Patient, Physician, and Health-System Factors Influencing the Quality of Antidepressant and Sedative Prescribing for Older, Community-Dwelling Adults

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Objective. To identify determinants of potentially inappropriate (PI) antidepressant and anxiolytic/sedative prescribing for older, community-dwelling adults.

Data Sources/Study Setting. Office visits from the 2010 National Ambulatory Medical Care Survey.

Study Design. A cross-sectional study measuring associations between various patient and physician factors and prescribing of PI antidepressants, and PI sedatives among elderly, using Beers 2012/2015 criteria, a clinical decision model, and multivariate logistic regressions.

Data Collection. Visits by older adults (≥ 65 years) involving medications were extracted to identify visits with antidepressants and sedatives.

Principal Findings. Black race, asthma, depression, osteoporosis, payment type, consultation time, and computer systems with prescribing support were associated with reduced odds of PI antidepressant prescribing among users. Income, chronic renal failure, diabetes, and obesity were associated with reduced odds of PI sedative prescribing. Female sex, white race, depression, increasing number of medications, and physician specialty were associated with increased odds of PI sedative prescribing.

Conclusions. Various patient and health-system factors influence the quality of antidepressant and sedative prescribing for older community-dwelling adults. Longer consultations and the use of computer systems with prescribing support may minimize potentially inappropriate antidepressant prescribing. As medication numbers increase, exposure to PI sedatives is more likely, requiring medication review and monitoring.

Key Words. Pharmaceuticals, prescribing/use/costs, quality of care/patient safety (measurement), aging/elderly/geriatrics, mental health, information technology in health

In 2012, approximately 13.4 percent of Americans were aged 65 years or older. This is expected to increase to 16.9 percent by 2020 and to 21.7 percent by 2040 (U.S. Census Bureau, 2013; U.S. Census Bureau, and

Population Division, 2014). As a result, the proportion of older adults requiring medical care will also increase, along with costs of care. With increasing medication use by this population, the prevalence of adverse drug events will also increase. Antidepressants, anxiolytics, and sedative-hypnotics are widely used in the treatment of various behavioral, psychiatric, and neurological disorders, including major depression and anxiety (DeBattista 2012). In one U.S. survey, Pratt et al. found that 14.5 percent of adults ≥ 60 years took antidepressants between 2005 and 2008 (Pratt, Brody, and Gu 2011), and in a recent report, Olfson et al. found that 8.7 percent of Americans aged 65–80 years received benzodiazepines in 2008 (Olfson, King, and Schoenbaum 2015). Unfortunately, the use of antidepressants and anxiolytics and/or sedative-hypnotics in older adults may result in unintended harm due to aging physiology, multiple comorbidities, and drug interactions. Subsequent adverse events include cognitive impairment, confusion, falls, and hospitalization (O'Connor, Gallagher, and O'Mahony 2012).

Beers criteria, which identify potentially inappropriate medications (PIMs) to avoid in older adults, was updated in 2012 and 2015 in collaboration with the American Geriatrics Society (AGS) to provide more current, evidence-based guidance to health professionals (Campanelli 2012; Radcliff et al. 2015). Both versions of the criteria (2012/2015) classify tertiary tricyclic antidepressants (TCAs) as PIMs to avoid in older adults. Secondary amine TCAs, selective serotonin reuptake inhibitors (SSRIs), serotonin–norepinephrine reuptake inhibitors (SNRIs), bupropion, and mirtazapine are classified as PIMs to avoid in selected conditions due to drug–disease/syndrome interactions, and/or as medications to use with caution. Most sedative-hypnotics and anxiolytics are classified as PIMs to avoid, except ramelteon, and midazolam. Although Beers 2012 criteria recommend avoidance of benzodiazepines for the treatment of insomnia, agitation, or delirium, and avoidance of chronic use (>90 days) of nonbenzodiazepines, the 2015 criteria no longer apply these conditions (Campanelli 2012; Radcliff et al. 2015). Beers criteria are used in the development of quality of care measures, such as those used by Healthcare Effectiveness Data and Information System (HEDIS) (HEDIS 2015 Measures: Summary Table of Measures, Product

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Lines and Changes, 2015). As a result, the findings of reviews applying these measures inform prescribing policies, insurance coverage, and educational interventions. Therefore, to understand the context of the use of PIMs, the identification of factors influencing their prescribing may guide the development, application, and interpretation of quality measures, and subsequent quality improvement strategies.

Aparasu and Mort in their study among older Americans in the 1996 Medical Expenditure Panel Survey found age was a determinant of potentially inappropriate (PI) antidepressant and sedative-hypnotic use, and Medicare status was a determinant of PI sedative-hypnotic use, using Beers 2003 criteria (Aparasu and Mort 2004). Although more recent studies have tested factors influencing the use of PIMs among community-dwelling elderly using Beers 2012 criteria, none involved Americans or factors influencing the choice of PI antidepressants or sedative-hypnotics (de Oliveira Baldoni et al. 2014; Blanco-Reina et al. 2014; McMahon et al. 2014; Nishtala et al. 2014; Davidoff et al. 2015). Following the introduction of financial incentives for the meaningful use of electronic health records (EHRs) through the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009, the use of EHRs by office-based physicians has increased (Hsiao et al. 2013). Subsequently, improvements in provider performance and the quality of care delivered by practices using EHR systems that meet meaningful use objectives have been reported (King et al. 2014; Wright et al. 2014).

