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Epidemiology of Drug-Disease Interactions in Older Veteran Nursing Home Residents

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Study concept and design: Aspinall, Zhao, Semla, Cunningham, Paquin, Pugh, Schmader, Stone and Hanlon.

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Abstract

Objectives—Few studies have examined drug-disease interactions (DDIs) in older nursing home residents. Therefore, the objective is to describe the prevalence of, and factors associated with, DDIs according to The American Geriatrics Society 2012 Beers Criteria.

Design—Cross-sectional study.

Setting—Fifteen Veterans Affairs Community Living Centers.

Participants—Patients 65 years old with a diagnosis of dementia/cognitive impairment, history of falls/hip fractures, heart failure (HF), history of peptic ulcer disease (PUD) and/or stage IV or V chronic kidney disease (CKD).

Measurements—Prevalence of medications that could exacerbate the above conditions (i.e., DDIs).

Results—Overall, 361 of 696 (51.9%) eligible residents had 1 DDI. None involved those with a history of PUD; one involved a resident with CKD, and four occurred in those with HF. In residents with dementia/cognitive impairment (N=540), 50.7% took a drug that could exacerbate these conditions; the most commonly involved medications were antipsychotics (35.4%) and benzodiazepines (14.4%). In those with a history of falls/hip fractures (N=267), 67.8% received an interacting medication, with SSRIs (33.1%), antipsychotics (30.7%) and anticonvulsants (25.1%) being most commonly involved. Using separate multivariable logistic regression models, factors associated with DDIs in both dementia/cognitive impairment and falls/fractures included: age 85+ (Adjusted Odds Ratio [aOR] and 95% confidence interval [CI] of 0.38; 0.24–0.60 and aOR 0.48; 95% CI 0.24–0.96, respectively); taking 5–8 medications (aOR 2.06; 95% CI 1.02–4.16 and aOR 4.76; 95% CI 1.68–13.5, respectively) and 9 medications (aOR 1.99; 95% CI 1.03–3.85 and aOR 3.68; 95% CI 1.41–9.61, respectively), and being a long stay patient (aOR 1.80; 95% CI 1.04–3.12 and aOR 2.35; 95% CI 1.12–4.91, respectively).

Conclusion—Drug-disease interactions were common in older nursing home residents with dementia/cognitive impairment and/or a history of falls/fractures.

Keywords

drug-disease interactions; Beers Criteria; nursing homes

INTRODUCTION

Older nursing home patients have various comorbidities and frequently are prescribed multiple medications,¹ which puts them at increased risk for the use of drugs that can exacerbate preexisting conditions (i.e., drug-disease interactions, or DDIs).² DDIs in older adults have been associated with increased risk of functional status decline, health services use and adverse drug events.^{2–7} In the United States, the most commonly used explicit criteria for measuring potentially inappropriate DDIs are the Beers Criteria.^{8–10} Using the

2003 Beers Criteria, the reported prevalence of DDIs in older, European nursing home residents ranges from 19%–55%.^{11–13}

In 2012, the Beers Criteria for DDIs were updated by The American Geriatrics Society (AGS). Notably, medications that can potentially exacerbate 13 individual diseases/syndromes are specified, along with the rationale, quality of the evidence and strength of the recommendation.¹⁰ Of these conditions, dementia/cognitive impairment, history of falls/fractures, heart failure (HF), peptic ulcer disease (PUD) and chronic kidney disease (CKD) are particularly prevalent and often result in hospital readmissions in older nursing home patients.^{14–20} To the best of our knowledge, no studies have been conducted using the updated 2012 Beers drug-disease criteria in older nursing home patients. Therefore, the objective of this study is to assess the prevalence of, and factors associated with, potentially inappropriate drug-disease combinations according to the AGS 2012 Beers Criteria that are clinically important in elderly patients residing in Veterans Affairs (VA) Community Living Centers (CLCs).

METHODS

Study Setting and Population

This is a cross-sectional study of 1270 patients residing in one of 15 VACLs (i.e., nursing homes) on October 17, 2012. Residents were included in this study if they were ≥65 years of age and had one or more of the following diseases of interest: 1) dementia and/or cognitive impairment; 2) history of falls and/or hip fractures; 3) HF; 4) history of PUD, and 5) stage IV or V CKD. The Institutional Review Boards for participating sites approved the study.

