Dementia and Medicare at Life's End

Vicki L. Lamb, Frank A. Sloan, and Anil S. Nathan

Objective. To determine the effect of a diagnosis of Alzheimer's disease or related dementias (ADRD), and the timing of first ADRD diagnosis, on Medicare expenditures at end of life.

Data Sources. Monthly Medicare payment data for the 5 years before death linked to the National Long-Term Care Survey (NLTCs) for decedents between 1996 and 2000 ($N = 4,899$).

Data Extraction Methods. Medicare payment data for the 5 years before death were used to compare 5-year and 6-month intervals of expenditures (total and six subcategories of services) for persons with and without a diagnosis of ADRD during the last 5 years of life, controlling for age, gender, race, education, comorbidities, and nursing home status. Covariate matching was used.

Principal Findings. On average, ADRD diagnosis was not significantly associated with excess Medicare payments over the last 5 years of life. Regarding the timing of ADRD diagnosis, there were no significant 5-year total expenditure differences for persons diagnosed with dementia more than 1 year before death. Payment differences by 6-month intervals were highly sensitive to timing of ADRD diagnosis, with the highest differences occurring around the time of diagnosis. There were reduced, non-significant, or negative total payment differences after the initial diagnosis for those diagnosed at least 1 year before death. Only those diagnosed with ADRD in the last year of life had significantly higher Medicare payments during the last 12 months of life, primarily for acute care services.

Conclusions. ADRD has a smaller impact on total Medicare expenditures than previously reported in controlled studies. The significant differences occur primarily around the time of diagnosis. Although rates of dementia are increasing per se, our results suggest that long-term (1+ year) ADRD diagnoses do not contribute to greater total Medicare costs at the end of life.

Key Words. Dementia, Alzheimer's disease, cost, end-of-life, Medicare

Alzheimer's disease and related dementias (ADRD) affect 3–11 percent of the United States elderly (Leon, Cheng, and Neumann 1998; Hill et al. 2002), and prevalence increases dramatically with age such that more than 47 percent of persons aged 85+ years are estimated to have ADRD (U.S. General Accounting Office 1998). Rates of dementia among the elderly appear to be

rising (Foley, Brock, and Lanska 2003; Taylor, Sloan, and Doraiswamy 2004) due to population aging and improved diagnoses. Education has a protective effect in that persons with higher levels of education are less likely to experience cognitive decline (Cagney and Lauderdale 2002; Lee et al. 2003). Some studies indicate that women have higher rates of dementia, particularly of the Alzheimer's type (Gao et al. 1998; Barnes et al. 2005), primarily due to longer life expectancy (Hebert et al. 2001). African Americans have higher rates of dementia diagnoses, higher rates of health services use, and lower scores on cognitive tests, in part because of higher prevalence of hypertension and stroke and lower educational attainment levels (Husaini et al. 2003; Sloan and Wang 2005).

Dementia imposes substantial costs on Medicare (Weiner et al. 1998; Taylor and Sloan 2000; Bynum et al. 2004) and other payment sources, e.g., for formal and informal health care (Menzin et al. 1999; Taylor et al. 2001). Persons with ADRD typically have more comorbidities (McCormick et al. 2001; Hill et al. 2002) and are more likely to use long-term nursing home care (Magaziner et al. 2000; Smith, Kokmen, and O'Brien 2000), particularly at the end of life.

It is difficult to evaluate the impact of ADRD on health expenditures because estimated medical costs attributable to dementia vary widely depending on study methodology (Bloom, de Pouvoirville, and Straus 2003), with the largest variation reported in studies of ADRD costs without control populations. With some exceptions (e.g., Kinoshian et al. 2000), most studies are based on cross-sectional data. Uncontrolled studies of medical expenditures for persons with ADRD can be useful for estimating current and projected costs associated with the dementia for persons with this diagnosis. However, such estimates give no indication of any added burden of dementia diagnosis on Medicare and other health care expenditures. Studies only including persons with dementia cannot address confounding characteristics, such as comorbidities, which may be associated with higher medical costs regardless of dementia diagnosis.

