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Predictors of Nursing Home Admission among Alzheimer's Disease Patients with Psychosis and/or Agitation

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Abstract

Background—The purpose of this study is to identify factors that predict nursing home placement among community-dwelling Alzheimer's Disease (AD) patients with psychosis or agitation in a randomized clinical trial.

Methods—418 participants with AD enrolled in the CATIE-AD trial of anti-psychotic medications and having no evidence of nursing home use at baseline were followed 9 months post-random assignment using data provided by caregiver proxy. χ^2 tests, t-tests and Cox proportional hazard modeling were used to examine the baseline correlates of nursing home use.

Results—Of outpatients with no prior nursing home use, 15.0% were placed in a nursing home in the 9 months following baseline, with the average time to placement being 122 days. Bivariate analyses indicate that those with prior outpatient mental health use at study entry were more likely to be admitted; so too were those with worse physical functioning—lower scores on the AD Cooperative Study Activities of Daily Living Scale (ADCS-ADL), lower utility scores on the Health Utility Index (HUI)-III, and worse cognition on the Mini-Mental State Examination. Controlling for other factors, non-Hispanic white race (hazard ratio [HR]=2.16) and prior mental health use (HR=1.87) increased the likelihood of admission. Those with higher ADCS-ADL scores were less likely to be placed (HR=0.97).

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CONFLICT OF INTEREST DECLARATION

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DESCRIPTION OF AUTHOR'S ROLES

EAM: Made substantial contributions to the conception and design, analysis and interpretation of data, preparation of manuscript, and final approval of the version submitted.

LSS: Substantial contribution to the interpretation of data, revising manuscript critically for important intellectual content, and final approval of version submitted.

RAR: Substantial contribution to the conception and design, interpretation of data, preparation of manuscript, and final approval of the version submitted.

Conclusion—Factors leading to nursing home entry among psychotic/agitated AD patients are similar to the general population, though high incidence of nursing home entry highlights the importance of accounting for such utilization in health economic studies of AD outcomes. It also highlights the importance of using information on ADLs and other characteristics to develop profiles identifying those at greater or lesser risk of nursing home entry and, in so doing inform population planning associated with AD and identification of those patients and caregivers who might benefit most from interventions to prevent eventual placement. (ClinicalTrials.gov number, NCT00015548.)

Keywords

Institutionalization; Elderly; Clinical Trial; Dementia; Risk Factors; Survival Analysis; Mental Health; Psychiatry

INTRODUCTION

Alzheimer's disease (AD) is the sixth leading cause of death in the United States, affecting one in eight persons 65 years and older (Alzheimer Association 2009). People with AD require substantial support and services. Consequently, the costs of caring for AD patients range from three-to-five times the costs of caring for those without AD (Alzheimer's Association 2009; Taylor and Sloan 2000). Total costs for AD care reached \$148 billion in 2005 (Alzheimer Association 2009). This is expected to rise substantially in the coming decades as the number of AD cases increase from 5.3 to 13.0 million between 2007 and 2050 (Alzheimer Association 2009; Hebert *et al.*, 2003).

The growing prevalence of AD will increase the demand for nursing home care. Estimates suggest that from 48 to 54% of nursing home residents have dementia (Magaziner *et al.*, 2000). People with AD and other dementias are substantially more likely to be admitted to a nursing home (Miller and Rosenheck 2006; Miller and Weissert 2000). They also incur substantially higher nursing home costs (Alzheimer's Association 2009; Taylor and Sloan 2000). No treatment has been shown to cure, reverse or arrest AD. However, pharmacological interventions continue to be developed to slow the progression of the disease. The high costs and prevalence of nursing home placement suggests that it would be useful to identify predictors of future placement to be intermediate targets for pharmacologic or psychosocial intervention.

