Cost effects of a specialized care center for people with Alzheimer's disease

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Abstract

A retrospective cohort control study of three populations, 65 years of age or older, at the same institution estimated the incremental cost of Alzheimer's disease (AD). The AD population of the ambulatory Alzheimer's Disease Center (ADC) (n = 640) was matched by age, gender, ethnicity, and address to one with AD from the general internal medicine practice (AD-GM) (n = 419) and to a control group without AD (n = 5331) from the same general medicine practice. Medicare costs of all care for all diagnoses were obtained for 1998 and 1999. Mean per person annual Medicare costs were $19,418 for ADC, $18,753 for AD-GM, and $12,085 for the control group. Incremental cost for ADC population was $7,333 and $6,668 for AD-GM population compared with the control group. Incremental cost was $665 (9.1 percent) higher for ADC than AD-GM. Higher non-AD hospitalizations and length of stay (LOS) by AD populations were the main cost drivers.

Key words: cost of Alzheimer's disease, cost of dementia, economics, cost of illness

Introduction

Cost-of-illness (COI) studies are the economic equivalent of epidemiological surveys of disease prevalence and incidence, and are usually the first step in formal economic evaluations. They are useful to understand the economic burden of illness, disease effects, and changes in care over time on patients, families, health systems, payers, and society. They also help decision makers to improve resource allocation by illustrating the intersection of benefits and costs under varying clinical and organizational circumstances. Incremental COI defines the added costs of care attributable to a specific diagnosis when compared to a population without the index disease but with similar personal and nonstudy disease characteristics.

The burden of Alzheimer's disease (AD) on individuals, families, health systems, and social services is widely recognized. Since AD is a disease mainly of the elderly, predicted growth of these populations ensures increasing AD prevalence.[1-5] As prevalence increases, so will expenditures.[6,7] Thus, understanding and planning for the potential economic impact of AD on health and medical care systems is paramount.

There have been multiple COI studies of AD over the past two decades. However, recent US estimates remain uncertain given five-fold annual variation of $20 billion to $100 billion.[8-13] Even control studies have found highly variable results, and that AD was[14-16] and was not[17,18] accompanied by increased service use and cost.

A recent review was published of AD costs among comparable control studies after adjusting for inflation among US studies and inflation and purchasing power parity between US and non-US studies. The review found adjusted annual incremental AD costs varied from about $1,500 to $79,000 per person.[24] In addition, five recently published US cohort control studies of AD cost using Medicare data were re-reviewed. After adjusting for medical care sector-specific inflation, incremental

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Table 1. Population demographics at study entry			
Variable	Patient group		
	Alzheimer's disease center (n = 640)	Alzheimer's general medicine (n = 419)	Control, non-AD (n = 5,331)
Age			
Mean (SD)	80.9 (6.8)	81.3 (6.7)	79.6 (6.6)
Ethnicity (%)			
African-American	23.2	22.8	29.7
All other	76.8	77.2	70.3
Gender (%)			
Male	31.1	32.6	31.2
Female	69.0	67.4	68.8
CCI score			
Mean (SD)	1.47 (2.08)	2.73 (2.49)	1.97 (2.48)

annual cost per person of AD still varied over three-fold, from $1,500 to $5,000.[14,15,25-27]

The two objectives of this study were to determine the incremental costs AD adds to total medical care cost of people with AD, and to measure the cost differences for comparable AD populations cared for by a general internal medicine practice (AD-GM) and a specialized AD center. Given the wide variation of existing AD cost estimates, even among control studies, this study seeks to shed further light on the cost effects of AD by including one of the largest control populations of any previously published studies.

Methods

We designed a two-year (1998-1999) retrospective, three-arm, matched cohort control study. We identified people aged 65 years or older who had any diagnosis of AD (ICD-9 294.10, 294.11, 331.0) from the total patient population of the University of Pennsylvania Health System's (UPHS) Pennsylvania Integrated Clinical and Research Database (PICARD). All personal, diagnostic, and clinical information was obtained on each participant from PICARD.

We identified and followed, retrospectively for two years, all Medicare patients with AD treated at the Alzheimer's Disease Center (ADC), a NIH-funded ambulatory research and clinical center for people with memory disorders, which also provides support services for families and caregivers. Any UPHS or community physician can refer people to ADC. The second AD group consisted completely of Medicare recipients with a diagnosis of AD from the UPHS AD-GM during the same period.