Several U.S. studies have compared differences in annual medical costs between demented and nondemented elderly, using data from managed care organizations (MCOs) (Richards et al. 2000; Hill et al. 2002), Medicare files

Address correspondence to Vicki L. Lamb, Ph.D., North Carolina Central University, Department of Sociology, 1801 Fayetteville Street, Durham, NC 27707. Frank A. Sloan, Ph.D., is with Duke University, Center for Health Policy, Durham, NC. Anil S. Nathan is with Duke University, Department of Economics, Durham, NC.

(Weiner et al. 1998; Newcomer et al. 1999; Bynum et al. 2004), and nationally representative surveys with linked Medicare files (Taylor and Sloan 2000; Taylor et al. 2001). Such studies match demented and nondemented persons on characteristics, such as age and gender, and estimate medical expenditure differences with nonparametric statistics, or estimate hazard or other regression models controlling for covariates. Most studies using control groups have found annual Medicare expenditures to be roughly 1.6 times higher for persons diagnosed with dementia. In all studies, higher costs were primarily due to significantly higher hospitalization costs. Other Medicare services contributing to higher ADRD costs include skilled nursing facility (SNF) and physician services.

Most research comparing costs incurred by ADRD and non-ADRD persons is cross-sectional. Dementia is a major predictor of death among the elderly (Tschanz et al. 2004), and survival time after onset is reduced with increased levels of severity (Larson et al. 2004; Tschanz et al. 2004). If a diagnosis of dementia occurs near death, medical expenditures would be likely to be relatively higher (Hogan et al. 2001). Cross-sectional data are likely not to capture such effects on expenditures unless data collection is explicitly oriented to capturing events and costs at the end of life or controlling for higher risks of mortality (Newcomer et al. 2005). Indeed, most of these studies did not explicitly consider proximity to death. Thus, the subjects may be in different stages of illness, even when controlling for age, as health care costs are more correlated with time to death rather than age (Yang, Norton, and Stearns 2003).

Few studies have compared medical costs for demented and nondemented persons at the end of life. McCormick et al. (2001) examined end-of-life Medicare costs for patients in an established MCO. Their sample consisted of persons already diagnosed with AD or with other dementias 3 years before death and a comparison sample of nondemented persons. They found no or lower Medicare cost differences for both demented groups compared with the nondemented during the last 3 years and the last year of life.

McCormick et al. did not control for timing of ADRD diagnosis, and thus did not consider the health care cost effects of a dementia diagnosis within the last few years of life, particularly in the last year of life when health care costs soar. However, their research does indicate that a long-term ADRD diagnosis is associated with reduced Medicare cost differences.

The current study addresses some of the issues raised in previous research. The purpose of our study is to compare ADRD and non-ADRD Medicare fee-for-service expenditures to estimate the effect of any ADRD

diagnosis on expenditure differences during the last 5 years of life. A second goal is to assess whether having a dementia diagnosis for a longer period before death reduces Medicare fee-for-service expenditure differences, as McCormick et al. (2001) found using MCO data. A third goal is to extend such results to evaluate the impact of ADRD onset in the last few years of life on Medicare expenditure differences at the end of life.

METHODS

Monthly Medicare payment data linked with nationally representative longitudinal survey data are used to compare expenditures for Medicare services for 5-year and 6-month intervals for ADRD and non-ADRD persons in the last 5 years of life. The Medicare files are also used to document the timing of first ADRD diagnosis relative to year of death. We use a modeling procedure to match demented and nondemented persons on a number of covariates to control for ADRD selection effects.