A large number of studies have examined the correlates of nursing home use among community-dwelling patients with dementia generally (Chan *et al.*, 2003; Gaugler *et al.*, 2009; Smith *et al.*, 2001) and AD specifically (Gilley *et al.*, 2004; Hatoum *et al.*, 2009; Knopman *et al.*, 1999; Stern *et al.*, 1997; Yaffe *et al.*, 2002). Several examine the relationship between psychotic symptomatology and nursing home placement (Chan *et al.*, 2003; Gaugler *et al.*, 2009; Gilley *et al.*, 2004; Stern *et al.*, 1997), with some finding a positive relationship between the presence of psychotic symptoms and nursing home use, others finding no statistically significant relationship between the two variables (Gaugler *et al.*, 2009). No study, however, as far as we could determine, has examined the predictors of nursing home admissions among AD patients with prominent psychotic symptoms or agitation/aggression more generally. This is important because AD patients with psychosis can be distinguished from those with “uncomplicated” AD and agitation alone (Schneider and Dagerman 2004); and as such, the factors underlying nursing home use among AD patients with prominent psychotic symptoms may differ from those underlying use among other patients with AD.

Dimensions of AD-related psychosis include delusions, hallucinations, and misidentifications, frequently accompanied by agitation, aggression or depression. Prevalence estimates of psychosis in AD vary with setting and definition but range from 10% to 73% in clinic populations and from 7 to 20% in community and clinical trial populations (Schneider and Dagerman 2004). Approximately 20% of AD patients without psychosis develop it after one year (Schneider and Dagerman, 2004). These symptoms tend to endure for indefinite periods of time; among 40 to 50% of community-dwelling AD patients with psychosis, hallucinations and delusions persist from at least three to 12 months.

In an effort to better understand nursing home use among AD patients, the goals of the present study were (1) to determine the incidence of nursing home entry among AD patients with prominent psychosis; and (2) to identify the socio-demographic and baseline clinical correlates of eventual nursing home entry in this population. We use data from the Clinical Antipsychotic Trial of Intervention Effectiveness—AD (CATIE-AD), a 9 month randomized trial designed to evaluate the performance of second generation antipsychotics (SGAs) and placebo in relation to the psychological and behavioral symptoms associated with dementia (Schneider *et al.*, 2006). Since participants had to have moderate to severe hallucinations, delusions, agitation, aggression, or conceptual disorganization in order to participate, CATIE-AD provides an excellent setting with which to model time to nursing home placement in this population.

METHODS

Sample and source of data

Details about CATIE-AD have been provided elsewhere (Schneider *et al.*, 2006; Rosenheck *et al.*, 2007). The trial was conducted at 42 sites in the United States and included 421 ambulatory outpatients who fulfilled criteria dementia of the Alzheimer's type (DSM-IV) and probable AD on the basis of history, physical examination, structural brain imaging and Mini-Mental State Examination (MMSE) scores ranging from 5 to 26 (Folstein *et al.*, 1975). Participants had to be living in the community, either in their own home or in the home of a friend or relative, or in assisted living. They had to have clinically significant delusions, hallucinations, aggression, or agitation, occurring after the onset of dementia that was severe enough to disrupt their functioning and, in the opinion of the study physicians, to justify treatment with antipsychotic drugs. These had to have occurred nearly daily during the week prior to randomization or at least intermittently for four weeks.

Eligible participants also had a severity rating of at least “moderate” for conceptual disorganization, suspiciousness, or hallucinatory behavior on the Brief Psychiatric Rating Scale (BPRS) (Beller and Overall, 1984), or a frequency rating of “often” or “more frequently” and a severity rating of at least “moderate” for delusions, hallucinations, agitation/aggression, or “aberrant motor behavior” on the Neuropsychiatric Inventory (Cummings *et al.*, 1994). In all, 82.0% of participants had delusions, 49.0% hallucinations, and 86% agitation; 76.0% fulfilled criteria for psychosis of AD. A caregiver who lived with or visited the participant for at least 3 days per week for an accumulative 8 hours was required to contribute to the assessments. The study was approved by the institutional review board for each site. Written informed consent was obtained from participants or their legal representatives and from the study partners.

Measures

Of the 421 individuals enrolled in CATIE-AD, 418 showed no evidence of nursing home use in the month preceding baseline. This is in contrast to three participants who had used at least some nursing home care. Those 418 participants without prior nursing home used

served as our study population and were followed nine months post-random assignment. Participants determined to be nursing home users during the follow-up period were identified, along with the date of first nursing home use. Independent variables were measured at baseline.

