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Featured Article

# Impact of programs to reduce antipsychotic and anticholinergic use in nursing homes

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## Abstract

**Introduction:** Antipsychotics are used for managing behavioral and psychological symptoms of dementia (BPSD) but have risks. Anticholinergics can worsen outcomes in dementia. The Improving Antipsychotic Appropriateness in Dementia Patients educational program (IA-ADAPT) and Centers for Medicare and Medicaid Services Partnership to Improve Dementia Care (CMS Partnership) promote improved care for BPSD. The purpose of this study was to evaluate the impact of these programs on medication use and BPSD among nursing home residents.

**Methods:** This quasi-experimental longitudinal study used Medicare and assessment data for Iowa nursing home residents from April 2011 to December 2012. Residents were required to be eligible for six continuous months for inclusion. Antipsychotic use and anticholinergic use were evaluated on a monthly basis, and changes in BPSD were tracked using assessment data. Results are presented as odds ratios (ORs) per month after exposure to the IA-ADAPT or the start of the CMS Partnership.

**Results:** Of 426 eligible Iowa nursing homes, 114 were exposed to the IA-ADAPT in 2012. Nursing home exposure to the IA-ADAPT was associated with reduced antipsychotic use (OR [95% CI] = 0.92 [0.89–0.95]) and anticholinergic use (OR [95% CI] = 0.95 [0.92–0.98]), reduced use of excessive antipsychotic doses per CMS guidance (OR [95% CI] = 0.80 [0.75–0.86]), increased odds of a potentially appropriate indication among antipsychotic users (OR [95% CI] = 1.04 [1.00–1.09]), and decreased documentation of verbal aggression (OR [95% CI] = 0.96 [0.94–0.99]). Facilities with two or more IA-ADAPT exposures had greater reductions in antipsychotic and anticholinergic use than those with only one. The CMS Partnership was associated with reduced antipsychotic use (OR [95% CI] = 0.96 [0.94–0.98]) and decreased documentation of any measured BPSD (OR [95% CI] = 0.98 [0.97–0.99]) as well as delirium specifically (OR [95% CI] = 0.98 [0.96–0.99]).

**Discussion:** This study suggests that the IA-ADAPT and the CMS Partnership improved medication use with no adverse impact on BPSD.

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**Keywords:** Antipsychotics; Anticholinergics; Dementia; Nursing home; Education

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## 1. Introduction

Antipsychotics are commonly used to manage behavioral and psychological symptoms of dementia (BPSD). Their probable overuse has been criticized because of evidence of their limited efficacy and significant adverse effects [1]. These include a small increase in the risk of mortality and stroke, which led the Food and Drug Administration to require a black box warning on antipsychotic labels highlighting these risks. Despite these risks, antipsychotics are sometimes effective for BPSD and may be deemed necessary when symptoms are dangerous or severely distressful and other treatments have failed [2,3]. However, wide variability in antipsychotic use among nursing homes, not explainable by resident characteristics, suggests uncertainty about use in this population [4].

To address these issues, we developed a training program and toolkit to improve care and medication use for BPSD, the Improving Antipsychotic Appropriateness in Dementia Patients program (IA-ADAPT), and conducted a dissemination study in partnership with stakeholders. The IA-ADAPT outlines a step-by-step approach to BPSD management, including evaluation of BPSD and non-drug interventions, and provides guidance on antipsychotic use in dementia based on the Agency for Healthcare Research and Quality-sponsored comparative effectiveness research review on off-label use of antipsychotics and Centers for Medicare and Medicaid Services (CMS) guidance for surveyors of long-term care facilities [5,6]. Education and resources were provided for several types of learners, including prescribers, nurses, direct care providers, and other providers. The resources included a set of decision aids. One contained a list of drugs that may contribute to delirium or BPSD, many of which have anticholinergic effects. The IA-ADAPT highlighted anticholinergic toxicity as a cause of delirium and BPSD and discouraged anticholinergic use. People with dementia are particularly susceptible to the adverse cognitive and psychiatric effects of anticholinergics, and they are considered potentially inappropriate for use in older adults [7-9].

