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Pro Re Nata (PRN) Prescribing and Administration of Psychotropic Medications in Assisted Living: A Seven State Study

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Abstract

OBJECTIVES: Psychotropic medications administered on a *pro re nata* (PRN) basis can alleviate acute symptoms and facilitate deprescribing, although PRN use is associated with negative outcomes such as polypharmacy and drug interactions. The aim of this study was to examine the extent to which PRN psychotropic medications are prescribed and administered to assisted living (AL) residents, overall and in relation to resident- and community-level characteristics.

DESIGN: Cross-sectional study.

SETTING AND PARTICIPANTS: All AL residents and select staff in 250 AL communities in seven states.

METHODS: Data regarding prescribing and administration of five types of PRN psychotropic medications in the prior 7 days (antipsychotics, mood stabilizers and antiepileptics, antidepressants, anxiolytics/hypnotics, and cognitive enhancers) were abstracted and compared across resident and community characteristics.

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RESULTS: Prescribing of PRN psychotropics in AL is low (10.3%). Of prescribed PRN medications, 2.5% of residents were administered a PRN and 8% had PRN that was not administered in the previous seven days. Anxiolytics were administered PRN more commonly compared to antipsychotics (2.0% vs. 0.2%). Of all PRN psychotropic prescriptions (N=1,039), 70.5% had a written indication describing the reason for administration. Among PRN medications administered (n=242), the proportion with an indication was lower (62.0%). PRN psychotropic medication prescribing was higher among residents with dementia and a psychiatric diagnosis, and in larger AL communities and those with a higher proportion of dementia care beds.

CONCLUSIONS AND IMPLICATIONS: The prescribing and administration of PRN psychotropic medications in AL is relatively rare, although more common among residents with dementia. Emerging psychotropic medication policies should be expanded to address mental health care, anxiolytic/hypnotic use for residents living with dementia, PRN prescribing in chart review, and the use of detailed indications for PRN use, especially when medications are administered by unlicensed care staff.

Summary:

Administration of as-needed psychotropic medications to assisted living residents is low. As-needed prescribing was higher among residents with dementia; anxiolytic medications were prescribed more often than antipsychotics.

Keywords

assisted living; psychotropic; antipsychotic; dementia

INTRODUCTION

The use of psychotropic medications, particularly antipsychotics, in older persons is an important clinical and health policy concern because of the potential for side effects (e.g., dizziness, sedation), increased risk of adverse events (e.g., falls, mortality), and misuse as a chemical restraint.¹⁻⁶ A United States (U.S.) study of assisted living (AL) communities found that 57% of residents with behavioral symptoms had a medication prescribed for their behaviors, accounting for 22% of all residents.⁷ Although a national initiative was implemented to reduce antipsychotic medication use in nursing facilities,⁸ no parallel effort has been made in AL communities.⁹

In the U.S., approximately 811,500 residents live in one of 28,900 AL communities, where 42% or more of AL residents have a diagnosis of Alzheimer's disease or a related disorder (ADRD).^{7,10,11} Nearly all AL settings provide medication management services, although physician involvement in AL is minimal,¹²⁻¹⁴ only 38 states require AL communities to employ or contract with a licensed nurse,¹⁵ and most states permit unlicensed care staff to administer medications, including in memory care communities.¹⁶ This lack of clinical oversight and reliance on care staff to make decisions about PRN medication use raises safety and quality of life concerns for residents prescribed psychotropic medications to treat behaviors associated with ADRD.

Psychotropic medications may be prescribed *pro re nata* (PRN) to respond to acute or escalating behaviors, including those associated with mental illness or dementia. From a clinical standpoint, PRN medications play an important role in the treatment of medical conditions, patient safety, and patients' overall quality of life when used to treat acute symptoms and to phase out or reduce the dosage of a scheduled (e.g., routine, or regularly charted) order⁴⁻⁵. However, the use of PRN medications of any type can increase the risk of drug interactions and polypharmacy among older adults as well as increase medication errors.^{17,18}

A systematic review of PRN medication use in nursing homes reported a median of 2.5 PRN drugs prescribed per resident.¹⁹ An earlier national study using a convenience sample of AL communities reported 3 PRN medications per resident.²⁰ Nursing home resident characteristics associated with higher PRN use of any medication class include older age and larger number of prescriptions,¹⁸ longer length of stay²¹ and dementia diagnosis.^{19, 22-23} Whether PRNs are prescribed, but not administered, is an important distinction. Australian nursing home residents hospitalized in the prior year had more PRN prescriptions compared to those not hospitalized, however no statistically significant associations between hospital use and PRN administration in the nursing home were reported.²⁴ Facility-level associations, including larger bed capacity, were associated with more PRN prescriptions per resident, but not administration.²⁴

Few U.S. studies of PRN medication use prevalence in AL exist, although research conducted in other countries is instructive. An Australian residential care study found that residents with higher dependence in activities of daily living and more scheduled medications were more likely to receive a PRN medication of any type.²⁵ In a sample of Canadian AL communities, associations with antipsychotic medication use—including those administered PRN—included resident characteristics (eg, dementia diagnosis, behavioral expressions, length of stay, age) and community characteristics (eg, chain membership, proportion of dementia care beds, presence of onsite pharmacist).²⁶ Another Australian study of residential care homes found that increased PRN administration of antipsychotic and benzodiazepine medication occurred after a reduction in the scheduled use of these medications.²⁷

To address the paucity of data regarding PRN psychotropic medication use in U.S. AL communities, this study examined PRN medication prescribing and administration within a seven-state sample, evaluating medication prevalence, variation in relation to residents and community characteristics, and whether the prescriptions included written indications (eg, instructions) for their use. Findings have implications for care provision and medication-related policy.