Andersen's behavioral model of health services use suggests that an individual's use of health services is a function of predisposing, enabling, and need characteristics (Anderson 1995). It also suggests that future health services use is, in part, a function of health services use in the past. We measured need—or one's state of health or illness—using several clinical indicators. *Cognitive functioning* was measured on a 0-30 scale using the MMSE, with lower scores indicating poorer performance (Folstein *et al.*, 1975). *Psychiatric symptoms* were assessed using the NPI, with higher scores indicating more severe problems (Cummings *et al.*, 1994). Alternative measures based on the psychosis items of the NPI and the BPRS were assessed as well with no difference in results. *Physical functioning* was measured using the AD Cooperative Study Activities of Daily Living Scale (ADCS-ADL), with lower scores indicating greater impairment (Galasko *et al.*, 1997). *Quality of life* was assessed using the AD-Related Quality of Life scale (ADRQoL), with lower scores indicating poorer quality of life (Rabins *et al.*, 1999). *Health utilities* were assessed using the Health Utilities Index (HUI)-III, a generic, multi-attribute preference-based utility instrument validated for use in AD (Feeny *et al.*, 2002). Scores range from 0 (dead) to 1 (perfect health), with negative values indicating states worse than death. Original HUI-III scores were multiplied by 10 to facilitate interpretation, so that a unit difference on the transformed HUI-III corresponds to a 0.10 difference on the original.

We measure predisposing characteristics using demographic and social structure indicators. *Demographic factors* were represented by age and gender. *Social structural factors* were represented by race and education. We measure enabling characteristics using indicators of personal/familial resources. These include *residence* (own home vs. other—family/other home, assisted living). Most participants (73.2%) lived in their own home. Few lived in the home of a family member (15.6%) or someone else (0.5%); few lived in assisted living (9.6%) or in some other, unspecified location (1.2%). Given the predominance of participants living in their own home, it made the most sense to use a single indicator variable comparing those living at home to those living in other locations. This proved to be the most parsimonious approach to take as well. Results reported are the same as when residence is measured using multiple indicator variables (e.g., living at home vs. living in assisted living vs. other). In addition to residence, enabling characteristics include *caregiver burden*. This was measured using a four-item version of the Caregiver Activity Survey (CAS), which measures the number of hours assisting AD patients with transportation, eating, dressing, and their appearance during a 24-hour period (Davis *et al.*, 1997). Time spent supervising patients were excluded; results are similar no matter whether supervision time is used or not. Three alternative measures of caregiver burden were also assessed—the Caregiver Distress Scale, Beck Depression Inventory, and Caregiver Burden Interview Scale. Results are the same no matter which caregiver burden measure is used, both alone and in combination with others. For the sake of parsimony, a single measure—the CAS—was chosen.

Service utilization is measured using three indicators of outpatient care use in the month prior to baseline assessment: AD-specific services, general mental health, and medical-surgical. *AD-specific services* include outpatient services commonly used by patients with AD, including various home- and community-based supports, therapies, and caregivers. *Mental health* includes outpatient care addressing drug/alcohol abuse, or emotional/psychiatric problems. *Medical-surgical* includes medical-surgical visits to various settings, including private offices, outpatient clinics, day surgeries, and community health centers.

Approximately one-third of CATIE-AD participants (33.7%) were initially assigned to placebo; the remainder to one of three atypical antipsychotic medications: olanzapine (23.7%), quetiapine (22.3%), and risperidone (20.2%). Thus, a final predictor variable indicates whether participants were assigned to one of the three “treatments” or placebo. Results reported do not differ from those including receipt of each antipsychotic medication as separate indicator variables.

Analysis

The analysis proceeded in several steps. First, we identified the percentage of participants who eventually entered a nursing home, including the average number of days to admission. Second, we used t-tests and χ^2 tests to compare baseline characteristics of participants who eventually entered a nursing home to those who did not. Third, we employed Cox proportional hazard modeling to estimate adjusted hazard ratios for nursing home admission associated with the baseline independent variables described above. This involved use of PROC PHREG in SAS 10.0.