The primary goal of this study was to evaluate the effectiveness of the IA-ADAPT in improving measures related to antipsychotic and anticholinergic use in nursing home residents, without negatively impacting BPSD. Although the focus was on dementia patients, those without dementia were also included in primary analyses. The CMS Partnership to Improve Dementia Care in Nursing Homes (CMS Partnership) was announced near the beginning of the intervention period, creating a need to control for its effects and stimulating a secondary goal of this study—to evaluate the impact of the CMS Partnership on the same outcomes [10,11]. The CMS Partnership set goals for reducing antipsychotic use in nursing homes and organized opportunities to share information about best practices and quality improvement strategies [12]. Since the CMS Partnership initially focused on reducing antipsychotic use but not

anticholinergic use, the analysis evaluating anticholinergic use provided some indication of whether IA-ADAPT effects could be disentangled from those of the CMS Partnership in analyses.

## 2. Methods

### 2.1. Data sources

This study used Medicare, Minimum Data Set (MDS), and Certification and Survey Provider Enhanced Reports data from 2011 and 2012. Measures were characterized monthly from April 2011 (1 year before launch of the IA-ADAPT intervention) through December 2012 to perform longitudinal analyses. [Supplementary Fig. 1](#) illustrates the study timeline.

### 2.2. Interventions

The web-based IA-ADAPT is an evidence-based training program with an accompanying toolkit focused on care for BPSD [13]. The program includes a series of case-based lectures spanning approximately 2 hours. The toolkit consists of clinical decision aids: laminated pocket guides also available as a mobile device application, an algorithm for treating BPSD, a tip sheet for managing a behavioral crisis, and a shared decision-making guide on antipsychotic use. The decision aids were provided to help participants recall and apply the information conveyed in the training and enhance procedural learning through such application [14]. The web-based IA-ADAPT became available in April, 2012 [13]. The content was also delivered through presentations at professional meetings where laminated copies of decision aids were provided. Stakeholders assisted with marketing the web-based education and arranging presentations.

On March 29, 2012, CMS announced the Initiative to Improve Behavioral Health and Reduce the Use of Antipsychotics in Nursing Homes, with a goal to reduce antipsychotic use by 15% by the end of 2012 [10]. This initiative, later renamed the Partnership to Improve Dementia Care in Nursing Homes, aimed to reduce antipsychotic use by promoting person-centered care and nonpharmacologic interventions for BPSD [11]. It stimulated cointerventions such as educational offerings and quality improvement activities.

### 2.3. Study population

This study included residents of nursing homes in Iowa from April 2011 to December 2012. Residents were eligible for inclusion in a given month if they were aged  $\geq 65$  years for the entire year being evaluated, eligible for fee-for-service Medicare benefits and Medicare Part D for the current month and prior 3 months and residents of a nursing home for  $\geq 14$  days that month. Residents were excluded during a month if they had  $> 15$  days during which medication use was unobservable due to hospital inpatient status,

skilled nursing facility resident status, or enrollment in hospice because Medicare Part D does not pay for all medications for these individuals. Residents were excluded if they had any of the following diagnoses during the study period, based on Medicare or MDS data: schizophrenia, schizoaffective disorder, bipolar disorder, Huntington's disease, Down syndrome, or developmental disability (Supplementary Table 5). Residents who were comatose on the most recent MDS assessment were excluded. Residents of skilled nursing facilities that did not accept long-stay patients were excluded, as were residents of two facilities exposed to the IA-ADAPT about 6 months before any others. Finally, only residents who experienced at least one consecutive stay leading to at least 6 months of continuous eligibility during the study period were selected for analysis. Supplementary Fig. 2 illustrates the resident selection process. Supplementary Table 1 provides the number of residents included in each analysis. This project was approved by the University of Iowa Institutional Review Board.

#### 2.4. Outcome variables

Outcome variables included medication use and symptoms. The primary outcome variables were any antipsychotic use (0 = "no" and 1 = "yes") and any non-antipsychotic anticholinergic use (Supplementary Table 2 and 3). Anticholinergics were defined based on level 2 and 3 drugs from an updated version of the Anticholinergic Drug Scale [15] (those with clinically significant anticholinergic effects) identified as having anticholinergic effects on the IA-ADAPT clinical decision aids, as well as anticholinergics identified by the 2012 Beers Criteria [8].

Secondary analyses evaluated other outcomes, including receipt of antipsychotics at excessive doses as defined in CMS guidance to nursing home surveyors [6] (Supplementary Table 2) and evidence of a potentially appropriate indication in antipsychotic users.

Behavioral and psychotic symptoms considered potentially appropriate antipsychotic indications were evaluated to monitor for undesirable intervention effects on BPSD (e.g., from undertreatment). These symptoms included the presence of hallucinations, delusions, physical behavioral symptoms directed toward others (physical aggression), verbal behavioral symptoms directed toward others (verbal aggression), and delirium. Symptom status was updated at the time of each MDS assessment.