METHODS

Sample.

A random sample of 250 AL communities weighted by bed size was recruited in seven states: Arkansas (AR), Louisiana (LA), New Jersey (NJ), New York (NY), Oklahoma (OK), Pennsylvania (PA), and Texas (TX), representing census divisions with the lowest and

highest reported use of medications to control behaviors (derived from the National Survey of Residential Care Facilities, 2010, unpublished). These states had 4,331 AL communities at the time of recruitment. Eligibility was limited to licensed AL communities that provide non-nursing home long-term care, have a census larger than four, and primarily serve adults 65 years of age or older (N=1,624). To efficiently navigate on-site data collection, two geographically-clustered regions that represent the entire state based on eight demographic variables were identified based on prior work: per capita income, percent of population below the poverty level, percent of population identified as persons of color, unemployment rate, percent of the population aged 65 and over; number of primary care physicians, and hospital and nursing home beds per individual ages 65 and over.²⁸ In AR, LA, NJ, OK the clustered regions comprised the entire state. Recruitment continued until 35–40 communities in each state agreed to participate. Administrators received a letter describing the study followed by a phone call; all participants received a \$100 gift card.

Data Collection.

To avoid chronological biases based on the timing of data collection by state, one half of communities across all states participated in a first round of data collection, and then the other half participated in a second round of data collection. A limited amount of data was abstracted from every residents' chart (including psychotropic administration and select demographics), and a more extensive amount was abstracted from a stratified sample (prescribing including non-administration of PRNs and indication for administration) and later weighted. To obtain community-level data, interviews were conducted with the AL administrator and health care supervisor (i.e., the individual most knowledgeable about residents' health). Data collectors were trained for chart abstraction to a mean inter-rater reliability level of Cohen's $k=0.93$ for medication data and $k=0.89$ for other chart data. A Health Insurance Portability and Accountability Act waiver was obtained to abstract chart data, and all interviewees provided written, informed consent. The Office of Human Research Ethics of the University of North Carolina at Chapel Hill approved all study procedures.

Measures.

Resident chart data included demographics, dementia status, psychiatric diagnoses, incontinence, hospice use, payor status (Medicaid or public assistance), presence of confusion/disorientation or agitation, PRN psychotropic medications administered and not administered within the previous seven days, and written indications for PRN psychotropic medications. Psychotropic medications included in these analyses are antipsychotics, mood stabilizers and antiepileptics, antidepressants, anxiolytics and hypnotics, and cognitive enhancers (eg, donepezil). Interview data included community characteristics of interest in relation to prescribing and administration: organizational characteristics (ownership, size, dementia beds, years in operation); policies and practices (assessment of cognition and agitation, pharmacy review); staffing (presence of a nurse or medical director, resident-to-staff ratio, turnover); staff attitudes (PRN endorsement, health care supervisor pharmacologic and nonpharmacologic attitudes using items from the Attitudes Regarding Interventions for Behavior Problems measure);²⁹ and mental health care provision (percent receiving care in last year).

Analysis.

All analyses used weights based on probability proportional to bed size whereby data on sampled communities and residents were scaled to represent the entirety of the population of AL residents within the seven states. Details regarding weighting procedures are in the appendix.

Analyses focused on PRN medication prescribing at both the resident- and community-level. Resident-level PRN prescribing was summarized using weighted proportions that included administered and not administered PRNs. Total prescribing proportions were calculated overall, by residents' dementia status, and by medication type using data on a sub-set of residents. For statistics related specifically to administered PRNs, data were available for all residents within communities. The PRN proportions (prescribed, administered, not administered) were then transformed into percentages for ease of understanding. Next, resident- and community-level characteristics were analyzed for their associations with any resident- and community-level PRN prescribing (0,1). Differences in prescribing were determined using Rao-Scott X^2 tests (ie, categorical comparisons of proportions) and Wald tests (i.e., continuous comparisons of means) as appropriate to correct for the complex survey design. Finally, retained community-level characteristics that demonstrated approaching significant ($p < 0.15$) associations were modeled collectively to determine their association with community PRN prescribing proportions. As appropriate given the bounded nature of counts of PRN prescribing (ie, total community size is the highest possible count when each resident has a dichotomous outcome of either any PRN or no PRN prescribed), this multivariable model was a survey-adjusted binomial logistic regression featuring community-level count of total residents as the binomial denominator, community-level count of residents with any PRN prescribed as the binomial numerator, and logit link. Using this approach, the resulting odds ratios (OR; > 1.00 = increased odds) identifies community-level variables associated with PRN prescribing while accounting for variation in numbers of residents across communities. All analyses were conducted in Stata 16.1 (StataCorp, College Park, TX), with a statistical significance level of $p < .05$ used throughout.

RESULTS

A total of 743 AL communities were eligible and invited to participate. Forty-eight percent refused ($n=354$), 1% had incomplete data ($n=9$), and 17% were pending consent at the end of the study ($n=130$), resulting in a 34% participation rate. There was no significant difference between non-participating and participating communities based on size ($p=0.43$). The 250 participating communities produced data from 13,603 residents overall, including 5,777 who had more detailed chart data. In total, 432 staff respondents completed 499 administrator and health care supervisor interviews (i.e., some staff served in both positions); one health care supervisor did not complete an interview.

