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Psychotropic medication prescribing in assisted living and nursing home residents with dementia after the National Partnership

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Key Points

- Among a national sample of fee-for-service Medicare beneficiaries with Medicare Part D, the impact of the Centers for Medicare & Medicaid Services' National Partnership to Improve Dementia Care in Nursing Homes on decreasing antipsychotic prescribing in nursing home residents with Alzheimer's disease and related dementias (ADRD) did not affect prescribing in assisted living residents with ADRD.
- The prescribing of psychotropic medications was prevalent among assisted living residents with ADRD; however, the percentage of psychotropic medication prescribed for each medication class (i.e., antipsychotics, anticonvulsants/mood stabilizers, antidepressants, anxiolytics/sedative-hypnotics, benzodiazepines, and antidementia medications) was lower among assisted living residents with ADRD than long-stay nursing home residents with ADRD.
- An increase was observed in mood stabilizer/anticonvulsant medication prescribing, particularly gabapentin, and future monitoring for all psychotropic medication prescribing among assisted living residents with ADRD may better reflect quality dementia care.

Why does this matter?

Antipsychotic and other psychotropic medication prescribing in assisted living residents with ADRD is prevalent and suggests the need to develop strategies to monitor their use in assisted living facilities.

ABSTRACT

Background: The Centers for Medicare & Medicaid Services implemented the National Partnership to Improve Dementia Care in Nursing Homes (the Partnership) to decrease antipsychotic use and improve care for nursing home (NH) residents with dementia. We determined whether the extent of antipsychotic and other psychotropic medication prescribing in AL residents with dementia mirrored that of long-stay NH (LSNH) residents after the Partnership.

Methods: Using a 20% sample of fee-for-service Medicare beneficiaries with Part D, we conducted a retrospective cohort study including AL and LSNH residents with dementia. The monthly prevalence of psychotropic medication prescribing (antipsychotics, antidepressants, anxiolytics/sedative-hypnotics, anticonvulsants/mood stabilizers, benzodiazepines, and antidementia medications) was examined. We used an interrupted time-series analysis to compare medication prescribing before (July 1, 2010–March 31, 2012) and after (April 1, 2012–December 31, 2017) the Partnership in both settings.

Results: We identified 107,931 beneficiaries with ≥ 1 month as an AL resident and 323,766 beneficiaries with ≥ 1 month as a LSNH resident with dementia, including 1,923,867 person-months and 4,984,405 person-months, respectively. Antipsychotic prescribing declined over the study period in both settings. After the launch of the Partnership, the rate of decline in antipsychotic prescribing slowed in AL residents with dementia (slope change = 0.03 [95% CLs: 0.02, 0.04]) while the rate of decline in antipsychotic prescribing increased in LSNH residents with dementia (slope change = -0.12 [95% CLs: -0.16, -0.08]). Antidepressants were the most prevalent medication prescribed, anticonvulsant/mood stabilizer prescribing increased, and anxiolytic/sedative-hypnotic and antidementia medication prescribing declined.

Conclusions: The federal Partnership to reduce antipsychotic prescribing in NH residents did not appear to affect antipsychotic prescribing in AL residents with dementia. Given the increase in the prescribing of mood stabilizers/anticonvulsants that occurred after the launch of the Partnership, monitoring may be warranted for all psychotropic medications in AL and NH settings.

Keywords: Assisted Living Facilities, Nursing Homes, Dementia, Alzheimer Disease, Psychotropic Drugs

INTRODUCTION

The Centers for Medicare & Medicaid Services (CMS) launched the National Partnership to Improve Dementia Care in Nursing Homes ("the Partnership") to improve the quality of care for nursing home residents with dementia in 2012.[1] The Partnership specifically targeted off-label prescribing of antipsychotics for their well-documented adverse health consequences in people with dementia.[2,3] By 2016, a 30% decrease in antipsychotic use among long-stay nursing home (LSNH) residents was attributed[4] to the Partnership's multifaceted efforts, including stakeholder engagement, training for nursing home staff and surveyors, public reporting on antipsychotic drug use (i.e., Nursing Home Compare), and emphasis on non-pharmacologic alternatives to antipsychotic use.[1,4] Nursing homes (NH) were a good place to implement this policy as they fall under Federal regulations and care for a population with a high prevalence (48%) of dementia.[5] However, the prevalence of dementia or severe cognitive impairment among assisted living (AL) residents is also high, with estimates ranging from 42 to 76%. Furthermore, a substantial subset of AL residents (37-69%) have exposure to antipsychotics or other medications used to treat dementia-related psychiatric and behavioral symptoms.[6,7]

Since regulation of AL facilities is the responsibility of individual states, there is less consistent oversight of medication use than in NH.[8] Some states require medication reviews for AL residents while others require that residents seek their own medical care, rendering antipsychotic prescribing beyond the facility's control. The Joint Commission's Assisted Living Community accreditation program is an initiative to advance quality within AL facilities and includes an off-label antipsychotic drug use performance standard,[9] but this program started in 2021. To date, there has been no analogous federal Partnership that uses stakeholder

engagement, education resources, public reporting, quality measures, state surveyor guidance and direction, or monetary penalties to decrease antipsychotic use in AL facilities. Previous work indicated that AL facilities affiliated with NHs have a lower rate of potentially inappropriate antipsychotic prescribing versus unaffiliated.[10] However, we do not know whether the national extent of antipsychotic and other psychotropic medication prescribing among AL residents with dementia warrants improved quality oversight and regulation.