Our data came from the National Long-Term Care Survey (NLTCs) linked to individual Medicare records. The NLTCs has been conducted in 1982, 1984, 1989, 1994, and 1999. In each survey year, NLTCs uses Medicare administrative data to identify new and former respondents. All respondents are given a screener interview to determine: (1) whether they are community or institutional residents, and (2) if community residents, whether they are chronically impaired on 1+ ADL or IADL limitations for 90+ days. If a person meets either criterion, the person receives a detailed institutional or community interview. Those who received a detailed interview in a previous NLTCs wave will automatically receive a detailed interview after the screener. New samples of persons aged 65–69 are drawn with each survey year. Contact rates have been 99+ percent in all survey years, with detailed interview response rates of 95+ percent.

All sample persons are continuously tracked with Medicare administrative records from 1982–2000, or from becoming Medicare age-eligible, until death, whichever is shorter. Claims records give type and amounts, payments, and dates of service, and ICD-9-CM diagnosis codes. Medicare Vital Statistics files provide beneficiaries' gender, race, and dates of birth and death.

Persons were included in this study if: (1) the NLTCs sample person was alive in 1991, (2) the sample person died between January 1, 1996 and December 31, 2000, (3) there were 5 years of continuous Medicare records for

the individual, and (4) the person was not in Medicare MCOs during the last 5 years of life. The fourth inclusion criterion was necessary as Medicare does not collect utilization information on beneficiaries enrolled in MCOs.

During the observational period, there were 5,779 decedents among persons Medicare-eligible for 5+ years. Excluding persons enrolled in MCOs for at least some time during the observational period yielded an analysis sample of 4,899 persons for the study. At first glance, the exclusion of beneficiaries enrolled in Medicare MCOs may be seen as a particularly important study limitation. However, other studies of Medicare costs linked to survey data (e.g., Daviglus et al. 2005), including the NLTCs (Taylor, Sloan, and Doraiswamy 2004), have documented minimal bias when MCO enrollees were excluded. We found the excluded MCO group to have similar gender, race, and age-at-death distributions compared with the fee-for-service group under study.

Monthly Medicare claims payments for the last 60 months of life were calculated from the linked Medicare files for 1991–2000. We collapsed Medicare payment data into ten 6-month intervals (i.e., 55–60, 49–54, . . . , 1–6 months before death) for analysis of total and six subcategories of Medicare service payments. The subcategories were service types: inpatient, physician/Part B (including clinical laboratory and durable medical equipment), home health, SNF, outpatient, and hospice. The Medicare payments were inflation-adjusted to 2000 dollars using both the all-items consumer price index (CPI) and the medical care CPI (MC-CPI). Both methods yield similar trends of results. We present results adjusted by MC-CPI.

Alzheimer's disease and related dementias diagnoses were identified from ICD-9 diagnosis codes of 331, 331.2, 331.7, 331.9, 290–290.43, 294–294.8, and 797 from Medicare claims. We identified the first time an ADRD diagnosis was reported on any Medicare claim following Taylor and Sloan (2000). A separate examination of claims records indicated that 63.8 percent of the initial ADRD diagnoses were found on physician Part B records. The timing of first ADRD onset was classified into four categories: 5+, 3–5, 1–3, and < 1 year(s) before death.

Our analyses controlled for several covariates that plausibly affect Medicare payments and are correlated with dementia. Among demographic characteristics, we matched on gender, age, race, and education. We used six discrete 5-year age groups: from 65–9 through 90–4, and 95+. Race was classified as white/nonwhite because whites comprise 90 percent of the sample. Race was missing for 23 persons. Educational attainment was only asked of persons receiving detailed NLTCs interviews; thus we lacked information

on education for 48.1 percent of our sample who screened-out as nondisabled. Education data were collapsed into six categories: <7 years, 7–8 years, 9–11 years, high school graduate, any college education, and “missing education” to account for healthy persons who did not receive a full NLTC interview.