Examining overall prescribing, Table 1 summarizes the proportion of residents with a PRN psychotropic prescription (10.3%). Most prescriptions were anxiolytics/hypnotics (9.1%; 88.3% of those with any PRN), with only 1.3% having an antipsychotic; more specifically, of the 13,603 observed residents with PRN data, only 74 had a PRN that was another category of medication. The share of residents with a dementia diagnosis prescribed an

anxiolytic/hypnotic was nearly double that of residents without this diagnosis (12.9% versus 6.6%). Similarly, the share of residents with dementia prescribed a PRN antipsychotic was 2.5% compared to 0.5% for residents without dementia.

The administration of psychotropic medications prescribed PRN (2.3%) was primarily accounted for by those administered an anxiolytic/hypnotic medication (2.0%). When comparing residents with dementia to those without dementia, a larger share of residents with dementia received either a PRN anxiolytic/hypnotic (2.7% versus 1.5%; $p=.054$) or antipsychotic medication (0.5% versus 0.1%; $p<.001$). Examining non-administration of prescribed PRNs (8%), the majority was similarly accounted for by residents not administered a PRN anxiolytic/hypnotic (6.9%). A larger share of residents with dementia were not administered either an antipsychotic medication (absolute difference: -1.4% ; $p<.01$) or an anxiolytic/hypnotic (-4.9% ; $p<.001$).

Examining associations of PRN prescribing by resident characteristics, no differences were observed for gender, race, or age (Table 2). However, more residents prescribed a PRN psychotropic medication had a dementia diagnosis ($+20.8\%$; $p<.001$), a psychiatric diagnosis ($+13.6\%$; $p<.001$), incontinence ($+12.5\%$; $p<.001$), received hospice services ($+16.8\%$; $p<.001$), displayed confusion or disorientation ($+19.6\%$; $p<.001$), or agitation ($+22.8\%$; $p<.001$). In contrast, residents receiving public assistance or Medicaid were less likely to be prescribed a PRN psychotropic medication (-5.8% ; $p=.016$).

In terms of community-level prescribing, 194 (78%) of the 250 communities had at least one resident with a PRN prescription for a psychotropic medication (see Figure 1); among these communities, the mean rate of prescribing was 15.6%. Numerous characteristics differentiated communities with and without PRNs prescribed (Table 3). Communities were more likely to have a resident prescribed a PRN if they were larger ($+16$ beds; $p<.001$), had a greater percentage of dementia beds ($+19.4\%$; $p=.001$), conducted formal pharmacy reviews of resident medications 4 or more times/year ($+26.7\%$; $p=.010$), had more health care supervisor turnover in the previous 5 years ($+0.6$; $p=.003$), and had health care supervisors with lower endorsement of pharmacological practice use (-0.4 ; $p=.031$). The community-level multivariable analysis found that of the eight characteristics included in the model (Supplemental Table 1), only having a larger proportion of dementia beds was associated with significantly increased PRN prescribing. Specifically, each 10% increase in dementia beds relative to all beds in the community was associated with a 17% greater odds of prescribing (OR=1.17; 95% CI: 1.11, 1.23).

In relation to documented indications for PRN use, of all PRN psychotropic prescriptions (N=1,039), 70.5% had a written indication (e.g., “as needed for anxiety” or “for sleep”); see Table 4. Among PRN medications administered (n=242), the share with an indication was lower (62.0%). Of the three primary medication types reviewed, the percent of prescriptions with documented indications ranged from 67.6% for antipsychotics to 76.5% for mood stabilizers and antiepileptics. None of the charts referenced nonpharmacologic options as an alternative or in advance of using PRN psychotropic medications.

DISCUSSION

This study is unique in its focus on AL resident- and community-level characteristics associated with the prescription and administration of PRN psychotropic medications. PRN medication administration is an emerging issue in drug therapy in acute care and nursing homes,^{30,31} in part because PRN administration can result in increased errors, polypharmacy, and poor health outcomes.^{17–19} While PRN psychotropic medication prescriptions and administration are rare, residents with dementia account for a proportionately larger share of PRN psychotropic medication use. Of the psychotropic medication classes reviewed, anxiolytic/hypnotics were more commonly used than antipsychotic medications.

About one in ten AL residents had a psychotropic medication prescribed PRN. A systematic review reported that 13% of nursing home residents were prescribed a PRN antipsychotic and 7%–60% were prescribe PRN hypnotics.¹⁹ As a comparison to international prn prescribing rates, for example, in Australian “residential aged care” homes, 11% and 30% of residents had PRN orders for antipsychotics and benzodiazepines, respectively.²⁷ We found that residents with dementia, compared to those without dementia, accounted for most PRN psychotropic prescriptions and administrations, a finding that corresponds to use in nursing homes.^{19, 21–22} Anxiolytics/hypnotics accounted for the largest share of psychotropic medications prescribed and administered PRN to AL residents. While we cannot account for the context of this finding with cross-sectional data, recent research suggests that antipsychotic policies might have resulted in the substitution of other sedating psychotropic medications in nursing homes.^{32,33} Given that anxiolytic/hypnotic medication use in older adults can result in adverse events such as sedation, falls and cognitive impairment,^{2–3} can be used as chemical restraints,³⁰ and are not approved for treating behaviors,^{34–36} overall psychotropic medication use in AL warrants more attention.

