Receipt of High Risk Medications among Elderly Enrollees in Medicare Advantage Plans

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BACKGROUND: Since 2005, the Centers for Medicare and Medicaid Services (CMS) has required all Medicare Advantage (MA) plans to report prescribing rates of high risk medications (HRM).

OBJECTIVE: To determine predictors of receipt of HRMs, as defined by the National Committee for Quality Assurance's "Drugs to Avoid in the Elderly" quality indicator, in a national sample of MA enrollees.

DESIGN AND PARTICIPANTS: Retrospective analysis of Healthcare Effectiveness Data and Information Set (HEDIS) data for 6,204,824 enrollees, aged 65 years or older, enrolled in 415 MA plans in 2009. To identify predictors of HRM use, we fit generalized linear models and modeled outcomes on the risk-difference scale.

MAIN OUTCOME MEASURES: Receipt or non-receipt of one or two HRMs.

KEY RESULTS: Approximately 21 % of MA enrollees received at least one HRM and 4.8 % received at least two. In fully adjusted models, females had a 10.6 (95 % CI: 10.0–11.2) higher percentage point rate of receipt than males, and residence in any of the Southern United States divisions was associated with a greater than 10 percentage point higher rate, as compared with the reference New England division. Higher rates were also observed among enrollees with low personal income (6.5 percentage points, 95 % CI: 5.5–7.5), relative to those without low income and those residing in areas in the lowest quintile of socioeconomic status (2.7 points, 95 % CI: 1.9–3.4) relative to persons residing in the highest quintile. Enrollees ≥ 85 years old, black enrollees, and other minority groups were less likely to receive these medications. Over 38 % of MA enrollees residing in the hospital referral region of Albany, Georgia received at least one HRM, a rate four times higher than the referral region with the lowest rate (Mason City, Iowa).

CONCLUSIONS: Use of HRMs among MA enrollees varies widely by geographic region. Persons living in the Southern region of the U.S., whites, women, and persons of low personal income and socioeconomic status are more likely to receive HRMs.

KEY WORDS: high risk medications; geriatric prescribing; potentially inappropriate medication; quality prescribing; disparities.

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Adverse drug events resulting from poor quality prescribing are a significant public health problem.¹ An increased burden of chronic diseases and age-related changes in drug metabolism predispose the elderly to adverse drug events precipitated by the use of high risk medications (HRM).^{2,3} HRM use in the geriatric population is associated with increases in morbidity, mortality, hospitalization, inpatient length of stays, and health care spending.^{4–6}

HRMs in the elderly are broadly defined as medications that should be avoided among patients 65 years of age or older, because the associated adverse effects outweigh potential benefits or because safer alternatives are available,⁷ a principle codified most prominently by the Beers⁸ and Zhan⁹ criteria. To improve the quality of drug prescribing in the elderly, the Centers for Medicare and Medicaid Services (CMS) requires all Medicare Advantage (MA) health plans to report publicly on the prescribing rates of HRMs, as defined by the Healthcare Effectiveness Data and Information Set's (HEDIS) "Drugs to Avoid in the Elderly" quality measure. The term HRM is often used interchangeably with 'potentially inappropriate medication',^{8,9} a phrase that acknowledges the complexity inherent in assessing the quality of patient-specific drug management decisions among heterogeneous patient populations. In this manuscript, we use 'high risk,' because that is the specification of the quality measure used in the analysis.

Successful efforts to reduce HRM use in the elderly require knowledge of how prescribing of these agents varies geographically and the factors that predict their use. However, there are few nationally representative studies of the prevalence and predictors of HRM use, particularly following the implementation of the Medicare prescription drug benefit in 2006. Medicare Part D extended prescription drug coverage to the majority of

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Medicare's approximately 44 million beneficiaries, only one-third of whom had drug coverage previously. More universal access to drug coverage among the elderly has increased pharmaceutical use,^{10,11} and therefore, by extension, opportunities for receipt of HRMs. Further, there is limited evidence about HRM use in the MA program, which now comprises approximately 25 % of the Medicare population. Because such plans assume financial risk for paying for Medicare-covered services and integrate the financing and delivery of care, and because the MA population may be healthier, on average, and younger than traditional Medicare enrollees,¹² the rate of HRM use in this population may differ from that observed in the traditional Medicare population.

In this study, we examined predictors of HRM use utilizing the HEDIS quality indicator in a national sample of over 6 million elderly MA enrollees. We also characterized geographic variation in HRM use with the aim of identifying subpopulations at increased risk of receiving these medications.

