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Effects of Diagnosed Dementia on Medicare and Medicaid Program Costs

This study examines the impacts of physician-diagnosed Alzheimer's disease and related dementias (ADRD) on Medicare and Medicaid program costs in 1994 and 1999. An innovative method is employed to estimate program payments over the life cycle starting at age 65. Using data from the 1994 and 1999 National Long-Term Care Surveys, merged Medicare claims, and national program data for Medicaid, we find that the share of total Medicare and Medicaid payments attributable to diagnosed ADRD was 5.46% in 1999. Total annual program payments attributable to ADRD decreased between 1994 and 1999, in contrast to an increase implied by a cross-sectional approach.

Alzheimer's disease and related dementias (ADRD) affect 3% to 11% of elderly Americans (Leon, Cheng, and Neumann 1998), and prevalence increases dramatically with age. ADRD is an expensive disease (Langa et al. 2004). One study estimated annual per person costs in California at $47,000 (Ernst and Hay 1994).Total costs associated with ADRD in the United States in 1994 were estimated at over $100 billion (Wimo and Winblad 2001). In 2005, the global cost of dementia was estimated to be $315 billion (Wimo, Windblad, and Jönnson 2007). Dementia imposes substantial time, emotional, and financial burdens on families (Rice et al. 1993; Taylor et al. 2001) and is potentially costly to Medicare and Medicaid (Weiner et al. 1998; Taylor and Sloan 2000; Menzin et al. 1999; Martin et al. 2000).

Previous studies assessing costs related to dementia have relied on cross-sectional measures, for example, costs incurred over the course of a year by individuals with specific diagnoses (Bartels et al. 2003; Kronborg et al. 1999; Wimo et al. 1997). Costs may increase due to requirements for additional help with personal tasks, and people with dementia may have higher rates of hospital admissions, due to such factors as falls (Rowe and Fehrenbach 2004). In addition, the prevalence of diagnosed ADRD is likely to rise as the elderly population increases in the next several decades due to baby boomers aging (Hebert et al. 2003). This may cause the financial burden of ADRD to rise substantially as well. However, costs also may decrease due to less aggressive care for individuals with an ADRD diagnosis (Sloan

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et al. 2004) or due to decreased longevity of ADRD patients (Perenboorn et al. 1996; Ritchie et al. 1994). The latter would tend to offset in part the increase in prevalence caused by the population aging. The net effect on the financial burden of ADRD and on public program solvency is an empirical issue requiring further analysis.

To address these uncertainties, we estimated the impact of physician-diagnosed ADRD on Medicare and Medicaid payments in 1994 and 1999, using an innovative approach for estimating life-cycle program payments. This approach accounts for the increased mortality of ADRD patients, which is not considered in a cross-sectional approach. Total program payments attributable to diagnosed ADRD in 1999 were about 5% of Medicare and Medicaid payments according to the life cycle approach, and about 9% according to the cross-section estimates. The cross-sectional approach suggested that costs attributable to ADRD increased substantially between 1994 and 1999, whereas the life-cycle approach suggested that they actually decreased. Overall, our results imply that the future burden of ADRD may be lower than often is forecast because most studies do not account for changes in patterns of care of people with an ADRD diagnosis or their shorter life expectancy. Our results have important implications for policymakers planning for future public expenditures on Medicare and Medicaid.

Methods

Data

We use a sample of Medicare beneficiaries participating in the 1994 and/or 1999 waves of the National Long-Term Care Survey (NLTCS), a national household survey of the U.S. elderly, and Medicare claims and enrollment data merged with the NLTCS. The sample frame for the NLTCS is a national random sample of Medicare beneficiaries ages 65 and older. In 1994, 19,079 people in the NLTCS sample received screener interviews. Based on their responses, all people with activities of daily living (ADL) or instrumental activities of daily living (IADL) limitations, as well as some individuals without limitations, were administered longer interviews, either a community or a nursing home survey depending on their living arrangement.

In 1999, the NLTCS sample consisted of 19,907 people. Of these, we removed 4,308 because of missing Medicare data. The 1999 sample consisted both of individuals included in the 1994 survey and about 5,000 younger respondents who turned 65 between 1994 and 1999. Payment data were not reported in Medicare claims if a person was enrolled in a Medicare risk plan; about 6% of the Medicare population in 1994 and 17% in 1999 were in such plans (Lamphere et al. 1997; Laschober et al. 2002). These people are relatively healthy on average (Angell 1997; Riley et al. 1996). Lacking claims data on individuals in Medicare managed care organizations (MCOs), we excluded such people from our analysis.

Medicare enrollment files provided data on demographic information, dates of first ADRD diagnosis, and Medicare payments. Medicare claims data provided information on whether respondents received any hospital inpatient, outpatient, or physician services in the interview year and whether they received payments from Medicaid. The community survey provided information by self-report on whether respondents received Medicaid-covered home health services. The institutional survey provided information on whether Medicaid paid for nursing home services.