#### 2.5. Exposure variables and covariates

IA-ADAPT participation data were collected through website registrations and learner characteristics forms collected at presentations. Participation data were linked to nursing home data. Nursing homes were considered exposed to the IA-ADAPT on the first date that any staff member participated in an educational program. The IA-ADAPT effect was modeled using a continuous variable representing

the number of months from first exposure of a nursing home staff member until the month of each observation. The value of this variable was set to zero before exposure and for unexposed facilities. Total facility exposure counts totaled website registrations, learners at in-person presentations, and laminated decision aid orders.

The number of months since the announcement of the CMS Partnership until the month of each observation was also included as a continuous covariate. May 2012 was considered month 1 after the intervention because it was implausible that the announcement on March 29 would impact measures in April. The value of this variable was set to zero in previous months.

Other covariates included age, sex, dementia, hallucinations, delusions, delirium, verbal behavioral symptoms directed toward others, physical behavioral symptoms directed toward others, Parkinson's disease dementia, Lewy body dementia, diabetes, and the number of months since entry of each resident into the eligible population (Supplementary Table 4). In contrast to the analysis of undesirable effects, BPSD defining covariates and subgroups were considered present for the next 6 months, or 3 months for delirium, after an MDS assessment on which they were present. Past symptoms within these time periods were considered evidence of a potentially appropriate antipsychotic indication. The presence of these BPSD cannot determine whether they posed a danger to the resident or others or severe distress, necessary to justify antipsychotic use [5] or whether non-drug interventions were attempted before antipsychotic use. Therefore, they were a proxy for appropriate use.

#### 2.6. Statistical analyses

Descriptive statistics for nursing homes were calculated for the March 2012 sample, before any intervention exposures. We used the nursing home survey from Certification and Survey Provider Enhanced Reports data that were closest in time to this month. Facilities that were or were not exposed to the IA-ADAPT were compared, using two-sample independent *t* tests and  $\chi^2$  tests as appropriate. Facility characteristics were also calculated based on residents eligible for analysis in March 2012 and compared by IA-ADAPT exposure status. Facilities with fewer than 10 eligible residents were excluded from these comparisons to avoid overweighting their characteristics. Average unadjusted rates of antipsychotic and non-antipsychotic anticholinergic use in December 2012 were evaluated for descriptive purposes.

Analyses of intervention effects included repeated monthly observations of individuals in the study population. Longitudinal analyses were performed using generalized linear mixed logistic regression models with resident-specific random intercepts. Resident-specific random intercepts were used in preference to facility-level terms, as facility-level variability can be reasonably assumed to be

accounted for by resident-specific intercepts and covariates, and accounting of intervention effects on facilities. All models included both intervention effects.

Secondary analyses evaluated antipsychotic use among subgroups of residents defined by the following characteristics (Supplementary Table 4): dementia, no dementia, evidence of an appropriate antipsychotic indication, and no evidence of an appropriate antipsychotic indication. Anticholinergic use was evaluated in residents with and without dementia. Hypothesis tests were performed at a 0.05 level, with no adjustment for multiple comparisons.

Post hoc analyses evaluated whether the number of facility exposures modified IA-ADAPT effects on antipsychotic and anticholinergic use in all residents.

All data processing and statistical analyses were performed using SAS, versions 9.3 and 9.4, and longitudinal analyses were performed using Proc GLIMMIX in SAS, version 9.4 (SAS Institute, Inc, Cary, NC, USA).

### 3. Results

#### 3.1. Sample characteristics

Of 426 eligible nursing homes in Iowa with eligible subjects, 114 were exposed to the IA-ADAPT during the study period, 71 through the website only, 29 through presentations only, and 14 through both. The mean (SD) total exposure count among exposed facilities was 1.9 (1.8); 43% (49/114) had two or more exposures. Tables 1 and 2 summarize characteristics of intervention and nonintervention facilities as of March 2012, excluding seven facilities with fewer than five eligible residents that month. On average, intervention facilities had more residents, more Alzheimer's disease special care beds, fewer registered nurse directors of

nursing staffing hours per resident, and more certified nurse aides staffing hours per resident compared to nonintervention facilities. Intervention facilities had a higher mean prevalence of any potentially appropriate indication for antipsychotics and antipsychotic use among eligible residents. The mean prevalence of diabetes and hyperlipidemia was lower in intervention facilities. The final analysis data set included 246,264 monthly observations of 16,200 residents (Supplementary Table 2). The mean (SD) observed person-time was 15.2 (5.5) months, the mean (SD) age was 86.7 (7.6) years, and 77.0% (12,470/16,200) of included residents were female. Initial IA-ADAPT facility exposures occurred over time starting in April 2012; 40.9% of facilities being exposed by June and 84.3% by August.