Given that prescribing may be influenced by both clinical and nonclinical factors, including additional therapeutic alternatives and health technologies, factors influencing potentially inappropriate prescribing are expected to change over time (Eisenberg 1979; McKinlay, Potter, and Feldman 1996; Hajjaj et al. 2010). In Eisenberg's model of clinical decision making, factors that may influence clinical decisions are listed in four categories: (1) *physician characteristics* (e.g., age, qualification, specialty), (2) *patient characteristics* (e.g., age, sex, income), (3) the *physician-patient relationship* (e.g., rapport), and (4) the *physician's interaction with the health system* (e.g., administrative constraints, peer influence) (Eisenberg 1979).

In the absence of recent studies of factors influencing the quality of antidepressant and sedative-hypnotic prescribing using the revised criteria, this study aimed to (i) assess the influence of sociological factors on prescribing of potentially inappropriate antidepressants, and (ii) assess the influence of these factors on prescribing of potentially inappropriate anxiolytics/sedative-hypnotics for older community-dwelling Americans. For purposes of this study, the term *sedatives* will include anxiolytics (e.g., benzodiazepines) as well

as sedative-hypnotic medications (e.g., barbiturates, nonbenzodiazepine hypnotics).

METHODS

National Ambulatory Care Survey

Data on visits to office-based practices and community health centers by adults aged 65 years or older were extracted from the public use file of the National Ambulatory Medical Care Survey (NAMCS) 2010. In this survey, physicians were selected using multistage cluster sampling of nonfederal doctors of medicine or osteopathy engaged in patient care activities. At the first stage, 112 geographic segments of counties, groups of counties, county equivalents, towns, or townships within the 50 states and the District of Columbia were selected. Subsequently, a second probability sample of 3,525 physicians was drawn from the files of the American Medical Association and the American Osteopathic Association.

Eligible physicians (2,406) were interviewed, with participation from 1,482 practitioners, who were randomly assigned one week of the year for record review. Records of patients seen in the assigned week were randomly selected from the physician's log by office staff or field representatives. From the participating practices, 32,229 patient record forms were completed for 1,292 practices: a response rate of 58.9 percent (57.3 percent weighted) (National Center for Health Statistics, 2012). Missing data were imputed via a randomly assigned value from patient records, based on region, specialty, and diagnoses. Data entry and quality control procedures were conducted in Durham, NC, by SRA International, Inc. (National Center for Health Statistics, 2012).

Identification of Visits and Determinants

Visits involving new and continued medication orders were identified from the public data files of the survey. Antidepressants and sedatives were identified using generic equivalent codes of the Lexicon Plus system, Cerner Multum, Inc. (National Center for Health Statistics, 2011).

Patient characteristics selected were as follows: age, sex, median household income, expected payment type, race, ethnicity, injury-related visit, the number of medications ordered, and the presence of 14 chronic conditions. Diagnostic coding based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), was used to identify PI

drug–disease combinations (Centers for Disease Control and Prevention, and Centers for Medicare & Medicaid Services, 2009). For SSRIs and SNRIs, potentially inappropriate conditions were as follows: delirium, dementia, and/or cognitive impairment, history of falls, seizures, history of fractures, syncope, constipation, lower urinary symptoms, or benign prostatic hyperplasia. For benzodiazepines and nonbenzodiazepine hypnotics, these were history of falls or fractures, dementia, and cognitive impairment, and for all sedatives, delirium (Radcliff et al. 2015).

The *patient–physician relationship* was measured using three proxy variables, estimating the degree of interaction between the patient and the physician. These included whether the patient was established or a new patient, the time spent with the physician, and the number of extended physician services. To measure the latter, a continuous variable was created by summing the number of extended services provided by the physician during the last normal week of practice: evening/weekend consultations, hospital visits, home visits, and/or telephone or email or Internet consultations.

Physician characteristics were based on physician specialty, the involvement of nonphysician providers during visit (nurse practitioner/midwife, registered nurse/licensed practical nurse, physician assistant), geographic region, and metropolitan location.

Physician–health-system interaction factors were based on aspects that may introduce the influence of peers and/or other professionals, administrative restrictions, and/or clinical protocols. Selected variables used were as follows: physician ownership, solo practice, the use of electronic health records (EHRs), and the use of computer systems with any features to support prescribing (patient history and demographics, clinical notes, laboratory results, prescription ordering, and the presence of reminders for interventions).

Classification of Visits

Visits involving antidepressant prescribing were reviewed and classified as potentially inappropriate (PI) if either was present:

1. Tertiary TCAs; or
2. An SSRI or SNRI or bupropion in combination with a PI condition (e.g., delirium, dementia, a history of falls/fractures, or syncope).

Medication lists for visits with “miscellaneous antidepressants” were used to identify the antidepressant, and subsequently classified or excluded if the antidepressant was not identified.

Given that almost all sedatives were listed as PIMs, all visits by older adults were reviewed and classified as potentially inappropriate if either was identified:

1. Barbiturates, meprobamate, benzodiazepines (except midazolam), and/or nonbenzodiazepine hypnotics; or
2. Ramelteon or midazolam in combination with a diagnosis of delirium.

Data Analysis

Proportions and measures of central tendency were determined based on the weighted number of visits involving antidepressant or sedative orders for categorical and continuous variables. Statistical estimates including tests of association (likelihood ratio) were calculated using complex sampling analyses, incorporating patient weights and the sampling design (National Center for Health Statistics, 2012). Statistical significance was set at $p < .05$. Bivariate, logistic regression models were used to measure associations between the various factors and the presence of PI antidepressant prescribing among visits with antidepressants, and for PI sedative prescribing among all visits. Associations involving continuous variables were assessed using adjusted Wald F -tests. Variables with small unweighted counts that resulted in unreliable estimates were collapsed into fewer categories (e.g., specialty, payment type).

