Prevalence and Predictors of Potentially Inappropriate Medication Prescribing among Older Adults in the United States: A Population-based Study

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ABSTRACT

Introduction: Potentially inappropriate medications (PIMs) have been shown to be associated with adverse clinical outcomes. Updated information on PIM exposure in the elderly as well as attributes associated with PIM prescribing is needed to implement focused interventions.
Hypothesis: We hypothesize that PIM exposure is associated with socio-demographic and clinical risk factors.
Study Design: Cross-sectional study using U.S. nationally representative data from the 2011–2015 Medical Expenditure Panel Survey.
Methods: We defined our exposure to PIMs based on the 2019 Beers Criteria and applied it to adults age ≥65 from 2011-2015 (n=19,726). Exposure to PIMs was first defined as any PIM use during the time period. Next, we examined exposure to multiple PIMs which was defined as receipt of ≥2 therapeutic PIM categories. The change in PIM prevalence was assessed using the Cochran-Armitage test for trend. A multinomial logistic regression model was used to identify patient-level predictors associated with PIM prescribing (SAS version 9.4).
Results: PIM use decreased from 35.3% in 2011 to 32.5% in 2015 (p=0.04). Patients on multiple PIMs also decreased from 12.3% to 10.3% during this time period (p≤0.01). The three most common PIM classes were benzodiazepines (9.0%), sulfonylureas (4.4%), and first generation antihistamines (4.1%). Therapeutic classes with the most significant change included: digoxin (-62.3%, p<0.001), non-benzodiazepine hypnotics (-36.7%, p=0.01) and antidepressants (-34.7%, p<0.01). Our results suggest that poor general and mental health status were significantly associated with higher PIM use, while male sex, race/ethnicity, and residence in the northeast were significantly associated with lower PIM use (p<0.05). Results were similar for patients exposed to multiple PIM categories.
Conclusions: Although PIM use remains high among older adults, our results suggest that PIM prescribing is declining. Understanding how patient characteristics are related to PIM exposure will be needed to improve patient safety through prescriber education and patient-centered interventions.

BACKGROUND

- Beers criteria are recommendations updated every 3 years that identifies medications that are potentially inappropriate in individuals aged 65 and older based on disease state or side effect profile.
- The use of potentially inappropriate medication prescribing in older adults has been associated with poor health outcomes and adverse clinical events.
- Studies have shown that receipt of potentially inappropriate medication prescribing is associated with certain socio-demographic and clinical risk factors.

OBJECTIVES

- Determine the prevalence and trend over time of potentially potentially inappropriate prescribing among older adults.
- Determine predictors of being prescribed a potentially inappropriate medication

METHODS

Study Design: Cross-sectional analysis

Data Source: 2010-2015 Medical Expenditure Panel Survey (MEPS) data – Prescribed Medicines (PM), Full-year Consolidated (FY), and Medical Conditions (MC) files

Study Sample: All adults aged ≥65 years

Primary Exposure:
- Medications from the 2019 Beers Criteria using a qualified definition to consider route, dose, and comorbidities as appropriate

METHODS

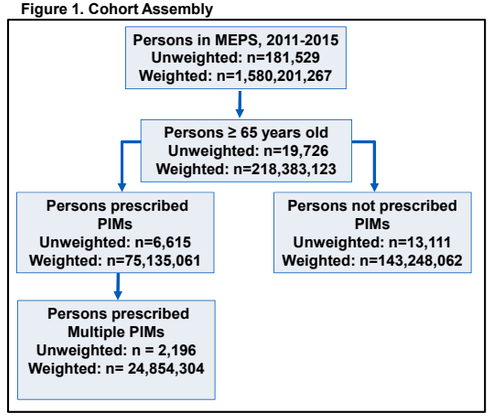
Outcomes:
- PIM period prevalence: Percent with any fill for PIMs between 2011-2015
- Trends in PIM prevalence: total prevalence in individual agents
- Predictor of PIMs prescribing: receipt of ≥2 therapeutic PIM categories