While antipsychotic prescribing has declined in long-term care settings, there has been increased prescribing of other medication classes not subject to CMS and NH regulations—such as antiepileptics and mood stabilizers—medications that also carry safety risks while being less effective in treating behavioral symptoms.[11,12] It is unclear if these same substitution effects are also occurring in AL facilities.

The goal of this study was to determine whether the extent to which antipsychotic and other classes of psychotropic medications prescribed in AL residents with dementia mirrored that of LSNH residents with dementia after the launch of Partnership.[11,12] We hypothesized that the percent of residents with dementia in AL facilities prescribed antipsychotics would decline after the launch of the Partnership, but to a lesser extent than in LSNH where regulatory oversight is stronger. We also hypothesized that the overall percentage of AL residents with dementia prescribed psychotropic medications would remain constant due to an increased prescribing of anticonvulsant/mood stabilizers, particularly gabapentin.

METHODS

Study Design and Data Sources

We conducted a retrospective cohort study using a person-month data structure, whereby each person contributed one observation for each calendar month in which they were a LSNH or AL resident for at least one day. Data sources included a 20% sample of enrolled Medicare beneficiaries from the Medicare Master Beneficiary Summary Files (MBSF) (demographics and enrollment), Medicare Provider Analysis and Review (inpatient, skilled nursing facility stays), outpatient hospital, carrier (visits and diagnoses), hospice, home health, and Part D event files (prescription drug claims). Medicare files were linked with a 9-digit ZIP code file identifying assisted living facilities with 25 beds or more and the residential history file to identify beneficiaries' residence using a previously validated algorithm.[13,14] This study was approved by the Brown University institutional review board.

Study Population

We included Medicare fee-for-service beneficiaries with at least one person-month with diagnosed Alzheimer's disease and related dementias (ADRD) and at least one person-month as an AL or LSNH resident. The study timeframe was from July 1, 2010 to December 31, 2017.

Diagnosed ADRD was identified using a validated algorithm through International Classification of Diseases Ninth or Tenth Revision, Clinical Modification (ICD-9-CM or ICD-10-CM) diagnosis codes in the Medicare claims (Supplementary Table S1).[15,16] The first claim with an ADRD diagnosis was considered the beneficiary's first observed person-month with ADRD. The beneficiary was considered to have ADRD from that time point until the end of observation or study period. Medicare beneficiaries without enrollment in Medicare Part D or

with a claim including a Huntington's disease, Tourette syndrome, or schizophrenia ICD-9-CM or ICD-10-CM diagnosis were excluded (Supplementary Table S1).

We excluded from analysis beneficiaries' person-months before ADRD diagnosis or with no LSNH or AL resident days. Person-months with incomplete Medicare coverage (Parts A/B/D) and person-months with any hospice enrollment or attributable to a Medicare-covered skilled nursing facility stay were excluded because medication use is unobservable in Part D claims data during such periods (Figure 1). An example timeline of included person-months for analysis is included as Supplementary Figure 1.

Residential Setting of Care

The beneficiaries' setting of care was determined for every calendar month based on having at least one day in the highest level of care. Using residential history methodology, we assigned Medicare beneficiaries to a NH, AL, and other residence location for each observed person-month.[13,14] To identify AL residence, beneficiaries' 9-digit ZIP codes reported in the MBSF files were linked with ZIP codes of known AL communities with 25 beds or more.[14,17] NH was the highest level of care, then AL, and then all other settings. For example, a Medicare beneficiary with one NH day and one AL day in a calendar month was assigned to the NH residence group for that person-month. We included those who met inclusion criteria and were assigned to the AL and LSNH residence setting in our study.

LSNH residents were defined as those with a continuous stay at any NH facility for ≥ 100 days and no more than ten days outside of a facility. AL residents were defined as those with at least one day in AL assigned as the highest level of care. A month with at least one day of AL

residence and no NH days was assigned as an AL month. Beneficiaries may have contributed to both the AL and LSNH settings if they transitioned from one setting to another during the study period.