Data sources and data collection

Using a structured data collection form, trained clinical pharmacists retrospectively reviewed the VA electronic medical record, known as the Computerized Patient Record System (CPRS), and Minimum Data Set (MDS) 3.0 assessments²¹ and recorded age and the presence or absence of the five disease states listed above for each resident of the CLC. For those who met the age and disease state eligibility criteria, clinical pharmacists also collected information on sex, race, Hispanic ethnicity, comorbidities (other than the diseases of interest), number of regularly scheduled, chronic medications (ophthalmics, otics, nasal inhalers and topicals not used for systemic purposes, and as needed medications were excluded from the count), symptoms consistent with psychosis and/or urinary incontinence, type of stay (e.g., long [≥90 days], short, palliative care) and the use of potentially inappropriate medications (i.e., name of drug, dose, route and schedule) in older adults with dementia and/or cognitive impairment, history of falls/hip fractures, HF, history of PUD and/or stage IV or V CKD according to the AGS 2012 Beers Criteria.¹⁰ Lastly, pharmacists recorded the following site-level characteristics: census region; facility size (i.e., small [≤60 beds], medium [60–120 beds], and large [≥120 beds]), and teaching status as indicated by the presence or absence of medical interns and residents participating in the care of CLC patients.²²

Outcome Measures

The outcome measure was defined operationally as evidence of clinically important DDIs that may exacerbate the diseases of interest from the AGS 2012 Beers explicit criteria.¹⁰ Clinically important DDIs for those with dementia/cognitive impairment were the use of any of the following medications: 1) anticholinergics; 2) H₂ blockers; 3) benzodiazepine receptor agonists, and 4) antipsychotics. Highly anticholinergic drugs were those included in the Beers criteria (i.e., first generation antihistamines, tertiary tricyclic antidepressants, certain antipsychotics, gastrointestinal or genitourinary antispasmodics, skeletal muscle relaxants except tizanidine).¹⁰ Clinically important DDIs for those with a history of falls/hip fractures included the use any of the following medications: 1) tricyclic antidepressants; 2) selective serotonin reuptake inhibitors (SSRIs); 3) antipsychotics; 4) benzodiazepine receptor agonists, and 5) anticonvulsants, except for seizure disorders. Important DDIs for those with HF included using any of the following: 1) dronedarone; 2) cilostazol; 3) nonsteroidal anti-inflammatory drugs (NSAIDs); 4) celecoxib; 5) nondihydropyridine calcium channel blockers in those with an ejection fraction <40%, and 6) thiazolidinediones. The DDIs for those with a history of PUD were taking NSAIDs, or aspirin in doses >325 mg/day, without concomitant use of agastroprotective agent (i.e., proton pump inhibitor or misoprostol). Finally, clinically important DDIs for those with stage IV or V CKD included NSAIDs, celecoxib or triamterene.

Statistical Analyses

Demographics, comorbidities (other than diseases of interest), symptoms, regularly scheduled medications, type of stay and facility-level characteristics were described for residents meeting the eligibility criteria overall and by disease state of interest because the DDIs are disease specific. We also describe the proportion of residents with potentially inappropriate DDIs overall and by disease state and the specific medications involved in the DDIs. Residents with multiple DDIs are counted once in the *overall* proportion of residents with potentially inappropriate DDIs. Residents receiving a potentially inappropriate medication that is listed for more than one of their disease states (e.g., antipsychotics in dementia/cognitive impairment and history of falls/hip fracture) are counted as having a DDI in each applicable disease state. For the two common disease states of dementia and/or cognitive impairment and history of falls and/or hip fractures, we fit separate random effects multivariable logistic regression models, which accounted for clustering at the site-level, to assess factors associated with potentially inappropriate DDIs. All patient and site-level characteristics were included in the final model, except for comorbidities, urinary incontinence and psychosis. For these latter characteristics, due to the large number of potential predictors, we entered only those that were suggestive of an association with either outcome (i.e., $P < 0.15$) in preliminary univariate analyses and retained those significant at the 0.05 level in the final model for either outcome. Comorbidities that could be treated with the potentially inappropriate medications were not included in the model (e.g., schizophrenia, depression) because they are potential surrogate measures of the outcome. Data management was done using SAS software (Cary, NC) version 9.2, and all models were run in Stata (College Station, TX) version 11.