To control for identified confounders, multivariate models for PI antidepressant prescribing and for sedative-hypnotic prescribing were developed separately. To develop parsimonious models, factors with likelihood ratio (adjusted F) or modified Wald tests of statistical significance $p < .25$ were entered into each model in a forward stepwise approach. The significance of the each multivariate model was assessed using Wald F -tests, and individual coefficients were assessed using t -tests and 95 percent confidence intervals of the adjusted odds ratios. Factors that made the final model unreliable were excluded. Analyses were conducted using *IBM SPSS Statistics* version 22.0 Complex Samples module (IBM Inc., Armonk, NY).

RESULTS

In 2010, 8,156 sampled visits, representing 258,976,010 weighted visits to office-based practices, were by patients older than 65 years of age, of which

206,392,122 (79.7 percent) involved medication orders. Approximately 56.9 percent of visits were by female patients, and the mean age of patients seen during the visits was 75.4 years. Approximately 24,942,644 (12.1 percent) of the medication-related visits involved antidepressants, where 24,867,306 (12.0 percent) were identifiable; and 23,821,026 visits (11.5 percent) involved orders for sedatives.

Potentially Inappropriate Antidepressants

Among visits with antidepressants, sertraline, citalopram, and escitalopram were the most common antidepressants ordered during 18.1, 14.9, and 14.8 percent of visits, respectively—Table S1. After classification, 2,636,414 visits (10.6 percent) involved potentially inappropriate (PI) antidepressant prescribing: 2,532,624 (10.2 percent) were potentially inappropriate due to orders for tertiary TCAs and 103,790 (0.4 percent) were due to PI antidepressant–disease combinations. Proportions of PI antidepressant prescribing by various patient, physician/practice, and health-system characteristics are shown in Table 1. Factors that were eligible for the multivariate model were as follows: asthma, depression, osteoporosis, income, race, payment type, time spent, specialty, metropolitan area, and use of computer systems with prescribing support.

Significant bivariate associations ($p < .05$) were found between potentially inappropriate antidepressant prescribing and asthma, depression, osteoporosis, income, payment type, and metropolitan area. Household income in the first quartile was associated with higher unadjusted odds of PI antidepressant prescribing, whereas asthma, depression, osteoporosis, private insurance or self-pay methods, and metropolitan area were associated with lower unadjusted odds of PI antidepressant prescribing. In the multivariate model, all the identified determinants of potentially inappropriate antidepressant prescribing were associated with reduced odds of PI prescribing, namely asthma, depression, osteoporosis, black race, private insurance or self-pay methods, consultation time, and the use of systems supporting prescribing—Table 2.

Black race was associated with 94.5 percent lower odds of PI antidepressant prescribing, relative to other non-white races. The presence of osteoporosis, asthma, and depression was associated with 88.8, 83.0, and 72.4 percent lower odds, respectively. Payment via private insurance or self-pay was associated with 85.3 percent lower odds. With each additional minute of consultation, a corresponding 5.7 percent reduction in odds of PI antidepressant prescribing was found, and 68.5 percent reduction in odds was found among

Table 1: Population Characteristics and Potentially Inappropriate Antidepressant Prescribing for Older Adults in 2010

Factors	Variables	Weighted		PI Antidepressant Prescribing, Weighted %		Sig. *
		Visits	Visit % [‡]	Yes (10.6)	No (89.4)	
Age	Mean = 74.8 (SE = 0.36)	24,867,306	100	Mean = 74.6	Mean = 74.9	0.772
Sex	Female	15,451,082	62.1	10.9	89.1	0.770
	Male	9,416,224	37.9	10.1	89.9	
Race	White	23,653,860	95.1	10.9	89.1	0.137
	Black	772,153	3.1	1.8	98.2	
	Other	441,293	1.8	10.3	89.7	
Ethnicity	Hispanic	1,391,105	5.6	6.5	93.5	0.475
	Not Hispanic	23,476,201	94.4	10.8	89.2	
Median household income (USD)	Q1: Below \$32,793	4,810,430	20.3	17.7	82.3	0.079
	Q2: \$32,794–\$40,626	5,828,475	24.6	11.3	88.7	
	Q3: \$40,627–\$52,387	6,266,758	26.4	7.9	92.1	
	Q4: \$52,388 or more	6,788,585	28.7	7.8	92.2	
Payment type	Private/self	4,100,215	16.8	5.8	94.2	0.053
	Medicare	19,597,649	80.7	11.3	88.7	
	Medicaid	420,426	1.7	19.9	80.1	
	Other	235,366	1.0	33.8	66.2	
Injury visit	Yes	1,912,430	7.7	12.2	87.8	0.724
	No	22,954,876	92.3	10.5	89.5	
Chronic conditions						
Arthritis	Yes	6,563,544	26.4	11.0	89.0	0.882
	No	18,303,762	73.6	10.5	89.5	
Asthma	Yes	1,709,791	6.9	2.2	97.8	<0.001
	No	23,157,515	93.1	11.2	88.8	
Cancer	Yes	3,630,817	14.6	16.7	14.4	0.669
	No	21,236,489	85.4	10.3	89.7	
CBVD	Yes	1,109,131	4.5	13.9	86.1	0.551
	No	23,758,175	95.5	10.4	89.6	
CHF	Yes	1,139,987	4.6	7.2	92.8	0.58
	No	23,727,319	95.4	10.8	89.2	
CRF [‡]	Yes	1,090,437	4.4	0	100	0.05
	No	23,776,869	95.6	11.1	88.9	