Outcomes

The percentage of AL and LSNH residents with ADRD prescribed psychotropic medications was the primary outcome. We examined the following psychotropic medication classes: antipsychotics, anticonvulsants/mood stabilizers, anxiolytics/sedative-hypnotics, benzodiazepines, antidepressants, and antidementia medications. A list of included medications, adapted from published resources,[12,18-22] is provided in Supplementary Table S2. Medicare Part D claims were used to identify prescription fills for each psychotropic medication using generic drug names. The days' supply of each psychotropic medication fill was used to determine a beneficiary's exposure to that medication over time, accounting for subsequent fills and adjusting for early refills. For example, a 90-day supply counted as exposure for the corresponding three months. If the next 90-day supply was filled early, the supply was appended to the last day of the prior fill. We calculated the percentage of residents with ADRD prescribed a psychotropic medication by class in AL and LSNH settings on a monthly basis.

Demographic and Clinical Characteristics

We obtained age, sex, race/ethnicity, ZIP code, and state of residence from the Medicare MBSF to describe our cohorts. Geographic residence region was categorized based on the US

Census (Northeast, South, Midwest, West).[23] We calculated the Combined Comorbidity Score from ICD-9-CM and ICD-10-CM diagnosis codes. The Combined Comorbidity Score predicts one year-mortality and was developed and validated in a Medicare population based on conditions in the Charlson Comorbidity Index and Elixhauser Comorbidity Index.[24,25] The presence of additional clinical conditions, including anxiety, depression, bipolar disorder, and chronic pain/fibromyalgia/fatigue, was determined using the MBSF Chronic Condition Warehouse end-of-year indicator flags.

Statistical Analysis

We used descriptive statistics (means, SD, frequency, %) to describe the demographic and clinical characteristics of AL and LSNH Medicare beneficiaries with ADRD at three time points (2011, 2013, and 2017). Beneficiaries were required to have one year of continuous enrollment in Medicare Parts A, B, and D prior to July 1 of 2011, 2013, and 2017 to ascertain these characteristics. We also calculated the total number of included person-months for AL and LSNH over the entire window of observation (July 1, 2010-December 31, 2017).

The proportion of psychotropic medication prescribed by class and month for AL and LSNH residents was calculated. We used an interrupted time-series (ITS) analysis using a segmented ordinary least-squares linear regression model to examine the association of the Partnership with monthly antipsychotic and other psychotropic medication prescribing in both AL and LSNH residents. The ITS approach was selected because it provided estimates of two effects of interest: 1) the "change in level of antipsychotic prescribing", defined as the change immediately after the Partnership was introduced, and 2) the "change in slope of antipsychotic

prescribing", defined as the difference in trends in prescribing before and after the Partnership. We performed the analysis separately for each medication class and residential setting. We considered July 1, 2010 – March 31, 2012, to be pre-Partnership (i.e., Period 1, 21 months) and April 1, 2012- December 31, 2017, to be post-Partnership (i.e., Period 2, 69 months). We used the Cumby-Huizinga test to examine each ITS model for autocorrelation and then refit our ITS models with appropriate lag and a Newey-West correction to standard errors. We did not include benzodiazepines in our ITS analysis as Medicare Part D did not cover benzodiazepines until 2013. All tests were 2-sided and a P value of .05 or less was considered significant.

Stability Analysis

As a stability analysis to examine the robustness of our results to alternate modeling choices, we also conducted ITS analyses using a linear generalized least-squares regression model with robust standard errors, assuming that the errors followed a first-order autoregressive process.

Software

SAS version 9.4 (Cary, NC) and Stata version 17.0 (College Station, TX) were used for analysis.

RESULTS

Among fee-for-service Medicare beneficiaries with one or more months with an ADRD diagnosis, we identified 107,931 beneficiaries with one or more months as an AL resident and 323,766 beneficiaries with one or more months as a LSNH resident (Supplementary Figure 2). A higher proportion of AL residents were excluded due to no Part D coverage than LSNH residents

(9.1% vs. 0.01%). The demographics, Combined Comorbidity Score, and additional clinical conditions of AL and LSNH residents with ADRD are summarized in Table 1. Most included beneficiaries were female, non-Hispanic White, and over 80 years old across 2011, 2013, and 2017. Compared to LSNH residents with ADRD, AL residents with ADRD had a lower proportion of non-Hispanic Black race/ethnicity, dual-eligible Medicare-Medicaid status, and lower number of comorbidities.

Psychotropic Medication Prescribing among Assisted Living and Long-stay Nursing Home Residents with ADRD

Overall Psychotropic Medication Prescribing by Residential Setting

After applying person-month exclusion criteria, 1,923,867 person-months for AL residents and 4,984,405 person-months for LSNH residents with ADRD were included in our medication analyses (Figure 1). Figure 2 compares the observed percent of psychotropic medication prescribing in AL and LSNH residents with ADRD before the Partnership (Period 1) and after the start of the Partnership (Period 2). Throughout the study period, the extent of psychotropic medication prescribing was lower among AL residents with ADRD than LSNH residents with ADRD for each medication class.