The finding that Medicaid recipients had a lower rate of PRN prescriptions may suggest that these residents, who disproportionately have a mental illness,³⁷ are more likely to have standing orders for psychotropic medications, which merits further examination. Neither gender, race, nor age explained PRN use, similar to nursing home studies.²²

Five AL community-level characteristics had bivariate associations with higher prevalence of PRN prescribing in ways that might be anticipated. Larger community size has been associated with lower quality of life for AL residents³⁸ and more regulatory deficiencies.³⁹ The finding about higher antipsychotic use in memory care, and serving residents with dementia compared to general AL care, has been reported by others.^{11,40} A larger number of health care supervisors in the past five years was associated with more PRN prescriptions; this measure indicates turnover, a sign of instability identified with poor resident care outcomes in long-term residential care.⁴¹ Health care supervisors’ less favorable attitudes about the use of medications to manage “behavior” problems was marginally associated with higher prevalence of PRN prescriptions, perhaps being protective against standing orders. In other work, staff distress at nursing home residents’ neuropsychiatric symptoms were associated with increased psychotropic medication prescribing.⁴²

Another important policy and practice topic concerns medication chart review. A larger share of AL communities with residents with PRN prescriptions reported using formal pharmacy reviews compared to those with fewer residents prescribed PRN psychotropics. This finding may be reassuring, suggesting that communities are monitoring PRN prescribing; however, the extent to which doing so is common is questionable. A 2010 national survey found that 68% of AL communities reported availability of physician/pharmacist medication reviews.⁴³ In 2011, 30 states' regulations required AL to conduct medication review, although the frequency, health care professional involvement, and criteria to trigger a review varied by state.⁴⁴

Relatedly, adding drug indications to prescription orders, both scheduled and PRN, is recommended by medication safety organizations as a strategy to improve drug safety.⁴⁵ An analysis of more than 4 million U.S. medication prescriptions ordered over 5 years found that only 7.4% included indications; presence of indications varied by drug class and exceeded 90% for antipsychotics, anxiolytics, and hypnotics.⁴⁵ However, the as-needed nature of PRN medication orders introduces an additional decision-making component compared to scheduled orders. An Oregon-based study described state regulations requiring licensed nurses to write "written parameters" for PRN medications, defined as "directions that are so specific that the unlicensed caregivers use no discretion in administering PRN medications or treatments."⁴⁶ More research is needed on the feasibility and efficacy of chart review and interpretation of indications in the AL context given the limited use of electronic health records⁴⁷ or institutional pharmacies. It may be beneficial to have policies that more stringently require chart review of written indications for PRN psychotropic medications.

Finally, AL residents with ADRD might have cognitive or verbal impairments that limit their ability to express the need for or rejection of a PRN medication. Community staff need to assess the resident's behaviors to decide which, if any, PRN medication to use and to assess effectiveness. Most states permit trained, unlicensed staff to administer medications.⁴⁸ If these staff assess whether to administer PRN medications to people who cannot accurately express their symptoms, they might practice out of the scope of state Board of Nursing rules.¹⁵ Hence, it may be helpful to have more specific guidance as to when indications for a PRN have been met. Importantly, the Society for Post-Acute and Long-Term Care Medicine recommends minimizing PRN orders in AL.⁴⁹ Given the potential value of PRN orders, what is most needed is research to inform policies which can be adopted by the majority of AL providers, allowing for the variability of AL license types in the U.S.

Some limitations worth noting include that this study used a 7-day window for chart review; that said, although it does not reflect overall use, it is a useful indicator given that it captured a snapshot in time. We lack information regarding whether some AL communities have a policy regarding PRN use, the context of PRN use (e.g., for specific behaviors; only with assessment and oversight by a health care professional), the frequency of PRN administration over time, and health-related outcomes. Finally, the seven states might differ from other states, and future research should examine PRN psychotropic medication use and policies in additional states.

Conclusions and Implications

This seven-state study of psychotropic PRN prescribing and administration in a random sample of AL communities found low rates of PRN prescribing and administration compared to nursing home and international research. Anxiolytic/hypnotic agents were the most common psychotropic medications used on a PRN basis, and were more often used in persons with dementia and psychiatric illness. Prescribing PRN psychotropic medications occurs more commonly in communities with more beds, a higher proportion of dementia care beds, and those that conduct regular medication chart review. Consequently, when considering policy and program implications, there is cause to closely examine the relationship between community and resident characteristics, the outcomes and efficacy of medication review, and the administration of psychotropic medications other than antipsychotics, the class that to date has been the primary focus of AL quality initiatives.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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APPENDIX

Appendix

Addressing Behavior and Mood in Assisted Living

Funded by the National Institute on Aging (R01 AG050602) Sheryl Zimmerman, PhD, Principal Investigator

Selection, Sampling, and Weighting Procedures

Study Overview

The National Institute on Aging study entitled *Addressing Behavior and Mood in Assisted Living* (NIA R01AG050602) recruited a stratified random sample of 250 assisted living (AL) sites (i.e., “communities”) across seven states to learn about care practices for residents with dementia.