Continued

Table 1. *Continued*

Factors	Variables	Weighted		PI Antidepressant Prescribing, Weighted %		Sig.*
		Visits	Visit % [†]	Yes (10.6)	No (89.4)	
COPD	Yes	3,223,512	13.0	8.8	91.2	0.643
	No	21,643,794	87.0	10.9	89.1	
Depression	Yes	8,039,687	32.3	4.3	95.7	<0.001
	No	16,827,699	67.6	13.6	86.4	
Diabetes	Yes	5,285,066	21.3	12.1	87.9	0.624
	No	19,582,240	78.7	10.2	89.8	
Hyperlipidemia	Yes	8,402,627	33.8	11.7	88.3	0.60
	No	16,464,679	66.2	10.1	89.9	
Hypertension	Yes	13,467,535	54.2	11.1	88.9	0.632
	No	11,399,771	45.8	10.0	90.0	
IHD	Yes	2,154,083	8.7	8.6	91.4	0.658
	No	22,713,223	91.3	10.8	89.2	
Obesity	Yes	1,751,655	7.0	11.0	89.0	0.934
	No	23,115,651	93.0	10.6	89.4	
Osteoporosis	Yes	1,953,910	7.9	1.0	99.0	<0.001
	No	22,913,396	92.1	11.4	88.6	
Number of medications ordered	Mean = 6.4 (SE = 0.12)	24,867,306	100	Mean = 6.6	Mean = 6.4	0.618
Seen before	Yes	22,906,611	92.1	10.6	89.4	0.950
	No	1,960,695	7.9	11.0	89.0	
Time spent (minutes)	Mean = 21.8 (SE = 0.73)	24,520,921	98.6	Mean = 18.1	Mean = 22.3	0.050
Number extended services	Mean = 1.4 (SE = 0.10)	24,442,306	98.3	Mean = 1.4	Mean = 1.4	0.807
Physician specialty	General/family	6,181,800	24.9	14.1	85.9	0.079
	Internal medicine/CVS	7,701,289	31.0	6.3	93.7	
	Psychiatry	1,192,665	4.8	6.6	93.4	
	Surgical	1,333,316	5.4	23.2	76.8	
	Other	8,458,236	34.0	10.6	89.4	
Physician assistant seen	Yes	1,240,239	5.0	10.1	89.9	0.875
	No	23,627,037	95.0	10.6	89.4	
NP/MW seen [‡]	Yes	246,907	1.0	0	100.0	0.276
	No	24,620,399	99.0	10.7	89.3	
RN/LPN seen	Yes	5,952,082	23.9	12.1	87.9	0.587
	No	18,915,224	76.1	10.1	89.9	
Region	Northeast	3,804,030	15.3	9.1	90.9	0.349
	Midwest	5,786,900	23.3	11.5	88.5	
	South	9,272,699	37.3	13.3	86.7	
	West	6,003,677	24.1	6.6	93.4	

Continued

Table 1. Continued

Factors	Variables	Weighted		PI Antidepressant Prescribing, Weighted %		Sig. *
		Visits	Visit % [†]	Yes (10.6)	No (89.4)	
Metropolitan area	Yes	21,610,513	86.9	9.4	90.6	0.058
	No	3,256,793	13.1	18.3	81.7	
Solo practice	Solo	7,084,790	28.5	11.2	88.8	0.766
	Group	17,779,060	71.5	10.3	89.7	
Ownership	Physician or physician group	19,919,157	80.1	10.8	89.2	0.762
	Other	4,948,149	19.9	9.9	90.1	
EHR use	Yes	14,687,670	59.6	10.7	89.3	0.785
	No	9,971,979	40.4	10.0	90.0	
Any computer features	Yes	22,302,034	90.2	9.9	90.1	0.166
For prescribing support [§]	No	2,426,441	9.8	16.2	83.8	

*Significance based on likelihood ratio tests (categorical) and Wald *F*-tests (interval) of model coefficients.

[†]Based on valid visits (*N* = 24,867,306). Total percentages may not equal 100 percent due to missing data values.

[‡]Validity of model fit is uncertain due to zero cell counts.

[§]Prescribing support indicators: Patient history/demographics, clinical notes, laboratory results, e-prescribing, reminders for interventions.

CBVD, cerebrovascular disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; CRF, chronic renal failure; EHR, electronic health records; IHD, ischemic heart disease; NP/MW, nurse practitioner/midwife; PA, physician assistant; PI, potentially inappropriate; Q1–4, income quartiles 1–4; RN/LPN, registered nurse/licensed practical nurse; SE, standard error (continuous variables); USD, United States dollar.

visits where the practice used a computer system with prescribing support features.

Potentially Inappropriate Sedatives

Among visits by older adults involving sedatives, zolpidem, alprazolam, and lorazepam were the most common sedatives ordered during 27.5, 22.5, and 21.4 percent of visits, respectively—Table S2. After classification, 23,452,231 visits (11.4 percent) involved PI sedative prescribing; 23,162,776 visits (11.2 percent) were due to PI sedatives to avoid and 289,455 visits (0.2 percent) were due to PI sedative–disease combinations. Table 3 presents PI sedative prescribing by various patient, physician, and health-system factors.

Table 2: Bivariate and Multivariate Logistic Models of Factors Influencing Potentially Inappropriate Antidepressant Prescribing for Older Adults Receiving Antidepressants