Antipsychotics

Almost 9% of AL residents with ADRD were prescribed an antipsychotic in July 2010 compared to 8% in December 2017 (Supplemental Table S3). Our ITS results of psychotropic medication prescribing pre- and post-Partnership for AL and LSNH residents with ADRD are provided in Table 2 and Table 3, respectively. Although the rate of antipsychotic prescribing pre- and post-Partnership was decreasing (i.e., negative slopes) among AL residents with ADRD, the

slope change pre- and post-Partnership for antipsychotic prescribing was positive (slope change = 0.03 (95% CL: 0.02, 0.04), $p < 0.001$) (Table 2). This positive slope change indicates that the Partnership policy on antipsychotic prescribing in NH did not affect antipsychotic prescribing in AL residents with ADRD. The prescribing of antipsychotics decreased in LSNH residents with ADRD (23% in July 2010 vs. 13.5% in December 2017, Supplemental Table S3). In contrast to AL residents, the slope change pre- and post-Partnership of antipsychotic prescribing among LSNH residents with ADRD was -0.12 (95% CL: -0.16, -0.08), $p <0.001$), and represents an accelerated decline in antipsychotic prescribing after the start of the Partnership (Table 3).

Antidepressants

Antidepressants were the most prevalent medication class, with almost one-third of AL residents and half of LSNH residents with ADRD prescribed an antidepressant in December 2017 (Supplementary Table S3). The Partnership did not impact antidepressant prescribing among AL residents with ADRD — antidepressant prescribing increased over the pre-Partnership and post-Partnership periods with no significant slope change between the two periods (Table 2). Antidepressant prescribing increased in the pre-Partnership period, but slightly decreased among LSNH residents after the Partnership (slope change = -0.33 (95% CL: -0.52, -0.15), $p <0.05$ (Table 3)).

Anticonvulsants/mood stabilizers

The prescribing of anticonvulsants/mood stabilizers increased over time in both cohorts, from 9.3% to 14.4% in AL residents and 16.7% to 26.8% in LSNH residents with ADRD (Supplemental Table S3). While both pre- and post-Partnership slopes increased among both cohorts, the Partnership impacted anticonvulsants/mood stabilizer prescribing only among the AL residents with ADRD (Table 2 and 3). After the Partnership, the prescribing of

anticonvulsants/mood stabilizers in AL residents with ADRD increased (slope change = 0.01 (95% CL: 0.0004, 0.02), $p < 0.05$ (Table 2)).

Anxiolytic/sedative-hypnotics and antidementia medications

Anxiolytic/sedative-hypnotic and antidementia medication prescribing declined in both cohorts over time. While the Partnership did not have a significant impact on antidementia medication prescribing in AL residents ADRD, there was a further decrease in the prescribing of anxiolytic/sedative-hypnotics (slope change = -0.02 (95% CL: -0.03, -0.002), $p < 0.05$ (Table 2)). The Partnership did not affect anxiolytic/sedative-hypnotic or antidementia medication prescribing among LSNH residents with ADRD. After the start of coverage of benzodiazepines by Medicare Part D (2013), their prescribing was stable in both LSNH and AL residents with ADRD (approximately 15% and 10%, respectively, Figure 2, Supplementary Table S3).

Most Common Psychotropic Medications

Supplemental Table S4 provides the ten most commonly prescribed psychotropic medications in decreasing order by class in 2011, 2013, and 2017. In both AL and LSNH residents with ADRD, quetiapine and gabapentin were the most commonly prescribed antipsychotic and mood stabilizer/anticonvulsant, respectively (Supplementary Tables S5 and S6).

Stability Analyses

Results were stable and inferences qualitatively similar when implementing first-order autoregressive generalized least-squares regression models with robust standard errors (Supplementary Tables S7 and S8).

DISCUSSION

The launch of the Partnership did not appear to affect antipsychotic prescribing for AL residents with dementia while antipsychotic prescribing decreased in LSNH residents with ADRD. The extent of anticonvulsant/mood stabilizer prescribing increased from 2010 to 2017 in AL residents, with growth largely attributed to gabapentin prescribing, similar to what was seen in the NH settings. Across both settings, antidepressants were the most commonly prescribed psychotropic medication class and the prescribing of both anxiolytic/sedative-hypnotic and antidementia medications decreased. Benzodiazepine prescribing remained relatively constant after coverage began in 2013.

Our study observed an unexpected slight increase in the rate of antipsychotic prescribing in AL residents with ADRD after the Partnership. In contrast to AL residents, we found that among LSNH residents with ADRD the rate of antipsychotic prescribing decreased after the Partnership. A previous study evaluating LSNH residents with fee-for-service Medicare and Part D prescription coverage found that antipsychotic and overall psychotropic medication prescribing declined from 2009 to 2014, but the Partnership did not accelerate this decline.[12] Using a longer timeframe and monthly prevalence, our analysis demonstrates a greater rate of decline in antipsychotic prescribing after the Partnership among LSNH residents. Our findings support that federal policy with multiple interventions, such as the Partnership, can impact antipsychotic medication prescribing in older adults with ADRD.