RESULTS

The study sample included 696 residents aged 65 years with one or more disease states of interest (Table 1). Among these residents, 77.6% had dementia (n=394) or cognitive impairment (n=146); 38.4% had a history of falls (n=215) or hip fractures (n=52); 22.8% had HF; 10.8% had a history of PUD, and 8.8% had stage IV or V CKD. About 47% had more than one disease state of interest. In particular, 199 (28.6%) residents had dementia/cognitive impairment and a history of falls/hip fracture. Overall, residents were almost equally distributed in the age categories of 65–74, 75–84 and 85 years and had an average of 2.9 other comorbidities. Most residents were male (96.1%), took 9 regularly scheduled medications (74%), had long-stays (70.8%) and received care in large CLCs (62.9%). Compared to the other disease states of interest, higher percentages of residents with HF had coronary artery disease (54.7%), diabetes (59.7%) and chronic lung disease (40.3%) as comorbid conditions, and were more likely to take 9 or more regularly scheduled medications (91.1%). Compared to those without CKD, higher percentages of residents with CKD were younger (i.e., 65–74 years old) (55.7%), black (32.8%) and had diabetes (59%). Characteristics were similarly distributed across the other disease states.

Overall, 361 (51.9%) older residents with one of these five diseases had evidence of a potential DDI (Table 2). Residents with dementia/cognitive impairment and/or a history of falls/hip fractures were most likely to receive a potentially inappropriate medication (50.7% and 67.8%, respectively). Only four DDIs occurred in those with HF; none occurred in those with a history of PUD, and one involved a patient with CKD. Of the residents with dementia/cognitive impairment and history of falls/hip fractures, 13.8% had potentially inappropriate medications in both disease states.

Residents could have more than one potentially inappropriate medication within a given disease state. In those with dementia/cognitive impairment, 37.6% received one interacting drug; 10.7% were given two; 2.2% were given three, and one resident (0.2%) received four interacting medications. In residents with a history of falls/hip fractures, 40.8% received one interacting drug; 19.1% were given two; 6% were given three, and 1.9% received four potentially inappropriate medications.

Table 3 lists the medications involved in the potentially inappropriate DDIs for dementia/cognitive impairment and history of falls/hip fractures. In residents with dementia/cognitive impairment, the medication classes most commonly involved in DDIs were antipsychotics (35.4%) and benzodiazepines (14.4%). Quetiapine (17.2%), risperidone (13.5%), haloperidol (8.2%), olanzapine (7.4%) and aripiprazole (5.6%) accounted for the vast majority of antipsychotics prescribed, while lorazepam (14.3%) and clonazepam (5.0%) were the most commonly used benzodiazepines. Of the 191 residents receiving antipsychotics, 56.0% had schizophrenia, manic depression and/or symptoms of psychosis documented, and of the 78 residents who were taking benzodiazepines, 19.2% had a diagnosis of anxiety. In those with a history of falls/hip fractures, SSRIs (33.3%), antipsychotics (30.7%) and anticonvulsants (25.1%) were most commonly involved in DDIs. Sertraline (25.5%) and citalopram (24.8%) were the most frequently prescribed SSRIs, and gabapentin (19.4%) and valproic acid (13.9%) were the most commonly used

anticonvulsants. The antipsychotics were the same as those prescribed in residents with dementia and/or cognitive impairment. Of the 89 residents receiving an SSRI, 44.9% had a diagnosis of depression, and of the 82 residents who were prescribed antipsychotics, 59.8% had schizophrenia, manic depression and/or symptoms of psychosis. None of the residents receiving anticonvulsants had a documented seizure disorder; those DDIs were excluded per the updated Beers Criteria.¹⁰ The five individuals who received a drug that could potentially exacerbate their HF or CKD were given an NSAID (i.e., ibuprofen, naproxen, meclofenamate, diclofenac [2]).

Table 4 summarizes the separate multivariable logistic regression analyses for those with dementia or cognitive impairment (n=540) and for those with a history of falls or hip fractures (n=267). For those with dementia/cognitive impairment, older age (75–84 and 85+ versus 65–74) was independently associated with lower risk of a DDI; being either a long stay or hospice/palliative care patient or taking 5–8 or 9+ chronic medications was independently associated with increased odds versus short stay status and taking 0–4 chronic medications, respectively. In those with a history of falls/hip fractures, age 85+ was independently associated with reduced risk relative to age 65–74, and being a long stay patient or taking multiple medications was independently associated with increased odds of a DDI.

