

Research Article

Effects of Cognition, Function, and Behavioral and Psychological Symptoms on Medicare Expenditures and Health Care Utilization for Persons With Dementia

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Received September 28, 2016; Editorial Decision Date February 20, 2017

Decision Editor: Stephen Kritchevsky, PhD

Abstract

Background: Clinical features of dementia (cognition, function, and behavioral/psychological symptoms [BPSD]) may differentially affect Medicare expenditures/health care utilization.

Methods: We linked cross-sectional data from the Aging, Demographics, and Memory Study to Medicare data to evaluate the association between dementia clinical features among those with dementia and Medicare expenditures/health care utilization ($n = 234$). Cognition was evaluated using the Mini-Mental State Examination (MMSE). Function was evaluated as the number of functional limitations (0–10). BPSD was evaluated as the number of symptoms (0–12). Expenditures were estimated with a generalized linear model (log-link and gamma distribution). Number of hospitalizations, institutional outpatient visits, and physician visits were estimated with a negative binomial regression. Medicare covered skilled nursing days were estimated with a zero-inflated negative binomial model.

Results: Cognition and BPSD were not associated with expenditures. Among individuals with less than seven functional limitations, one additional limitation was associated with \$123 (95% confidence interval: \$19–\$227) additional monthly Medicare spending. Better cognition and poorer function were associated with more hospitalizations among those with an MMSE less than three and less than six functional limitations, respectively. BPSD had no effect on hospitalizations. Poorer function and fewer BPSD were associated with more skilled nursing among individuals with one to seven functional limitations and more than four symptoms, respectively. Cognition had no effect on skilled nursing care. No clinical feature was associated with institutional outpatient care. Of individuals with an MMSE less than 15, poorer cognition was associated with fewer physician visits. Among those with more than six functional limitations, poorer function was associated with fewer physician visits.

Conclusions: Poorer function, not cognition or BPSD, was associated with higher Medicare expenditures.

Keywords: Dementia care—Dementia and Medicare expenditures—Health care utilization—Alzheimer’s disease costs

Dementia is one of the most costly diseases to society (1,2), because persons with dementia can live more than 10 years with the disease while experiencing a complex set of clinical features including cognitive and functional decline and behavioral and psychological symptoms of dementia (BPSD) (3–5).

Recent studies from RAND and others have demonstrated that persons with dementia have higher health care costs and use more health care services than those without dementia (1,2,6,7), though less

is known about how the clinical features of dementia affect the cost of dementia care. This study extends the literature by evaluating the association between the clinical features with cost among those with dementia. Understanding the separate contributions of cognition, function, and BPSD to the cost of dementia care and to the types of health care services used (eg, number of hospitalizations) can provide insight into the possible mechanisms that drive higher costs, and informs the development of services, programs, and interventions to reduce such costs.

Prior studies have found that the total cost of caring for a person with dementia and the number of health care services used generally increases with disease severity (6–15). Despite employing different methodologies, most prior studies have noted that poorer function is associated with more spending and more health care utilization (hospitalizations, emergency room visits, and outpatient treatment) (6,7,10). Several of those studies have shown that within a disease stage (eg, mild, moderate, and severe) costs and resource utilization are moderated by clinical features. For example, results from a study using data from the National Long Term Care Survey found that within a level of dementia severity (severe and moderate) costs were 10 times greater among those with five functional limitations compared to those with no limitations (6). Results are inconclusive regarding the effect of cognition and BPSD with studies finding significant and nonsignificant associations between these clinical features and cost/health care utilization (10,12,14,16). Many studies have important methodological limitations including using non-representative data, relying on claims data to determine dementia status, and not separating expenditures by payer (eg, individual out-of-pocket spending or Medicare expenditures). Relying on claims data to identify dementia cases may result in an overestimation of Medicare cost attributable to dementia (17,18). Identifying the source of cost by payer is important for policymaking and budgetary planning because the responsibilities and the amount of cost vary by payer. Our study addresses these limitations by using nationally representative data, identifying dementia cases based on a clinical diagnosis, and evaluating cost from a Medicare perspective.