Antipsychotic use in older adults with ADRD residing in AL is not regulated or monitored at the federal level. There is wide variation in state-level regulation of antipsychotic use for behavioral disturbances in ADRD in AL facilities, from little regulation to regulation on par with NH standards. One review of state regulations for AL facilities through 2013 indicated

that 33 states regulated the use of chemical restraints. Still, only ten states had prohibited the use of chemical restraints, sedatives, and psychotropic medications under any circumstance.[8] Beyond policy, staff training may play a role in antipsychotic use among AL residents with dementia.[26] Results from the 2010 National Survey on Residential Care Facilities indicated that 21% of AL residences had medications administered by staff who were not trained in medication administration and 69% regularly gave medications for behavior control.[7] A similar federal-level Partnership training and education program around non-pharmacological alternatives to antipsychotic medications for behavioral disturbances in ADRD[1] for AL staff and providers may help decrease inappropriate medication use.

To our knowledge, this is the first study to provide national estimates of trends in antipsychotic and other psychotropic medication prescribing among AL residents with ADRD in a Medicare fee-for-service sample. Our results, in general, show lower psychotropic prescribing than previous studies of medication use among AL residents that were restricted to a limited geographic subset or used cross-sectional survey data. In a study of over 2,000 AL residents with documented dementia in 90 AL facilities in one state, an analysis from electronic medical record data indicated that approximately 41% were prescribed an antidementia medication, 37% an antipsychotic, 39% an antianxiety medication, and 57% received an antidepressant.[6] A cross-sectional analysis of the 2015 National Health and Aging Trends Study (NHATS) and linked Medicare prescription claims found that among AL residents with dementia, about 27% had antipsychotic and 47% had antidepressant prescriptions filled.[27] This study may have had higher medication prescribing due to the inclusion of fee-for-service and Medicare Advantage beneficiaries, use of proxy and self-reported dementia diagnosis, and because the 2015 NHATS AL respondents in 32 states may differ from our national 20% Medicare sample.[27] Additionally,

the previous studies provide a period prevalence estimate of medication prescribing while our study adds information on medication prescribing patterns over time.

Previous studies have demonstrated that declines in antipsychotic prescribing in NH have been largely matched by increases and substitution with other psychotropic medication prescribing, such as mood stabilizers.[11,12] Our study adds that this increase in mood stabilizer/anticonvulsant prescribing also occurred in AL residents with ADRD with parallel increases in prescribing during 2010 - 2017 among LSNH residents with ADRD. This increasing trend in the prescribing of mood stabilizers/anticonvulsant medications among AL and NH residents is particularly concerning given that these medications have even less evidence in treating behavioral disturbances in ADRD and a nonignorable potential for medication-related adverse effects and harms.[28,29]

Our analysis has several limitations. First, we limited our analysis to fee-for-service Medicare beneficiaries, and our results may not be generalizable to beneficiaries covered by Medicare Advantage for whom we did not have access to encounter data for the entire study period. We used a validated claims-based algorithm with high specificity to identify beneficiaries with ADRD limiting our population to those with an ADRD diagnosis on an administrative claim.[16] In AL facility populations, there are no federally mandated sources of clinical data such as the Minimum Data Set for Medicare and Medicaid certified NHs to add to our ADRD identification. We may have also underestimated the number of AL residents because we could not identify AL residents in small facilities or whose listed residential address according to Medicare was not the AL facility. We used prescription claims as a proxy for medication exposure and did not have information about actual medication ingestion or indication. We cannot rule out the possibility that prescribers attempted to reduce the use of antipsychotics in

AL but were unsuccessful due to the lack of a similar Partnership program (e.g., staffing and programmatic structures to manage ADRD-related behaviors) in AL settings. Finally, we did not examine how medication prescribing might vary based on provider or prescriber characteristics (e.g., specialty), a topic of potential future research.

Though prescribers who treat NH residents may also care for AL residents, the impact of major federal initiative to alter antipsychotic prescribing in NH residents with ADRD did not appear to affect prescribing in AL residents with ADRD at the national level. The potential dangers of antipsychotic and other psychotropic medication use in people with ADRD can occur regardless of setting. Strategies to decrease antipsychotic prescribing in AL residents with ADRD should include multiple stakeholders, such as prescribers, healthcare providers, patients, and care partners, to ensure safe medication use and prevent harm. Given the observed increase in mood stabilizer/anticonvulsant prescribing, future monitoring for all psychotropic medication prescribing among AL residents with ADRD may better reflect quality dementia care than antipsychotic prescribing alone.