Demented persons typically have higher levels of comorbidities. To control for health status and comorbidities, we calculated a DxCG score (version 4.1), which uses ICD-9-CM codes plus age and gender to create risk adjustment estimates for future medical costs (Ellis et al. 1996). The strategy to estimate cost risks is based on a hierarchical category of disease groups and the results are normalized to the Medicare population ($\text{DxCG} = 1$) for comparison purposes. Higher scores reflect higher comorbid risks for care. We used all ICD-9 codes, except those associated with ADRD, to estimate DxCG scores. We first estimated a mean DxCG score over the person’s last 5 years of life, and then estimated annual levels of DxCG for each year before death for the more detailed analyses.

Because institutional long-term care is not covered by Medicare, and those with dementia have a higher probability of requiring nursing home care, comparative Medicare cost differences may be reduced because costs for such care is covered via other sources. We controlled for being in nursing home at the end of life. A flag was created to identify persons who received an institutional survey in 1994 (for those dying 1996–1998) or 1999 (for those dying 1999–2000).

Statistical Analysis

Ideally, to study the effect of an ADRD diagnosis on end of life Medicare payments we need to observe each individual’s Medicare payments in the last 5 years of life both with *and* without an ADRD diagnosis. However, both sets of Medicare payments cannot be simultaneously observed. To deal with this counterfactual problem we used covariate matching methods. With this approach, one estimates the average treatment effect (ATE) of a binary “treatment,” such as a dementia diagnosis, on an outcome, such as Medicare payments (Rubin 1974; Wooldridge 2002). This technique closely matches treated and untreated individuals on a number of important covariates to impute the missing outcome to determine ATE. For example, the observed Medicare expenditures for a person with dementia would be known. The unobserved outcome is estimated by averaging the Medicare expenditures for the most closely matched person (or persons) who do not have dementia. The matching procedure estimates the treatment effect, the difference in actual

Medicare expenditures for the demented person minus the estimated expenditures for a matched nondemented person, and produces the ATE and level of significance. Covariate matching was conducted in *Stata 8.2* using *match*, the matching estimators program (see Abadie et al. 2001 for more detail).

We first used the *match* procedure to estimate the effect of an ADRD diagnosis on differences in Medicare expenditures, in total and for 6 subcategories of Medicare services, for the last 5 years of life. We then estimated the effects of the timing of ADRD onset (5+ years, 3–5 years, 1–3 years, and within 1 year of death) on 5-year Medicare expenditure differences. The last set of models estimated the impact of the timing of ADRD onset on 6-month expenditures (55–60 to 1–6 months before death) for Medicare services in the last 5 years of life.

RESULTS

Half of the 4,899 sample persons were diagnosed with ADRD before death, 24.6 percent were diagnosed 5+ years before death, 28.4 percent within a year of death, with the remaining 47.0 percent diagnosed with ADRD 1–5 years before death (Table 1). An ADRD diagnosis is significantly associated with nursing home stay at the end of life, higher level of comorbidities, being female and older, and having lower education. Race is not associated with a dementia diagnosis.

Table 2 shows the effect of an ADRD diagnosis on differences in Medicare expenditures over the last 5 years of life for beneficiaries, controlling for age, gender, race, education, nursing home status, and 5-year average DxCG score. Over the last 5 years of life Medicare spent \$5,033 (2000 dollars) more on beneficiaries diagnosed with ADRD; however the difference was not statistically significant ($p = .063$). The largest statistically significant difference in total spending was for SNF care, \$3,386, and home health care, \$1,613. There were no significant differences in physician/Part B, out patient, or hospice care expenditures.

In contrast to previous research, the difference for inpatient care expenditures was not significant. This is partially explained by considering the effect of the timing of ADRD onset, shown in the bottom panel of Table 2. Inpatient care expenditures for persons diagnosed with ADRD at least 5 years before death was \$5,866 *lower* over the last 5 years of life, as compared with persons not diagnosed with dementia. However, when persons were diagnosed with ADRD within the last year of life inpatient expenditures were

Table 1: Descriptive Statistics of Dementia Diagnosis and Matching Variables Stratified by Dementia Diagnosis ($n = 4,899$)