DISCUSSION

In this study, approximately half of older nursing home residents with dementia/cognitive impairment, history of falls/hip fractures, HF, history of PUD and/or stage IV or V CKD were taking potentially inappropriate medications that could exacerbate their condition. However, the prevalence of DDIs varied widely between disease states, with the majority occurring in those with dementia/cognitive impairment or a history of falls/fractures. Our overall prevalence of DDIs is consistent with that reported in previous nursing home studies with different explicit criteria.^{11–13} In addition, nearly 50% of residents did not have a potentially inappropriate DDI, which suggests many can be managed without exposure to these medications. For some disease states this might be easier to accomplish because alternative treatments are available. This may partly explain why our study found negligible use of medications that could exacerbate CKD, HF or PUD. Similarly, a study of 732 residents in 14 long-term care facilities in Ireland reported only nine instances of NSAID use in residents with PUD.¹¹ This suggests judicious use of chronic NSAIDs in older adults with these comorbidities, as recommended by the 2009 AGS pain guideline.²³

We did, however, find a high proportion of potential DDIs, most commonly involving antipsychotics, in those with dementia or cognitive impairment. It is important to note that highly anticholinergic antipsychotics (e.g., chlorpromazine, trifluoperazine, thioridazine, clozapine or olanzapine) can worsen cognition, and excluding antipsychotics that are *not* highly anticholinergic would reduce the percentage of DDIs attributable to these drugs from 35.4% to 5.9% (data not shown). Nevertheless, we are in agreement with recent initiatives in VA and non-VA nursing homes to reduce the use of antipsychotics as they have modest effectiveness in managing psychotic symptoms in those with dementia, even when the resident is a threat to self or others, and can increase the risk of stroke and death.^{24,25}

Use of medications with anticholinergic properties in residents with cognitive impairment has been a common problem in other nursing home studies.^{11,12} For example, the Ruggiero et al. study of older Italian nursing home residents reported that 5.7% of those with cognitive impairment (n=1193) received anticholinergics, and 9.6% received antispasmodics, which have anticholinergic activity as well.¹² One potential contributor to these DDIs is the use of bladder antispasmodics to treat the urinary incontinence that can be seen in patients receiving acetyl cholinesterase inhibitors for dementia.²⁶ This example of the prescribing cascade, where one drug is given to treat the adverse effects of another, is also problematic because the anticholinergic can negate the effectiveness of the acetyl cholinesterase inhibitor.^{27,28}

We also found that a high proportion of residents received medications, especially SSRIs and antipsychotics, which can potentially increase the risk of falls/fractures in those with a prior history. This may reflect the dramatic rise in the use of antidepressants and antipsychotics in the U.S. since the mid-1990s in both non-VA and VA nursing homes.^{22,29–31} However, we recognize that depression remains undertreated in nursing home residents despite increased use,³¹ and depression itself has been associated with a greater fall risk. Nonetheless, even after adjusting for the severity of depression, SSRIs and tricyclic antidepressants are associated with an increased risk of falls,³² and clinicians should consider the risk versus benefit.

Although we evaluated the factors associated with the use of potentially inappropriate medications in residents with dementia/cognitive impairment or history of falls/hip fractures separately because we thought distinct factors could be influencing prescribing, results were fairly similar. To the best of our knowledge, no previous studies in the nursing home setting have examined risk factors for DDIs. However, like the Pugh et al. study in older community-dwelling Veterans, we found that the odds of a DDI decreased as age increased in residents with dementia and/or a history of falls/fractures;⁷ although, the association was not seen until 85+ years of age among those with a fall/fracture history. Residents who were 85+ years of age took fewer medications (data not shown) and were either “healthier” or had such advanced disease that potentially inappropriate medications were prescribed less frequently (e.g., bedbound dementia patient for whom behavioral or mood disturbances are no longer perceived issues). We also found increased odds of a DDI in residents with dementia/cognitive impairment or a history of falls/fractures who were taking 5 or more regularly scheduled medications as compared with <5, perhaps reflecting more treated comorbidities. Unlike the study by Pugh et al., we did not find an association between race or ethnicity and DDIs, but very few Blacks and Hispanics resided in the CLCs we studied.⁷ Finally, the odds of a DDI were increased among long-stay compared with short-stay residents. This is not unexpected as short-stay residents typically are admitted for rehabilitation or completion of other medical therapy following hospitalization rather than chronic care due to a decline in independent function. The only difference was that those with dementia/cognitive impairment who were receiving hospice/palliative care were more likely to have a potential DDI. This likely reflects the use of anticholinergics and benzodiazepines in the appropriate management of excessive secretions and severe agitation in end-of life residents with this condition.³³

