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The Accuracy of Medicare Claims as an Epidemiological Tool: The Case of Dementia Revisited

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Abstract

Our study estimates the sensitivity and specificity of Medicare claims to identify clinically-diagnosed dementia, and documents how errors in dementia assessment affect dementia cost estimates. We compared Medicare claims from 1993–2005 to clinical dementia assessments carried out in 2001–2003 for the Aging Demographics and Memory Study (ADAMS) cohort ($n = 758$) of the Health and Retirement Study. The sensitivity and specificity of Medicare claims was 0.85 and 0.89 for dementia (0.64 and 0.95 for AD). Persons with dementia cost the Medicare program (in 2003) \$7,135 more than controls ($P < 0.001$) when using claims to identify dementia, compared to \$5,684 more when using ADAMS ($P < 0.001$). Using Medicare claims to identify dementia results in a 110% increase in costs for those with dementia as compared to a 68% increase when using ADAMS to identify disease, net of other variables. Persons with false positive Medicare claims notations of dementia were the most expensive group of subjects (\$11,294 versus \$4,065, for true negatives $P < 0.001$). Medicare claims overcount the true prevalence of dementia, but there are both false positive and negative assessments of disease. The use of Medicare claims to identify dementia results in an overstatement of the increase in Medicare costs that are due to dementia.

Keywords

Dementia costs; medicare; sensitivity; specificity

INTRODUCTION

The increasing number of persons diagnosed with dementia is a defining demographic fact of American society that will have a profound impact on both families and the formal health care system [1]. Estimating the prevalence of dementia, and its most common subtype Alzheimer's disease (AD), and determining how rates vary by population subgroup is an

important public health function. Medicare claims are a potentially valuable epidemiological tool because virtually all persons age 65 and over are covered by Medicare. Further, an obvious use of claims-based dementia diagnoses is to determine the effect of dementia on Medicare costs, a key policy question on which there is no consensus [2]. The question is how good are Medicare claims at identifying dementia?

A series of dementia prevalence estimates have been reported over time [3–6], each using different study samples and methods of disease identification. Two common problems with such studies are the limited representativeness of study samples and/or concerns about disease identification. A recent estimate of the number of persons in the United States with dementia was designed to address both of these concerns by using a comprehensive clinical evaluation to diagnose dementia in a nationally-representative sample of persons age 71 and older [7]. Such an approach is the best way to obtain reliable estimates of the prevalence of dementia, but is expensive [8].

Medicare claims records have been used in past research to identify the cost and outcome of care financed by the program for patients with specific conditions [8, 9], including AD and other dementias [11–14], as well as to identify trends in diagnosed prevalence of dementia [15,16]. Medicare claims records are a less expensive alternative to tracking disease prevalence via in-person evaluations, and are more representative of the elderly population in the US than clinical, or convenience samples. For some acute events such as hip fracture, the use of Medicare claims records to identify disease occurrence has been relatively uncontroversial given high sensitivity and positive predictive values (0.96 and 0.94) relative to clinical assessment [17]. In contrast, because of the insidious onset of dementia, concerns remain about the accuracy of AD and other dementia diagnosis codes in Medicare claims records, and what effect errors in disease identification may have on estimates of the cost implications of dementia.

Previous research has shown modest sensitivity of claims to detect dementia diagnosed by other means [17–19], and past sensitivity estimates of claims to detect dementia (80% in one study) [20] may not hold in a broader sample because a non-clinical study population would be expected to have a broader range of disease severity. Errors associated with using Medicare claims records (undercounting clinically diagnosed disease) have been found to lead to overstating the cost increase to the Medicare program associated with having dementia [18].

The objective of this study is to assess the accuracy of Medicare claims records to identify dementia, and to then assess how errors in diagnosis may affect estimates of the effect of dementia on Medicare costs. In doing so, we add to past work by comparing a clinical diagnosis of dementia (“gold standard”) with Medicare claims records in a national sample of elderly persons that is broadly representative of persons age 71 and over, including persons with normal cognition, allowing us to identify the rate of false positive claims-based diagnoses of dementia. This allows us to comprehensively estimate how errors in dementia assessment (false positive and false negative) may impact cost estimates. Such information is necessary to provide a more comprehensive understanding of the value of Medicare claims records as an epidemiological tool for estimating and tracking dementia prevalence, and for understanding any biases inherent in the use of Medicare claims to estimate the impact of this disease on Medicare costs.