Within each state, two geographic regions were identified that represent the entire state based on eight variables used in other studies (see below). Within each region, AL communities were randomly sampled using sampling probabilities proportionate to size. Within each AL community, data collection included chart abstraction, interviews, and observations. A few key additional details regarding data collection are as follows:

- A limited amount of data were collected by abstracting the charts of all AL residents (e.g., demographic characteristics, residence on a dementia special care unit, use of medications)—these are referred to as “short forms”
- A more in-depth chart abstract was completed for a stratified random sample of residents (i.e., four strata defined by those with and without dementia, and those with and without antipsychotic prescriptions; data included medical, behavioral, and functional status, as well as other information)—these are referred to as “long forms”
- A subsample of family members of residents with dementia who were receiving an antipsychotic medication participated in an interview
- All AL administrators and health care supervisors (i.e. the staff member most knowledgeable about residents’ health care and status, often referred to as a resident care coordinator or by another title) participated in an interview
- Data collectors completed an observational assessment of the physical structure of the AL community

As detailed below, because these 250 communities were randomly sampled within regions, site-level probability weights can be used to scale up individual-level short form data to the region-level. For the subset of residents that were randomly sampled within communities, probability weights that are the product of individual level-weights and the aforesaid site-level weights can be used to scale up individuals’ long form data to the region-level. Finally, using post-stratification weights to account for disproportionate coverage of beds in a state’s regions, region-level data can be scaled up to the two-region area within a state, which we call a super-region and which comprises the entire state in four states. In three states where the two selected regions do not provide complete coverage of the state, super-region-level data are nonetheless deemed to be representative of states because the two regions were selected to be representative of the state on key variables. Henceforth, we refer to super-regions as states.

Selection of States and Regions

The study focused on residents within AL sites within regions within states, meaning that individual-level resident data are multiply nested. In particular, the sampling design defines 14 regions as strata (two per state), randomly samples sites (primary sampling units) within regions, and then samples individuals within sites.

States.—To maximize expected variability in dementia care practices across states, states were chosen within two pre-specified census areas representing the (a) lowest and (b) highest expected rates of “medication used to control resident behavior” based on data provided by the National Center for Health Statistics. These two areas were the “Middle Atlantic” and “West South Central,” respectively. The Middle Atlantic area contains the three states of New Jersey, New York, and Pennsylvania, and the West South Central area contains the four states of Arkansas, Louisiana, Oklahoma, and Texas.

Regions.—Regions were created within each of these seven states from groups of contiguous counties. Counties were selected based on representativeness to the state on eight variables used in previous work:¹ (a) per capita income, (b) percent of population below the poverty level, (c) percent of non-white population, (d) unemployment rate, (e) percentage of population aged 65+, (f) number of primary care physicians per individual aged 65+, (g) number of hospital beds per individual aged 65+, and (h) number of nursing home beds per individual aged 65+.

Two regions were purposively selected within each state for a total of 14 eligible regions. For four states (Arkansas, Louisiana, New Jersey, Oklahoma), the resultant regions represented the entirety of the states. For the other states (New York, Pennsylvania, Texas), regions represented only a portion of the state.

Sampling and Site Weighting

The general sampling strategy for sites was probability proportional to size random sampling using sites' total bed size. In this way, larger sites had a larger probability of being sampled. We define strata to be the regions ($N = 14$). The primary sampling units are the AL sites selected within the regions.

Calculation of the site-level (i.e., first stage) weights begins by defining the total number of beds in the h -th region in the s -th state as

$$M_{1sh} = \sum_{i=1}^{N_{sh}} M_{1shi}$$

where M_{1shi} = total number of licensed beds in the i -th site from the h -th region of the s -th state in 2014–2015 and N_{sh} = number of sites in the h -th region of the s -th state. On a single draw with probability proportionate to size, the probability of selecting the i -th site in the h -th region in the s -th state is M_{1shi}/M_{1sh} . Because we randomly select n_{sh} sites from the h -th region in the s -th state, the probability that the i -th site is selected is

$$n_{sh}M_{1shi}/M_{1sh}$$

where $n_{sh} = 20$ or $n_{sh} = 40$ depending on the region and draw. Of the 250 community probabilities, a single probability that was > 1.0 was winsorized down to exactly 1.0.

The first-stage weight is thus defined as the inverse of the probability of the site-level selection probability

$$w_{1shi} = M_{1sh}/n_{sh}M_{1shi}.$$

¹Zimmerman S, Sloane PD, Eckert JK, Gruber-Baldini AL, Morgan LA, Hebel JR, Magaziner J, Stearns SC, Chen CK. How good is assisted living? Findings and implications from an outcomes study. *J Gerontol B Psychol Sci Soc Sci.* 2005;60(4):S195–204.

Of the 250 site-level weights, 4 (1.6%) that were > 5.0 times the mean were winsorized down to exactly 5.0 times the mean. This is the weight used to compute representative region-level statistics for site level data or individual short-form measures. In other words, all individuals were included, meaning that no individual-level selection probability nor second-stage weight was necessary. For these measures, the individual-level weight is simply the first-stage (i.e., site-level) analytic weight.