<i>Factors[†]</i>	<i>Values</i>	<i>Crude OR</i>	<i>95% CI</i>	<i>Adjusted OR[‡]</i>	<i>95% CI</i>
Asthma	Yes	0.181	0.065–0.504**	0.170	0.058–0.500**
Depression	Yes	0.284	0.148–0.547***	0.276	0.126–0.607**
Osteoporosis	Yes	0.081	0.021–0.320***	0.112	0.021–0.589*
Median household income (USD)	Q1: Below \$32,793	2.562	1.08–6.082*	1.551	0.484–4.967
	Q2: \$32,794–\$40,626	1.517	0.649–3.549	1.150	0.377–3.506
	Q3: \$40,627–\$52,387	1.015	0.361–2.855	1.056	0.392–2.841
Race	White	1.063	0.155–7.314	0.318	0.048–2.094
	Black	0.158	0.015–1.616	0.055	0.004–0.695*
Payment type	Private/Self	0.120	0.038–0.375***	0.147	0.029–0.750*
	Medicare	0.250	0.111–0.562**	0.265	0.062–1.130
	Medicaid	0.486	0.081–2.916	0.230	0.021–2.510
Time spent	1–150 minutes	0.955	0.912–1.000	0.943	0.899–0.990*
Physician specialty	General/Family	1.391	0.685–2.826	2.168	0.771–6.093
	Internal/CVS	0.567	0.227–1.415	0.748	0.261–2.149
	Psychiatry	0.596	0.226–1.577	2.430	0.572–10.319
	Surgical	2.559	0.745–8.792	1.594	0.458–5.547
Metropolitan area	Yes	0.464	0.219–0.986*	0.665	0.264–1.677
Computer system features prescribing	Yes	0.570	0.266–1.219	0.315	0.106–0.930*

* $p < .05$; ** $p < .01$; *** $p < .001$.

[†]Reference groups are “No,” except for race (other), income (Q4: \$52,388 or more), payment type, specialty (Other), and time spent (mean).

[‡]Adjusted model information: Population size = 22,750,211 (740 cases); sampling degrees of freedom = 133; adjusted Wald $F = 2.620$ ($p = .003$); pseudo R -squares = 0.201 (Nagelkerke), 0.154 (McFadden).

CI, confidence interval; CVS, cardiovascular specialty; OR, odds ratio; PI, potentially inappropriate; Q1–3, quartiles 1–3; USD, United States dollar.

Significant bivariate associations ($p < .05$) were found between PI sedative prescribing and sex, race, chronic renal failure, depression, diabetes, obesity, the number of medications ordered during the visit, physician specialty, and physician assistant involvement. Additional factors included in the multivariate model were as follows: ethnicity, income, chronic obstructive pulmonary disease (COPD), practice ownership, and the use of electronic health records (EHRs). Female sex, white race, depression, the number of medications, visits to general/family practices, neurology, and psychiatry specialties

Table 3: Population Characteristics and Potentially Inappropriate Sedative-Hypnotic Prescribing for Older Adults in 2010

<i>Factors</i>	<i>Values (SE)</i>	<i>Weighted</i>		<i>PI Sedative Prescribing, Weighted %</i>		<i>Sig.[†]</i>
		<i>Visits</i>	<i>Visit %[*]</i>	<i>Yes (11.4%)</i>	<i>No (88.6%)</i>	
Age	Mean = 75.4 (SE = 0.1)	206,392,122	100	Mean = 75.8	Mean = 75.3	0.274
Sex	Female	117,417,397	56.9	13.5	86.5	<0.001
	Male	88,974,725	43.1	8.5	91.5	
Race	White	182,213,639	88.3	12.0	88.0	0.001
	Black	17,322,013	8.4	7.5	92.5	
	Other	6,856,470	3.3	3.9	96.1	
Ethnicity	Hispanic/Latino	13,322,829	6.5	7.5	92.5	0.070
	Not Hispanic/Latino	193,069,293	93.5	11.6	88.4	
Median household income (USD)	Q1: Below \$32,793	41,936,239	21.2	12.2	87.8	0.067
	Q2: \$32,794–\$40,626	44,387,193	22.5	12.0	88.0	
	Q3: \$40,627–\$52,387	52,487,965	26.5	9.0	91.0	
	Q4: \$52,388 or more	58,891,937	29.8	13.2	86.8	
Payment type	Private/self	30,987,007	15.3	9.8	90.2	0.499
	Medicare	166,544,177	82.1	11.4	88.6	
	Medicaid	3,047,505	1.5	16.7	83.3	
Injury visit	Other	2,195,764	1.1	11.0	89.0	0.581
	Yes	14,194,907	6.9	10.2	89.8	
	No	192,197,215	93.1	11.4	88.6	

Continued

Table 3. *Continued*

Factors	Values (SE)	Weighted		PI Sedative Prescribing, Weighted %		Sig. [†]
		Visits	Visit %*	Yes (11.4%)	No (88.6%)	
Chronic conditions	Arthritis	49,381,234	23.9	12.0	88.0	0.570
	No	157,010,888	76.1	11.2	88.8	
	Asthma	11,767,652	5.7	13.6	86.4	0.481
	No	194,624,470	94.3	11.2	88.8	
	Cancer	28,847,039	14.0	12.5	87.5	0.334
	No	177,545,083	86.0	11.2	88.8	
	CBVD	8,347,745	4.0	10.6	89.4	0.808
	No	198,044,672	96.0	11.4	88.6	
	CHF	9,118,141	4.4	9.7	90.3	0.453
	No	197,273,981	95.6	11.4	88.6	
	CRF	7,963,034	3.9	3.7	96.3	<0.001
	No	198,429,088	96.1	11.7	88.3	
	COPD	20,919,679	10.1	14.9	85.1	0.057
	No	185,472,443	89.9	11.0	89.0	
	Depression	16,133,594	7.8	24.9	75.1	<0.001
	No	190,258,528	92.2	10.2	89.8	
	Diabetes	46,432,892	22.5	7.7	92.3	0.001
	No	159,959,230	77.5	12.4	87.6	
	Hyperlipidemia	67,849,451	32.9	11.1	88.9	0.750
	No	138,542,671	67.1	11.5	88.5	
	Hypertension	112,091,267	54.3	11.2	88.8	0.748
	No	94,300,855	45.7	11.5	88.5	
	IHD	2,162,2795	10.5	10.7	89.3	0.756
	No	18,476,9327	89.5	11.4	88.6	
	Obesity	11,937,914	5.8	7.2	92.8	0.025
	No	194,454,208	94.2	11.6	88.4	