Alzheimer's and Related Dementias

Diagnosis of ADRD was provider-coded and identified from the International Classification of Diseases, Ninth Revision, Clinical Modification, (ICD-9-CM) diagnosis codes of 331, 331.2, 331.7, 331.9, 290, 290.43, 294, 294.8 and 797. These codes include Alzheimer's disease, arterioseceloric and senile dementia, and other cerebral dementias.

We relied on provider-coded diagnoses. Pressley et al. (2003) evaluated the relationship between a diagnosis of ADRD and functional status, cognitive screening, and proxy reports of cognitive impairment of elderly individuals living in the community. They found some but far from total overlap between physician-diagnosed dementia and performance on a cognitive screening test and

Table 1. National mean Medicaid payments by ADRD status and type of service (in 1999 dollars)

Service	Medicaid payments, 1994 ($)		Medicaid payments, 1999 ($)	
	ADRD	No ADRD	ADRD	No ADRD
Nursing home	22,241	20,027	23,283	21,728
Home health	2,302	1,191	1,141	638
Inpatient	1,094	1,092	870	913
Outpatient	173	287	245	279
Physician's services	263	436	286	357
Prescription drugs	637	678	1,056	943
Total	7,080	1,958	7,498	2,241

Note: Means are calculated for people who report any payment for the year.

proxy-reported impairment. To the extent that reliance on physician diagnosis may have resulted in our failing to identify people with ADRD or any other dementia, we would underestimate the cost of ADRD. In this sense, our results are conservative.

Medicare and Medicaid Payments

Using Medicare claims data, we measured payments in 1994 and 1999 for all Medicare-covered services on behalf of sample individuals during the calendar year of the interview. The mean Medicare payment was virtually identical in both years once we adjusted for inflation (using the Consumer Price Index): $5,686 in 1994 (in 1999 dollars) and $5,692 in 1999.

We did not acquire claims data for Medicaid. Instead, we developed estimates of Medicaid payments for each sample person for the following types of services (using a procedure described later): nursing home, home health, hospital inpatient and outpatient, physician services, and prescription drugs. We used data on national mean Medicaid payments for each type of service per person aged 65 and older who received any such services. We calculated the payments separately for individuals with and without an ADRD diagnosis.

To develop separate estimates of mean Medicaid payments by ADRD status, we used data from the 1994 and 1999 Medicare Current Beneficiary Surveys (MCBS). In total, in 1994, Medicaid spent $7,080 on behalf of individuals diagnosed with ADRD, and $1,958 on behalf of those without this diagnosis (in 1999 dollars) (Table 1). In 1999, mean Medicaid payments for the two groups of individuals were $7,498 and $2,241, respectively. The largest Medicaid expenditure by far was for nursing home care.

Explanatory Variables and Imputations

In regression analysis, we included explanatory variables for age-gender interactions, race, marital status, years of education, number of ADLs, incontinence, DxCG (diagnostic cost group) score, years since ADRD diagnosis, and interactions between ADRD status and DxCG and between ADRD status and number of ADLs. DxCG uses claims data to classify individuals into clinical groupings by applying hierarchies and interactions to create a measure of expected resource use. The measure reflects the individual's expected illness burden or morbidity (Ellis et al. 1996; DxCG 2005). We imputed values for missing data on marital status, years of education, and number of ADL limitations using a sequence of regression models (Raghunathan et al. 2001). Data on marital status were missing for 69% of the sample; years of education were missing for 71%, and number of ADL limitations was missing for 13% of the sample.

Statistical Approach

Methodological Framework

We computed the lifetime costs of ADRD to Medicare and Medicaid by calculating the difference between: A) the present value of Medicare and Medicaid payments for a 65-year-old, discounted at a 3% rate with observed patterns of ADRD onset, and B) the present value of discounted payments for a 65-year-old in a hypothetical state where

ADRD no longer existed. Calculation of the present value of payments—performed separately for Medicare and Medicaid—by nursing home and other types of services, was done in these steps: 1) predict the probability of ADRD onset; 2) predict the survival probability for individuals with and without ADRD; and 3) predict program payments. Lifetime payments with observed patterns of ADRD (L_A) were calculated using:

$$L_A = \sum_{t=65}^{99} c(d,t)s(d,t) + c(nd,t)s(nd,t) + s(d,100)c(d,100) + s(nd,100)c(nd,100),$$

where $c(d, t)$ refers to average annual program payments for individuals at age t with a previous diagnosis of ADRD, while $c(nd,t)$ refers to average annual program payments for people at age t with no previous diagnosis of ADRD. Individuals surviving to age 100 were assigned cost $c(d,100)$ or $c(nd,100)$, respectively, to account for program payments for their remaining lives. For these individuals, we assumed another 2.7 years of life for women and 2.3 years for men, using mean payments for 99-year-olds. The expression $s(d, t)$ is the probability that a person will be alive at age t and will have been diagnosed with ADRD; $s(d,t)$ evolves according to:

$$s(d,t+1) = s(d,t)[1 - m(d,t)] + p(t+1)s(nd,t)[1 - m(nd,t)].$$

This probability depends on the annual mortality probability for a person with dementia $m(d,t)$, the annual mortality probability for a person without dementia $m(nd,t)$, and the probability of being first diagnosed with dementia at age $t+1$, $p(t+1)$. We assumed that no person was diagnosed with ADRD before age 65. (We had no way of knowing this since all people were at least age 65 at baseline.) The probability that a person was alive at a given age and not diagnosed with dementia ($s(nd,t)$) evolved according to:

$$s(nd,t+1) = s(nd,t)[1 - p(t+1)] \times [1 - m(nd,t)].$$

Lifetime payments in a hypothetical state of the world where ADRD no longer exists (L_B) are given by:

$$L_B = \sum_{t=65}^{99} \times c(cf,t)s(cf,t) + s(cf,100)c(cf,100)$$

where $c(cf,t)$ represents the counterfactual average annual costs for a person of age t in a state with zero prevalence of ADRD, as subsequently discussed. The expression $s(cf,t)$ is the probability of surviving to age t in the counterfactual state, which evolves according to:

$$s(cf,t+1) = s(cf,t)[1 - m(nd,t)].$$

To derive estimates of the ADRD burden, we estimated the following variables separately for 1994 and 1999: 1) the probability of the onset of ADRD for every person aged 65+, $p(t)$; 2) annual mortality rates for individuals with and without ADRD, $m(d,t)$, $m(nd,t)$; and 3) mean Medicare and Medicaid payments by age and for people with and without an ADRD diagnosis, $c(d,t)$, $c(nd,t)$, and counterfactual mean payments in a state in which ADRD no longer exists, $c(cf,t)$. We computed the present value of lifetime Medicare and Medicaid payments separately for men and women. We estimated program payments separately for Medicare, Medicaid nursing home services, and other Medicaid services.

A limitation of our estimation approach is that our life-cycle cost estimates do not allow for potential cohort effects: for example, for the younger subjects in the sample, estimated costs for their older years were based on current patterns of medical care use by older participants. It is possible that when today's younger participants are older, their patterns of use may not match those of today's older participants

Probability of Onset of ADRD

We used probit regression to estimate the probability of the onset of ADRD for each year a person survived beyond age 65, limiting the sample to NLTCS respondents not previously diagnosed with ADRD. The dependent variable was binary, 1 for individuals diagnosed with ADRD in the year following the NLTCS interviews. The probability of onset was estimated separately for 1994 and 1999. Explanatory variables were: age interacted with gender; marital status (married, not married); race (white, nonwhite); educational attainment (years); number of ADL limitations (0–6), incontinence; nursing home residence; and the person's overall health measured by the person's DxCG score. We calculated DxCG scores from sample individuals' Medicare claims filed in 1993 or 1998 (DxCG risk-adjustment software, analytic guide release 6.0). Age-gender interactions were binary variables, 1 for 5-year age-gender groups starting with ages 65 to 69. We used the parameter estimates to predict the mean probability of being diagnosed with ADRD for 5-year age-gender groups. The null hypothesis that there is no relationship between the dependent and the explanatory variables was rejected, using a Wald test ($p<.001$).

Mortality

We estimated a Weibull proportional hazard model for the probability of death starting with age 65. The analysis measured time to death or to April 19, 2001 (the last date for our data), whichever occurred first. The dependent variables were identical to the specification for the probability of onset, except we additionally included a binary variable on whether a respondent had been diagnosed previously with ADRD. We applied estimates of the effects of ADRD to standard life tables (Anderson 2001). We computed separate life tables for people with and without ADRD so that the relative mortality hazard rate of respondents matched our estimation results, while the mean mortality hazard for the population in all age/gender groups equaled life table mortality hazard rates. We also estimated models for the probability of death within one year after the 1994 and 1999 NLTCS interviews.

Medicare Payments

We used ordinary least squares (OLS) to estimate the effect of ADRD on annual Medicare payments, for each year 1994 and 1999. The dependent variable was total Medicare payment for each person and year. Explanatory variables included a binary variable indicating whether a respondent previously had been diagnosed with ADRD, the number of years since the first ADRD diagnosis, and ADRD interacted with the number of ADL limitations, nursing home residency status, and the DxCG score. We also included age interacted with gender, marital status, race, educational attainment, number of ADL limitations, incontinence, nursing home residence, and the DxCG score. Based on the regression, we predicted payments for each person in the sample and computed mean Medicare payments for 5-year age-gender groups with observed patterns of dementia. Based on the linear regression model, we also computed counterfactual predicted payments for each person in the sample with all characteristics unchanged, except for the diagnosis of ADRD: the binary variable that indicated a diagnosis of ADRD and all other variables based on interactions with the ADRD variable were set to 0 for all respondents. This allowed us to calculate counterfactual mean predicted payments for 5-year age-gender groups.