Last, we selected all Medicare recipients without any AD diagnosis from the AD-GM (control, non-AD). Population groups were matched by age, gender, ethnicity, and address, which served as a surrogate for socioeconomic status. For the latter variable, a person with AD was matched to at least one without AD from the closest address in the same neighborhood. From AD-GM, 419 people were matched (1:1) to 640 from ADC, and both AD populations were matched (1:5) by all criteria to 5,331 people without AD, who were also from the AD-GM. Non-AD Charlson Comorbidity Index (CCI) scores were calculated after study entry and were adjusted for in all cost analyses. The CCI is a medical record-based system whose integer scores, 1-10, represent an increasing level of burden of illness.[19]

We obtained health resource utilization data and Medicare reimbursements (costs) for all care for each participant during 1998 and 1999. We used the MEDPAR

Table 2. Mean annual total medical services reimbursement, all diagnoses, 1998 – 1999			
Patient group	**Inpatient**	**Outpatient**	**Total**
Alzheimer's disease center (n = 640)			
Mean (SD)	$17,885 ($14,038)	$1,533 ($2,761)	$19,418 ($14,242)
Median	$14,328	$654	$16,067
Alzheimer's general medicine (n = 419)			
Mean (SD)	$17,352 ($3,119)	$1,400 ($2,175)	$18,753 ($13,169)
Median	$14,117	$631	$15,877
Control (n = 5,331)			
Mean (SD)	$10,111 ($15,002)	$1,974 ($3,530)	$12,085 ($1,538)
Median	$4,208	$776	$6,711
p < 0.0001 for all comparisons across populations, by Wilcoxon Rank Sum test for medians and ANOVA for mean values.			

inpatient care and Standard Analytical Files (SAF) Medicare reimbursement files for outpatient, home health, and hospice care. Medicare reimbursements for each person were aggregated across two study years.

Reliance on Medicare payment data alone means we did not have Medicaid or supplementary private insurance expenditures, which could present a potential bias. In addition, data on copayments, deductibles, and coinsurance paid by participants, and of supplemental insurance and payments for other care such as ambulatory prescription pharmaceuticals, were not available.

We tested means by analysis of variance (ANOVA) and medians by Wilcoxon rank sum across the three groups. Log-linear analysis with smearing technique[20] was used to predict cost. Log-linear analysis was chosen because of non-normal cost distribution.

Results

Population characteristics

The three study populations were comparable by all characterizing variables (Table 1).

Distribution of initial AD diagnosis year was comparable for both AD groups. Mean age was about 80 years, more than two-thirds were female, and 23 to 30 percent were African-American. CCI scores were relatively low, indicating that all three populations were relatively healthy, and none of the differences were significant.

As the CCI score was not a participant-matching criterion, we adjusted in cost analyses for the small differences across matched populations.

Medicare expenditures

Total mean annual medical care costs, adjusted by CCI scores, were $19,418 for ADC group, $18,753 for AD-GM population, and $12,085 for non-AD controls ($p < 0.0001$ for all comparisons) (Table 2).

Costs were similar across study years for each population. Annual incremental cost attributable to AD for the ADC population was $7,333, and $6,668 for the AD-GM population compared to the control group, $665 higher for ADC than AD-GM group ($p < 0.0001$). Adjustment for the small CCI score differences had no effect on cost. For example, the nearly two-fold higher CCI scores in the AD-GM group compared with the ADC group were accompanied by only a 3.5 percent difference in CCI-adjusted Medicare expenditures. Cost distributions for all populations were skewed by approximately 5 percent of the population whose annual Medicare reimbursements were in excess of $50,000.

Table 3. Mean annual hospitalizations, surgical operations, and length of stay									
Service	Alzheimer's disease center			Alzheimer's general medicine			Control, non-AD		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Surgical procedures	2.2	2.1	1.5	2.4	2.2	2.0	2.3	2.5	2.6
Hospitalizations*	2.3	1.6	2.3	3.2	2.2	3.2	2.3	1.7	2.0
Length of stay*	10.1	14.3	7.0	12.1	15.2	7.0	7.5	9.9	4.5

* $p < 0.0001$ across populations by Wilcoxon Rank Sum test for medians and ANOVA for mean values.