Continued

Table 3. Continued

Factors	Values (SE)	Weighted		PI Sedative Prescribing, Weighted %		Sig. [†]
		Visits	Visit %*	Yes (11.4%)	No (88.6%)	
Seen before	Osteoporosis	14,328,312	6.9	13.4	86.6	0.377
	No	192,063,810	93.1	11.2	88.8	
	Yes	186,780,605	90.5	11.4	88.6	0.793
	No	19,611,517	9.5	10.9	89.1	
	Mean = 21.0 (SE = 0.6)	206,392,122	100	Mean = 20.1	Mean = 21.1	0.286
	Mean = 4.7 (SE = 0.1)	206,392,122	100	Mean = 6.2	Mean = 4.5	<0.001
	Mean = 1.5 (SE = 0.1)	204,951,294	99.3	Mean = 1.4	Mean = 1.5	0.587
	General/family	39,106,178	18.9	14.2	85.8	0.001
	Internal medicine	48,440,111	23.5	11.3	88.7	
	Cardiovascular	15,809,229	7.7	9.3	90.7	
Physician specialty	Gen/ObGyn/ orthopedic surgery	14,609,496	7.1	9.7	90.3	
	Urology	7,385,974	3.6	9.0	91.0	
	Psychiatry	1,805,679	0.9	44.5	55.5	
	Neurology	3,703,463	1.8	16.6	83.4	
	Oncology	11,200,752	5.4	11.5	88.5	
	Other	64,331,240	31.2	9.6	90.4	
	Physician assistant	11,657,136	5.6	6.9	93.1	0.017
	No PA	194,734,986	94.4	11.6	88.4	
	NP/MW	1,899,476	0.9	8.0	92.0	0.474
	No	204,492,646	99.1	11.4	88.6	
Nonphysician provider	RN/LPN	53,975,993	26.2	12.9	87.1	0.250
	No	152,416,129	73.8	10.8	89.2	

Continued

Table 3. *Continued*

<i>Factors</i>	<i>Values (SE)</i>	<i>Weighted</i>		<i>PI Sedative Prescribing, Weighted %</i>		<i>Sig.[†]</i>
		<i>Visits</i>	<i>Visit %*</i>	<i>Yes (11.4%)</i>	<i>No (88.6%)</i>	
Region	Northeast	35,714,274	17.3	10.5	89.5	0.894
	Midwest	48,443,752	23.5	11.0	89.0	
	South	80,390,209	39.0	12.0	88.0	
	West	41,843,887	20.3	11.3	88.7	
Metropolitan area	Yes	178,979,367	86.7	11.5	88.5	0.566
	No	27,412,755	13.3	10.4	89.6	
Solo practice	Solo	62,112,608	30.1	10.2	89.8	0.323
	Group	144,002,714	69.9	11.9	88.1	
Ownership	Physician or	170,536,752	82.8	10.9	89.1	0.135
	physician group					
Computer system with	Other	35,479,310	17.2	13.6	86.4	0.471
	Yes	180,723,118	88.2	11.6	88.4	
Features for prescribing support [‡]	No	24,113,282	11.8	10.0	90.0	0.130
	Yes	114,432,139	55.6	12.2	87.8	
EHR use	No	91,134,754	44.4	10.3	89.7	

*Based on valid visits ($N = 206,392,122$). Total percentages may not equal 100 percent due to missing data values.

[†]Significance based on likelihood ratio tests (categorical) and Wald F -tests (interval) of model coefficients.

[‡]Prescribing support indicators: Patient history/demographics, clinical notes, laboratory results, e-prescribing, reminders for interventions. CBVD, cerebrovascular disease; CD, chronic disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; CRF, chronic renal failure; EHR, electronic health record; ER, emergency room; IHD, ischemic heart disease; NP/MW, nurse practitioner/midwife; PA, physician assistant; PI, potentially inappropriate; SE, standard error (continuous variables); Q1–4, income quartiles 1–4; RN/LPN, registered nurse or licensed practical nurse; SE, standard error; USD, United States dollar.

were associated with higher crude odds of PI sedative prescribing. Conversely, household income in the third quartile, chronic renal failure, diabetes, obesity, and physician assistant involvement were associated with lower crude odds. In the multivariate model, sex, race, income, chronic renal failure, depression, diabetes, obesity, and specialty remained influential on PI sedative prescribing—Table 4.

Table 4: Bivariate and Multivariate Logistic Models of Factors Influencing Potentially Inappropriate Sedative-Hypnotic Prescribing for Older Adults

<i>Factor[†]</i>	<i>Values</i>	<i>OR</i>	<i>95% CI</i>	<i>AOR[‡]</i>	<i>95% CI</i>
Sex	Female	1.689	1.319–2.163***	1.598	1.238–2.062***
Race	White	3.324	1.479–7.471**	2.674	1.115–6.412*
	Black	1.971	0.765–5.075	1.680	0.644–4.385
Ethnicity	Hispanic	0.618	0.355–1.075	0.991	0.679–1.253
Median household income (USD)	Q1: Below \$32,793	0.912	0.644–1.291	0.924	0.686–1.244
	Q2: \$32,794–\$40,626	0.891	0.633–1.254	0.828	0.581–1.181
	Q3: \$40,627–\$52,387	0.652	0.481–0.882**	0.634	0.463–0.869**
COPD	Yes	1.415	1.000–2.004	1.203	0.798–1.814
CRF	Yes	0.292	0.153–0.558***	0.239	0.108–0.529***
Depression	Yes	2.916	2.246–3.786***	1.751	1.221–2.511**
Diabetes	Yes	0.584	0.421–0.810**	0.472	0.325–0.687***
Obesity	Yes	0.587	0.356–0.969*	0.538	0.322–0.900*
Number of medications	Mean = 4.6	1.318	1.268–1.37***	1.403	1.337–1.472***
Physician ownership	Yes	0.774	0.557–1.076	0.922	0.679–1.253
Specialty	General/ family	1.555	1.021–2.368*	1.320	0.883–1.973
	Internal	1.202	0.757–1.909	1.131	0.726–1.764
	Cardiovascular	0.972	0.636–1.487	0.708	0.447–1.121
	Surgical	1.015	0.608–1.694	1.206	0.734–1.979
	Urology	0.930	0.488–1.773	0.973	0.564–1.678
	Neurology	7.549	4.401–12.947***	11.649	6.108–22.217***
	Psychiatry	1.902	1.213–2.979**	1.735	1.037–2.904*
	Oncology	1.229	0.717–2.104	1.160	0.721–1.866
Physician assistant seen	Yes	0.560	0.334–0.938*	0.697	0.448–1.084
EHR use	Yes	1.215	0.943–1.566	0.991	0.770–1.276