	<i>No ADRD Dx</i>		<i>ADRD Dx</i>		<i>p</i>
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	
Any dementia diagnosis	2,450	50.0	2,449	50.0	
Dementia onset					
5+ years before death	–		603	24.6	
3–5 years before death	–		497	20.3	
1–3 years before death	–		653	26.7	
Within 1 year of death	–		696	28.4	
<i>Matching variables</i>					
In nursing home 1994/1999	178	7.3	740	30.2	<.001
DxCG score mean (SD)	1.40	(0.82)	1.72	(0.87)	<.001
Male sex	1,111	45.3	856	35.0	<.001
White race	2,216	90.9	2,190	89.8	.177
Race missing	13	0.5	10	0.4	
Age 5 years before death					<.001
65–69	338	13.8	99	4.0	
70–74	593	24.2	337	13.8	
75–79	635	25.9	561	22.9	
80–84	404	16.5	536	21.9	
85–89	225	9.2	414	16.9	
90–94	163	6.7	317	12.9	
95–105	92	3.7	185	7.6	
Education level					.013
6 years or less	157	15.1	270	17.9	
7–8 years	216	20.8	347	23.1	
9–11 years	180	17.3	212	14.1	
High school graduate	275	26.5	420	27.9	
College	211	20.3	256	17.0	
Education missing	1,411	57.6	944	38.5	

\$8,262 higher. Thus, the timing of an ADRD diagnosis influences Medicare expenditures.

Having a dementia diagnosis in the last year of life resulted in the greatest total Medicare expenditure difference, \$14,049, whereas ADRD diagnoses 1+ years before death yielded no total 5-year payment differences. The 5-year expenditures for physician/Part B services were much less for persons diagnosed 3+ years before death, and were not significantly different when dementia was diagnosed within 3 years of death. SNF expenditure differences were significant regardless of when ADRD was diagnosed, and ranged from \$2,138 to \$4,659. Expenditures for home health services were greatest (\$5,824) for those who were diagnosed 5+ years before death.

Table 2: Medicare Expenditure Differences in Last Five Years of Life by Service Type for Total and Time of Dementia Onset

	<i>Medicare Service</i>						
	<i>Total</i>	<i>Inpatient</i>	<i>Physician and Part B</i>	<i>Home Health</i>	<i>Skilled Nursing</i>	<i>Out- Patient</i>	<i>Hospice</i>
Total dementia effect	5,033	2,009	– 1,567	1,613**	3,342***	– 109	– 298
Dementia onset effect							
5+ years before death	– 6,793	– 5,866*	– 8,254*	5,824**	2,490**	– 722	– 266
3–5 years before death	– 8,538	– 2,162	– 8,896*	1,433	2,138**	– 662	– 389
1–3 years before death	3,606	2,435	– 2,268	– 32	4,659***	– 823	– 365
Within 1 year of death	14,049***	8,262***	204	1,713*	3,860***	377	– 368

Note: In 2000 \$ adjusted by medical care CPI, matched on age group, gender, race, education level, nursing home status, and 5-year average DxCG score.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

We then examined Medicare expenditure differences in 6-month intervals to consider the effect of the timing of ADRD onset on concurrent and subsequent Medicare costs. The DxCG score used in the matching procedure was estimated for each year before death, rather than the average for the last 5 years of life, so that persons with and without ADRD diagnoses were more closely matched in terms of health status for each year before death. Table 3 presents the results with shaded areas denoting the time of ADRD onset.

We found no significant differences in total Medicare payments based on ADRD diagnosis for persons diagnosed 5+ years before death (Panel A). Regarding specific services, there are significant differences in home health expenditures ranging from \$431 to \$1,145 (per 6-month interval) 1–4 years before death. The home health expenditure differences are no longer significant in the last year of life, perhaps because those with more severe dementia had been transferred to long-term care institutions, where such services would not be provided. The largest significant SNF difference, \$1,841, is for the last 6 months of life.