Inpatient cost

Adjusted inpatient care was 92.1 percent of ADC mean annual Medicare cost, 92.5 percent of AD-GM cost, and 83.7 percent of costs for the control population (Table 2). It was approximately 70 percent higher for each AD population than for the non-AD group ($p < 0.0001$). This finding is contrary to results from two recent studies that found similar hospital use and cost for people with and without AD.[17,18] Discharge diagnoses for hospitalizations were comparable across patient groups, with pneumonia, heart disease (mainly heart failure), and diabetes being the most common. For both AD groups, AD was in the top five primary discharge diagnoses.

Mean hospitalizations were essentially the same in the ADC group and non-AD controls, while nearly 40 percent higher among the AD-GM group (Table 3) ($p < 0.0001$).

Length of hospital stay (LOS) was lowest for non-AD controls ($p < 0.0001$). For both AD populations, LOS was at least 25 percent longer than for the non-AD group, and mean LOS was about 25 percent lower for ADC than AD-GM. The sharp differences between mean and median LOS attests to the effect of long-stay outliers. There were no significant differences across groups for number of surgical procedures.

Ambulatory services and cost

Expenditures for outpatient services were about 20 percent higher for controls than either AD group (Table 4).

ADC had the lowest expenditures for selected services such as diagnostic testing (radiology and laboratory) and emergency room visits. The small impact of outpatient costs means expenditure differences between AD and non-AD populations were due almost entirely to greater inpatient service use, mainly for non-AD diagnoses and by both AD populations. Thus, adding an additional diagnosis of AD led to a disproportionate increase in total costs, mainly of inpatient care and mainly for non-AD diagnoses.

Other services

Use of other services also showed important differences (Table 5).

For example, the ADC group had fewer than half the emergency room visits and one-tenth to one-thirtieth the admissions to a skilled nursing facility as the AD-GM group and control group, respectively. ADC and the control group had comparable admissions to nursing homes (2.0 percent) but one-seventh of those of AD-GM.

Statistical analysis

Log-linear regression with smearing technique found a diagnosis of AD to be the main predictor of increased Medicare reimbursements (Table 6).

An AD diagnosis increased expenditures compared to a population without AD, irrespective of whether care was provided in a AD-GM or specialty AD Center. Older age and African-American ethnicity had additional independent effects on expenditure increases.

Discussion

Aging populations in high-income countries implies that the prevalence of, and expenditures for, AD will

Table 4. Mean annual reimbursement for selected outpatient services			
Service	**Alzheimer's disease center (SD)**	**Alzheimer's general medicine (SD)**	**Control, non-AD (SD)**
Radiology	$175 (483)	$412 (840)	$254 (690)
Laboratory	$343 (978)	$924 (1,957)	$596 (1,670)
MD/clinic visit	$30 (27)	$43 (45)	$15 (254)
Emergency room	$40 (104)	$95 (177)	$56 (173)

increase over time, in the absence of effective prevention and therapies. There are few current medical treatments for AD, and those are of only modest efficacy and provide mainly short-term effects;[21,22] they also have low direct medical cost.[23] One advantage of this study is that there were two comparable AD populations getting care from two different organizations within the same health system—one a AD-GM and one a specialized ambulatory AD Center. This study shows that the cost of AD is relatively low, but the cost of caring for a person with AD is high; the incremental cost for people with AD added between 50 to 60 percent to total care costs. It appears that once a diagnosis of AD is made, it is accompanied by substantial increases of all medical care, mainly inpatient care for non-AD diagnoses.

A diagnosis of AD may lead to re-evaluation of the person's health status and medical needs, which then leads to increased future services. It may also lead to more and longer inpatient stays because of direct and indirect effects of AD on all other diagnoses. When highly effective AD care finally is discovered and used, medical care expenditures for AD are likely to increase—increased benefits usually entail increased expenditures.

Whether the future cost of non-AD medical care for persons with AD will moderate with the advent of highly effective treatment for AD must remain a research question. In addition, the burden of indirect and family care may also change. It could be reduced as people with AD can remain independent longer, while the disease itself spans less time from onset to death (compressed morbidity). Accurate estimates of direct medical care, indirect costs, quality of life, and daily function under varying care circumstances are vital to planning and implementing AD policies, from coverage and expenditure decisions to research on alternative delivery systems to end-of-life care. However, of concern are the highly variable estimates of AD cost derived from apparently similar populations using similar control designs. Widely variable cost estimates reduce confidence in all results.