METHODS

Data Sources

We obtained individual-level Medicare HEDIS data for the 2009 calendar year from CMS. The National Committee for Quality Assurance (NCQA) developed HEDIS to measure and compare the quality of care delivered to enrollees in health plans. Since 1997, all Medicare managed care plans have been required to submit HEDIS data to the CMS. In 2005, NCQA developed two HEDIS quality indicators, both entitled "Drugs to Avoid in the Elderly," to measure the percentage of Medicare enrollees in each plan that received at least one HRM or at least two different HRMs. Clinical comorbidity information and the names of specific medications are not available in the HEDIS data (refer to eTable 1 in the online appendix for a list of medications included in the measure).

Conceptually and operationally, the Beers and Zhan criteria for use of "potentially inappropriate medications in the elderly" form the backbone of the HEDIS measures. Both measures, Beers in particular, are widely used in the literature and have been accepted through various iterations as the best available clinical tools for the screening of HRMs. Research has shown a link between medications on the Beers list and serious adverse effects in the elderly, including falls, fractures, gastrointestinal bleeding, and delirium.^{13–15} The final list of 110 medications used to identify claims for HRMs borrows heavily from the Zhan and Beers criteria and was determined by NCQA through a modified Delphi consensus process that included a panel of clinical, method-

Table 1. Sociodemographic, Geographic, and Health Plan Characteristics of Medicare Advantage Enrollees Receiving and Not Receiving at Least One High Risk Medication (HRM), Based on HEDIS' Drugs to Avoid in the Elderly Measure*

Characteristics	Received ≥ 1 HRM (n=1,333,307)	Did not receive ≥ 1 HRM (n=4,871,517)
Women (%)	71	55
Age group, years (%)		
65–69	31	30
70–74	25	25
75–79	20	20
80–84	14	14
≥ 85	10	10
Race (%)		
White	84	83
Black	10	10
Other	7	7
Low Personal Income (%)	16	11
SES indicator(zip code), mean (SD)	50.7 (4)	51.2 (4)
Geographic division (%)		
New England	3	5
Middle Atlantic	15	21
East North Central	9	10
West North Central	6	7
South Atlantic	21	16
East South Central	6	4
West South Central	11	7
Mountain	9	10
Pacific	20	21
Plan size (%)		
0–24,999	29	28
25,000–99,999	47	46
≥100,000	25	26
Model Type (%)		
Group/Staff	7	10
Independent Practice Association	10	11
Network/Mixed	83	79
Plan Start Year (%)		
Before 1980	< 1	< 1
1980–1999	60	64
After 2000	39	35
Profit Status (%)		
For Profit	74	70

Abbreviations: HEDIS Healthcare Effectiveness Data and Information Set; SES socioeconomic status

Note: The SES index score is derived from zip code-level US census variables based on the Agency for Healthcare Research and Quality's specifications; higher SES values imply higher SES (U.S. mean, 50).²³ All numbers refer to percentages, with the exception of SES index score; values rounded to nearest whole number

*The χ^2 or t test was performed to compare the characteristics of individuals who received high risk medications with those who did not; all tests resulted in P values of less than 0.001

ological, and organizational science experts. A more detailed description of this process¹⁶ and comparison of the HEDIS measure with other criteria can be found elsewhere.¹⁷

Study Population

We matched 98 % of the HEDIS observations to the Medicare enrollment file from the corresponding year to determine enrollees' demographic characteristics. We used the CMS Medicare Advantage Plan Directory to

obtain information on health plan characteristics. If these data were missing, we contacted the health plan directly. Using the Dartmouth Atlas of Healthcare, we assigned each enrollee to a hospital-referral region (HRR) on the basis of zip code of residence. HRRs represent distinct regional health care markets within which residents seek the services of a tertiary hospital or major referral center.¹⁸ HRRs have been utilized widely to characterize geographic variation in healthcare quality and delivery.^{19–21}

Among 6,514,278 enrollees eligible for the HEDIS measure, we excluded 86,131 who died during the measurement year, who were outside the U.S., or those enrolled in health plans outside the U.S. We further excluded 8,707 observations from six plans that erroneously reported a greater rate of enrollees receiving two or more HRMs than the rate of enrollees receiving one or more HRMs. After all exclusions, the final study sample consisted of 6,204,824 enrollees.