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CONFLICT OF INTEREST

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AUTHORS' CONTRIBUTIONS

ABC, TZ, ARZ, LBG, KST, LAD: Study concept and design, analysis and interpretation of data, and preparation of manuscript; HV, DL, RJ: Analysis and interpretation of data; TIS, JPWB: Study concept and design, acquisition of data, analysis and interpretation of data, and preparation of manuscript.

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The funders had no role in design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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LEGENDS

Figure 1. Selection of person-months for inclusion in the study.

Figure 2. Observed percentage of psychotropic medications prescribed among assisted living residents and long-stay nursing home residents with ADRD, 2010-2017.

Supplemental Material:

Supplementary Table S1. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) and International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis codes used to identify beneficiaries with Alzheimer's disease and related dementias, Huntington's disease, Tourette syndrome, or schizophrenia.

Supplementary Table S2. Psychotropic medications and classes.

Supplementary Table S3. Percentage of psychotropic medications prescribed in assisted living (AL) and long-stay nursing home (NH) residents with ADRD, 2010-2017.

Supplementary Table S4. Top 10 individual medications prescribed per class in assisted living (AL) and long-stay nursing home residents (NH) with ADRD – 2011, 2013, 2017.

Supplementary Table S5. Monthly percent of mood stabilizer/anticonvulsant prescribing attributed to gabapentin, divalproex sodium and levetiracetam among assisted living (AL) and long-stay nursing home (LSNH) residents with ADRD, July 2010 – December 2017.

Supplementary Table S6. Monthly percent of antipsychotic prescribing attributed to quetiapine, risperidone, and olanzapine among assisted living (AL) and long-stay nursing home (LSNH) residents with ADRD, July 2010 – December 2017.

Supplementary Table S7. Interrupted time series stability analyses using a first-order autoregressive model with robust standard errors for medication prescribing among assisted living residents with ADRD pre- and post-Partnership.

Supplementary Table S8. Interrupted time series stability analyses using a first-order autoregressive model with robust standard errors for medication prescribing among long-stay nursing home residents with ADRD pre- and post-Partnership.

Supplementary Figure 1. Example timeline of Patient A's included person-months for medication prescribing analyses.

Supplementary Figure 2. Selection of persons for inclusion in the study.

Table 1: Characteristics of Medicare fee-for-service assisted living and long-stay nursing home resident beneficiaries with ADRD, 2011, 2013 and 2017.[a]

	Assisted Living Residents			Long-Stay Nursing Home Residents		
	Year			Year		
Characteristic	**2011**	**2013**	**2017**	**2011**	**2013**	**2017**
Total N	12750	15215	16031	31401	62262	60002
Age, mean (SD), years	85.8 (7.3)	86.4 (7.4)	87.3 (7.2)	84.0 (8.9)	84.6 (9.0)	84.8 (9.6)
Female, N (%)	9750 (76.5)	11533 (75.8)	12005 (74.9)	23165 (73.8)	46601 (74.9)	43438 (72.4)
Race/Ethnicity, N (%)						
Non-Hispanic White	12160 (95.4)	14541 (95.6)	15315 (95.5)	25690 (81.8)	51171 (82.2)	48818 (81.4)
Non-Hispanic Black	294 (2.3)	317 (2.1)	328 (2.1)	3497 (11.1)	6652 (10.7)	6553 (10.9)
Hispanic	88 (0.7)	92 (0.6)	75 (0.5)	1455 (4.6)	2907 (4.7)	2846 (4.7)
Other	208 (1.6)	265 (1.7)	313 (2.0)	759 (2.4)	1532 (2.5)	1785 (3.0)
Full dual-eligible, N (%)	1670 (13.1)	1859 (12.2)	1823 (11.4)	22932 (73.0)	46944 (75.4)	46873 (78.1)
Geographic residence, N (%)[b]						
Northeast	2559 (20.1)	2921 (19.2)	2981 (18.6)	7804 (24.9)	14383 (23.1)	13992 (23.3)
South	4690 (36.8)	5610 (36.9)	6031 (37.6)	12017 (38.3)	24257 (39.0)	23498 (39.2)
Midwest	3023 (23.7)	3682 (24.2)	3902 (24.3)	8229 (26.2)	17047 (27.4)	16079 (26.8)
West	2478 (19.4)	3000 (19.7)	3116 (19.4)	3347 (10.7)	6571 (10.6)	6431 (10.7)
Combined Comorbidity Score, mean (SD)	2.88 (2.8)	2.82 (2.9)	3.76 (3.2)	4.98 (3.4)	4.27 (3.3)	5.27 (3.6)
Anxiety, N (%)	2416 (19.0)	3487 (22.9)	4831 (30.1)	8173 (26.0)	19895 (32.0)	26035 (43.4)
Depression, N (%)	4656 (36.5)	5777 (38.0)	6142 (38.3)	16043 (51.1)	33125 (53.2)	34482 (57.5)
Bipolar disorder, N (%)	392 (3.1)	558 (3.7)	675 (4.2)	1919 (6.1)	4233 (6.8)	5875 (9.8)
Chronic pain, N (%)	1350 (10.6)	2076 (13.6)	3681 (23.0)	3353 (10.7)	8566 (13.8)	13500 (22.5)

[a] Characteristic determined on July 1, based on highest level of care in July 2011, 2013, and 2017

[b] The number of residents in each geographic region may not add to the total number of yearly assisted living and long-stay nursing home residents due to missing state information.

