help target interventions and innovative models-of-care delivery that take into account the interaction of chronic medical illness and dementia to prevent morbidity and unnecessary hospitalization in this high-risk group.

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