#### 3.2. Intervention outcomes

In March 2012 and December 2012, mean antipsychotic use rates among eligible residents in intervention facilities were 20.7% and 19.0%, whereas nonintervention facility means were 17.7% and 17.6%, respectively. Mean non-antipsychotic anticholinergic use rates in these months were 28.2% and 26.4% in intervention facilities, and 28.4% and 28.3% in nonintervention facilities, respectively. In models adjusted for resident characteristics, IA-ADAPT exposure was associated with reduced antipsychotic use (OR [95% CI] = 0.92 [0.89–0.95] per month after exposure) and anticholinergic use (OR [95% CI] = 0.95 [0.92–0.98] per month after exposure). Interactions with total facility exposure count were not significant. This count variable was highly skewed. Greater reductions in both antipsychotic and anticholinergic use were observed in facilities with two or more exposures versus those with only one

Table 1  
Comparison of characteristics of nursing homes, by IA-ADAPT intervention status of facilities\*

Characteristic	No intervention (N = 307) Mean (SD)	Intervention (N = 112) Mean (SD)	t test P value <sup>†</sup>
Census: total residents	54.3 (22.4)	64.1 (33.1)	<.001
Special care beds—Alzheimer's disease	3.1 (7.2)	6.2 (9.8)	<.001
Medical director—hours/resident bed	0.05 (0.14)	0.04 (0.14)	.609
Registered nurse director of nursing—hours/resident bed	1.0 (0.43)	0.89 (0.41)	.025
Registered nurse—hours/resident bed	3.3 (1.8)	3.3 (1.8)	.987
Licensed practical nurse/licensed vocational nurse—hours/resident bed	4.9 (2.1)	4.8 (1.9)	.654
Certified nurse aides—hours/resident bed	16.3 (5.5)	17.6 (4.2)	.022
Therapeutic recreational specialty—hours/resident bed	0.025 (0.147)	0.013 (0.086)	.449
Activity professional part—hours/resident bed	0.81 (0.46)	0.81 (0.41)	.965
Activity staff other part—hours/resident bed	0.58 (0.74)	0.73 (0.66)	.064
Mental health services—hours/resident bed	0.011 (0.033)	0.013 (0.044)	.645
Proportion of residents with a psychiatric diagnosis	25.3% (16.6%)	24.7% (16.0%)	.769
Proportion of residents receiving psychoactive medications	65.3% (12.7%)	64.8% (12.5%)	.752
Proportion of residents receiving antipsychotics	21.0% (10.9%)	22.0% (11.0%)	.437

Abbreviations: CASPER, Certification and Survey Provider Enhanced Reports; IA-ADAPT, Improving Antipsychotic Appropriateness in Dementia Patients program; SD, standard deviation.

\*Analyses based on the CASPER record closest to March 2012. Total number of facilities in modeling data file in March 2012, N = 426 (114 with intervention); seven facilities were not included in the comparison because of a low number of eligible participants (<5 participants).

<sup>†</sup>Significant P values shown in bold.

Table 2

Facility averages for characteristics of residents included in the study sample in March 2012, by IA-ADAPT intervention status of facilities