RESULTS

Eventual Nursing Home Entry

Of the 418 psychotic/agitated individuals participating in CATIE-AD without any nursing home use in the month preceding baseline, 64 (15.0%) were eventually placed in a nursing home during the 9 month following up period. The average time to nursing home use among these individuals was 122 days.

Baseline Characteristics

Study participants' averaged 77.9 years at baseline. The majority were female (56.0%), white (79.0%), and residing within their own home (73.2%). Less than one third (28.0%) were college educated (Table 1). Average HUI-III scores at baseline were 0.18, with individual scores ranging from -0.29 (worse than death) to 1.0 (perfect health). Average ADCS-ADL, NPI, MMSE, ADRQoL and CAS scores were 39.4, 36.9, 15.1, 67.3, and 5.21, respectively. Outpatient service utilization in the month preceding baseline was as follows: 37.0% used at least one AD-related outpatient services, 22.0% an outpatient mental health service, and 52.0% a medical-surgical outpatient service. Two-thirds (66.0%) were assigned to one of the three study medications; the remainder to placebo.

Bivariate Associations with Eventual Nursing Home Entry

Table 2 reports bivariate associations between participant characteristics and eventual nursing home service use. Results indicate that those with prior outpatient mental health use at baseline ($p<0.05$) were more likely to be admitted to a nursing home during the nine month follow-up period. They also indicate that those with worse physical functioning—lower scores on ADCS-ADL ($p<0.001$), weaker utilities—lower scores on the HUI-III ($p<0.05$), and worse cognition—lower scores on the MMSE ($p<0.10$), were also more likely to enter a facility.

Multivariate Model of Time to Nursing Home Entry

Table 3 reports results from the Cox proportional hazard model. The likelihood of nursing home use was more than two times greater for non-Hispanic white than minority patients with AD (hazard ratio [HR]=2.16) ($p<0.10$). Prior use of outpatient mental health services was associated with an 87.0% increase in the likelihood of nursing home entry as well (HR=1.87) ($p<0.05$). The likelihood of nursing home use declined with improved physical

functioning, with every one unit increase on the ADCS-ADL being associated with a 3.0% reduction in the probability of being placed ($HR=0.97$) ($p<0.05$).

DISCUSSION

Few, if any studies, examine nursing home use among AD patients with prominent psychotic symptoms or agitation. Our results indicate that 15.0% of participants in CATIE-AD without any nursing home use in the month preceding baseline were eventually placed in a nursing home during the 9 month follow-up period, translating to an annualized rate of placement of 20.0%. This figure is substantially higher than annual rates of incidence reported in probability samples of community-dwelling elderly people, both with (5.6% to 8.5%) and without (1.0 to 5.5%) activity of daily living limitations (Miller and Weissert 2001). It is also higher than the annual rates of incidence reported in most studies of community-dwelling patients with AD and other dementia (8.4 to 12.3%) (AD2000 2004; Chan *et al.*, 2003; Gilley *et al.*, 2004; Hatoum *et al.*, 2009; Knopman *et al.*, 1996; Smith *et al.*, 2001). Hatoum *et al.* (2009), for example, report that 16.8% of AD patients enrolled in a randomized trial comparing rivastigmine and donepezil (R-D) entered a nursing home during a two year study period for an average annual rate of placement of 8.4%. Another example, AD2000 (2004), report that 11.6% of AD patients enrolled in a randomized trial of donepezil or placebo entered a nursing home during the first year of observation. What explains the marked difference in incidence found among AD patients recruited for CATIE-AD (20.0%) and the R-D and AD2000 trials (8.4% and 11.5%, respectively)? Both CATIE-AD and R-D report similar levels of cognitive impairment; MMSE scores of 15.1 and 15.2, respectively. AD2000 reports that 49% and 51% of study participants had MMSE scores in the 10-18 and 19-26 range, respectively. But whereas CATIE-AD recruited subjects with prominent agitation or psychosis, R-D and AD2000 did not, thereby possibly explaining why higher rates of nursing home placement were found in CATIE-AD.