Table 3: Six-Month Intervals of Medicare Expenditure Differences in Last Five Years of Life by Timing of Dementia Onset and by Medicare Service Type

Months to Death	Total	Inpatient	Physician and Part B	Home Health	Skilled Nursing	Out Patient	Hospice
<i>(A) Dementia onset 5+ years before death</i>							
55-60	-207	-342	-81	51	11	144	10
49-54	-158	53	-242	67	10	-50	4
43-48	412	72	-219	431**	119	-4	12
37-42	1,213	410	-95	470*	507*	-78	-1
31-36	276	14	-362	431*	262	-82	13
25-30	-496	-419	-859	666*	60	39	17
19-24	62	-441	-626	1,145**	-83	42	25
13-18	618	-256	-546	1,009**	301	55	56
7-12	-1,556	-463	-1,477	298	87	-135	135
1-6	-1,178	-2,162	-860	310	1,841**	-22	-286
<i>(B) Dementia onset 3-5 years before death</i>							
55-60	2,716**	1,411**	892*	270*	23	123*	-4
49-54	1,825**	844**	621	286*	91	-16	-3
43-48	1,536	745	333	180	267	14	-3
37-42	5,837***	2,810***	2,045**	279	584***	77	42
31-36	-1,460	-553	-948	24	165	-136	-12
25-30	-775	-193	-486	52	-10	-129	-9
19-24	115	79	-590	105	203	283	35
13-18	-952	-215	-945	172	212	-145	-31
7-12	-796	252	-1,626	423	353	-161	-36
1-6	-6,239*	-3,291*	-3,287**	-103	821*	-103	-275
<i>(C) Dementia onset 1-3 years before death</i>							
55-60	-201	-59	-48	-66	-22	2	-7
49-54	445	189	220	22	64	-50	47
43-48	240	181	41	68	-83	-15	

Table 3. Continued

Months to Death	Total	Inpatient	Physician and Part B	Home Health	Skilled Nursing	Out Patient	Hospice
37-42	779	466	79	103	182*	-32	-19
31-36	1,126	179	712	160	116	-3	-37
25-30	2,244*	1,000	778	178	339*	-25	-27
19-24	1,405	693	-61	-132	982***	-85	7
13-18	4,543***	2,419***	1,164	138	935***	-132	20
7-12	321	340	-557	159	613*	-305	73
1-6	-2,751	-1,712	-1,827	-43	1,342***	-283	-228
<i>(D) Dementia onset < 1 year before death</i>							
55-60	-161	-142	-46	46	-56	40	-4
49-54	35	80	-155	128	-18	0	
43-48	-308	-185	-332	174*	38	8	-12
37-42	-308	-327	-151	70	89	23	-13
31-36	-648	-393	-267	107	-30	-33	-32
25-30	-1,052	-544	-569	166	-77	-4	-24
19-24	392	880	-640	96	-90	165	-18
13-18	-459	103	-668	203	-42	16	-72*
7-12	3,589***	1,715**	281	614***	918***	104	-43
1-6	15,926***	7,711***	4,557***	446*	3,218***	224	-229

Note: In 2000 \$ adjusted by medical care CPI, matched on age group, gender, race, education level, nursing home status, and annual DxCG score. Shaded areas indicate timing of dementia onset.

* $p < .05$,

*** $p < .01$,

**** $p < .001$.

Persons diagnosed with ADRD 3–5 years before death (Panel B) had significant differences in total Medicare expenditures during this period of onset. The higher differences in expenditures were primarily due to inpatient care and physician/Part B services. After that period, there are no significant differences in Medicare expenditures until the last 6 months of life. In the last 6 months this group has significantly *lower* total, inpatient, and physician care expenditures. SNF care is somewhat higher, \$821, compared with matched non-ADRD persons.