Characteristic	No intervention (N = 301)*	Intervention (N = 110)*	t test
	Mean (SD)	Mean (SD)	P value <sup>†</sup>
Total N	25.5 (11.6)	31.6 (16.6)	<.001
Dementia or cognitive impairment	79.3% (10.7%)	81.1% (10.6%)	.133
Any appropriate indication for antipsychotic	33.3% (18.1%)	37.3% (19.1%)	<b>.044</b>
Physical aggression	10.4% (9.7%)	12.2% (9.3%)	.089
Verbal aggression	15.5% (12.5%)	16.4% (12.6%)	.511
Wandering	8.5% (8.5%)	10.3% (8.6%)	.056
Reject or resist care	17.1% (15.5%)	18.8% (15.4%)	.317
Delusions	12.2% (14.1%)	14.2% (15.2%)	.204
Hallucinations	3.9% (5.4%)	4.8% (5.3%)	.134
Delirium	14.9% (15.6%)	18.3% (18.0%)	.059
Recent history of fall	45.6% (14.0%)	45.0% (11.7%)	.692
Unsteady gait	56.1% (16.5%)	56.2% (17.5%)	.938
Parkinson's disease or Lewy body dementia	10.4% (7.5%)	11.8% (6.6%)	.097
Parkinson's disease	9.9% (7.5%)	11.2% (6.5%)	.107
Lewy body dementia	3.2% (4.3%)	3.3% (3.7%)	.912
Diabetes, hyperlipidemia, or hypertension	93.6% (5.8%)	93.5% (5.5%)	.881
Diabetes	37.8% (13.8%)	33.8% (10.6%)	<b>.006</b>
Hyperlipidemia	5.9% (6.9%)	4.3% (4.5%)	<b>.020</b>
Hypertension	89.5% (7.8%)	89.7% (7.6%)	.810
Antipsychotic use	17.7% (10.4%)	20.7% (10.6%)	<b>.010</b>
Antipsychotic use at excessive dose	2.3% (3.9%)	2.0% (3.0%)	.442
Anticholinergic use	35.9% (12.0%)	36.1% (10.9%)	.912
Non-antipsychotic anticholinergic use	28.4% (11.4%)	28.2% (9.9%)	.897

Abbreviations: IA-ADAPT, Improving Antipsychotic Appropriateness in Dementia Patients program; SD, standard deviation.

\*Total number of facilities in modeling data file in March 2012, N = 426 (114 with intervention); seven facilities were not included in the comparison because of a low number of eligible residents (<10 residents). Data are means of facility-level resident counts and prevalence data rather than a summary of individual-level data.

<sup>†</sup>Significant P values shown in bold.

(Supplementary Tables 6 and 7). The CMS Partnership was associated with reduced antipsychotic use (OR [95% CI] = 0.96 [0.94–0.98] per month after initiation). In regard to covariates, odds of antipsychotic use were increased in those with dementia, Lewy body dementia, physical aggression, verbal aggression, hallucinations, delusions, delirium, in males, and with increased time from entry into the study sample. Increased age, Parkinson's disease, and diabetes were associated with reduced odds of antipsychotic use (Table 3). The odds of anticholinergic use were reduced in those with increased age and increased time since entry into the study sample and in males. A protective effect of dementia was of borderline significance ( $P = .050$ ). The odds of anticholinergic use were increased in those with Lewy body dementia (Table 4).

In secondary analyses (Table 5) conducted in all residents, IA-ADAPT exposure was associated with reduced odds of antipsychotic use at excessive doses, reduced verbal aggression, and no change in other BPSD measures. In subgroups, IA-ADAPT exposure was associated with less antipsychotic use in residents with dementia and those with appropriate indications for antipsychotics. The IA-ADAPT was associated with more antipsychotic use among residents without dementia, a finding that did not change in a post hoc analysis adjusting for BPSD. In March and December 2012, respectively, the rates of antipsychotic use in these residents

were 3.8% and 4.8% in exposed facilities and 4.2% and 3.6% in unexposed facilities. The IA-ADAPT was associated with increased odds of appropriate indications among antipsychotic users. IA-ADAPT exposure was associated with less anticholinergic use irrespective of dementia. Among all residents, the CMS Partnership was associated with less BPSD justifying antipsychotic use and less delirium. In subgroups, it was associated with less antipsychotic use among residents with and without dementia, and with no appropriate indication. Full models not presented in the manuscript are available in Supplementary Tables 6-21.

#### 4. Discussion

IA-ADAPT exposure was associated with reductions in odds of antipsychotic and anticholinergic use in nursing home residents over time, albeit relatively modest reductions in unadjusted average rates. Facilities with more than one exposure had greater reductions. Most secondary analyses of medication use changes found results consistent with IA-ADAPT goals. The CMS Partnership was associated with reduced antipsychotic use, overall and in most subgroups. This is consistent with the decline in antipsychotic use rates defined by quality metrics since the initiation of the CMS Partnership [12,16].