Severity of ADRD has a substantial effect on disease cost (Taylor et al. 2001). Unfortunately, it is not possible to measure ADRD severity from diagnosis codes. However, we controlled for various factors associated with severity, such as the number of ADL limitations. If anything, some specifications may have over-controlled for the effect of ADRD.

Medicaid Payments to Nursing Homes

To calculate mean predicted Medicaid payments for nursing home services, we first estimated the probability of any such payment for each person, and then multiplied this probability by the mean payment for each person who received such a payment. Mean payments were computed separately for individuals with and without ADRD, and for the years 1994 and 1999.

First, we identified respondents who were living in a nursing home at the NLTCS interview date and stated that Medicaid was a source of payment for room/board and nursing care. We then used probit to estimate the probability that Medicaid paid for such care. Explanatory variables were the same as for the Medicare payment regression discussed previously.

Next, we multiplied predicted probabilities by the national mean Medicaid payments for nursing home services for people with and without ADRD. This yielded mean predicted Medicaid payments for nursing home services for age-gender groups with observed patterns of ADRD, and counterfactual mean predicted Medicaid payments for nursing home services for age-gender groups in the absence of ADRD.

Medicaid Payments for Inpatient Care, Outpatient Care, Physician Visits, Prescription Drugs, and Home Health Care

To calculate payments for hospitalizations, physician visits, and drugs, we first identified individuals from Medicare claims files who were covered by Medicaid in the NLTCS interview year and who incurred some Medicare payments for each service. To calculate payments for home health, we identified NLTCS respondents who reported either that: 1) they received paid help for their ADL limitations during the preceding week and that Medicaid paid for at least one helper, or 2) during the past month they received nursing services at home from a visiting nurse, home health aide, or nurse's aide and also received Medicaid for other services. We used probit regression to estimate the joint probability of using the type of service and having Medicaid pay for it. Explanatory variables were the same as for the Medicare payments regression discussed earlier. We then multiplied the national mean of Medicaid payments for each service type for individuals with and without ADRD by the predicted probabilities. Using the estimation results, we computed mean predicted Medicaid payments for these services for age-gender groups with and without ADRD, and counterfactual mean predicted Medicaid payments for these services in the absence of ADRD.

Standard Errors

We used a sample of 200 bootstrap estimators to calculate standard errors of the lifetime payment estimates.

Cross-Section Estimates

In addition to estimating lifetime costs of ADRD, we also employed a cross-sectional approach to estimate Medicare payments attributable to ADRD. Mean Medicare payments per beneficiary attributable to ADRD were calculated as the difference between the mean of predicted payments at actual prevalence of ADRD in either 1994 or 1999 and the mean of counterfactual predicted payments with zero prevalence of ADRD. Predicted Medicare payments were calculated for each person based on the results of regressions described previously. We also calculated mean Medicare payments attributable to ADRD for the sub-sample of individuals with such a diagnosis. We used a similar procedure to compute payments attributable to ADRD for Medicaid nursing home services and for other Medicaid services.

Total Program Payments

We calculated percentage shares of program payments for Medicare, Medicaid nursing home services, and other Medicaid services attributable to ADRD. We then multiplied these shares by actual program expenditures in 1994 and 1999, obtaining estimates of total program payments attributable to ADRD. Actual program payments came from the Centers for Medicare and Medicaid Services (CMS). We estimated total program payments on both a lifetime and cross-sectional basis.

Results

The share of Medicare beneficiaries diagnosed with ADRD almost doubled between 1994 and 1999 (Table 2). There was a substantial increase for all age groups and for people living in nursing homes. By contrast, total Medicare payments per person aged 65 and older increased only slightly between 1994 and 1999, and such payments per person aged 65 and older with an ADRD diagnosis decreased (Table 3). Patterns for Medicaid payments for other services were qualitatively similar. Medicaid nursing home payments decreased between 1994 and 1999 for all individuals 65 and older and for those with an

Table 2. Descriptive statistics: share of people diagnosed with ADRD (population 65+)

	Diagnosed with ADRD, 1994 (%)			Diagnosed with ADRD, 1999 (%)		
	Total	Male	Female	Total	Male	Female
Age						
65 69	1.16	.95	1.34	3.15	3.17	3.13
70–74	3.35	3.11	3.53	8.50	8.03	8.87
75 79	6.14	6.46	5.93	13.53	13.04	13.84
80–84	11.74	9.57	12.93	21.97	22.24	21.81
85+	26.03	22.72	27.20	40.87	34.27	43.13
In nursing home	55.5	54.55	55.81	73.33	73.2	73.36
Full sample	8.92	6.87	10.21	17.95	14.74	19.9
N	19,709	7,325	11,754	15,599	5,860	9,714

ADRD diagnosis. The decrease was much larger for people with an ADRD diagnosis than for the full sample. Compared to all people 65 and older, individuals with an ADRD diagnosis tended to be older, female, nonwhite (1999 only), single, in a nursing home, and incontinent. People with ADRD had, on average, lower educational attainment, higher DxCG scores—implying poorer health and more comorbidities (other than ADRD)—and more ADL limitations.