In a prior analysis, we used the nationally representative Aging, Demographics, and Memory Study (ADAMS), a subsample of the Health and Retirement Study (HRS), to evaluate the effect of cognition, function, and BPSD on out-of-pocket expenditures and time spent receiving informal care for persons with dementia (19). We found that poorer function was associated with more out-of-pocket spending and more caregiving, and an increase in the number of BPSD was associated with more caregiving. In the current analysis, we use ADAMS to evaluate the effect of cognition, function, and BPSD on Medicare expenditures and health care utilization (number of inpatient admissions, number of Medicare covered skilled nursing facility days, number of outpatient institutional visits, and number of physician visits) for persons with dementia.

Methods

Study Design and Data

We used cross-sectional data from ADAMS (Wave A). The ADAMS subsample was drawn from HRS (individuals at least 70), and ADAMS was specifically designed to collect clinical measures related to cognitive health and dementia. Unlike the core HRS, ADAMS contains a clinical diagnosis of dementia and measures related to BPSD (20). ADAMS Wave A assessments were conducted between 2001 and 2003. During the ADAMS in-home assessment, a trained nurse and neuropsychology technician administered a standardized protocol that included measures to assess cognition, function, and BPSD. Following the ADAMS assessment, an independent consensus panel comprised of a geropsychiatrist, neurologist, neuropsychologist, and internists reviewed respondent medical records and responses to the in-home assessment to determine if an individual had normal cognitive function, cognitive impairment not dementia, or dementia. Diagnosis was based on published criteria including DSM-III-R and DSM-IV (20). Although diagnostic categories (eg, Alzheimer's dementia) are provided in the data, we did not limit our

analysis to a specific type of dementia because diagnosis is subject to misclassification (21,22).

In addition to using the data in the ADAMS survey, we linked respondents to their nearest HRS survey (mean time between surveys 8.14 months) to obtain additional information on comorbidities that were not captured in the ADAMS survey (RAND HRS version N [The RAND HRS Data File is an easy to use data set based on the HRS data. The RAND HRS file combines multiple HRS files into a single data file and contains imputations for missing data. The RAND HRS file was developed at RAND with funding from the National Institute on Aging and the Social Security Administration.]) (20). That is, ADAMS provided a clinical diagnosis of dementia, measures for cognition, function, and BPSD, and demographic information. HRS provided detailed data on comorbidities.

More than 80% of ADAMS respondents consented to linking their survey data with CMS Medicare data. We combined ADAMS survey respondents with their corresponding CMS Medicare data. Specifically, we linked the cross-sectional ADAMS assessment with an annual summary Medicare file. We included only annual Medicare expenditures and health care utilization for the year in which the subject was interviewed in ADAMS. The summary Medicare file aggregates Part A & B claims and enrollment data on an annual basis and was developed for use with HRS/ADAMS.

Our sample was restricted to ADAMS respondents identified as having dementia with complete data on the variables of interest and who were continually enrolled in fee-for-service Medicare for the year of the ADAMS assessment. The University of Minnesota institutional review board approved this study.

Measures of Clinical Features of Dementia

Dementia was modeled using cognition, function, and BPSD (4,5). All three clinical features were evaluated during the ADAMS in-home clinical assessment. Cognition was evaluated using the Mini-Mental State Examination (MMSE) (23). The MMSE is scored from 0 to 30 with lower scores indicating greater cognitive impairment.

Function was evaluated as the total number of functional limitations (0 to 10) an individual had difficulty performing (yes/no) among the following domains: (1) handling small sums of money, (2) handling complicated financial transactions, (3) shopping independently, (4) performing hobbies, (5) carrying out routine household tasks, (6) difficulty feeding self, (7) recalling recent events, (8) understanding what s/he reads or sees on television, (9) remembering things about family and friends, and (10) finding one's way around familiar streets. These domains were specifically chosen as they correspond with the functional domains assessed in the Functional Activities Questionnaire, one of the few standardized measures for assessing functional ability (24).