MATERIALS AND METHODS

Study sample

The Aging, Demographics, and Memory Study (ADAMS) selected a stratified random sample of respondents to the Health and Retirement Study who were age 70 or older in 2000 [7,8]. There were five strata that represented cognition among respondents as defined by responses to cognitive screening measures and proxy reports on their most recent HRS interview (conducted in either 2000 or 2002). Persons in each stratum were then assessed for dementia in their home using a comprehensive evaluation that has been previously described in detail [7,8], and is here briefly reviewed.

All participants were assessed for cognitive impairment in-person in their residence by a nurse and neuropsychology technician. The following information about the participant was collected from a knowledgeable informant: 1) a chronological history of cognitive symptoms; 2) medical history; 3) current medications; 4) current neuropsychiatric symptoms; 5) measures of severity of cognitive and functional impairment; and 6) family history of memory problems. During the assessment, the participant completed: 1) a battery of neuropsychological measures; 2) a self-report depression measure; 3) a standardized neurological examination; 4) a blood pressure measure; 5) collection of buccal DNA samples for APOE genotyping; and 6) a 7-minute videotaped segment covering portions of the cognitive status and neurological examinations. Medical record releases were also sought to obtain relevant prior neuroimaging and laboratory results from participants' physicians.

All information collected during the in-home assessment was reviewed and final diagnoses were assigned by a consensus expert panel of neuropsychologists, neurologists, geropsychiatrists, and internists. Diagnoses fell within the three general categories: normal cognitive function, cognitive impairment not demented, and dementia. The consensus panel used clinical judgment to assign the final diagnosis, but the diagnosis was anchored by the following criteria. Dementia diagnosis was based on guidelines from Diagnostic and Statistical Manual of Mental Disorders, edition III-R [21] and Diagnostic and Statistical Manual of Mental Disorders, edition IV [22] criteria; and currently accepted diagnostic criteria for AD and other types of dementia were used [23–26]. Cognitive impairment, not dementia (CIND) was defined as: 1) mild cognitive or functional impairment reported by the participant or informant that did not meet criteria for dementia; or 2) performance on neuropsychological measures that was both below expectation and 1.5 standard deviations below published norms on any test. The assessment and diagnostic procedures have been validated against neuropathological diagnoses for AD [27].

A total of 856 persons completed the initial ADAMS dementia assessment, and all subjects were classified as having dementia or not (including type, operationalized in this study as Alzheimer's type, or all dementias, but more detailed categories were assigned in the ADAMS study). For those found to have dementia in ADAMS, an age of onset was estimated as the age at which the individual clearly met standard criteria for dementia based on systematic review of the retrospectively reported chronological history of cognitive and functional decline. The initial dementia assessment conducted by ADAMS (between July 2001 and December 2003) is used as the gold standard to assess the accuracy of Medicare claims records. A subset of the cases received a second in-home dementia assessments (ADAMS follow up), approximately 16–18 months following the initial assessment. All persons classified as having CIND at the initial assessment received a follow up assessment [28]. A smaller number of persons receiving an ADAMS diagnosis of dementia or normal cognition received a follow up assessment when the consensus panel making diagnoses

thought that findings from initial assessments were ambiguous and that longitudinal follow up would help clarify the diagnosis [28].

Seven hundred ninety (92%) of the individuals in the ADAMS sample gave consent to link their Medicare claims records with their HRS survey and dementia assessment (449 female, 56.8%, and 341 male, 43.2%). Persons with no Medicare claims records (N = 32) were excluded because they had no chance of being identified as having dementia from the claims. Most of these individuals were in Medicare HMOs for the entire period, and therefore did not have claims records. Population weights were constructed for the respondents with Medicare claims records and are used in both epidemiological and cost analyses that are described below. There are 758 persons in the final study sample.