What are the clinical implications of these findings? As suggested by the forthcoming 2014 National Committee for Quality Assurance (NCQA) Healthcare Effectiveness Data and Information Set (HEDIS) measure for potentially harmful medications in patients with dementia/cognitive impairment, anticholinergics should not be used in these patients as equally effective and safer alternatives are available for conditions commonly treated with these drugs (e.g., consider a serotonin-norepinephrine reuptake inhibitor, topical capsaicin or lidocaine, or gabapentin instead of tricyclic antidepressants for neuropathic pain).³⁴ To better identify those at risk and avoid the use of anticholinergics, results of the Brief Interview for Mental Status scores from MDS 3.0 assessments should be made more readily available to providers so residents with severe cognitive impairment can have this condition added to their problem list.³⁵ For those with a history of falls/fractures, a growing body of evidence suggests that multiple CNS medications, or higher cumulative doses, are associated with an increased risk of another fall/fracture.^{36,37} Therefore, in older nursing home residents with a history of falls/fracture, clinicians who have diagnosed new onset depression, epilepsy or psychosis (that is harmful to the patient or staff) that requires treatment with an antidepressant, anticonvulsant or antipsychotic, respectively, consideration should be given to reducing the use and/or dosage of other risky, and perhaps less critical, CNS active medications (e.g., benzodiazepine receptor agonists for insomnia).

Although our data are comprehensive, there are a number of potential limitations that should be considered. First, there could also be unmeasured confounding that might affect the factors associated with DDIs. For example, information about the registered nurse to resident ratio, which has been shown to influence optimal medication use in nursing homes, was not available at the time of the study.³⁸ Second, prescribers may have considered the risk to benefit ratio and decided the benefits of the medications outweighed the risks, especially in patients who have been taking the medications long-term without problems. Finally, our findings may not be generalizable to non-VA nursing home settings because the majority of those patients are older females. However, we believe the clinical implications highlighted above are still applicable.

Conclusion

We found that drug-disease interactions were common in older Veteran nursing home residents with dementia/cognitive impairment and/or a history of falls/hip fracture. Future studies examining the predictive validity of these DDIs with health outcomes are warranted as this represents a potential target for interventions aimed at improving geriatric medication safety.

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Table 1
 Characteristics of VA Community Living Center Residents, Overall and by Disease State of Interest^a

Characteristic	Residents with Disease States of Interest (Total) (N=696; 100%)	Dementia and/or Cognitive Impairment (N=540; 77.6%)	History of Falls and/or Hip Fractures (N=267; 38.4%)	Heart Failure (N=159; 22.8%)	History of Peptic Ulcer Disease (N=75; 10.8%)	Stage IV or V Chronic Kidney Disease (N=61; 8.8%)
Multiple Disease States of Interest	326 (46.8)	54.1	82.0	72.3	74.7	82.0
Age (years)						
65–74	244 (35.1)	32.0	33.7	34.0	29.3	55.7
75–84	236 (33.9)	34.1	33.7	35.2	38.7	18.0
85	216 (31.0)	33.9	32.6	30.8	32.0	26.2
Male	669 (96.1)	95.7	96.6	95.6	98.7	98.4
Race						
White	524 (75.3)	75.2	79.0	73.6	84.0	60.7
Black	119 (17.1)	16.1	13.1	18.2	10.7	32.8
Other	6 (0.9)	1.1	1.5	0.6	2.7	0.0
Unknown	47 (6.8)	7.6	6.4	7.5	2.7	6.6
Hispanic Ethnicity						
Yes	13 (1.9)	1.9	1.9	3.1	5.3	3.3
No	658 (94.5)	94.1	95.5	95.0	93.3	95.1
Unknown	25 (3.6)	4.1	2.6	1.9	1.3	1.6
Number of Other Comorbidities^b						
mean (±SD)	2.9 (1.6)	2.8 (1.5)	2.9 (1.6)	3.3 (1.5)	2.9 (1.6)	2.9 (1.5)
Other Comorbidities						
Coronary artery disease	234 (33.7)	32.0	29.2	54.7	39.2	39.3
Hypertension	434 (62.4)	61.3	61.4	64.2	58.7	63.9
Diabetes	278 (39.9)	36.5	37.8	59.7	34.7	59.0
Arthritis	220 (31.7)	32.0	36.3	30.8	44.6	23.0
Cerebrovascular accident/transient ischemic attack	99 (14.2)	15.2	17.3	11.3	9.3	18.0
Parkinson's disease	46 (6.6)	6.5	7.9	4.4	9.3	3.3