* $p < .05$; ** $p < .01$; *** $p < .001$.
[†]Reference groups are “No,” except for race (other), income (Q4: \$52,388 or more), payment type, specialty (Other), and time spent (mean).
[‡]Adjusted model information: Population size = 196,528,585 (6,000 unweighted cases); pseudo R -squares: Nagelkerke = 0.183, McFadden = 0.137; test of model effects: Wald $F = 14.27$, $p < .001$.
AOR, adjusted odds ratio; CI, confidence interval; CRF, chronic renal failure; COPD, chronic obstructive pulmonary disease; EHR, electronic health record; OR, crude odds ratio; PI, potentially inappropriate; USD, United States dollar.

The presence of chronic renal failure was associated with 76.1 percent lower odds, diabetes was associated with 52.8 percent lower odds, and obesity was associated with 46.2 percent lower odds of PI sedative prescribing. Household income in the third quartile was associated with 36.6 percent lower odds. In contrast, visits to neurologists and psychiatrists were associated with 11.6 and 1.7 times higher odds of PI sedative prescribing, respectively. Female sex, white race, depression, and the number of medications ordered were associated with 1.6, 2.7, 1.8, and 1.4 times higher odds of PI sedative prescribing, respectively.

DISCUSSION

Our study found that nearly one in ten visits by older adults to physician offices involved PI sedative prescribing, with a slightly higher prevalence of PI antidepressant prescribing during visits where antidepressants were ordered. Factor analyses highlighted that prescribing of potentially inappropriate antidepressants and sedatives was influenced by various clinical and nonclinical factors. Most of the determinants of PI antidepressants and PI sedatives identified in our study were novel, except for income, and sex, respectively. Race was the sole determinant that influenced both PI antidepressant and sedative prescribing, when controlling for other determinants. Additional nonclinical factors that influenced PI antidepressant prescribing were payment type, consultation time, and computer systems with prescribing support. For PI sedative prescribing, these were income and specialty.

Factors Reducing Potentially Inappropriate Prescribing

Race was the strongest determinant of PI antidepressant prescribing in our study, where visits by patients of black race were less likely to involve PI antidepressant prescribing. In contrast, visits by white patients were more likely to involve PI sedative prescriptions. These variations in the influence of race on the likelihood of PI antidepressant and PI sedative prescribing may be due to variations in indications, previous therapeutic responses, or patient preference. Our findings contrast with an earlier study of PI psychotropic prescribing among Americans, where race was not a significant determinant (Aparasu and Mort 2004).

Chronic diseases that were associated with a lower likelihood of PI antidepressant prescribing were as follows: asthma, depression, and

osteoporosis. The avoidance of tertiary TCAs during visits involving patients with osteoporosis may be due to caution by prescribers based on the risk of orthostatic hypotension, and subsequent falls and fractures (DeBattista 2012). Patients with asthma were also less likely to receive tertiary TCAs than other antidepressants, possibly due to concerns about drug–disease interactions, as well as the anticholinergic and sedative effects of the class (DeBattista 2012). Given that inhaled anticholinergic medications are commonly used in patients with asthma, physicians may prefer to avoid additive anticholinergic effects. Although there are no respiratory warnings or adverse respiratory reactions directly attributed to tertiary TCAs, the use of medications with sedative effects in patients with asthma has been associated with increased risks of asthmatic complications and death (Ryan et al. 1991; Joseph et al. 1996). However, these factors (asthma, osteoporosis) were not found to be determinants of PI sedative prescribing. The reduced likelihood of tertiary TCA use among patients with depression indicates concordance with treatment guidelines for major depression in older adults, where selective serotonin reuptake inhibitors are recommended as first-line agents (American Psychiatric Association 2010). We expect this trend to lead to continued improvements in prescribing decisions, fewer drug-related problems, and ultimately better patient care.

Visits where payment was primarily via private insurance or self-pay were less likely to involve PI antidepressants than other forms of payment. This may be due to prescription coverage restrictions by private insurance, where tertiary TCAs are excluded or due to patient preference. As the consultation time increased, prescribing of PI antidepressants became less likely, with no effect on PI sedative prescribing. This may be a result of the exchange of additional information between patient and prescriber, and the development of rapport. The additional time spent may facilitate problem identification, discussion of patient preferences, and medication-related experiences. This resembles findings of earlier studies among British and Canadian physicians where longer periods of consultation time were associated with increased physician assessment, educational activities, and improved quality of care (Morrell et al. 1986; Roland et al. 1986; Tamblyn et al. 1997).