Perhaps the primary reason that community-dwelling AD patients with prominent psychosis or agitation are more likely than other AD patients to be placed in a nursing home is that they are more difficult for caregivers to manage. Psychosis in AD and other dementia includes simple delusions, misidentifications, hallucinations, agitation, aggression, and depression (Schneider and Dagerman 2004). Furthermore, AD patients with psychosis differ demographically and clinically from AD patients without psychotic symptoms. Those with psychosis are more likely to be characterized by female gender, neuropsychological deficits, anxiety, physical aggression and accelerated cognitive impairment (Schneider and Dagerman 2004). They are also more likely to be verbal and ambulatory. Community-based caregivers face substantial financial, physical, mental, and emotional challenges caring for frail and disabled individuals (Alzheimer's Association 2009; Miller, Allen and Mor, 2009). This is particularly true among those caring for dependent people afflicted with AD or other dementia (Orry, *et al.*, 1999); of whom, more burdened caregivers have been shown less able to keep care recipients from entering a nursing home (Herbert, *et al.*, 2001; Spruytte, *et al.*, 2001). It is likely that the challenges and subsequent risk of nursing home placement that caregivers face are only magnified further when caring for those AD sufferers with additional psychotic symptomatology.

It should be noted that there are a few exceptions to the general finding that studies investigating the rate of nursing home placement among the general population of AD patients is lower than the rate of placement among the AD patients with psychosis or agitation in CATIE-AD. This is reflected in Knopman *et al.* (1999), which reports that 33.0% of AD patients enrolled in the AD Cooperative Study (ADCS) trial of alpha-tocopherol and selegiline entered a nursing home during the course of the two year study period for an average annual incidence of 16.5%. It is also reflected in Yaffe *et al.* (2002),

which reports that 22.0% of AD patients enrolled in the Medicare AD Demonstration (MADD) of expanded case management and home- and community-based services entered a nursing home during that study's first year. Neither the tocopherol/selegiline trial nor MADD focused on AD patients with prominent psychotic symptoms. Yet the annualized incidence rates reported for nursing home placement—16.5% and 22.0%—correspond roughly with what we found in our investigation—20.0%. If most other studies demonstrate that AD patients with prominent psychoses are more likely to be institutionalized why would the incidence rates in these two studies approximate our results? Participants in the two earlier studies reported greater cognitive impairment than the participants in CATIE-AD. This is reflected in average MMSE scores at baseline for ADCS, MADD and CATIE-AD of 12.6, 14.2, and 15.1, respectively. Thus, greater cognitive impairment could be one reason why the incidence of nursing home entry found in the tocopherol/selegiline trial and MADD approached the incidence found in CATIE-AD despite the prominence of psychotic symptoms in the latter but not the former.

No matter whether average cognitive impairment is high or low it has been found to be a consistently significant correlate of nursing home placement, both in general and among cognitively-impaired populations (Gaugler *et al.*, 2007; 2009; Hatoum *et al.*, 2009; Knopman *et al.*, 1999; Smith *et al.*, 2001; Miller and Weissert 2000; Yaffe *et al.*, 2002). This too is reflected in our study but with respect to the bivariate findings only; in the multivariate model MMSE score did not prove significantly related to nursing home placement. One possible explanation can be found in the moderate correlation between the MMSE and ADCS-ADL ($r=.63$, $p<0.001$), which is consistent with extant research revealing significant functional impairment and medical comorbidities among those with AD or other dementia (Blaum *et al.*, 2002). However, when we reran the multivariate model without the ADCS-ADL, results for MMSE still did not prove statistically significant. Another possible explanation, therefore, is that MMSE scores do not adequately capture disease cognitive severity or progression in AD patients with prominent psychotic symptoms. This possibility is reflected in one recent review which concluded that the “dominance of cognitive function in the modeling literature is a big drawback in the area of AD, where disease progression is characterized by a number of factors and not just cognitive scores alone” (Green 2007). Indeed, agitation and/or psychotic symptomatology may serve to moderate the effect of cognitive impairment on the risk of nursing home placement where the effect is weaker in AD patients with prominent psychotic symptoms and stronger in AD patients without, possibly because the former are more difficult to manage no matter whether the degree of cognitive impairment is high or low.