Comparing ADAMS and Medicare claims

This study compared the ADAMS [7,8] dementia diagnosis with Medicare claims records to assess the sensitivity and specificity of Medicare claims to identify true disease as well as to identify the agreement between these two sources of diagnostic information. December 31, 2003 was the date of comparison for Medicare claims records and ADAMS dementia assessment. Persons were classified as having dementia or not based on Medicare claims as of that date, and were also assessed as having dementia or not as of that date. Further, we compared the age of dementia onset, as estimated in ADAMS, to the age of a subject when they first had a Medicare claim that noted dementia. In such cases, persons were categorized as having their initial Medicare claim denoting dementia more than one year prior to dementia onset as estimated in ADAMS; occurring within a year of ADAMS onset; occurring more than one year after ADAMS onset.

Medicare claims records are generated when beneficiaries receive care financed through the program. Such records note not only payment information, but also the date that care was received, diagnosis code information (ICD-9-CM codes) for one primary diagnosis, and several secondary diagnoses. Some files (inpatient hospital claims), have up to 9 secondary diagnosis codes in addition to the primary diagnosis, while others (part B physician supplier claims), have only 3. This study uses the ICD-9-CM codes used in past work to identify dementia in Medicare claims (Appendix 1) [19]. We also conducted sensitivity analyses by adding several additional ICD-9-CM codes suggested by colleagues associated with the ADAMS dementia assessment, but the differences were trivial (e.g., 4 additional cases of dementia identified in claims) so results are shown using the ICD-9-CM codes that were used in past work to increase comparability [20]. All available Medicare claims records were used to complete the study; inpatient, outpatient; part B physician supplier file; home health; Skilled Nursing Facility (SNF); hospice; and durable medical equipment. Persons having a claim with at least one of the codes (in any position, primary or secondary) listed in the appendix were classified as having dementia. Separate analyses were run for dementia of the AD type, which was defined in Medicare claims by the presence of ICD-9-CM code 331.0.

Cost to the Medicare program was defined as the amount that Medicare actually paid for an episode of care and using all files as noted above, following past work in this area [9,11,12].

Analyses

We identified the percentage of persons across all ADAMS strata (all persons, persons with dementia, persons without dementia, persons with AD [a subset of those with dementia]) that were noted as having dementia or AD in Medicare claims records, and then calculated sensitivity, specificity, and positive and negative predictive value of Medicare claims to identify dementia, using the ADAMS diagnosis as the gold standard. Analyses were run

using raw data, as well as weighted. We also compared the agreement of ADAMS and Medicare claims diagnoses by calculating the kappa statistic to estimate agreement between ADAMS and Medicare claims [29]. For those with Medicare claims noting dementia or AD, we compared the first mention in claims with the estimated onset age from ADAMS to determine which occurred first. We conducted a series of analyses to determine the extent to which overall exposure to Medicare claims (e.g., number of visits paid for by Medicare) was related to agreement, and to whether persons who were not identified as having dementia had a large number of claims in which they might have been so notified.

We compared the mean annual per capita cost of care paid by the Medicare program in 2003 (year end 2003 is the latest dementia onset estimated by ADAMS) of persons with Dementia, and the subset of those with AD, to the control group of those ADAMS participants with neither to determine the unadjusted impact of dementia on Medicare costs. Cost analyses were completed using sample weights, excluding persons who died prior to 2003, but including those who died during 2003. We compared the impact on costs when disease was defined by Medicare claims versus ADAMS. T tests were used to determine whether differences were statistically significant. We then estimated multivariate regression models (Ordinary Least Squares Regression) with total Medicare cost in 2003 as the dependent variable, with the key explanatory variable being dementia (first using claims, then ADAMS to identify disease), while controlling for: age, sex, race (white v. non-white), married, years of education, household income, residence in a nursing home (v. community), death during 2003, and number of months survived during 2003 (range 1–12) [11]. This analysis was run for dementia and AD.

The funder of this research had no role in the design on completion of this study, which was approved by the Duke University Institutional Review Board.