Characteristic	Residents with Disease States of Interest (Total) (N=696; 100%) N (col %)	Dementia and/or Cognitive Impairment (N=540; 77.6%) %	History of Falls and/or Hip Fractures (N=267; 38.4%) %	Heart Failure (N=159; 22.8%) %	History of Peptic Ulcer Disease (N=75; 10.8%) %	Stage IV or V Chronic Kidney Disease (N=61; 8.8%) %
Other Comorbidities (cont.)						
Seizure disorder	54 (7.8)	8.9	7.9	3.8	8.0	3.3
Anxiety disorder	53 (7.6)	7.1	7.9	8.8	8.0	11.5
Depression	200 (28.9)	27.8	28.9	37.7	27.4	23.0
Bipolar	45 (6.5)	7.2	8.6	3.8	5.3	3.3
Schizophrenia	123 (17.7)	18.2	17.2	10.7	16.0	14.8
Chronic lung disease	202 (29.1)	27.6	24.7	40.3	28.4	24.6
Urinary Incontinence	443 (63.6)	67.8	65.2	61.0	60.0	52.5
Psychosis	59 (8.5)	9.3	11.2	4.4	18.7	1.6
Regularly Scheduled Medications (#/person)^c						
0-4	46 (6.6)	8.3	9.4	1.9	4.0	3.3
5-8	135 (19.4)	22.2	26.6	7.0	20.0	14.8
9	514 (74.0)	69.4	64.0	91.1	76.0	82.0
Specialty						
Short stay	117 (16.8)	14.3	17.7	22.6	14.7	19.7
Long stay	492 (70.8)	74.4	68.8	67.3	73.3	67.2
Hospice/palliative care	86 (12.4)	11.3	13.5	10.1	12.0	13.1
Size of CLC (licensed beds)						
Small (< 60)	48 (6.9)	6.7	8.2	5.7	12.0	6.6
Medium (60-120)	210 (30.2)	28.7	32.6	38.4	30.7	36.1
Large (> 120)	438 (62.9)	64.6	59.2	56.0	57.3	57.4
Region						
North	177 (25.4)	25.9	22.5	20.8	18.7	21.3
South	303 (43.5)	45.4	46.8	43.4	44.0	44.3
Midwest	198 (28.4)	26.1	29.2	32.1	34.7	27.9
West	18 (2.6)	2.6	1.5	3.8	2.7	6.6
Medical Interns/Residents Rotate through CLC	458 (65.8)	63.1	64.0	72.3	69.3	70.5

CLC=Community Living Center

^aPatients with more than 1 disease state are included in multiple columns.

^bComorbidities other than heart failure, dementia and/or cognitive impairment, history of falls and/or hip fractures, history of peptic ulcer disease and stage IV or V chronic kidney disease

^cRegularly Scheduled Medications: Potentially inappropriate medications were removed from the count in the corresponding disease state columns, but not the total column.

Table 2

Potentially Inappropriate Drug-Disease Interactions, Overall and by Disease State of Interest

Disease State(N)^a	Residents with Drug-Disease Interactions^b N (row %)
Overall (N=696)	361 (51.9%)
Dementia and/or Cognitive Impairment (N=540)	274 (50.7)
History of Falls and/or Hip Fractures (N=267)	181 (67.8)
Heart Failure (N=159)	4 (2.5)
History of Peptic Ulcer Disease (N=75)	0
Stage IV or V Chronic Kidney Disease (N=61)	1 (1.6)

^a N=number of residents with the disease state^b Residents could have potentially inappropriate drug-disease interactions for >1 disease state.