**Table 3**  
Model evaluating associations of interventions with antipsychotic use among all eligible residents\*

Effect	Parameter estimate	Standard error	P value	1 unit odds ratio (95% CI)
Intercept	-1.7605	0.8403	N/A	-
Months	-0.08064	0.01710	<.001	0.92 (0.89, 0.95)
post-IA-ADAPT				
Months	-0.03649	0.01048	<.001	0.96 (0.94, 0.98)
post-CMS Partnership				
Subject month	0.05103	0.004536	<.001	1.05 (1.04, 1.06)
Age	-0.1376	0.009951	<.001	0.87 (0.85, 0.89)
Male (vs. female)	0.3790	0.1656	.022	1.46 (1.06, 2.02)
Dementia	2.3231	0.1426	<.001	10.21 (7.72, 13.50)
Lewy body dementia	1.2993	0.2234	<.001	3.67 (2.37, 5.68)
Parkinson's disease	-0.8778	0.1699	<.001	0.42 (0.30, 0.58)
Diabetes	-0.6211	0.1229	<.001	0.54 (0.42, 0.68)
Delirium	0.2590	0.05107	<.001	1.30 (1.17, 1.43)
Physical aggression	0.8221	0.05881	<.001	2.28 (2.03, 2.55)
Verbal aggression	0.6913	0.05286	<.001	2.00 (1.80, 2.21)
Hallucinations	0.7800	0.07653	<.001	2.18 (1.88, 2.53)
Delusions	0.5848	0.05823	<.001	1.79 (1.60, 2.01)

Abbreviations: CI, confidence interval; CMS Partnership, Centers for Medicare and Medicaid Services Partnership to Improve Dementia Care; IA-ADAPT, Improving Antipsychotic Appropriateness in Dementia Patients program.

NOTE. 1 unit odds ratio = odds ratio for one unit of change in a variable (one month for interventions and subject month, presence vs. absence for other variables). Resident month = number of months since the first month the resident was in the database until the month of the observation.

\*Generalized linear mixed logistic regression model predicting antipsychotic use, using monthly measures and individual resident random intercepts.

The numerous analyses increase the potential for false positive findings but provide a more comprehensive evaluation. The only concerning finding associated with IA-ADAPT exposure was an increase in antipsychotic use among those without dementia, which remained significant after adjusting for behavioral and psychological symptoms that could justify antipsychotic use in dementia. This is difficult to explain since this subgroup was not the target of the intervention. This may relate to not adjusting for conditions that might lead to antipsychotic use in people without dementia who were not excluded from the study, for example, insomnia, depression, and posttraumatic stress disorder. Regardless, the rate of antipsychotic use in this subgroup was much lower than in those with dementia. Overall the results remain encouraging regarding the impact of the interventions.

Other covariates that predicted antipsychotic and anticholinergic use in this sample are largely confirmatory, but some findings were unexpected. The strong association of Lewy body dementia with antipsychotic use is concerning, given the high risk of extrapyramidal side effects in these residents [17]. Parkinson's disease was protective of antipsychotic use, although odds ratio point estimates from models in residents without dementia were in the direction of increased risk. This

**Table 4**  
Model evaluating associations of interventions with non-antipsychotic anticholinergic use among all eligible residents\*

Effect	Parameter estimate	Standard error	P value	1 unit odds ratio (95% CI)
Intercept	-6.4712	0.6397	N/A	-
Months	0.05084	0.01408	<.001	0.95 (0.92, 0.98)
post-IA-ADAPT				
Months	0.01148	0.007966	.149	1.01 (1.00, 1.03)
post-CMS Partnership				
Subject month	-0.02084	0.003417	<.001	0.98 (0.97, 0.99)
Age	-0.03407	0.007208	<.001	0.97 (0.95, 0.98)
Male (vs. female)	-0.4806	0.1341	<.001	0.62 (0.48, 0.80)
Dementia	-0.1461	0.07442	.050	0.86 (0.75, 1.00)
Lewy body dementia	0.7594	0.1953	<.001	2.14 (1.46, 3.13)
Parkinson's disease	-0.05483	0.1385	.693	0.95 (0.72, 1.24)

Abbreviations: CI, confidence interval; CMS Partnership, Centers for Medicare and Medicaid Services Partnership to Improve Dementia Care; IA-ADAPT, Improving Antipsychotic Appropriateness in Dementia Patients program.

NOTE. 1 unit odds ratio = odds ratio for one unit of change in a variable (one month for interventions and subject month, presence vs. absence for other variables). Resident month = number of months since the first month the resident was in the database until the month of the observation.