Finally, the number of BPSD (0 to 12) was identified using the Neuropsychiatric Inventory Questionnaire (25). The Neuropsychiatric Inventory Questionnaire asks caregivers to identify if the following BPSD occurred and if so, its frequency and severity: (1) delusions, (2) hallucinations, (3) agitation or aggression, (4) depression, (5) apathy, (6) elation, (7) anxiety, (8) disinhibition, (9) irritability, (10) motor disturbance, (11) night-time behaviors, and (12) change in appetite and eating. For our analyses, we generated a summary score reflecting the total number of BPSD endorsed by a caregiver as being present. The number of BPSD is associated with resource utilization (26).

Outcomes

We calculated average monthly Medicare expenditures (annual expenditures in the year of the ADAMS assessment/12). Medicare expenditures were converted to 2015 United States dollars using the medical

care component of the Consumer Price Index. To provide insight into the potential drivers of Medicare expenditures we also evaluated average monthly Medicare health care utilization: number of inpatient admission, number of Medicare covered skilled nursing facility days, number of institutional outpatient visits, and number of physician visits. The number of inpatient admissions represents unique hospital stays in which an individual was designated as being an inpatient. To receive Medicare covered skilled nursing an individual had to have a qualifying inpatient stay and be hospitalized for at least 3 nights. We evaluated the number of inpatient admissions since inpatient care is reimbursed based on an episode of care. In contrast, we evaluated the number of skilled nursing care days since Medicare reimburses for skilled nursing care based on days of care. Institutional outpatient utilization represents unique outpatient episodes of care for events such as observation services and outpatient surgery. The number of physician visits represents unique office visits for evaluation and management services. These unique physician visits can include care that occurs during an outpatient institutional visit.

Covariates

We controlled for confounders in our model to separate the extra Medicare cost associated with the clinical features from other factors that might impact cost. Confounders were identified from the literature based on their prior empirical associations with health care costs and the clinical features of dementia and included age, gender, race, marital status, and total number of chronic conditions (0 to 8) among the following: stroke, diabetes, heart problems, hypertension, lung disease, cancer, psychiatric problems, or arthritis (1,11,12,27).

Statistical Analysis

We estimated separate adjusted multivariate regression models for each outcome of interest (five adjusted models in total): Medicare expenditures, number of inpatient admission, number of Medicare covered skilled nursing facility days, number of outpatient institutional visits, and number of physician visits.

Due to skewness in Medicare expenditures we estimated a generalized linear model with a log-link and gamma distribution. All measures of health care utilization, except the number of skilled nursing days, were estimated with a negative binomial regression. A zero-inflated negative binomial model was used to evaluate the number of skilled nursing days since the data exhibits excessive zeros. In preliminary analyses, the zero-inflated model failed to coverage when all covariates were included in the zero-inflation portion of the model. The final zero-inflated model included all covariates in the count portion of the model, and only individual demographic characteristics in the inflation portion of the model.

For each model, we separately predicted the outcome and calculated the average marginal effects at representative values for each clinical feature (eg, marginal effects when number of functional limitations was 0, 1, 2, ..., 10) to provide insight into their differential effect on the outcome at levels of feature severity. That is, we sought to understand how a change in cognition (one point decline), function (one point increase), or BPSD (one point increase) affected the outcome when the clinical features took on different values.

All analyses were conducted using ADAMS survey weights and Stata version 12 survey commands (Stata, College Station, TX).

Results

Sample Characteristics

Of the 308 individuals in ADAMS Wave A with a diagnosis of dementia, 234 had complete data on the variables of interest

(Supplementary eFigure 1 shows the derivation of the analysis sample). Comparison between those excluded/included from the analysis showed no statistically significant differences (Supplementary eTable 1). The mean age of the 234 individuals with dementia was 84.12 (standard deviation [SD] 10.87) (Table 1); individuals had a mean MMSE score of 16.06 (SD 11.94), and had an average of 6.18 (SD 3.71) functional limitations and 2.63 (SD 4.23) BPSD.