Sampling and Weighting of Individual Residents

For long-form measures, sub-sets of individuals were sampled within sites using stratified random sampling based on their probability of belonging to pre-specified groups based on (a) dementia diagnosis status and (b) antipsychotic prescription status. Calculation of the individual-level (i.e., second-stage) weights began by defining the probability of selecting an individual from the *j*-th group from the *i*-th site, given that the site is selected in the first-stage of sampling, as

$$m_{shij}/M_{2shij}$$

where m_{shij} = the number of individuals sampled in the *j*-th group at the *i*-th site from the *h*-th region in the *s*-th state, and M_{2shij} = the total number of individuals in the *j*-th group at the *i*-th site from the *h*-th region of the *s*-th state based off of the actual number of records available at the time of data collection. The second-stage weight is thus defined as the inverse of the probability of the individual-level selection probability:

$$w_{2shij} = M_{2shij}/m_{shij}$$

The number of residents sampled in the *j*-th group at the *i*-th site from the *h*-th region in the *s*-th state is set to $m_{sh1} = 15$ (dementia diagnosis, antipsychotic prescription), $m_{sh2} = 15$ (dementia diagnosis, no antipsychotic prescription), $m_{sh3} = 15$ (no dementia diagnosis, antipsychotic prescription), and $m_{sh4} = 5$ (no dementia diagnosis, no antipsychotic prescription). When the number of residents of a particular group at the *i*-th site is less than the target sample number we set $m_{shij} = M_{2shij}$.

When residents are sampled within sites, such as for long-form measures, the individual-level weight is thus defined as

$$w_{shij}^* = w_{1shi}w_{2shij}$$

which is the product of the first-stage and second-stage weights.

Post-Stratification State-level Estimates

Scaling of the regions up to states requires a third component to combine region-level estimates. For producing state estimates, the region-level estimates ($N = 2$) for each state are combined with a weighting adjustment for the oversampling of one strata (i.e., region) relative to the other with respect to the total number of beds per stratum.

First consider that the proportion of all beds in a state that are in the h -th region is M_{2sh}/M_s where M_s is the total number of beds in the state. Formally, this value would be the total number of beds in the two-county region that defines the sampling frame in the s -th state given by $M_s = M_{2s1} + M_{2s2}$, where $M_{2sh} = \sum_{i=1}^{N_{sh}} M_{2shi}$ and $M_{2shi} = \sum_{j=1}^4 M_{2shij}$.

The post-stratification weight for an individual from the h -th region in the s -th state is thus defined as the inverse of the probability of the region-level selection probability as

$$w_{0sh} = M_s/M_{2sh}$$

and for individuals within states the individual-level weight is the product defined as

$$w_{shij}^{**} = w_{0sh}w_{1shi}w_{2shij}$$

where w_{1shi} is the first-stage weight and w_{2shij} is the second-stage weight.

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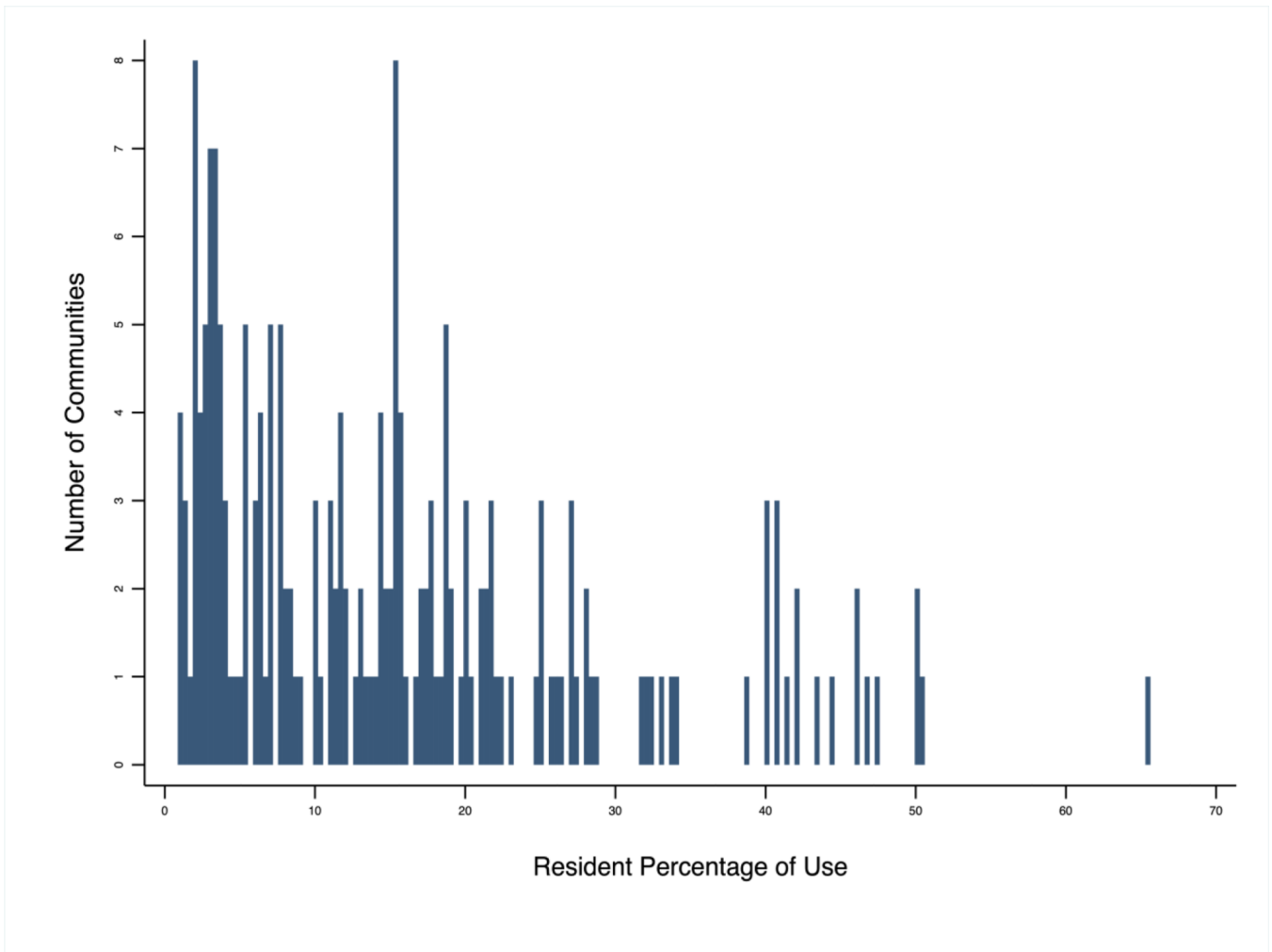