While the fraction of nursing home residents with a diagnosis of ADRD increased from .55 to .73 between 1994 and 1999, the fraction of all Medicare beneficiaries diagnosed with ADRD living in nursing homes decreased from .43 to .26; the mean time from diagnosis to the study year increased from 3.2 to 4.0 years. The mean value of the DxCG score for those diagnosed with ADRD increased. This increase was smaller, in percentage terms, than for the overall population 65 and older.

Based on our cross-sectional findings, we computed mean Medicare and Medicaid payments related to treatment for ADRD for both the entire Medicare population aged 65 and older and the group diagnosed with ADRD (Table 4). For those diagnosed with ADRD, disease-related Medicare payments were an additional $207 ($1,999) in 1994. This cost was significantly different from zero. Corresponding payments in 1999 were an additional $91. A diagnosis of ADRD increased Medicaid nursing home payments by $1,871 in 1994 and $1,719 in 1999. For other Medicaid services, minor differences in spending were observed in both 1994 ($106) and 1999 ($108).

The full sample calculations show the differences in payments per year for all people 65 and older, independent of ADRD diagnosis. For the sample as a whole, annual per-beneficiary payments increased between 1994 and 1999 for Medicare, Medicaid nursing home services, and other Medicaid services.

A diagnosis of ADRD increased the hazard of dying per year over the period 1994–2001 by 23.5% for men and by 28.8% for women (Table 5). There was a corresponding reduction in life expectancy at age 65 of .25 years for men and .49 years for women between 1994 and 1999 (Table 5). These estimates refer to a person not yet diagnosed with ADRD as of his or her 65th birthday and reflect the risk of that individual developing ADRD at a later date. To test whether the effect of an ADRD diagnosis on the hazard of dying changed over time, we used a probit model to assess the effect of an ADRD diagnosis on the probability of dying within a year separately for 1994 and 1999 (not shown). There was no change in the effect of an ADRD diagnosis.

The possibility that a person aged 65 in 1994 would be diagnosed with ADRD before death increased lifetime Medicare payments by $1,447 (the difference between actual diagnosed ADRD prevalence in the sample and the counterfactual, Table 6). By contrast, in 1999 this probability reduced projected lifetime Medicare payments by $1,102. For the Medicaid nursing home category, this

Table 3. Sample means

	All respondents		Respondents with ADRD	
	1994	1999	1994	1999
Dependent variables (1999 $)[a]				
Total Medicare payments	5,686 (12,154)	5,692 (12,910)	11,454* (16,936)	10,710*(19,192)
Medicaid nursing home payments	824* (2,400)	791* (2,144)	5,733* (4,527)	3,427* (3,841)
Total other Medicaid payments	202* (275)	207* (205)	666* (475)	446*(278)
Explanatory variables				
Age	77.106 (7.960)	77.960 (8.422)	84.502* (7.962)	84.266* (8.145)
Male	.383 (.486)	.376 (.484)	.295* (.456)	.308* (.462)
White	.874 (.330)	.908 (.288)	.861 (.345)	.890* (.312)
Married	.496 (.500)	.459 (.498)	.268* (.443)	.360* (.480)
Years of education	11.027 (3.638)	11.114 (3.664)	10.058* (3.953)	10.789* (3.645)
Nursing home	.069 (.254)	.063 (.243)	.432* (.495)	.259* (.438)
DxCG score	1.115 (1.112)	1.376 (1.318)	2.080* (1.510)	2.215* (1.689)
ADL limitations	.679 (1.496)	.802 (1.700)	2.926* (2.176)	2.125* (2.396)
Incontinent	.058 (.234)	.093 (.291)	.084* (.278)	.219* (.414)
Years since ADRD diagnosis	.287 (1.091)	.712 (1.911)	3.215* (1.980)	3.971* (2.727)
N	19,011	15,599	1,703	2,801

Note: Standard errors are in parentheses.
[a] Per person aged 65+, total for full sample and for person aged 65+ with a diagnosis of ADRD for dementia sample.
* Sample mean is different from sample mean for all respondents in same year at 1% significance level.

probability increased payments, by $3,605 in 1994 and $2,892 in 1999. For other Medicaid-covered services, the probability of being diagnosed with ADRD increased payments in both years, although by much more in 1994 ($505) than in 1999 ($309).