Covariates:
- Demographics: Age, sex, race/ethnicity, census region, general health status, income, education level
- Comorbidities: Coronary heart disease, angina, myocardial infarction, heart failure, chronic renal failure, cancer, arthritis, hypertension, dyslipidemia, asthma, stroke, emphysema, chronic bronchitis, diabetes, dementia

Statistical Analyses:
- Baseline demographics and comorbidities were compared between those with and without PIM use with the chi-squared test
- Overall PIM period prevalence was considered the proportion of respondents with any fill for a PIM within the five-year sample
- Cochran-Armitage test for trend of PIM prevalence
- Multinomial Logistic Regression to assess predictors of PIM prescribing
- Chi-squared for trend analysis for individual PIMs
- Survey weighted procedures were used to produce national estimates and account for the complex survey design
- All statistical tests were 2-tailed with a level of significance set at P<0.05. SAS version 9.4 was used for the analysis

RESULTS

Figure 1. Cohort Assembly



RESULTS

Figure 1. Multiple PIM Prevalence by Year

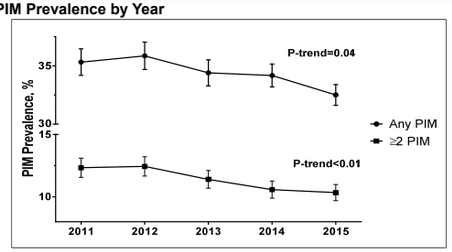


Table 1. Demographics

Characteristic	All (n=19,726)	SE	No PIM (n=13,111)	SE	PIM (n=6,615)	SE	p-value
Age							**0.02**
65-74	56.93	0.81	57.76	0.88	55.34	1.05	
75-84	30.87	0.66	29.93	0.76	32.65	0.87	
85+	12.20	0.55	12.30	0.60	12.01	0.75	
Sex							**0.004**
Female	55.91	0.48	54.76	0.88	58.09	0.94	
Race/Ethnicity							**0.0007**
Hispanic	7.65	0.52	7.85	0.55	7.26	0.57	
White (Non-Hispanic)	77.84	1.04	76.76	1.15	79.89	1.01	
Black (Non-Hispanic)	8.66	0.54	9.14	0.57	7.75	0.60	
Other	5.85	0.73	6.25	0.87	5.11	0.57	
Insurance							**<.0001**
Medicare only	35.99	0.77	36.41	0.86	35.18	1.00	
Medicare and private	52.12	0.87	52.21	0.96	51.96	1.06	
Medicare and public	10.77	0.53	9.99	0.49	12.26	0.77	
No Medicare/uninsured	1.12	0.13	1.39	0.16	0.60	0.12	
Comorbidities							
Coronary heart disease	19.48	0.47	17.13	0.55	23.93	0.87	**<.0001**
Dyslipidemia	62.52	0.62	59.58	0.75	68.09	0.98	**<.0001**
Diabetes	22.36	0.52	18.29	0.56	30.08	0.93	**<.0001**

Table 2. Socio-Demographic Risk Factors of PIM Receipt[a]

Characteristic	1 PIM		Multiple PIMs	
	Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value
Age				
65-74	1.00 ref		1.00 ref	
75-84	1.04 (0.94, 1.15)	0.54	0.95 (0.81, 1.12)	0.59
85+	0.96 (0.80, 1.16)	0.51	0.68 (0.51, 0.90)	**0.0013***
Sex				
Female	1.00 ref		1.00 ref	
Male	0.81 (0.72, 0.90)	**<0.001***	1.13 (0.98, 1.31)	0.08
Race/Ethnicity				
White (Non-Hispanic)	1.00 ref		1.00 ref	
Hispanic	0.83 (0.70, 0.97)	**0.02***	0.76 (0.60, 0.96)	**0.02***
Black (Non-Hispanic)	0.71 (0.62, 0.81)	**<0.001***	0.56 (0.45, 0.69)	**<0.001***
Other	0.82 (0.67, 0.97)	**0.026***	0.74 (0.56, 1.02)	0.06
Insurance				
Medicare only	1.00 ref		1.00 ref	
Medicare and private	1.05 (0.95, 1.16)	0.35	1.04 (0.88, 1.23)	0.65
Medicare and public	1.02 (0.87, 1.20)	0.78	1.20 (0.94, 1.52)	0.15
No Medicare/uninsured	0.77 (0.44, 1.34)	0.35	0.30 (0.12, 0.76)	**0.01***