Medicare Expenditures

An individual with dementia had average-adjusted monthly Medicare expenditures of \$1,041 (95% confidence interval [CI]: \$771, \$1,311). Cognition and BPSD were not significantly associated with Medicare expenditures and this was consistent across levels of severity (Supplementary eFigure 2). Poorer function was associated with significantly more Medicare spending (Table 2). The effect of function on Medicare expenditures increased with greater levels of functional impairment, but this effect was only significant among those with less than seven functional limitations (Supplementary eFigure 2). Specifically, an increase from one to two functional limitations was associated with \$75 (95% CI: \$48, \$102) additional Medicare spending per month, while an increase from five to six limitations was associated with \$140 (95% CI: \$22, \$257) additional spending per month. The average marginal effect of one additional functional limitation on Medicare expenditures among those with less than seven limitations was \$123 (95% CI: \$19, \$227).

Health Care Utilization

On average, individuals had 0.05 (95% CI: 0.04, 0.06) inpatient admission per month. A one-unit decline in cognition was associated with -0.001 (95% CI: -0.003, 0.00) fewer inpatient admissions among those with an MMSE less than 3 (Supplementary eFigure 3). One-additional functional limitation was significantly associated with 0.006 (95% CI: 0.001, 0.012) more inpatient admissions among those with less than six limitations (Supplementary eFigure 3). BPSD was not associated with inpatient admissions (Table 2).

Individuals had an average of 0.42 (95% CI: 0.21, 0.63) Medicare covered skilled nursing care days per month. Cognition was not associated with skilled nursing care. Poorer function was associated with 0.10 (95% CI: 0.02, 0.18) more Medicare skilled nursing care days among those with one to seven functional limitations (Supplementary eFigure 4). One-additional BPSD was associated with -0.07 (95% CI: -0.12, -0.01) fewer Medicare covered skilled nursing days among those with more than four symptoms.

Table 1. Sample Characteristics^a

	Demographic Characteristics (<i>n</i> = 234)
Mean cognition ± <i>SD</i> (range), MMSE	16.06 ± 11.94 (0–27)
Mean function ± <i>SD</i> (range)	6.18 ± 3.71 (0–9)
Mean number of BPSD ± <i>SD</i> (range)	2.63 ± 4.23 (0–10)
Mean age ± <i>SD</i> (range), <i>y</i>	84.12 ± 10.87 (70–110)
Male, %	35.37
Non-Caucasian, %	18.88
Married, %	21.76
Mean number of comorbidities ± <i>SD</i> (range)	2.96 ± 2.67 (0–7)

Notes: BPSD = Behavioral and psychological symptoms of dementia; MMSE = Mini-Mental State Examination.

^aAging Demographics and Memory Study sample weights were used.

Table 2. Regression Coefficients (95% confidence interval) for Monthly Medicare Expenditures/Health Care Utilization (*n* = 234)^a

	Medicare Expenditures (generalized linear model log link gamma distribution)	Number of Inpatient Admission (negative binomial model)	Number of Medicare Covered Skilled Nursing Facility Covered Days (zero-inflated negative binomial model)		Number of Institutional Outpatient Visits (negative binomial model)	Number of Physician Visits ^b (negative binomial model)
			Inflation Portion	Count Portion		
Intercept	6.37 (3.06, 9.68)	-4.09 (-7.91, -0.27)	5.76 (-2.84, 14.35)	-0.08 (-6.37, 6.22)	-1.66 (-5.75, 2.43)	-0.27 (-2.72, 2.18)
MMSE	0.03 (-0.01, 0.07)	0.04 (-0.03, 0.10)		-0.01 (-0.09, 0.06)	0.02 (-0.02, 0.06)	0.02 (0.00, 0.05)
Number of functional limitations	0.15 (0.02, 0.29)	0.17 (-0.02, 0.36)		0.39 (0.13, 0.66)	0.02 (-0.08, 0.13)	-0.06 (-0.11, -0.01)
Number of BPSD	0.03 (-0.05, 0.10)	0.01 (-0.09, 0.11)		-0.16 (-0.31, -0.01)	-0.01 (-0.12, 0.10)	0.02 (-0.05, 0.08)
Age	-0.01 (-0.05, 0.02)	-0.01 (-0.05, 0.02)	-0.06 (-0.17, 0.05)	-0.02 (-0.08, 0.04)	0.00 (-0.05, 0.05)	-0.01 (-0.04, 0.01)
Male	0.46 (-0.07, 0.99)	0.32 (-0.29, 0.92)	-2.60 (-2.87, -2.327)	-1.49 (-2.60, -0.38)	0.63 (0.24, 1.01)	0.04 (-0.37, 0.45)
Non-Caucasian (ref = white)	0.06 (-0.58, 0.69)	0.04 (-0.49, 0.56)	-0.69 (-2.13, 0.74)	-0.73 (-1.60, 0.13)	0.12 (-0.34, 0.58)	0.03 (-0.44, 0.50)
Married (ref = not married)	-0.41 (-0.93, 0.10)	-0.03 (-0.57, 0.51)	-0.91 (-3.10, 1.28)	-2.12 (-3.97, -0.27)	-0.15 (-0.91, 0.62)	0.67 (0.25, 1.10)
Number of chronic conditions	0.07 (-0.09, 0.22)	0.10 (-0.10, 0.31)	0.10 (-0.55, 0.76)	0.26 (-0.02, 0.53)	0.08 (-0.10, 0.25)	0.06 (-0.12, 0.24)