Finally, we computed the annual burden of ADRD. In 1994, the risk of being diagnosed

Table 4. Cross-section estimates of annual mean Medicare and Medicaid payments per person: actual ADRD prevalence and zero ADRD prevalence (1999 $)

	All respondents				Respondents with ADRD diagnosis			
	1994		1999		1994		1999	
	$	*P*-value	$	*P*-value	$	*P*-value	$	*P*-value
Medicare								
Actual ADRD prevalence[a]	5,700		5,701		11,763		10,916	
Counterfactual[b]	5,665		5,630		11,556		10,825	
Difference	35	<.001	71	<.001	207	<.001	91	.01
Medicaid—nursing home								
Actual ADRD prevalence[a]	927		791		6,236		3,285	
Counterfactual[b]	678		375		4,365		1,566	
Difference	249	<.001	417	<.001	1,871	<.001	1,719	<.001
Medicaid—other[c]								
Actual ADRD prevalence[a]	228		208		738		438	
Counterfactual[b]	221		187		633		329	
Difference	7	<.001	21	<.001	106	<.001	108	<.001

Note: Explanatory variables include: white, married, years of education, incontinent, nursing home, DxCG, ADRD, years since diagnosis, ADRD*ADL, ADRD*nursing home, ADRD*DxCG, and age-gender interactions.
[a] Mean of predicted payments with actual prevalence of ADRD, based on regression results.
[b] Mean of predicted payments with zero prevalence of ADRD and other characteristics unchanged, based on regression results.
[c] Includes home health, inpatient, outpatient, physician visits and prescription drugs.

Table 5. Mortality hazard and life expectancy of ADRD

	1994–2001
Hazard ratios[a]	
Male	
ADRD	1.235*
S.E	.086
Female	
ADRD	1.288*
S.E	.061
Life expectancy at age 65 (years)	
Male	
Actual ADRD prevalence	16.40
No ADRD	16.65
Difference	.25
Female	
Actual ADRD prevalence	19.48
No ADRD	19.97
Difference	.49

Note: Explanatory variables include: white, married, years of education, incontinent, nursing home, DxCG, ADRD, and age-gender interactions.
[a] Estimated with Weibull proportional hazard model.
* Significant at the 1% level.

with ADRD sometime before death accounted for 2.04% of Medicare payments on behalf of the cohort of people turning 65 in that year (Table 7, longitudinal estimates). By contrast, in 1999, the risk of being diagnosed with ADRD *reduced* such Medicare payments by 1.61%. For Medicaid, the share of costs attributable to ADRD for these same cohorts was substantial: 32% (1994) and 42% (1999) for nursing home costs, and 14% (1994) and 10% (1999) for other Medicaid costs. For program payments overall, there was little change in the percentage effect between 1994 and 1999. The possibility of a future diagnosis for individuals turning 65 accounted for 6.95% in 1994 and 5.46% in 1999 of Medicare and Medicaid lifetime payments in constant dollars. Applying these percentage increases to total program payments in these years (longitudinal estimates), the total increase in annual Medicare and Medicaid payments attributable to ADRD was $12.4 billion in 1994 and $9.7 billion in 1999 (in 1999 dollars).

A very different pattern emerges from the cross-sectional approach used in previous studies. The cross-sectional approach does not consider the effect of added mortality attributable to diagnosed ADRD. Thus, cross-sectional analysis yields an increase in annual program payments from $8.0 billion in 1994 to $16.6 billion in 1999. According to such analysis, not only was the burden of diagnosed ADRD larger in 1999 than in 1994, but if the trend of increased probability

Table 6. Lifetime payments attributable to ADRD at the 65th birthday

	1994		1999	
	$	*P*-value	$	*P*-value
Medicare				
Actual ADRD prevalence[a]	70,896		68,140	
Counterfactual[b]	69,449		69,242	
Difference	1,447	<.001	−1,102	<.001
Medicaid—nursing home				
Actual ADRD prevalence[a]	11,251		6,885	
Counterfactual[b]	7,647		3,993	
Difference	3,605	<.001	2,892	<.001
Medicaid—other[c]				
Actual ADRD prevalence[a]	3,630		3,094	
Counterfactual[b]	3,124		2,785	
Difference	505	<.001	309	<.001

Note: Lifetime payments are calculated at 3% discount rate. Explanatory variables include: white, married, years of education, incontinent, nursing home, DxCG, ADRD, years since diagnosis, ADRD*ADL, ADRD*nursing home, ADRD*DxCG, and age-gender interactions.
[a] Mean expected lifetime program payments for a cohort of 65-year-olds with no current diagnosis of ADRD yet with actual risk of future diagnosis.
[b] Mean expected lifetime program payments for a cohort of 65-year-olds with all characteristics unchanged, but no risk of a future ADRD diagnosis.
[c] Includes home health, inpatient, outpatient, physician visits and prescription drugs.