For ADRD onset 1–3 years before death (Panel C), total Medicare expenditures were significantly higher for 25–30 (\$2,244) and 13–18 (\$4,543) months before death. This group had significantly greater SNF expenditures for most of the final 3.5 years of life with the greatest difference in the last 6 months of life. The higher SNF expenditures indicate a greater need for post-acute care after hospitalization. Only the 13–18 month period before death showed significantly higher inpatient costs. Except for SNF, expenditures for total and other Medicare services were not significantly different than for non-ADRD persons in the last year of life.

The largest significant differences in Medicare expenditures were for persons diagnosed with ADRD within the last year of life (Panel D), with the largest differences in the last year of life. Around the time of diagnosis, payment differentials were highest for inpatient, Part B services, and SNF care, suggesting that the ADRD diagnosis was made during a time in which such persons were being treated for major acute care events. Expenditures for home health care were also significantly higher in the last year of life. Before ADRD onset there was very little difference in Medicare expenditures as compared with matched non-ADRD beneficiaries.

DISCUSSION

This study focused on all Medicare-financed fee-for-service health care in the last 5 years of life for beneficiaries who died during 1996–2000. A major contribution was in studying demented and nondemented groups and using longitudinal data in measuring the time path of Medicare payments in 6-month intervals, allowing the time path to vary according to when the first diagnosis of ADRD occurred.

Another advantage of our study was the use of covariate matching to compare ADRD and non-ADRD persons of like characteristics. This technique allowed us to control for selection factors that may account for

differences in Medicare payments without assuming a functional form on the relationship between such payments and their determinants.

Our results imply that ADRD diagnosis has a smaller impact on Medicare expenditures toward the end of life than was previously reported. On average, we found that ADRD diagnosis was associated with \$5,033 in excess Medicare payments over the last 5 years of life or \$1,007 annually, although the difference was not significant. In Medicare MCO studies, annual costs were \$1,599 (Richards et al. 2000) to \$4,134 higher (Hill et al. 2002) for ADRD patients than others. Using Medicare claims data linked to the 1994 NLTCs, Taylor et al. (2001) found that persons with severe ADRD had median \$10,234 Medicare costs for the year contrasted with \$4,318 for those with moderate ADRD, and \$2,268 for beneficiaries without ADRD. Our estimate of cost differences is lower because we matched persons over a longer period of time and at the same period of life—the 5 years before death. We also matched on nursing home use and all comorbidities (rather than a select group of chronic conditions), which reduced differences due to selection effects.

The timing of the diagnosis of ADRD has an important impact on total expenditure differences incurred by Medicare due to ADRD. Diagnoses of ADRD made immediately before death are associated with much higher expenditure differences than those made 1 or more years before death. For persons diagnosed earlier than the last year of life, either there was no increase in relative spending, or spending was significantly lower after the initial dementia diagnosis. The conventional wisdom that spending should increase as a consequence of increasing cognitive impairment, which is likely to occur postdiagnosis, is not supported by this evidence, at least for Medicare expenditures. Instead we found a reduction in overall spending, as would happen for diseases with poor prognosis. Our results support the findings of previous research that showed reduced Medicare cost differences in the years after initial ADRD onset (Taylor and Sloan 2000), and no or lower cost differences in the last 3 years of life for those who were diagnosed with dementia for at least 3 years compared with the nondemented (McCormick et al. 2001).

Persons diagnosed with dementia 1–3 and 3–5 years before death did have higher differences in some Medicare expenditures during the periods of onset. The significant inpatient cost differences at the end of the onset periods are probably attributable to complications associated with dementia, such as infections and noncompliance problems, which affect demands for care and length of stay (Lyketsos, Sheppard, and Rabins 2000; Bynum et al. 2004). Such dementia-related complications may also explain the significant SNF

differences, particularly for the 1–3 year onset group. Persons with ADRD may require more postacute care after inpatient episodes, even when there are no differences in hospitalization costs. The lack of significant differences in SNF expenditures after the onset period for persons diagnosed 3–5 years before death is possibly due to lower rates of inpatient episodes, or placement in nursing homes.