\*Generalized linear mixed logistic regression model predicting anticholinergic use, using monthly measures and individual resident random intercepts.

may be due to hallucinations related to antiparkinson medications or delirium. Antipsychotic use is associated with a high risk of extrapyramidal side effects and increased mortality in Parkinson's disease, even among those without dementia [17,18]. This highlights the need to monitor for antipsychotic adverse effects in these patients and to encourage prescribers to consider reducing antiparkinson medication doses that may be causing hallucinations before considering an antipsychotic. Findings related to resident time in the data set suggest that longer time in a nursing home increases odds of antipsychotic use, though this was only a proxy for time in the nursing home.

Non-antipsychotic anticholinergic use was common, with an average facility rate of 28% at baseline. The positive association with Lewy body dementia is concerning since reduced cholinergic activity may worsen cognition and psychosis in this condition [17,19]. Dementia was only modestly protective of anticholinergic use. Use in these vulnerable individuals remains common. More promisingly, increased age and the number of months an individual was in the data set were associated with reduced odds of anticholinergic use in all residents and those with dementia.

Prior educational interventions to reduce antipsychotic use in nursing homes have had mixed success. Some studies suggested that educational interventions can reduce psychotropic drug prescribing if nursing home staff are involved and trained in non-drug management strategies, whereas academic detailing of physicians alone had

Table 5

Summary of associations of nursing home exposure to the IA-ADAPT intervention and CMS Partnership with antipsychotic and anticholinergic use outcomes in eligible residents

Outcome group included in analysis	Odds ratio and <i>P</i> value per month after IA-ADAPT exposure*		Odds ratio and <i>P</i> value per month after CMS Partnership start*	
	Odds ratio (95% CI)	<i>P</i> value	Odds ratio (95% CI)	<i>P</i> value
<b>Antipsychotic use</b>				
All eligible residents <sup>†</sup>	0.92 (0.89, 0.95)	<.001	0.96 (0.94, 0.98)	<.001
Dementia <sup>†</sup>	0.89 (0.86, 0.93)	<.001	0.97 (0.95, 0.99)	.011
No dementia <sup>§</sup>	1.42 (1.24, 1.62)	<.001	0.86 (0.79, 0.93)	<.001
Appropriate indication <sup>†</sup>	0.91 (0.87, 0.95)	<.001	0.98 (0.96, 1.01)	.243
No appropriate indication <sup>¶</sup>	0.95 (0.9, 1.01)	.083	0.93 (0.89, 0.96)	<.001
<b>Anticholinergic use</b>				
All eligible residents <sup>#</sup>	0.95 (0.92, 0.98)	<.001	1.01 (1.00, 1.03)	.149
Dementia**	0.96 (0.93, 0.99)	.017	1.00 (0.99, 1.02)	.644
No dementia <sup>††</sup>	0.90 (0.85, 0.95)	<.001	1.00 (0.98, 1.04)	.394
<b>Excessive antipsychotic dose</b>				
All eligible residents <sup>†</sup>	0.80 (0.75, 0.86)	<.001	1.01 (0.97, 1.05)	.530
<b>Appropriate indication</b>				
Antipsychotic users <sup>‡‡</sup>	1.04 (1.00, 1.09)	.048	0.98 (0.96, 1.01)	.152
<b>Any physical or verbal aggression, hallucinations, delusions, or delirium</b>				
All eligible residents <sup>†¶</sup>	0.99 (0.97, 1.01)	.230	0.98 (0.97, 0.99)	<.001
<b>Any physical aggression</b>				
All eligible residents <sup>†¶</sup>	1.02 (0.99, 1.05)	.282	0.99 (0.97, 1.01)	.113
<b>Any verbal aggression</b>				
All eligible residents <sup>†¶</sup>	0.96 (0.94, 0.99)	.007	1.00 (0.99, 1.02)	.572
<b>Hallucinations</b>				
All eligible residents <sup>†¶</sup>	1.00 (0.95, 1.05)	.969	1.01 (0.98, 1.04)	.394
<b>Delusions</b>				
All eligible residents <sup>†¶</sup>	0.99 (0.96, 1.02)	.512	1.01 (0.99, 1.03)	.318
<b>Delirium</b>				
All eligible residents <sup>†¶</sup>	1.02 (0.99, 1.05)	.115	0.98 (0.96, 0.99)	.008

Abbreviations: CI, confidence interval; CMS Partnership, Centers for Medicare and Medicaid Services Partnership to Improve Dementia Care; IA-ADAPT, Improving Antipsychotic Appropriateness in Dementia Patients program.

\*Odds ratios are for each month after exposure to the intervention. Significant *P* values are shown in bold. Both intervention variables were included in all models.