Table 7. Total annual Medicare and Medicaid payments (in 1999 $) attributable to ADRD

	ADRD payments as share of total program payments (%)				ADRD payments in millions (1999 $)			
	Longitudinal estimates[a]		Cross-sectional estimates[b]		Longitudinal estimates[a]		Cross-sectional estimates[b]	
	1994	1999	1994	1999	1994	1999	1994	1999
Medicare	2.04	−1.61	.61	1.24	2,930	−2,303	881	1,773
Medicaid—nursing home	32.04	42.01	26.90	52.67	8,161	11,164	6,853	13,999
Medicaid—other[c]	13.92	9.98	3.25	10.15	1,295	810	303	824
Total	6.95	5.46	4.51	9.37	12,386	9,671	8,036	16,596

[a] Based on share of lifetime payments at 65[th] birthday.
[b] Based on share of mean annual payments.
[c] The imputations were obtained using imputation and variance estimation software (Raghunathan, Solenberger, and van Hoewyk 2002).

of ADRD diagnosis observed for the period 1994–1999 were to continue, future program payments attributable to ADRD would be expected to increase dramatically.

Total program payments attributable to ADRD decreased by 21.4% between 1994 and 1999 according to the lifetime estimates, whereas they increased by 107.8% according to the cross-sectional estimates. We believe the lifetime estimates provide a more accurate estimate of public program burden due to ADRD.

Discussion

The number of Medicare beneficiaries diagnosed with ADRD increased dramatically during the 1990s, possibly because of newer diagnostic approaches, particularly PET, and increased availability of prescription drugs to treat the condition (e.g., cholinesterase inhibitors, atypical antipsychotics) (Taylor, Fillenbaum, and Ezell 2002). In our sample, 8.9% of Medicare beneficiaries were diagnosed with ADRD in 1994, and 18.0% in 1999. Existing studies vary in terms of how ADRD was defined and identified. Previous literature estimated ADRD prevalence rates from 2.7% to 11.2% of people 65 and older (Bachman et al. 1992; Beard et al. 1991; Evans et al. 1989; Pfeffer, Afifi, and Chance 1987; Ernst and Hay 1997; U.S. General Accounting Office 1998). Mild ADRD may not be diagnosed. Thus, prevalence rates estimated from provider codes in a Medicare database may be low because mild cases of ADRD often are not diagnosed (Rice et al. 2001; Taylor, Fillenbaum, and Ezell 2002), although such underdiagnosis may have been decreasing over time. Comparing provider-coded diagnoses in Medicare claims data with data from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD), 87% of CERAD-diagnosed cases were identified in Medicare claims (Taylor, Fillenbaum, and Ezell 2002).

Previous studies have reported that ADRD patients are around 1.6 to 1.9 times more expensive to Medicare on an annual basis than are elderly individuals without ADRD (Weiner et al. 1998; Taylor and Sloan 2000); patients with severe ADRD are even more expensive (Taylor et al. 2001). Our cross-sectional estimates are only slightly higher than previous estimates of per person cost increases attributable to dementia (2.06 times higher in 1994; 1.91 times higher in 1999). Studies of annual cost to Medicaid suggest that ADRD patients are between $9,435 and $9,995 (1999 dollars) more costly than patients without ADRD (Menzin et al. 1999; Martin et al. 2000), with high nursing home costs accounting for the majority of the cost difference. Our 1999 estimate is substantially lower than this. Previous estimates are only partly comparable to ours, as other analyses used only Medicaid recipients.

If we had relied on a cross-sectional rather than a longitudinal approach, the trend of increasing costs attributable to ADRD would imply larger program payments in the future. However, the cross-sectional approach does not account for the effect of ADRD on longevity. Our life-cycle estimates imply a much lower impact of ADRD on program payments than do previous cross-sectional studies (Martin et al. 2000; Menzin et al. 1999; Taylor and Sloan 2000; Taylor et al. 2001; Weiner et al. 1998). Our estimates are more appropriate for analyzing ADRD's effect on program payments because they incorporate the mortality hazard of the disease. While some studies have examined survival probabilities (Kinosian et al. 2000), 10-year costs, and costs near the end of life (McCormick et al. 2001), no previous study has used a life-cycle approach to estimate the cost of dementia.

The percentage of Medicare and Medicaid payments attributable to diagnosed ADRD decreased about 20% between 1994 and 1999; this implies that the rapid growth during the next two decades in the number of people 65 and older who will have ADRD may not increase the burden of ADRD on these programs and may well reduce it. There are several reasons for this finding of a reduction in payments. In our analysis, the first source of savings came from a higher number of relatively young individuals diagnosed with ADRD, who generated savings to Medicare and Medicaid from an increased likelihood of early death. Second, annual program payments attributable to ADRD decreased with time since date of diagnosis (results not shown). The mean time from diagnosis to the study year increased between 1994 and 1999. Third, the Medicare skilled nursing facility (SNF) prospective payment system was introduced in 1998, which had the objective of reducing growth in Medicare payments for SNF care. Fourth, earlier diagnosis of the disease may decrease lifetime costs because of initiation of treatment and an opportunity to better plan for future care choices and for functional decline. In analyses not shown, we found that costs declined with time since diagnosis and did so substantially faster in 1999 than in 1994.