The largest differences in Medicare expenditures were for those persons receiving an ADRD diagnosis in the last year of life. Only for this group did a major increase in Medicare spending occur in the last year of life relative to those without an ADRD diagnosis. The large increase in Medicare expenditures at the very end of life appears to follow a compression of morbidity (Fries 1980) pattern. There were little to no differences in Medicare expenditures before the onset of ADRD, and the cost differences only occur in the short period before death. Although we controlled for level of nondementia comorbidity status, it appears that health is declining quickly due to multiple chronic conditions, and the presentation of a dementia diagnosis adds further complications to the provision of health care.

We acknowledge several study limitations. First, there is no gold standard for dementia diagnoses. Persons with some cognitive impairment may not meet diagnostic criteria for a dementia diagnosis. Following previous studies (Taylor and Sloan 2000; Bynum et al. 2004) we required only one claim be used to identify dementia to increase identification of ADRD cases and onset. We cannot be sure about a secular change in the pattern of ADRD diagnosis over the period of study although research indicates the prevalence of dementia is increasing (Foley, Brock, and Lanska 2003; Taylor, Sloan, and Doraiswamy 2004). However, we did find the timing of first ADRD diagnosis significantly affected Medicare payment patterns. These trends were consistent using either the MC-CPI or the all-items CPI (not presented).

Second, Medicare claims data are limited in that one cannot measure the severity of dementia using the ICD-9 codes. Thus, we were not able to measure differences in cognitive or functional status for those who had been diagnosed with ADRD for longer periods of time to determine such effects on Medicare payment differences. The 5-year periodicity of the NLTCs limited our ability to systematically measure cognitive or functional status at the same point before death for those dying 1996–2000. Additionally, cognitive and functional statuses are dynamic and changes in such indicators could not be consistently measured. Future studies of dementia should move beyond claims-based diagnoses, when possible, to include measures of cognitive and functional status and changes in such statuses over time.

Third, only data from fee-for-service Medicare beneficiaries have been used because medical care expenditures from Medicare MCOs were unavailable. The study by McCormick et al. (2001) using an MCO sample yielded findings generally consistent with ours, and we found little difference between the MCO and fee-for-service beneficiaries in our sample.

Fourth, medical care expenditures from Medicaid, Veterans Administration benefits, prescription drug use, informal care, and other sources were not included due to nonavailability of such data. Thus, our comparison only covers a portion of medical care expenditures at the end of life. The inclusion of non-Medicare supported health care might yield important differences in the costs of care associated with ADRD, particularly at the end of life.

Fifth, Medicare payments not only reflect care patterns but Medicare payment policies. Medicare officially disallowed some expenses for treating beneficiaries with Alzheimer's disease (Centers for Medicare and Medicaid Services 2001; Charatan 2002). This policy affected payment patterns to an unknown degree. The effects of a coverage policy not only depend on the official position of Medicare, but also on the extent to which physicians do not change diagnosis reporting practices in response to a payer's policy and the extent to which Medicare intermediaries and carriers actually enforce Medicare's policy.

CONCLUSIONS

Further analyses of the types of services provided around the time of the dementia diagnosis are warranted. Additional examination of the claims data is necessary to determine other diagnoses and specific treatments that were provided over time to understand the increase in cost differences during the initial ADRD diagnosis and subsequent declines postdiagnosis. Is there a curtailment in some services due to the poor prognosis, such as a reduction in invasive surgical procedures for demented patients with acute myocardial infarction (Sloan et al. 2004)? In addition, an examination of claims data is needed to understand the reasons for the significantly higher costs of care, even when controlling for level of comorbidity and nursing home use, for those diagnosed with ADRD in the last year of life.

An important finding is that, compared with matched nondemented controls, those with long-term ADRD (i.e., diagnosed more than 1 year) had lower or nonsignificant total Medicare payment differences in the final years of life after the initial dementia diagnosis, and only SNF payments were higher in

the last 6 months of life. Although rates of dementia appear to be increasing, our results suggest long-term dementia does not contribute to greater Medicare costs in the last year of life.

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