<sup>†</sup>Adjusted for number of months since resident entry into the database until current month, age, sex, dementia, Parkinson's disease, Lewy body dementia, diabetes, physical aggression, verbal aggression, hallucinations, delusions, and delirium.

<sup>‡</sup>Adjusted for all variables in footnote <sup>†</sup> except dementia.

<sup>§</sup>Adjusted for all variables in footnote <sup>†</sup> except dementia and Lewy body dementia.

<sup>¶</sup>Adjusted for all variables in footnote <sup>†</sup> except appropriate indications.

<sup>#</sup>Adjusted for number of months since resident entry into the database until current month, age, sex, dementia, Parkinson's disease, and Lewy body dementia.

\*\*Adjusted for all variables in footnote <sup>#</sup> except dementia.

<sup>††</sup>Adjusted for all variables in footnote <sup>#</sup> except dementia and Lewy body dementia.

<sup>‡‡</sup>Adjusted for number of months resident in database up to current month.

<sup>†¶</sup>Adjusted for all variables in footnote <sup>†</sup> except appropriate indications and diabetes.

minimal impact in one study [20–24]. More recently, Tjia et al conducted a cluster randomized trial of dissemination of evidence-based antipsychotic prescribing guidelines to nursing homes [25]. Their toolkit provided to all groups comprised many resources, including some IA-ADAPT decision aids. Varying strategies were tested including academic detailing, on-site behavioral management training for nursing staff, and audit and feedback. The prevalence of antipsychotic use declined in all groups, but not more in intervention groups than the control group which was only mailed the toolkit. This may suggest that, among nursing homes with motivated leaders, a

low-intensity intervention with useful information may be adequate to stimulate changes in care. However, these changes may have been unrelated to the toolkit.

Despite some encouraging results, it is questionable to fully attribute the changes in practice associated with the IA-ADAPT to this intervention alone. The quasi-experimental study design is subject to selection bias, as facilities motivated to reduce unnecessary antipsychotic use may have been drawn to the intervention. Training from other sources may have impacted results. The measure of IA-ADAPT exposure was fairly liberal. If any facility staff were exposed, the whole facility was

considered exposed. The intervention may not have been disseminated facility-wide. Presentation participants were only identified if they completed an optional learner characteristics form. This would be expected to move effect estimates toward the null. Also, the MDS provides imperfect measures for resident characterization. Despite the limitations, it is notable that IA-ADAPT exposure was associated with reduced non-antipsychotic anticholinergic use, a specific target of this intervention, whereas the CMS Partnership was not. This supports the conclusion that findings related to the IA-ADAPT were not due solely to motivation to reduce antipsychotic use in response to the CMS Partnership, and related unmeasured factors, but may reflect real effects of the program.

Future work could more fully evaluate the IA-ADAPT, including which aspects are responsible for its effects. The effects of prescriber exposure are of interest but were challenging to examine. National Provider Identifiers were only recently made available to researchers in Medicare Part D data and were not in our original data set. We will evaluate the long-term effects of the program and also active dissemination strategies that we implemented after the present study period. Effects on prescribing of other drugs are of interest. Benzodiazepines were not covered by Medicare Part D until 2013, so we could not evaluate them. The use of anticonvulsants could be evaluated. Their use for managing BPSD was discouraged when it was addressed, but it was not discussed in the online lectures or decision aids. This is a first step in evaluating the IA-ADAPT and CMS Partnership, but further evaluation is needed.

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## Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.trci.2017.02.003>.

## RESEARCH IN CONTEXT

1. Systematic review: The authors reviewed published literature on educational interventions to reduce antipsychotic use in nursing home residents and searched for literature on the impact of the Centers for Medicare and Medicaid Services (CMS) Partnership to Improve Dementia Care. Antipsychotic use has decreased in some studies when nursing homes' staff training was involved. No studies evaluated programs delivered online and at professional meetings with accompanying decision aids. Improvements in antipsychotic use quality metrics have been observed since the CMS Partnership started, but no studies have evaluated it using individual-level data.
2. Interpretation: Both Improving Antipsychotic Appropriateness in Dementia Patients program (IA-ADAPT) participation and the CMS Partnership appeared to contribute to improved medication use among nursing home residents. Both were associated with reduced antipsychotic use and the IA-ADAPT with reduced anticholinergic use. No adverse impact on symptoms was detected.
3. Future directions: The IA-ADAPT is being tested using active dissemination to reduce potential bias related to motivation of participating nursing homes. Its longer-term effects will be evaluated.

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