While the share of elderly people with ADRD increased appreciably between 1994 and 1999, on several measures this population was healthier in 1999. The mean number of ADL limitations per person with diagnosed ADRD declined, as did the fraction of such individuals living in nursing homes. While the index of overall health (DxCG score) increased for all individuals between 1994 and 1999, the increase was less for those diagnosed with dementia than for elderly people overall. Thus, it appears that the increase in diagnosed ADRD may be accompanied by an improvement in the overall health and functional status of diagnosed individuals. Improved health would tend to reduce the effect of diagnosed ADRD on program expenditures.

We tested the hypothesis that people diagnosed with ADRD in 1999 were healthier than those diagnosed in 1994 by calculating a lifetime cost scenario with 1994 diagnosis and mortality patterns and 1999 program payments (not shown in tables). A diagnosis of ADRD decreased payments by 4.91% for Medicare; it increased Medicaid payments for nursing home services by 35.72% and for other Medicaid services by 6.78%. Total program payments increased by 1.72%. That is, for a constant prevalence and mortality, the share of total program payments attributable to ADRD was much lower than the ADRD burden in 1994 or 1999.

Although the diagnosed ADRD population appears to have become healthier, we did not find a change in the effect of ADRD on the probability of death within one year between 1994 and 1999. We thus assumed that the effect of ADRD on mortality was identical in our 1994 and 1999 calculations. If we could have observed mortality rates for more than a year after 1999, we might have detected a change in the hazard rates. Indeed, it seems plausible that if people are being diagnosed with ADRD when they are healthier, survival time should improve as well. If so, our study would have underestimated the burden of ADRD to Medicare and Medicaid in 1999 relative to 1994.

In sensitivity analyses (not shown in tables), we assumed, alternatively, a 10% and a 30% reduction in the relative mortality hazard of people diagnosed with ADRD between 1994 and 1999. Even with a 30% reduction, payments attributable to ADRD, although higher than estimates presented in Table 6, remained below the 1994 values.

The finding of decreased payments per elderly person with ADRD goes against the common observation that expenditures on personal health care services in the United States have been increasing (and for some subperiods, soaring). Thus, it was important to ascertain whether our findings are an artifact of the data we examined. We sought to determine whether we could identify reasons for reduced per capita payments from another national data source, the MCBS. For people with an ADRD diagnosis, we compared utilization by type of service between 1994 and 1999. Most striking was the decrease in use of nursing homes from 1994 to 1999. We also found a statistically significant reduction in physician visits. By contrast, hospital outpatient and home health care use increased. There was no statistically significant change in inpatient use between the two years.

One limitation of our analysis is that we did not include the cost of prescription drugs used to treat dementia unless the person was covered by Medicaid. During our study period, Medicare did not cover expenditures for prescription drugs. Thus, such expenditures were excluded from our main study findings. To gauge the sensitivity of this omission, we computed mean payments from the MCBS. We found that a higher percentage of people with an ADRD diagnosis used prescription drugs (donepezil, tacrine, and ergoloid mesylates) specifically designed to treat cognitive deficits from ADRD in 1999 (10.7%) than in 1994 (1.7%). The mean expenditure on these prescription drugs per person diagnosed with ADRD was not significantly different in these two years: $662 in 1994 (1999 dollars) versus $735 in 1999. The payments on such drugs were far too small on average to have had an important impact on our findings.

Since 2006, Medicare has covered prescription drugs. This policy change is likely to have three important effects. First, this may further increase the number of Medicare beneficiaries with a diagnosis of ADRD since more beneficiaries now will have prescription drug coverage that will pay for a dementia drug. Second, increased use of dementia drugs will add to dementia cost. Third, and perhaps most important, having for all practical purposes universal coverage for drugs to treat dementia will provide a much greater incentive for pharmaceutical innovation in this field. Although as a consequence beneficiaries may be better off, total Medicare spending will rise if new drugs have higher prices than existing drugs.

Also, as noted earlier, we excluded individuals in Medicare risk plans from our analysis. The percentage of such individuals was appreciably higher in 1999 than in 1994. However, to the extent that more individuals with mild ADRD enrolled in HMOs, this would lead us to understate the decline in payments per beneficiary with ADRD between 1994 and 1999.

Overall, the limitations are not likely to negate our conclusion. Although the number of people with a physician's diagnosis of ADRD increased between 1994 and 1999, Medicare and Medicaid payments per person with this diagnosis decreased in constant dollars. The decline is mainly attributable to reductions in spending by Medicare and reductions in Medicaid payments for services other than nursing homes, especially for inpatient care and home health care. To the extent that these trends continue, lifetime Medicare and Medicaid costs incurred by people diagnosed with ADRD will be lower than the estimates that cross-sectional studies suggest.

Notes

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