RESULTS

Approximately one-third of the study sample (N = 275, 36.3%) was found to have dementia at the initial ADAMS assessment, while the remainder was not (N = 483, 63.6%; Table 1a). A subset of those with dementia was identified as having AD (N = 205 of 275; Table 1b). ADAMS served as the gold standard dementia assessment that was used to estimate the sensitivity (0.86, 0.85 weighted) and specificity (0.86, 0.89 weighted) of Medicare claims to identify dementia (Table 1a). Medicare claims and ADAMS agreed on 650 of 758 (85.8%) subjects, resulting in a kappa statistic of 0.70 (in the substantial agreement range [29]). Just over half of all participants were found to have dementia by neither source (N = 415), while around one-third of cases (N = 235) were found to have dementia by both. The positive predictive value (PPV) of Medicare claims was substantially lower, 0.78 (0.56 weighted), than negative predictive value (NPV), 0.91 (0.97 weighted) for dementia. Sensitivity (0.61, 0.64 weighted) and agreement (kappa = 0.55) were lower for AD, while specificity was higher (0.91, 0.95 weighted). The two sources agreed on AD status for 630 of 758 subjects (83.1%). As was the case for dementia, PPV was lower (0.72, 0.58 weighted) than NPV (0.86, 0.96 weighted) when Medicare claims were used to assess AD.

Persons found to not have dementia in claims had a mean of 216 unique Medicare claims over the study period meaning that such persons typically had numerous Medicare claims records in which they could have been identified as having dementia. We further assessed agreement between Medicare claims and the ADAMS diagnosis process using multivariate models and identified age as the only significant predictor of agreement for both dementia and AD; agreement was slightly lower for older subjects (not shown).

When analysts use Medicare claims records to identify dementia, they are often interested in the effect of dementia on the cost to the Medicare program [10–12,18]. Unadjusted per capita annual Medicare costs were higher for persons with dementia compared to those who were not demented, regardless of whether Medicare claims or ADAMS was used to identify disease (Table 2). Cost differences were greater when using Medicare claims to identify dementia (\$11,270 v. \$4,135, $P < 0.001$ an increase of around \$7,100 using claims; as compared to an increase of \$5,600 found when using ADAMS \$10,523 v. \$4,839, $P < 0.001$). Thus, when using Medicare claims to identify dementia the unadjusted annual per capita increase in Medicare costs associated with dementia is 64%; when ADAMS is used to assess dementia the increase is 54%. Unadjusted annual per capita Medicare costs in 2003 were also higher for those with AD as compared to controls. When using Medicare claims to identify disease, those with AD had mean costs of \$8,657 compared to \$5,249 ($P = 0.02$), while the comparison when using ADAMS was \$9,240 versus \$5,231 ($P = 0.01$).

The adjusted increase in annual per capita Medicare costs in 2003 due to dementia identified by Medicare claims was \$6,177 ($P < 0.001$), while the adjusted cost when using ADAMS to identify disease was \$3,792 ($P = 0.01$; Table 2). This corresponds to an increase in costs for persons with dementia of 110% when using claims and 68% when using ADAMS, as compared to full sample mean costs. The impact of AD on adjusted per capita annual 2003 Medicare costs was positive, but much smaller and not statistically significant, whether using Medicare claims or ADAMS to identify AD. Our multivariate cost analyses show that death during 2003 was by far the largest predictor of costs during 2003 for both dementia and AD. Death during 2003 led to an increase in costs of between \$16,800–\$16,960 ($P < 0.001$ in all models) controlling for other factors, including how long during the year a subject survived, thus replicating a well-known finding of past work that Medicare-financed expenditures increase rapidly near death [30].

Medicare claims result in an overcount of dementia prevalence as measured by ADAMS, but the use of claims results in both false positive as well as false negative assessment of patients. Subjects characterized by these errors have different impacts on the effect of dementia on Medicare costs. The unadjusted mean per capita annual Medicare cost of false positive cases in 2003 (\$11,294, $N = 65$) was nearly triple the cost of caring for true negatives (\$4,065, $N = 412$, $P < 0.001$, Table 3). True positive cases had nearly the same mean costs in 2003 (\$11,251, $N = 215$) as did false positive ones, and were both significantly different from the cost of true negatives ($P < 0.001$). Mean annual Medicare costs for false negative cases (\$6,702, $N = 39$, $p = 0.37$) were not significantly different from true negatives, but had substantially lower (\$4,500) costs than did true positives. Multivariate analyses confirmed that adjusted annual per capita Medicare costs for false positive cases were greatly increased compared to true negatives (\$6,566, $p < 0.001$), controlling for key demographic variables, nursing home residence and survival, variables found in past work to be important predictors of Medicare expenditures. We completed the same analyses assessing errors in claims-based notations of AD, but there were fewer significant differences, and notably, the costs of false positive AD assessments did not differ significantly in costs from true negative cases.