Figure 1.
Assisted Living Community Psychotropic PRN Prescribing Among Communities With Any Prescribing ($N= 194$)

Note. PRN = *pro re nata*. PRN definition includes medications administered and not administered within the last 7 days at time of chart review.

Resident-level data weighted to the community level. Weighted total resident sample size is 152,719 based on 5,777 observed residents in 250 communities.

Percentages (0.00–100.0) transformed from original proportions (.000–1.00).

Data represent those from the 194 of 250 (77.6%) communities with any residents prescribed PRN medications; mean proportion of use = .156.

Table 1.

Resident PRN Psychotropic Prescribing and Administration, by Dementia Status and Medication Type

Medication Type	All Residents Percentage (SE)	Residents Without Dementia Percentage (SE)	Residents With Dementia Percentage (SE)	p
Any PRN psychotropic: Prescribed ¹				
Any psychotropic ²	10.3 (.007)	7.2 (.008)	15.2 (.012)	<.001
Antipsychotics	1.3 (.002)	0.5 (.002)	2.5 (.005)	<.001
Mood stabilizers & antiepileptics	0.2 (.001)	0.1 (.001)	0.3 (.001)	.29
Antidepressants	0.5 (.001)	0.3 (.002)	0.8 (.002)	.071
Anxiolytics & hypnotics	9.1 (.006)	6.6 (.008)	12.9 (.010)	<.001
Cognitive enhancers	0.01 (.0001)	0.0 (—)	0.03 (.0002)	.092
Any PRN psychotropic: Administered ^{3,4}				
Any psychotropic ²	2.3 (.003)	1.8 (.004)	3.0 (.005)	.057
Antipsychotics	0.2 (.001)	0.1 (.0002)	0.5 (.001)	<.001
Mood stabilizers & antiepileptics	0.2 (.001)	0.2 (.002)	0.1 (.001)	.36
Antidepressants	0.2 (.001)	0.2 (.002)	0.1 (.001)	.43
Anxiolytics & hypnotics	2.0 (.003)	1.5 (.004)	2.7 (.004)	.054
Cognitive enhancers	0.1 (.001)	0.2 (.002)	0.0 (—)	.42
Any PRN psychotropic: Not administered ^{1,4}				
Any psychotropic ²	8.0 (.006)	5.5 (.007)	11.9 (.010)	<.001
Antipsychotics	1.0 (.002)	0.5 (.002)	1.9 (.004)	.003
Mood stabilizers & antiepileptics	0.2 (.001)	0.1 (.001)	0.2 (.001)	.60
Antidepressants	0.5 (.001)	0.3 (.002)	0.8 (.002)	.095
Anxiolytics & hypnotics	6.9 (.006)	5.0 (.007)	9.9 (.008)	<.001
Cognitive enhancers	0.01 (.0001)	0.0 (—)	0.03 (.0002)	.092

Note. PRN = *pro re nata*; SE = proportion-based standard error.

Percentages (0.00–100.0) transformed from original proportions (.000–1.00); p<.05 is statistically significant.

p value tests difference between residents without and with dementia using Rao-Scott test (two-sided).

¹Weight = region-level weight*community-level weight*resident-level weight. Weighted total resident sample size is 152,719 based on 5,777 observed residents in 250 communities.

²Includes antipsychotics, mood stabilizers and antiepileptics, antidepressants, anxiolytics and hypnotics, and cognitive enhancers.

³Weight = region-level weight*community-level weight. Weighted total resident sample size is 152,843 based on 13,603 observed residents in 250 communities.

⁴Administered defined as within the last 7 days at time of chart review.

Table 2.

Resident Characteristics, by Psychotropic PRN Prescribing Status

Characteristics	All Residents Proportion or M (SE)	Residents Not Prescribed PRNs Proportion or M (SE)	Residents Prescribed PRNs Proportion or M (SE)	p
Is female	.723 (.012)	.720 (.012)	.752 (.022)	.21
Is white	.953 (.008)	.952 (.008)	.968 (.010)	.19
Age in years	84.73 (0.49)	84.63 (0.52)	85.61 (0.62)	.16
Has any dementia diagnosis	.395 (.019)	.373 (.019)	.581 (.039)	<.001
Has any psychiatric diagnosis	.420 (.014)	.406 (.014)	.542 (.026)	<.001
Is incontinent of urine or bowel	.473 (.018)	.460 (.018)	.585 (.027)	<.001
Is on hospice	.056 (.005)	.039 (.004)	.207 (.024)	<.001
Displays confusion/disorientation	.242 (.014)	.221 (.013)	.417 (.032)	<.001
Displays agitation	.133 (.009)	.109 (.008)	.337 (.032)	<.001
Receives state financial assistance or Medicaid	.144 (.022)	.150 (.023)	.092 (.022)	.016

Note. M = mean; SE = standard error; PRN = *pro re nata*. PRN definition includes medications administered and not administered within the last 7 days at time of chart review.