Abbreviations: PIM, potentially inappropriate medications; CI, confidence interval

Table 3. Clinical Risk factors of PIM Receipt[a]

Characteristic	1 PIM		Multiple PIMs	
	Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value
General health status				
Excellent/Very good	1.00 ref		1.00 ref	
Good	1.08 (0.95, 1.22)	0.24	1.14 (0.98, 1.33)	0.10
Fair/poor	1.19 (1.02, 1.38)	**0.02***	1.42 (1.20, 1.70)	**<0.001***
Mental health status				
Excellent/Very good	1.00 ref		1.00 ref	
Good	1.00 (0.89, 1.13)	0.98	1.07 (0.93, 1.34)	0.35
Fair/poor	1.10 (0.89, 1.36)	0.38	1.28 (1.00, 1.64)	**0.047***
SF-12v2				
Average	1.00 ref		1.00 ref	
Below average	1.07 (0.84, 1.36)	0.57	1.13 (0.82, 1.55)	0.45
Above average	0.78 (0.61, 0.99)	**0.047***	0.67 (0.48, 0.94)	**0.02***
Census region				
Northeast	1.00 ref		1.00 ref	
Midwest	1.28 (1.05, 1.56)	**0.016***	1.51 (1.20, 1.91)	**<0.001***
South	1.26 (1.07, 1.49)	**0.007***	1.68 (1.35, 2.10)	**<0.001***
West	1.23 (1.03, 1.47)	**0.022***	1.41 (1.10, 1.80)	**0.006***
Comorbidities				
Coronary heart disease	1.10 (0.93, 1.30)	0.29	1.06 (0.85, 1.32)	0.62
Dyslipidemia	1.10 (0.95, 1.26)	0.20	1.13 (0.91, 1.40)	0.27
Diabetes	1.61 (1.41, 1.84)	**<0.001***	1.57 (1.30, 1.90)	**<0.001***

Abbreviations: PIM, potentially inappropriate medications; CI, confidence interval
[a]Each estimate is adjusted for all other variables in the table; Notes: * indicates p<.05

Table 4. Change in PIM Prevalence, 2011 and 2015

Drug/Category	Percent with PIM Use in 2011	Percent with PIM Use in 2015	Percent Change	p-value
First Generation antihistamine	3.70	4.83	30.54	0.06
Antispasmodics	2.22	1.13	-49.10	**0.005***
Digoxin	1.28	0.47	-62.28	**<0.001***
Antidepressants	4.04	2.64	-34.65	**0.003***
Barbiturates	0.62	0.26	-58.06	**0.048***
Benzodiazepines	8.30	8.94	7.71	0.43
Non-BZD hypnotics	4.41	2.79	-36.73	**0.01***
Androgens	0.38	0.05	-86.84	**0.001***
Estrogens**	2.58	1.42	-44.96	**0.005***
Sulfonylurea, long duration	4.37	3.97	-9.15	0.44
Metoclopramide	0.62	0.25	-59.68	**0.03***
Proton pump inhibitors	3.16	2.81	-11.08	0.36
Non-COX-2 selective NSAIDs:	2.79	3.29	17.92	0.31

Abbreviations: non-BZD, non-benzodiazepine; NSAIDs, non-steroidal anti-inflammatory drugs; COX2, cyclooxygenase-2
Notes: * indicates p<.05; ** With and without progestin

CONCLUSIONS

- Potentially inappropriate medication prescribing is still high among older adults, with 33% of adults still receiving at least one potentially inappropriate medication in the year 2015
- We found the prevalence of potentially inappropriate medication prescribing to be decreasing from the years 2011-2015
- These results were consistent with other literature that suggests that potentially inappropriate prescribing has declined over time.
- Certain sociodemographic risk factors are associated with higher potentially inappropriate medication receipt, such as poor general and mental health status. In contrast, male gender, northeast census region, and African American ethnicity are associated with less potentially inappropriate medication prescribing.