False positive dementia cases have annual per capita Medicare costs that are much higher than costs for true negative cases because they use substantially more health care services that are financed by Part B physician supplier claims (e.g., physician visits), and are more likely to have been hospitalized during the year of cost assessment. False positive users had a mean of 29.0 visits financed by Part B during 2003 as compared to 22.1 such visits during 2003 for true negative cases ($P = 0.02$). Similarly, around one-third of false positive cases were admitted to the hospital during 2003 compared to one-fifth of true negatives ($P = 0.01$). The proportion dying during the year of cost assessment (2003) did not differ significantly

between false positives and true negatives. Medicare costs for the AD subsample did not differ systematically by the type of error.

Across the study period, the most common type of claim in which to find a notation of dementia was Part B physician supplier claims; 2,362 (60.2%) of the 3,791 unique Medicare claims noting dementia occurred in these files. Outpatient and durable medical equipment files were the next most common type of claim in which to find notations of dementia or AD, and approximately three-fourths of subjects were identified as having dementia in more than one type of file. Results were similar for AD.

DISCUSSION

The use of Medicare claims records to identify dementia results in an overcount of the true prevalence as determined by clinical assessment, and results in an overstatement of the increase in costs to the Medicare program due to a patient having dementia. Eighty-five percent of persons who were judged to have dementia by ADAMS were identified as demented by Medicare claims, while 64% were identified for AD. Our study, conducted in a nationally representative sample of persons age 71 and older, thus identified a higher sensitivity of Medicare claims than was found comparing autopsy-confirmed dementia with Medicare claims in a clinical sample [20]. The specificity of Medicare claims to identify dementia is 0.89, corresponding to a presumed false positive rate of 11%. Thus, the false positive and false negative rate of Medicare claims to identify dementia are similar, but given that more persons are not demented than are in the population, an overcount of the true dementia prevalence will result from using Medicare claims to identify disease.

Overall, the impact of errors associated with the use of Medicare claims to identify dementia is to overstate the degree to which a person with dementia increases costs to the Medicare program. When you use a Medicare claims based definition of dementia the (adjusted) cost increase to Medicare that was associated with dementia was around 110%, whereas the increase was around 68% when using ADAMS to identify dementia. We did not find clear differences in the AD sample. It is difficult to place these results in the context of the large body of research [2] investigating the effect of dementia on costs because of fundamental differences across studies in populations, conception of cost, measurement of cost, and time period. However, our work confirms [18] the tendency of a Medicare-claims based definition of dementia to overstate the effect of dementia on costs to the Medicare program.

False positive dementia cases are the most expensive group of subjects in our study, and drive the overstatement of the effect of dementia on Medicare costs that occurs when using claims to identify disease. This is driven by higher use of Part B physician services and hospitalization, and may be related to the investigation of ill defined health problems that seem to increase the chance of having an incorrect diagnosis of dementia. We investigated false positive cases to determine whether Medicare claims may simply result in a delay in noting dementia that is detectable by the clinical assessment process used by ADAMS. In a few cases this is probably true, and there is evidence of a lag between onset date as estimated in Medicare claims (tends to occur later) compared to the estimated ADAMS onset. However, when we re-estimated specificity under several more lax scenarios using ADAMS information there was no appreciable change. Therefore, false positive assessments in the range of at least 10% seem likely to be a reality when using Medicare claims to monitor dementia prevalence. Of course, without the ADAMS dementia assessment, which most persons using claims will not have, it is impossible to know which cases are false positives.