Table 2. Interrupted time series analysis results for medication prescribing among assisted living residents with ADRD pre- and post-Partnership, 2010-2017.

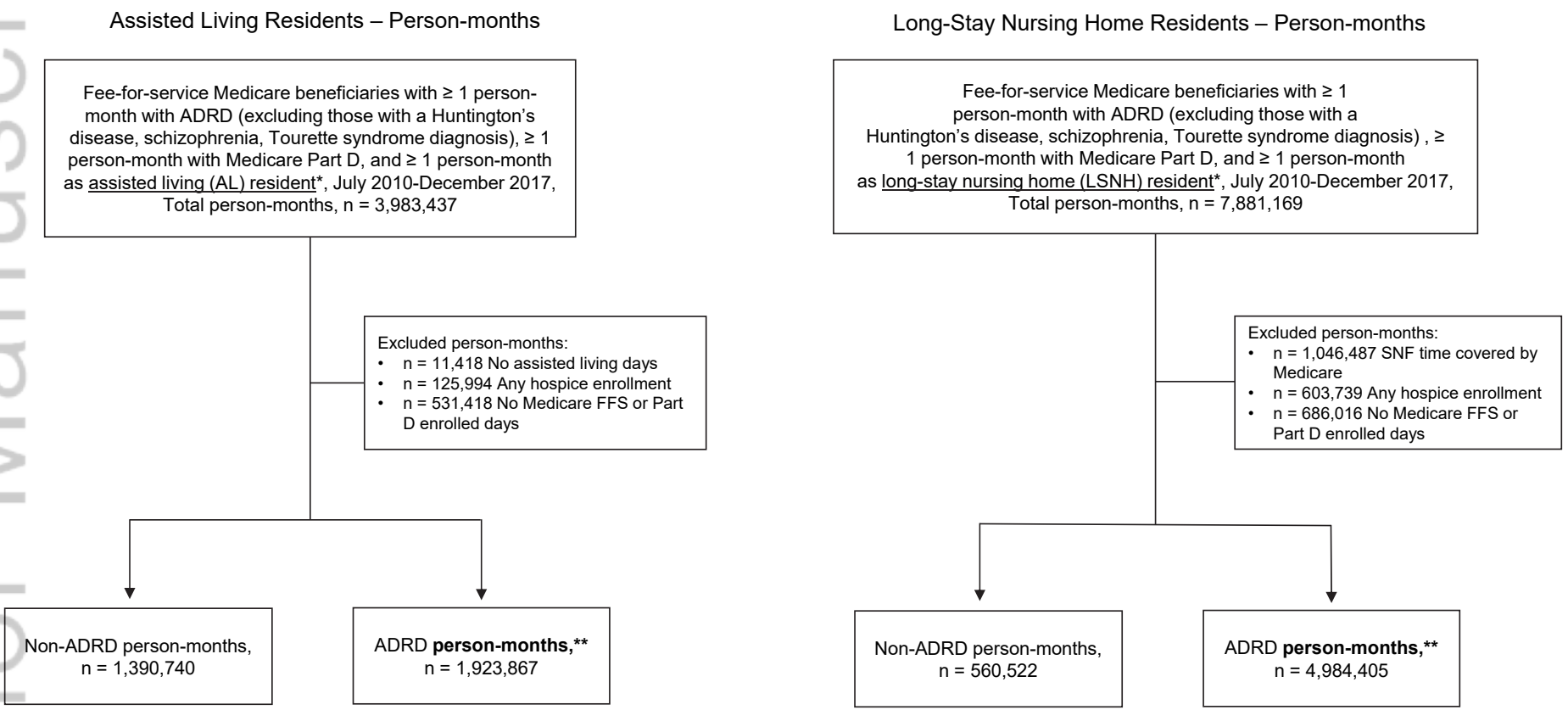
	Antipsychotics		Anticonvulsants / Mood Stabilizers		Anxiolytics / Sedative-Hypnotics		Antidepressants		Antidementia	
	Est.	95% CLs	Est.	95% CLs	Est.	95% CLs	Est.	95% CLs	Est.	95% CLs
Period 1: Pre-Partnership (Jul. 2010 - Mar. 2012)										
Prescribing at beginning of Period 1, Jul. 2010 (%)	8.96	(8.85, 9.06)	9.16	(9.02, 9.31)	5.35	(5.26, 5.45)	29.66	(29.52, 29.81)	27.98	(27.73, 28.23)
Slope during pre-Partnership period	-0.03	(-0.04, -0.02)**	0.05	(0.04, 0.06)**	-0.01	(-0.02, 0.01)	0.03	(0.02, 0.04)**	-0.08	(-0.10, -0.06)**
Period 2: Post-Partnership (Apr. 2012 - Dec. 2017)										
Level change	-0.17	(-0.35, 0.02)	0.26	(-0.03, 0.55)	-0.39	(-0.63, -0.17)*	0.02	(-0.33, 0.37)	0.12	(-0.29, 0.54)
Prescribing at start of period 2, Apr. 2012 (%)	8.10	(7.96, 8.23)	10.43	(10.16, 10.71)	4.85	(4.67, 5.04)	30.26	(29.95, 30.58)	26.42	(26.10, 26.75)
Slope during post-Partnership period	-0.01	(-0.01, -0.002)*	0.06	(0.05, 0.07)**	-0.02	(-0.03, -0.01)**	0.04	(0.03, 0.04)**	-0.08	(-0.09, -0.08)**
Slope change pre- and post-Partnership	0.03	(0.02, 0.04)**	0.01	(0.0004, 0.02)*	-0.02	(-0.03, -0.002)*	0.01	(-0.004, 0.02)	-0.002	(-0.03, 0.02)
Prescribing at end of period 2, Dec. 2017 (%)	7.67	(7.45, 7.90)	14.49	(14.34, 14.64)	3.42	(3.08, 3.76)	32.72	(32.54, 32.90)	20.83	(20.60, 21.06)