Perhaps the most consistently significant correlate of nursing home use, both in general and among cognitively impaired elderly populations, is physical functioning, typically measured using basic and instrumental activities of daily living (Chan *et al.*, 2003; Gaugler *et al.*, 2007, 2009; Hatoum *et al.*, 2009; Knopman *et al.*, 1999; Miller and Weissert 2000; Smith *et al.*, 2001; Yaffe *et al.*, 2002). This too is reflected in the current study where each unit increase on the ADCS-ADL scale was associated with a 3.0% reduction in the likelihood of being placed. A similar result is reported in Hatoum *et al.* (2009), which found that over two years a 3% change in the likelihood of nursing home placement for each unit change in ADL-score.

Similar to earlier studies we found that non-Hispanic white participants were two times more likely to be placed in a nursing home than minority ones (Chan *et al.*, 2003; Gaugler *et al.*, 2007, 2009; Miller and Rosenheck 2006; Miller and Weissert 2000; Yaffe *et al.*, 2002). This is typically attributed to cultural and attitudinal differences as well differences in socioeconomic characteristics, which, in the present study, we control for using education. Findings also reveal a direct association between prior utilization of outpatient mental health

services and eventual nursing home placement, with those using one or more services in the month preceding baseline being 78.0% more likely to be placed. Though few studies examine the association between outpatient mental health and nursing home use, this finding is consistent with previous research documenting a positive association between any outpatient mental health use and nursing home admission among mentally ill patients within the U.S. Department of Veterans Affairs (Miller and Rosenheck 2006). It is also consistent with studies demonstrating a positive association between nursing home admission and health services utilization more generally (Gaugler *et al.*, 2007, 2009; Miller and Weissert 2000).

Twenty-two percent of CATIE-AD participants used outpatient mental health services at baseline. This use may be positively related to subsequent nursing home admission because it serves as an additional measure of psychiatric impairment and severity. However, it may also be related because it serves as a measure of access -- in two respects. On the one hand, those patients and caregivers using outpatient mental health care in the month prior to randomization may have been better able to navigate the health system and obtain particular types of services when needed. On the other hand, those patients and caregivers using outpatient mental health care in the month prior to randomization may have done so because they had not accessed those services previously. Consequently, they may have been less likely to have been on a ChEi, antidepressant, conventional or atypical antipsychotic, which, if effective, may have slowed down the trajectory toward subsequent nursing home use. The extent to which they did so would only be temporary, however; ChEi's, for example, have only been shown to work for 6 to 12 months maximum.

That prior mental health services use is positively related to the risk of nursing home placement among AD patients with psychosis or agitation highlights the need to have sufficient psychiatric resources and staff available to ensure continuity of care for this population once they enter a facility. Doing so, however, is problematic in the current environment where the "treatment of mental disorders in the nursing facility population still does not receive the emphasis and attention that the prevalence of such disorders warrants" (Colenda, *et al.*, 1999). Less than half of nursing home residents in the U.S. with a serious mental illness receive appropriate preadmission screening (Office of the Inspector General 2001). Furthermore, nursing homes continue to be cited for deficiencies in mental health care, including failing to assess mental, psychosocial and cognitive status and inappropriate treatment of mental conditions (Castle, 2002). The result, according to one nationally representative study, is that two-thirds of nursing home residents with identified mental illness do not receive any mental health services (Shea, *et al.*, 2000). Prevailing deficits are also recognized by nursing home staff who perceive that the need for psychosocial services far exceeds the level of care provided (Reichman, *et al.*, 1998). Given persistent problems providing mental health care to nursing home residents, it is critical that additional funding be provided to hire and educate the additional staff necessary to care for not only the growing population of nursing home residents with AD but, especially, those AD cases complicated by delusions, hallucinations and other psychotic features.