Outcome Variables

The two primary dependent variables of interest were: (1) receipt of at least one prescription for a HRM; and (2) receipt of at least two different HRMs during the measurement year as defined by the HEDIS “Drugs to Avoid in the Elderly” quality indicators. To be eligible for inclusion in the denominator for either indicator, enrollees must be 65 years of age or older, continuously enrolled in the managed care plan throughout the measurement year, and have prescription drug benefits for the duration of the measurement year. To be included in the numerator, enrollees were required to have a prescription drug claim for at least one (for first measure) or at least two HRMs (for second measure).

Independent Variables

Descriptive variables defined at the individual level included age (65–69, 70–74, 75–79, 80–85, ≥ 85), sex, race (white, black, other), low personal income (defined by receipt of Medicare State Buy-in assistance²²), U.S. census division of residence (refer to eTable 2 in online appendix for list of states in each division), and socioeconomic status (SES) index score (by quintile). The SES index score is a composite measure of area-level socioeconomic status derived from zip code-level employment, housing, income, education and crowding data. Composition and creation of the score is described in detail by the Agency for Healthcare Research and Quality.²³ Plan-level independent variables included model type (group/staff, independent practice association, mixed/network), plan age (determined by the date the plan began its operation: before 1980, 1980–1999, and after 2000), beneficiary enrollment per plan (0–24,999,

25,000–99,999, $\geq 100,000$), and plan tax status (for-profit, not-for-profit). All variables were tested for non-collinearity.

Statistical Analysis

We determined the percentage of eligible enrollees who met the numerator criteria for the two HEDIS indicator measures in each sociodemographic and health plan-level subgroup and used χ^2 -square or t-tests to compare the characteristics of enrollees receiving a HRM to those who did not. To identify predictors of HRM use, we fit generalized linear models to predict receipt of a HRM using the independent variables described above. We modeled outcomes on the risk-difference scale and accounted for clustering of enrollees within health plans using generalized estimating equations. Three models were fit: model 1 controlled for the individual-level characteristics of age, sex, race, and low personal income; model 2 included all variables from model 1, as well as community-level characteristics of zip code-based SES index score and census division of enrollee residence; and model 3 included all variables from models 1 and 2, as well as health plan characteristics (model type, profit status, enrollment size, and plan age).

To determine the extent of geographic variation in HRM use, we calculated the proportion of total eligible enrollees in each HRR that met the criteria for each of the HEDIS indicators. National maps were created to display the geographic variation in rates of HRM use for each measure.

Statistical tests were two-sided, with only $P < 0.005$ considered statistically significant, due to the large sample size. All analyses were performed using SAS statistical software (version 9.3; Cary, North Carolina) and maps were created using ArcGIS software (version 9.3; Redlands, California). The study was approved by Brown University’s Human Research Protections Office.

RESULTS

In the final sample, the rates of receipt of at least one HRM and of at least two HRMs were 21.5 % and 4.8 %, respectively. The mean age of enrollees was 74.5 years; 58 % were women and 83 % were white. The characteristics of persons receiving and not receiving HRMs are presented in Table 1.

In fully adjusted analyses (Table 2), female gender, low personal income, and white race were significant predictors of receipt of a HRM at the individual level. In comparison to the reference age group, which included those 65–69 years of age, the oldest age category appeared to have a protective effect, with significantly lower rates of receipt of HRMs among those enrollees. At the community level, SES

Table 2. Observed and Adjusted Rates of HEDIS Drugs to Avoid in the Elderly Measure, Receipt of at Least One High Risk Medication*