*p < 0.05, **p < 0.001, Residents with diagnoses of Huntington's disease, Tourette syndrome, or schizophrenia were excluded. Prevalence reported in the predicted percent from the interrupted time series model. Est. = Estimate, CLs = Confidence Limits

Table 3. Interrupted time series analysis results for medication use among long-stay nursing home residents with ADRD pre- and post-Partnership, 2010-2017.

	Antipsychotics		Anticonvulsants / Mood Stabilizers		Anxiolytics / Sedative-Hypnotics		Antidepressants		Antidementia	
	Est.	95% CLs	Est.	95% CLs	Est.	95% CLs	Est.	95% CLs	Est.	95% CLs
Period 1: Pre-Partnership (Jul. 2010 - Mar. 2012)										
Prescribing at beginning of Period 1, Jul. 2010 (%)	24.00	(23.54, 24.46)	17.55	(16.435, 18.661)	8.63	(7.86, 9.39)	44.24	(41.68, 46.80)	37.86	(37.01, 38.71)
Slope during pre-Partnership period	-0.02	(-0.05, 0.02)	0.15	(0.07, 0.23)**	-0.06	(-0.12, 0.003)	0.33	(0.14, 0.52)*	-0.17	(-0.23, -0.12)**
Period 2: Post-Partnership (Apr. 2012 - Dec. 2017)										
Level change	-2.30	(-3.33, -1.27)**	-1.07	(-1.72, -0.42)*	-0.45	(-1.20, 0.29)	-3.39	(-5.43, -1.35)*	-0.64	(-1.07, -0.20)*
Prescribing at start of period 2, Apr. 2012 (%)	21.34	(20.42, 22.25)	19.65	(19.45, 19.85)	6.91	(6.65, 7.18)	47.76	(47.40, 48.12)	33.60	(33.45, 33.76)
Slope during post-Partnership period	-0.14	(-0.16, -0.11)**	0.10	(0.10, 0.11)**	-0.03	(-0.04, -0.02)**	-0.003	(-0.01, 0.007)	-0.13	(-0.13, -0.13)**
Slope change pre- and post-Partnership	-0.12	(-0.16, -0.08)**	-0.05	(-0.13, 0.03)	0.03	(-0.03, 0.09)	-0.33	(-0.52, -0.15)*	0.04	(-0.01, 0.10)
Prescribing at end of period 2, Dec. 2017 (%)	12.05	(11.07, 13.02)	26.43	(26.24, 26.63)	4.85	(4.49, 5.20)	47.59	(47.23, 47.92)	24.81	(24.72, 24.89)

*p < 0.05, **p < 0.001, Residents with diagnoses of Huntington's disease, Tourette syndrome, or schizophrenia were excluded. Prevalence reported in the predicted percent from the interrupted time series model. Est. = Estimate, CLs = Confidence Limits



*Beneficiaries were assigned to a care setting in a calendar month based on the highest level of care. LSNH resident was defined as those with a continuous stay at any facility for ≥ 100 days and no more than 10 days outside of a facility. Beneficiaries may contribute to both the AL and LSNH cohort if they transitioned from one setting to another during the study period **Denotes person-months included in AL or LSNH person-months denominators for psychotropic medication prescribing analyses. SNF = skilled nursing facility, FFS = fee-for-service, AL = assisted living, LSNH = long-stay nursing home