Limitations

The present study breaks new ground by examining the relationship between sociodemographic and clinical/disease-specific characteristics and time to nursing home placement among AD patients with prominent delusions, hallucinations, and agitation/aggression participating in a clinical trial. It also employs previously unexamined correlates such as health utilities, which proved marginally significant in the bivariate analyses. Several limitations are worth noting, however. First, results derived from CATIE-AD may not be generalizeable. All participants had active caregivers who were provided basic

information and education, two counseling sessions, and could speak with staff members as needed. Furthermore, CATIE relied exclusively on a cohort of AD cases thought to potentially benefit from antipsychotic therapy. Given the limited impact of the antipsychotic medications, however, on the primary outcomes of the trial (discontinuation from treatment for any cause, at least minimal improvement on the Clinical Global Impression Change scale) (Schneider *et al.*, 2006) or cost effectiveness (Rosenheck *et al.*, 2007), we did not expect the presence of the study medication to influence eventual nursing home placement, which our results confirm. Second, our analyses may have been improved if certain additional data had been available. Although Cox proportional hazard modeling enabled us to make maximal use of the available data, a longer follow-up period would have been preferable. We also did not have direct access to measures of medical comorbidity, though it tends to be highly correlated with age, functional limitations, cognitive impairment, and HUI-III score, and is only rarely found significant after controlling for other factors (Smith *et al.*, 2000). Furthermore, data on caregiver characteristics—age, gender and relationship—were incomplete. Consequently, these were excluded rather than conducting the analyses with more than one hundred fewer observations and thereby potentially biasing the results. Last, the data used in this study derived from proxy raters rather than from the patients themselves. Though this is also true of most other AD studies, it remains uncertain whether caregiver proxy or patient provided information is most appropriate, especially since proxies often rate impairments different than patients or objective measures do, including when measured using functional capacity, health utilities, or quality of life (see, for example, Loewenstein *et al.*, 2001).

CONCLUSION

This is the first study to examine the risk of nursing home admission in a population of AD patients characterized by prominent psychotic symptoms and/or symptomatic agitation. Results lend support to the proposition that the incidence of nursing home entry among such patients may be considerably higher than the incidence of entry among AD patients more generally. As such, the high incidence of nursing home placement during the nine-month study period highlights the importance of accounting for such utilization in health economic studies of AD outcomes associated with patients with prominent agitation and/or psychotic symptomatology. Furthermore, factors leading to nursing home entry among AD patients with delusions and hallucinations were similar to the broader population of AD sufferers, as well as to community-dwelling elderly people more generally.

Although a number of studies have modeled nursing home admission, the algorithm reported in Stern *et al.* (1997), incorporating psychosis, extrapyramidal symptoms, MMSE score, duration of illness and age at onset, has been widely used to predict AD patients' risk for eventual nursing home placement. Our study, however, indicates that the algorithm used to predict the risk of placement needs to be adjusted for the particular population examined. Indeed, at least one predisposing (race/ethnicity), need (physical functioning), and utilization (mental health) variable proved significantly related to time to nursing home entry, thereby suggesting that the risk of nursing home placement in AD sufferers characterized by prominent psychotic symptoms can be explained, in part, by drawing on Andersen's behavioral model of health services use.

That the ADCS-ADL proved significantly related to subsequent nursing home placement implies that ADLs may be used to help predict service use among AD patients with delusions and hallucinations. This suggests that it could inform the development of profiles identifying those at greater or lesser risk of nursing home entry, and in so doing inform population planning associated with AD and identification of those individuals and caregivers who might benefit most from interventions to prevent eventual nursing home

placement (Miller and Weisert 2000; Weissert and Miller 2001; Weissert, *et al.*, 2003). Through risk assessment those individuals deemed most at risk for nursing home entry could be directed toward additional resources and supports, including more simplified access to a broad array of services and the provision of timely and accurate information (Miller, Allen and Mor 2009). Examples range from respite and adult day care to home modification and in-home support to care coordination and counseling to integrated service delivery and consumer direction. Since risk assessment may be key to prioritizing participation in nursing home diversion programs, it is important that further research be undertaken to substantiate the relationship between ADLs and nursing home admission identified, perhaps by modeling future admission, in part, as a function of ADL scores at baseline and using longer observation periods and larger, more representative samples of AD patients with prominent psychosis.