Visits to practices with at least one prescribing support feature (patient information/demographics, clinical notes, laboratory results, e-prescribing, or reminders for interventions) were less likely to involve orders for PI antidepressants. The presence of systems with clinical decision support at the point of care may allow prescribers to avoid the use of PI antidepressants. Further, with the increase in electronic health records and computer systems, this trend should be self-sustaining as software may be perpetually updated to include

revised prescribing guidelines. This finding aligns with earlier reports of reductions in inappropriate prescribing for older adults in ambulatory care with the use of electronic prescribing and other clinical decision support technologies (Clyne et al. 2012).

Visits by patients with obesity were less likely to involve PI sedatives, possibly due to prescriber concerns about the lipophilic nature of some of these agents and the need for dose adjustment to balance therapeutic and adverse effects (Leykin, Miotto, and Pellis 2011). Also, obesity has been associated with increased prevalence and higher risks of falls among older adults, as well as lower health-related quality of life and a higher risk of disability after a fall (Fjeldstad et al. 2008; Himes and Reynolds 2012). Given that some patients with diabetes may also be obese, and given that diabetes increases the risk of falls in older adults, prescribers may avoid sedative use in these patients to minimize the risk of harm (Mokdad et al. 2003; Maurer, Burcham, and Cheng 2005). The need for dose adjustment and the risk of prolonged sedative effects in patients with reduced renal clearance may explain the reduction in likelihood of PI sedative use among patients with chronic renal failure.

Prescribing of PI sedatives was less likely during visits by patients with median household income between \$40,627 and \$52,387 (upper middle income) than other quartiles. This may be a result of unmeasured social and economic factors, including insurance coverage.

Factors Facilitating Potentially Inappropriate Prescribing

None of the determinants measured were found to increase the likelihood of PI antidepressant prescribing, unlike PI sedative prescribing. The increased likelihood of PI sedative prescribing among neurologists and psychiatrists is expected based on the scope of the respective practices and indications. Among neurologists, this finding may be a result of the higher prevalence of patients with severe neurological disorders treated with barbiturates and/or benzodiazepines, such as chronic epilepsy, migraines, and muscle disorders. The role of benzodiazepines as adjunct therapy for some psychiatric conditions, including generalized anxiety and bipolar disorders, may explain the increased likelihood of use in psychiatry, and among older patients with depression (American Psychiatric Association, 2002, 2010).

Visits by female patients were more likely to experience PI sedative prescribing. This may be a result of the influence of other confounders, including household income, payment type, and mental disorders, which require further

evaluation. As the number of medicines ordered during the visit increased, the likelihood for PI sedative prescribing also increased. This resembles findings by an earlier study using the NAMCS 1995 dataset, where the number of medicines prescribed was identified as a predictor of potentially inappropriate psychotropic prescribing in older Americans (Aparasu, Mort, and Sitzman 1998). However, our study found it to be a predictor of PI sedative prescribing, but not of PI antidepressant prescribing among older Americans.

Implications for Practice and Future Research

Based on the influence of systems with prescribing support features on potentially inappropriate antidepressant prescribing, these tools should be actively used by office-based physicians during consultations. With the use of such technologies providing patient information, including laboratory results, medication lists, and reminders to support the selection of safer alternatives for older adults, the quality of antidepressant prescribing is expected to improve. In addition, longer consultations for patients who require antidepressants may further facilitate the selection of less inappropriate antidepressants, through information exchange, rapport, and problem-solving. For patients with asthma and osteoporosis who require antidepressants, the avoidance of PI antidepressants will contribute to minimizing adverse events in these patients. This may also extend to patients with chronic renal failure, diabetes, and obesity, where PI sedative prescribing is less likely. The protective influences of race and payment type on antidepressant prescribing and the influence of income on sedative prescribing require further study to identify unmeasured confounders and/or interactions.

Based on the increased risk of exposure to PI sedatives, as the number of medications ordered increases, affected older adults should undergo periodic medication review, education, and monitoring. These patients and/or their caregivers should be taught to identify and report adverse effects, particularly patients seen in neurology and psychiatric specialties. Given the increased likelihood of PI sedative use among females, and whites, further evaluation of these factors and any interacting confounders is needed.

This study is novel as it highlights the influence of previously unidentified nonclinical factors, such as the use of computer systems with prescribing support, household income, consultation time, and physician specialty. These findings may serve as benchmarks for future assessments, as well as guide the development of policies and interventions to improve the quality of sedative and antidepressant prescribing for older adults.

Limitations

Although this study assessed the influence of selected clinical and nonclinical factors on potentially inappropriate prescribing in the context of AGS/Beers 2012 and 2015 criteria, there are limitations that warrant mentioning. Other forms of potentially inappropriate or harmful prescribing, such as errors in dosing or duration, were not evaluated, which limits the comprehensiveness of the findings. The scope of the database used prevented the assessment of unlisted conditions, nine or more medications, and physician demographics (age, sex, and experience). The cross-sectional nature of the survey facilitated identification of factors influencing potentially inappropriate prescribing, but it did not provide insight into the causal relationships. Interactions between factors were not assessed due to limitations in interpreting the findings. Also, given that the survey was based on prescribing in 2010, the findings may not reflect subsequent changes in practice.

CONCLUSIONS

Some visits by older adults in office-based practices in the United States involve potentially inappropriate antidepressants and sedatives, thereby highlighting the need for patient/caregiver education, and monitoring of adverse events in these patients. Potentially inappropriate antidepressant and sedative prescribing are influenced by patient, physician, and health-system factors, to varying extents. Longer physician consultations and the use of prescribing support systems may minimize inappropriate antidepressant prescribing. As the number of medicines ordered during visits increases, visits are more likely to involve PI sedatives prescribing, which may require periodic review, education, and monitoring.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Table S1. Visits with Antidepressant Orders for Community-Dwelling Older Adults in 2010.

Table S2. Visits with Sedative-Hypnotic Orders for Community-Dwelling Older Adults in 2010.