False negative cases had lower Medicare costs in 2003 than did true positives. We found that two-thirds ($N = 24$) of the false negatives had less than a high school education; there were no false positives with less than a high school education. However, this level of education is not unusual for this sample and education was not found to be a multivariate predictor of agreement, though education has been found to be a significant predictor of dementia in past work using ADAMS [7]. It is not clear why lower educational attainment should lead to not being noted in Medicare claims as having dementia in the presence of true disease, but it could signal lower quality of medical care for which those with low education are at increased risk [31]. Educational attainment can also make determination of dementia status more difficult [27,28, 32] but might be expected to lead to false positives, not false negatives. In none of the false negative cases did the person have very few Medicare claims records, so lack of exposure to Medicare claims records was not why such persons were not identified in claims as having dementia.

There are several drawbacks of a claims based approach other than misclassification. First, persons in Medicare+Advantage risk plans (Medicare HMOs) do not have Medicare claims records, meaning that this group of elderly persons cannot be assessed using claims. For the ADAMS study, around 9% of participants did not have Medicare claims records due to such enrollment (they did not differ systematically based on observed variables). If the proportion of elderly persons in Medicare HMOs were to rise (it has been fairly constant between 13–17% for 15 years) then this would affect the usefulness of claims. Second, Medicare claims obviously provide limited precision in diagnosis, especially for identifying dementia subtypes such as AD. Our cost findings are strong for dementia, but less so for AD. The sensitivity rate of claims for detecting AD was only 0.61, much lower than the 0.85 for dementia. However, 25 of the persons who are false positives for AD, were diagnosed by ADAMS as having dementia (a code other than 331.0), but not AD. Thus, Medicare claims seem most useful when looking at the broadest category of dementia.

As the population ages and the prevalence or at least absolute number of persons with true dementia rises, this will impact the Medicare program, and the desire to monitor the effect of dementia on Medicare costs will continue. On the whole, Medicare claims seem reasonable for providing an estimate of prevalence that is understood to be an overcount that likely overstates the cost impact of dementia on the Medicare program. When using Medicare claims records for monitoring dementia, a gold standard of diagnosis is not available, so false positives and false negatives cannot be identified. Careful thought into whether, and how, these subsets of cases are likely to be important in any cost studies is needed before using such cost estimates.

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APPENDIX 1. ICD-9-CM Codes used to signify Alzheimer's disease and other dementias

331.0	Alzheimer's disease
331.1	Pick's disease
331.2	Senile degeneration of the brain
331.7	Cerebral degeneration in diseases classified elsewhere
290.0	Senile dementia, uncomplicated
290.1	Presenile dementia (brain syndrome w/ presenile dementia)
290.10	Presenile dementia, uncomplicated
290.11	Presenile dementia, w/ delirium
290.12	Presenile dementia, w/ delusional features

290.13	Presenile dementia, w/ depressive features
290.20	Senile dementia, w/ delusional features
290.21	Senile dementia, w/ depressive features
290.3	Senile dementia, w/ delirium
290.40	Arteriosclerotic dementia, uncomplicated
290.41	Arteriosclerotic dementia, w/ delirium
290.42	Arteriosclerotic dementia, w/ delusional features
290.43	Arteriosclerotic dementia, w/ depressive features
294.0	Amnestic syndrome (Korsakoff's psychosis or syndrome, nonalcoholic)
294.1	Dementia in conditions classified elsewhere
294.8	Other specified organ brain syndrome (chronic)
797	Senility without mention of psychosis

Sensitivity and specificity of medicare claims to identify dementia and Alzheimer’s disease^a

Table 1

1a. Dementia ^{a,b}					
Medicare claims	ADAMS			Raw %	Weighted %
	Yes	No	Total		
Yes	235	68	303	Sensitivity	85.5%
				Specificity	89.2%
No	40	415	455	Positive predictive value	56.0%
Total	275	483	758	Negative predictive value	97.3%
1b. Alzheimer's disease ^c					
Medicare claims	ADAMS			Raw %	Weighted %
	Yes	No	Total		
Yes	126	49	175	Sensitivity	61.5%
				Specificity	91.1%
No	79	504	583	Positive predictive value	58.3%
Total	205	553	758	Negative predictive value	96.2%

ADAMS = Aging, Demographics and Memory Study.