Notes: BPSD = Behavioral and psychological symptoms of dementia; MMSE = Mini-Mental State Examination.

^aAging Demographics and Memory Study sample weights were used.

^bPhysician visits are for evaluation and management services and can include care that occurs during an institutional outpatient institutional visit.

Individuals had an average of 0.44 (95% CI: 0.34, 0.54) institutional outpatient visits per month. No clinical feature was associated with institutional outpatient care (Table 2, Supplementary eFigure 5).

Finally, individuals had an average of 0.39 (95% CI: 0.32, 0.48) physician visits (evaluation and management services) per month. A one-unit decline in cognition was associated with -0.01 (95% CI: $-0.01, 0.00$) fewer physical visits among those with an MMSE less than 15 (Supplementary eFigure 6). Similarly, poorer function was associated with -0.02 (95% CI: $-0.04, 0.00$) fewer physician visits among those with more than six functional limitations. BPSD was not associated with number of physician visits.

Discussion

We used nationally representative data to estimate the effect of three key clinical features of dementia—cognition, function, and BPSD—on Medicare expenditures and health care utilization. Poorer function, but not cognition or BPSD, was significantly associated with more Medicare spending. Our results complement prior studies that have found poorer function is associated with higher cost, and that among individuals with dementia, function is potentially a more important predictor of costs than cognition (6,9,10,12,14). Unlike prior studies, we explicitly evaluated the differential effect of the severity of dementia clinical features on Medicare expenditures and health care utilization. We further extend results by using nationally representative data and not relying on claims data to determine if an individual has dementia.

The marginal effect of function on Medicare expenditures increased with greater levels of functional impairment; however, among those with at least 7 limitations the effect of an additional limitation on expenditures was no longer significant. The significant effect of poorer function among those with less than seven limitations was enough to generate an overall significant average effect. The reason for lack of significance of the marginal effect for more severe levels of functional impairment are not entirely clear, but may reflect sparse data for those with at least 7 limitations. Clinically, one potential explanation is that with more severe functional limitations, which may be associated with more severe dementia, medical care may be less aggressive reflecting advance care directives (28).

The effect of function on Medicare expenditures appears to be driven, in part, through the effect of poorer function on more inpatient admissions among individuals with less than six limitations. While the effect of an additional functional limitation on inpatient admissions is low (0.006), this equates to a 12% increase in monthly inpatient admissions (0.05 average monthly inpatient admissions) and has potential cost implications. Others studies, including Zhu and colleagues and Small and colleagues, also reported that poorer function was associated with more inpatient care (10,14). Importantly, many dementia related hospitalizations are potentially avoidable (29). Although we found that more severe cognitive limitations (MMSE less than 3) were associated with fewer hospitalizations, this finding is likely not clinically or policy significant given the small effect size ($\sim 2\%$ decline in admissions) and narrow population for which findings apply (only individuals with MMSE less than 3).