Table 3

Specific Medications Involved in Potentially Inappropriate Drug-Disease Interactions for Dementia and/or Cognitive Impairment and for History of Falls and/or Hip Fractures

Drug-Disease Interaction(N)^a	Potentially Inappropriate Medication^b N (%)
Dementia and/or Cognitive Impairment (N= 540)	
Anticholinergic medications	48 (8.9)
Anticholinergic antidepressants	10 (1.9)
Anticholinergic antihistamines	11 (2.0)
Anticholinergic antimuscarinics	18 (3.3)
Anticholinergic antiparkinson agents	12 (2.2)
Anticholinergic skeletal muscle relaxants	1 (0.2)
Antipsychotics	191 (35.4)
Benzodiazepines	78 (14.4)
H2-receptor antagonists	34 (6.3)
Zolpidem	4 (0.7)
History of Falls and/or Hip Fractures (N=267)	
Anticonvulsants	67 (25.1)
Antipsychotics	82 (30.7)
Benzodiazepines	36 (13.5)
Non-benzodiazepine hypnotics	2 (0.7)
SSRIs	89 (33.3)
TCAs	3 (1.1)

^a N=number of residents with the disease state

^b Residents could have >1 potentially inappropriate medication for one disease state.

Table 4

Multivariable Logistic Regression of Factors Associated with Potentially Inappropriate Drug Disease Interactions for Dementia/Cognitive Impairment and History of Falls/Hip Fractures;^a N=608 (87.4%)

Variable	Dementia and/or Cognitive Impairment (N=540)		History of Falls and/or Hip Fractures (N=267)	
	Adjusted OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Age (years)				
65–74	Ref.		Ref.	
75–84	0.60 (0.38,0.94)	0.03	0.77 (0.38,1.55)	0.47
85	0.38 (0.24,0.60)	<0.001	0.48 (0.24,0.96)	0.04
Male	0.72 (0.29, 1.76)	0.47	1.23 (0.27, 5.51)	0.79
Race				
White	Ref.		Ref.	
Black	0.70 (0.42,1.14)	0.15	0.65 (0.29,1.46)	0.30
Other/ Unknown	0.97 (0.48,1.97)	0.93	1.77 (0.57,5.49)	0.32
Hispanic Ethnicity				
No	Ref.		Ref.	
Yes	1.04 (0.27,4.08)	0.96	1.89 (0.17,20.9)	0.60
Unknown	0.93 (0.35,2.52)	0.89	0.44 (0.08,2.53)	0.36
Regularly Scheduled Medications (#/person)^b				
0–4	Ref.		Ref.	
5–8	2.06 (1.02,4.16)	0.045	4.76 (1.68,13.5)	0.003
9	1.99 (1.03,3.85)	0.04	3.68 (1.41,9.61)	0.008
Coronary Artery Disease	1.31 (0.88,1.93)	0.18	1.95 (1.06,3.60)	0.03
CLC Specialty				
Short stay	Ref.		Ref.	
Long stay	1.80 (1.04,3.12)	0.04	2.35 (1.12,4.91)	0.02
Hospice/palliative care	3.01 (1.41,6.40)	0.004	1.88 (0.71,4.99)	0.21
Size of CLC (licensed beds)				
Small (< 60)	Ref.		Ref.	
Medium (60–120)	0.46 (0.18,1.19)	0.11	0.54 (0.14,2.11)	0.37
Large (> 120)	0.93 (0.42,2.07)	0.86	0.57 (0.18,1.78)	0.34
CLC Region				
North	Ref.		Ref.	
South	0.59 (0.36,0.97)	0.04	0.68 (0.32,1.44)	0.31
Midwest	0.98 (0.55,1.78)	0.96	0.63 (0.25,1.62)	0.34
West	1.11 (0.33,3.71)	0.87	1.29 (0.11,15.1)	0.84
Medical Interns/Residents Rotate through CLC	1.69 (1.00,2.85)	0.05	2.07 (0.87,4.94)	0.10

CLC=Community Living Center

^a Sample for modeling: We included only patients with the disease states of Dementia/Cognitive Impairment and/or History of Falls/Hip Fractures because patients from the other 3 disease states rarely had drug-disease interactions, and the 5 patients with interactions from the other disease

states were already included in the sample because they also received potentially interacting medications with their dementia/cognitive impairment and/or history of falls/hip fractures.

^b Potentially inappropriate medications were removed from the count of regularly scheduled medications.