^a All types of Medicare claims records were used: inpatient, outpatient; part B physician supplier file; home health; Skilled Nursing Facility (SNF); hospice, and durable medical equipment. A code corresponding to Alzheimer’s disease or more generally dementia could appear in either the primary or secondary diagnosis position of a claim.

^b Dementia was noted by a series of codes used in past work, including ICD-9-CM code 331.0, Alzheimer’s disease.

^c Alzheimer’s disease was noted by the presence of ICD-9-CM code 331.0.

Table 2

The effect of dementia and AD on per capita annual medicare costs (2003)^a

	N	Disease \$	N	Control \$	Unadjusted difference \$ ^b	p ^b	Adjusted* difference \$ ^c	p ^c
Dementia								
Claims	280	11,270	451	4,135	7,135	< 0.001	6,177	< 0.001
Adams	254	10,523	477	4,839	5,684	< 0.001	3,792	0.01
AD								
Claims	162	8,657	569	5,249	3,408	0.02	1,253	0.43
Adams	189	9,240	542	5,231	4,009	0.01	1,087	0.53

^a 27 persons who died prior to 2003 are excluded from all cost analyses, but are included in Table 1.

^b Unadjusted difference is the increase in amount that Medicare spent on care for those with disease (dementia or AD) compared to those without (controls). P value is for t test of means. Analyses run using sample weights.

^c Adjusted difference is a regression coefficient showing the increase in Medicare costs associated with having dementia. Results are from regression analysis of total 2003 Medicare expenditures while controlling for demographic factors (age, sex, race, marital status, income, education), residence (nursing home v. community), controls for death during 2003, and time survived during 2003 (No. months). Analyses run using sample weights.

Table 3

The effect of errors in claims-based dementia assessment on the cost of dementia and Alzheimer's disease to the Medicare program (2003)^a

	N	Medicare costs, 2003			Selected utilization and death, 2003							
		Unadjusted costs ^b	p ^b	Adjusted costs ^c	p ^c	Part B claims no.	p ^d	Hospitalized at least once %	p ^d	Died %	p ^d	
Dementia												
True negative	412	4,065	Ref	Ref		22.1	Ref		20.0	Ref	3.1	Ref
False negative	39	6,702	0.37	1,410	0.65	19.7	0.51		25.0	0.46	12.5	0.004
True positive	215	11,251	< 0.001	5,937	< 0.001	24.2	0.26		38.3	< 0.001	14.0	< 0.001
False positive	65	11,294	< 0.001	6,566	< 0.001	29.0	0.02		33.8	0.01	5.9	0.25
Alzheimer's disease												
True negative	497	18,618,517	Ref	Ref		23.0	Ref		22.6	Ref	4.6	Ref
False negative	72	731,059	0.46	155	0.96	23.5	0.85		32.9	0.05	13.9	< 0.001
True positive	117	1,312,071	0.01	2,668	0.20	22.8	0.92		38.9	< 0.001	15.1	< 0.001
False positive	45	937,174	0.64	-809	0.76	28.0	0.14		34.7	0.06	4.1	0.88

^a ADAMS dementia assessment is used as the standard against which Medicare claims are measured. For example, false negative means that Medicare claims did not identify dementia, while ADAMS did. Analyses exclude 27 subjects who died prior to January 1, 2003.

^b Unadjusted costs are mean amount spent by Medicare in 2003 for the care of false negative, true positive, and false positive compared individually to true negative cases. P value is for t test of means. Analyses run using sample weights.

^c Adjusted difference is a regression coefficient showing the increase in Medicare costs associated with being a false negative, true positive, or false positive case as compared to a true negative (omitted group). Regression model analyzed total 2003 Medicare expenditures as dependent variable while controlling for demographic factors (age, sex, race, marital status, income, education), residence (nursing home v. community), controls for death during 2003 and time survived during 2003 (No. months). Analyses run using sample weights.

^d P is for t test of means of Part B claims, percent hospitalized during 2003, and percent dying during 2003.