Individuals with dementia utilize Medicare skilled nursing care at greater rates than individuals without dementia (30). However, to our knowledge our study is first to investigate the relationship between dementia clinical features and Medicare covered skilled nursing utilization. The effect of function on Medicare expenditures also appears driven by the relationship between poorer function

and more skilled nursing care among individuals with one to seven limitations. In contrast, among those with more than four BPSD, one additional symptom was associated with less skilled nursing care. The negative effect of BPSD on Medicare skilled nursing care may reflect that a hospitalization triggered by a BPSD makes a person with dementia a poorer candidate for Medicare covered skilled nursing care as opposed to placement in a nursing home. However, we were unable to test this hypothesis since our data was limited to observing only Medicare covered skilled care.

We did not find an effect between the clinical features and institutional outpatient care. However, unlike several other studies, we found that poorer cognition among those with an MMSE less than 15 and poorer function among those with more than six limitations were associated with fewer physician visits (10,14). Again it is important to note that physician visits can include care that occurs during institutional outpatient care. The average effect of cognition (-0.01) and function (-0.02) on physician visits were low and equate to a $\sim 5\%$ decline in visits. The negative association between physician care and more severe cognitive and functional limitations may be due to the previously stated hypothesis of the use of less aggressive care with more severe disease reflecting advance care directives (28).

There are potential mechanisms for reducing Medicare spending, inpatient admissions, and skilled nursing care associated with poorer function in individuals with dementia. Foremost, functional limitations can be managed by effective ambulatory care, and by formal and informal caregivers (31–33). Better management of functional limitations may translate into lower Medicare expenditures through less inpatient and skilled nursing utilization. Additionally, ongoing post-acute care payment reform may result in a reduction in Medicare payments and overall skilled nursing utilization, and potentially render the effect of function on skilled nursing utilization null (34).

We did not find a significant relationship between the number of comorbidities and Medicare spending. In the literature, the effect of comorbidities on Medicare spending among those with dementia is inconclusive. Some studies have found that among those with dementia comorbidities are not associated with more Medicare spending, some have found that only specific comorbidities are associated with spending, and some have found an association between any comorbidities and spending (6,10,35). Future studies with larger sample sizes are needed to investigate the interaction between comorbidities and the clinical features.

Our study has several limitations. We used cross-sectional data, and were not able to evaluate the effect of the clinical features on costs over time within a person. Due to lack of data, our evaluation of Medicare expenditures did not include those for prescription medication (Part D). The likely result is an underestimation of total Medicare cost. Conceptually we believe we controlled for key confounders; however, it is possible that we may have omitted confounders from our analyses. If an omitted confounder is strongly correlated with the clinical features and outcomes then our results will be biased. Finally, in this analysis we did not evaluate the effect of the clinical features of dementia on the health and Medicare expenditures of family caregivers.

In conclusion, poorer function, but not cognition or BPSD, was associated with more Medicare expenditures. The effect of function on Medicare expenditures was predominantly due to the effect of poorer function on expenditures among those with less than seven limitations. Poorer function was also associated with greater inpatient and skilled nursing care among those with less than six and one to seven limitations, respectively. Poorer cognition among those with

an MMSE less than 3 was associated with fewer inpatient admission. BPSD was not associated with inpatient admissions, but more BPSD among those with more than four symptoms were associated with less skilled nursing care. No clinical feature was associated with institutional outpatient care. Poorer cognition among those with an MMSE less than 15 and poorer function among those with more than six limitations were associated with less physician visits. Interventions that target function could reduce Medicare expenditures.

Supplementary Material

Supplementary data is available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

Funding

This work was supported by the Agency for Healthcare Research and Quality (1R36HS024165-01 to E.J.). Health and Retirement Study is produced and distributed by the University of Michigan with funding from the National Institute on Aging (grant number NIA U01AG009740) Ann Arbor, MI. RAND HRS Data, Version N, produced by the RAND Center for the Study of Aging, with funding from the National Institute on Aging and the Social Security Administration, Santa Monica, CA.

Acknowledgments

The authors thank Carla Kahle, Aaron Gibbons, and Patty Homyak for their assistance in obtaining and securing the restricted CMS Medicare data.

Conflict of Interest

None.

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