This study, which also used Medicare reimbursements, found that the incremental costs of AD were at least 20 percent higher than recent comparably designed studies of US Medicare costs.[14,15,25-27] Previous studies also found, as did this one, that higher inpatient services for all diagnoses drove increased costs for people with AD. Finally, higher total costs for all study groups reported here also were likely affected by care provided in a university medical center, whereas many of the other comparable studies were of more generalizable community care.

Table 5. Use of other selected services: Emergency room, nursing home, skilled nursing facility			
Service	**Alzheimer's disease center (% using)**	**Alzheimer's general medicine (% using)**	**Control, non-AD (% using)**
Emergency room	14.7	37.4	32.8
Nursing home	2.0	14.8	2.0
Skilled nursing facility	1.9	27.9	9.9

Table 6. Results of log linear model predicting total reimbursement			
Variables	**Parameter estimate**	**95% CI**	**SE**
Intercept	1,207	804 – 1,790	0.202
Age	1.01	1.00 – 1.02	0.003
African-American ethnicity	1.53	1.39 – 1.69	0.051
Male gender	1.05	0.96 – 1.15	0.047
CCI score	1.01	0.99 – 1.02	0.008
Alzheimer's disease center	3.68	3.18 – 4.26	0.073
Alzheimer's general medical	3.63	3.06 – 4.31	0.086

Among the unexpected findings of this study was the small annual cost difference ($665, or 9.1 percent) between care for ADC and AD-GM populations. One explanation may be that medical care costs for AD among comparable populations are relatively and similarly low, irrespective of care site within the same health system.[23] It may be that more comprehensive patient care and follow-up, and support care to families by ADC, compared to AD-GM, leads to lower use of other services such as emergency room and nursing home placement. Another reason may be that for ADC patients, Medicare may not be charged for family and patient support and other nonmedical services, and ADC absorbs these costs. ADC may reduce inpatient care, from what it might have been, by providing caregiver and family support services and early targeted patient interventions. Substitution of less expensive support services (not reimbursed by Medicare) for more expensive medical services (reimbursed by Medicare) could also lead to lower Medicare inpatient and outpatient payments. Thus, the true costs of care provided relative to Medicare reimbursements may be undercounted. Families absorbing both direct medical and indirect costs may lead to additional undercounting of true costs. The wide variation of family and indirect costs found by multiple studies supports this hypothesis as well.[24]

Extrapolating costs of AD, even incremental costs, from a single academic university health system, may not be representative of AD costs in community-based care for a number of reasons. First, Medicare reimbursements to academic medical centers are generally higher than for nonacademic providers. Second, academic medical centers generally provide more care, and at higher cost, than nonacademic health systems. However, all participants were part of the academic medical center and Medicare was the primary payer for all their medical costs, so the relationships across costs probably would exist in community settings. Third, in addition to medical services, ADC emphasizes social and supportive care and counseling to patients and families; preventive services, i.e., periodic eye exams, prescribing exercises and diet, and preventing institutional care. This clinic also shares facilities with a specialty geriatrics clinic, and there are substantial formal and informal consultations among staff on all patient needs, which are rarely reimbursed.

Study limitations

The most important study limitation is the inability to estimate clearly the effects of individual factors that contribute to variability of Medicare reimbursements across study populations. Second, there was no information in computerized patient records on AD severity for either AD group. Next, the study was limited to Medicare expenditures and excludes important medical care costs not covered by Medicare, such as prescription pharmaceuticals, care paid by supplemental insurance, and out of pocket costs. Even after matching populations and adjusting for comorbidity, only a small part of the cost variation (less than 18 percent) could be explained. Last, all data are from one multisite university health system, a high-cost deliverer of services, where clinical care, education, and research are commingled. Research results from such institutions may not be representative of all service deliverers, and thus external validity is uncertain. Finally, no benefits were estimated. Thus, the benefit-cost tradeoff across providers remains unknown.

Conclusion

Cost of illness studies offer estimates of the current status of a disease, measure effects of changes over time (e.g., new treatments), and generate new research hypotheses. Like clinical research, control studies of cost lead to more accurate attributable estimates than studies without controls. The cost of caring for people with AD is relatively high when compared with caring for people without AD. And, these costs rise in a nonlinear fashion with the addition of the diagnosis of AD, even in the absence of highly effective treatment. The main reason for higher costs in AD than non-AD groups is greater inpatient care for non-AD diagnoses. However, the cost of care by a specialized AD Center emphasizing medical care plus family and social supports was only slightly higher than care for people with AD from a AD-GM.

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