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TABLE 1

Characteristics of Study Sample at Baseline (n=404-418)

	Mean	Standard Deviation	Minimum	Maximum
Age	77.9	7.5	51.0	103.0
Female	0.56	0.50	0.00	1.00
Non-Hispanic White	0.79	0.41	0.00	1.00
Living within Own Home	0.73	0.44	0.00	1.00
Some College or More	0.28	0.45	0.00	1.00
ADCS-ADL Scale	39.44	17.15	2.00	76.00
Neuropsychiatric Inventory	36.87	18.23	3.00	104.00
Mini-Mental State Exam	15.06	5.76	4.00	29.00
AD-Related Quality of Life	67.29	14.65	18.71	100.00
Health Utilities Index	0.18	0.25	-0.29	1.00
Caregiver Activity Survey	5.21	4.80	0.00	48.00
AD-Related Outpatient	0.37	0.48	0.00	1.00
Mental Health Outpatient	0.22	0.41	0.00	1.00
Medical-Surgical Outpatient	0.52	0.50	0.00	1.00
Treatment	0.66	0.47	0.00	1.00

n varies depending on the number of missing values

TABLE 2
Bivariate Associations between Participant Characteristics and Eventual Nursing Home Use (n=404-418)

	Eventual Nursing Home Placement			p
	Yes	No	χ^2 (d.f.)	
Age	77.79	77.92	0.13 (416)	0.9005
Female	54.69%	55.93%	0.03 (1)	0.8536
Non-Hispanic White	85.94%	77.84%	2.14 (1)	0.1429
Living within Own Home	76.56%	72.60%	0.43 (1)	0.5100
Some College or More	31.25%	27.97%	0.29 (1)	0.5921
ADCS-ADL Scale	32.70	40.68	3.46 (409)	0.0006***
Neuropsychiatric Inventory	38.13	36.63	-0.60 (409)	0.5505
Mini-Mental State Exam	13.94	15.26	1.69 (411)	0.0920 [#]
AD-Related Quality of Life	65.51	67.61	1.05 (411)	0.2955
Health Utilities Index	0.12	0.20	2.09 (409)	0.0368*
Caregiver Activity Survey	5.07	5.24	0.24 (402)	0.8072
AD-Related Outpatient	45.31%	35.88%	2.06 (1)	0.1509
Mental Health Outpatient	32.81%	19.77%	5.41 (1)	0.0200*
Medical-Surgical Outpatient	46.88	53.11	0.844 (1)	0.3583
Treatment	17.33%	11.35%	2.58 (1)	0.1084

Percentages and χ^2 test results reported for dichotomous variables

Means and t-test results reported for continuous variables

n varies depending on the number of missing values

***p<.01

[#] p<0.10

* p<0.05

*** p<0.001

TABLE 3
Cox Proportional Hazard Model of Eventual Nursing Home Placement in CATIE-AD (n=391)

	Hazard Ratio	95% Confidence	
		Lower	Upper
Age	1.000	0.9626	1.037
Female	1.049	0.610	1.806
Non-Hispanic White	2.216 [#]	0.938	5.236
Living within Own Home	1.677 [#]	0.865	3.250
Some College or More	1.105	0.635	1.924
ADCS-ADL Scale	0.968 [*]	0.943	0.993
Neuropsychiatric Inventory	0.992	0.974	1.009
Mini-Mental State Exam	1.014	0.953	1.078
AD-Related Quality of Life	0.996	0.973	1.019
Health Utilities Index (transformed)	0.948	0.821	1.096
Caregiver Activity Survey	0.959	0.890	1.033
AD-Related Outpatient	1.234	0.717	2.124
Mental Health Outpatient	1.873 [*]	1.061	3.306
Medical-Surgical Outpatient	0.798	0.470	1.35
Treatment	1.501	0.822	2.744

-2 Log Likelihood: 642.845^{*}

|Wald χ^2 |

**p<0.01

***p<0.001

[#]p<0.10

^{*}p<0.05