Weight = region-level weight*community-level weight*resident-level weight. Weighted total resident sample size is 152,719 based on 5,777 observed residents in 250 communities.

p value tests difference between residents not prescribed and prescribed PRNs using two-sided Rao-Scott tests (proportions) or Wald tests (means); p<.05 is statistically significant.

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Table 3.

Assisted Living Community Characteristics, by Psychotropic PRN Prescribing Status

Characteristics	All Communities Proportion or M (SE)	Communities Without Residents Prescribed PRNs Proportion or M (SE)	Communities With Residents Prescribed PRNs Proportion or M (SE)	P
Organizational characteristics				
Is for profit	.649 (.045)	.548 (.092)	.704 (.048)	.12
Total beds ¹	37.81 (2.23)	27.52 (3.35)	43.50 (2.55)	<.001
% of beds that are dementia beds ²	17.97 (2.97)	5.50 (2.32)	24.87 (4.12)	.001
Years in operation	28.53 (3.54)	37.62 (8.54)	23.44 (2.73)	.12
Policies and practices				
Conducts a formal evaluation of memory or cognitive status as part of resident assessment	.747 (.040)	.670 (.091)	.790 (.036)	.18
Conducts a standardized assessment when a resident is agitated	.672 (.040)	.621 (.085)	.700 (.042)	.39
Conducts formal pharmacy reviews of resident medication 4+ times/year	.631 (.046)	.459 (.089)	.726 (.049)	.010
Staffing				
Registered nurse or licensed nurse available on site	.798 (.042)	.701 (.091)	.852 (.040)	.093
Uses medical directors	.253 (.034)	.177 (.057)	.294 (.041)	.13
Resident-to-personal care assistant staffing ratio ³	11.93:1 (0.54)	12.31:1 (1.14)	11.72:1 (0.55)	.64
Number of administrators in the last 5 years	1.88 (0.10)	1.69 (0.17)	1.99 (0.11)	.15
Number of health care supervisors in the last 5 years	2.00 (0.11)	1.61 (0.17)	2.23 (0.13)	.003
Staff attitudes				
Administrator endorses PRNs for residents with dementia who are agitated	.706 (.038)	.723 (.075)	.697 (.042)	.76
Health care supervisor attitudes (1.0–6.0)				
Non-pharmacological attitudes score ⁴	4.52 (0.07)	4.39 (0.15)	4.58 (0.07)	.26
Pharmacological attitudes score ⁵	3.07 (0.08)	3.32 (0.16)	2.93 (0.07)	.031
Mental health care ⁵				
% of residents who received mental health care	32.05 (3.34)	32.69 (6.95)	31.71 (3.62)	.90
% of residents who received mental health care on-site	19.98 (2.73)	20.31 (6.28)	19.79 (2.65)	.94

Note. PRN = *pro re nata*. PRN definition includes medications administered and not administered within the last 7 days at time of chart review.

Resident-level data weighted to the community level to determine community PRN prescribing status. Weighted total resident sample size is 152,719 based on 5,777 observed residents in 250 communities. Weight = region-level weight*community-level weight. Weighted community sample size is 4,043 based on 250 observed communities.

p value tests difference between communities without and with any residents prescribed PRNs using Rao-Scott test (proportions) or Wald test (means); p<.05 is statistically significant.

¹Calculated as number of observed resident chart records/site.

²Calculated as number of observed residents in dementia beds/total beds.

³Mean of three shifts across entire community.

⁴Summary of 5 items with responses ranging from “1” (Strongly disagree) to “6” (Strongly agree); higher score is a more favorable attitude.

⁵Summary of 3 items with responses ranging from “1” (Strongly disagree) to “6” (Strongly agree); higher score is a more favorable attitude.

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Table 4

Total and Documented* Indications for PRN Prescriptions Among Residents With Any PRN Prescribed, by Administration Status and Medication Type (N = 883)

Medication Types	PRNs Prescribed N or n (%)		PRNs Administered N or n (%)		PRNs Not Administered N or n (%)	
	Total	Indicated	Total	Indicated	Total	Indicated
Any psychotropic	1039	733 (70.5)	242	150 (62.0)	797	583 (73.2)
Antipsychotics	139	94 (67.6)	26	15 (57.7)	113	79 (69.9)
Mood stabilizers and antiepileptics	17	13 (76.5)	5	5 (100.0)	12	8 (66.7)
Antidepressants	55	41 (74.5)	5	2 (40.0)	50	39 (78.0)
Anxiolytics and hypnotics	826	584 (70.7)	206	128 (62.1)	620	456 (73.6)
Cognitive enhancers	2	1 (50.0)	0	—	2	1 (50.0)

PRN definition includes medications administered and not administered within the last 7 days at time of chart review.

Total sample size is 5777 observed residents in 250 communities.

*“Documented” means that the resident’s chart included an Indication guiding PRN use; It does not suggest that the PRN was or was not administered in accordance with the indication, however.

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