Characteristics	Unadjusted Difference, % points	Model 1	Model 2	Model 3
Sex				
Women	11.2	10.8 (10.3, 11.3)†	10.6 (10.1, 11.2)	10.6 (10.0, 11.2)
Age group, years				
65–69	Reference	Reference	Reference	Reference
70–74	–0.4	–0.4 (–0.7, 0.0)	–0.2 (–0.5, 0.1)	–0.2 (–0.4, 0.1)
75–79	–0.3	–0.5 (–1.0, 0.0)	–0.1 (–0.5, 0.2)	–0.1 (–0.4, 0.3)
80–84	–0.3	–0.8 (–1.4, –0.3)	–0.3 (–0.7, 0.1)	–0.3 (–0.7, 0.1)
≥ 85	–0.8	–2.1 (–2.7, –1.4)	–1.3 (–1.8, –0.8)	–1.2 (–1.7, –0.8)
Race				
White	Reference	Reference	Reference	Reference
Black	–1.2	–2.6 (–3.8, –1.5)	–4.2 (–4.8, –3.5)	–4.0 (–4.6, –3.3)
Other	–0.8	–1.7 (–3.5, 0.1)	–2.1 (–3.2, –0.9)	–2.0 (–3.1, –1.0)
Personal income				
Low	8.6	7.8 (6.4, 9.2)	6.6 (5.6, 7.5)	6.5 (5.5, 7.5)
Zip-code based SES index Score				
Quintile 1 (low)	6.2	–	2.8 (2.0, 3.7)	2.7 (1.9, 3.4)
Quintile 2	3.4	–	1.9 (1.4, 2.4)	1.8 (1.3, 2.3)
Quintile 3	2.4	–	1.4 (0.9, 1.9)	1.3 (0.8, 1.8)
Quintile 4	1.4	–	1.1 (0.8, 1.5)	1.1 (0.7, 1.4)
Quintile 5 (high)	Reference	–	Reference	Reference
Geographic division				
New England	Reference	–	Reference	Reference
Middle Atlantic	1.2	–	1.3 (0.1, 2.6)	0.4 (–1.4, 2.3)
East North Central	4.6	–	4.6 (3.3, 5.9)	3.4 (1.5, 5.3)
West North Central	3.0	–	2.8 (1.4, 4.2)	1.9 (–0.0, 3.9)‡
South Atlantic	11.9	–	11.3 (9.0, 13.5)	10.3 (7.7, 12.9)
East South Central	14.0	–	12.4 (10.7, 14.0)	11.2 (9.0, 13.2)
West South Central	14.2	–	13.1 (9.7, 16.5)	12.0 (8.6, 15.4)
Mountain	6.0	–	5.3 (3.1, 7.6)	4.4 (1.5, 7.4)
Pacific	5.9	–	5.6 (3.5, 7.7)	5.8 (3.6, 8.1)
Plan size				
0–24,999	1.6	–	–	0.3 (–1.6, 2.2)
25,000–99,999	1.3	–	–	1.0 (–0.8, 2.9)
≥ 100,000	Reference	–	–	Reference
Model Type				
Group/Staff	Reference	–	–	Reference
Independent practice association	2.3	–	–	2.9 (–0.0, 5.8)‡
Mixed/Network	5.7	–	–	3.1 (0.8, 5.5)
Year HMO began contract				
Before 1980	Reference	–	–	Reference
1980–1999	–0.1	–	–	–0.2 (–3.9, 3.5)
After 2000	2.8	–	–	0.6 (–2.9, 4.2)
Profit Status				
For Profit	3.7	–	–	0.0 (–1.5, 1.5)

Abbreviations: HEDIS Healthcare Effectiveness Data and Information Set; CI confidence interval; HMO health maintenance organization; SES socioeconomic status

*All estimates on the risk difference scale, reported as percentage point difference (95 % CI)

†Except where noted, confidence intervals that do not cross 0 are significant at $P < 0.005$

‡Confidence interval crosses 0, not significant at $P < 0.005$

|| P -value = 0.008

index quintile showed a graded response, with lower SES scores associated with higher rates of receipt of HRMs. Although most of the census divisions had significantly higher rates of receipt of HRMs when compared to the reference New England division (with the exception of Middle Atlantic and the West North Central divisions), the extent of this difference was highest ($> 10\%$) among divisions in the Southern U.S. region, including the South Atlantic, East South Central, and West South Central divisions. Plan-level characteristics did not predict use of HRM medications.

HRRs vary substantially with respect to HEDIS measures of quality prescribing (Fig. 1). The HRR with the highest proportion of MA enrollees receiving at least one HRM was

Albany, Georgia, where 38.2 % of enrollees received at least one HRM. The HRR with the highest proportion of enrollees receiving at least two HRMs was Alexandria, Louisiana, where 13.5 % received at least two different HRMs. The rate in Albany was approximately four times higher than the HRR with the lowest rate of receipt of at least one HRM—Mason City, Iowa. Of additional note, the rate of receipt of at least two HRMs in Alexandria was 20 times higher as compared to the HRR with the lowest rate—Worcester, Massachusetts (13 % vs. 0.7 %). The twenty lowest performing HRRs were all in the Southern region of the U.S. In contrast, only one of the twenty highest performing HRRs was in the South; the remainder were either in the Midwest or Northeast census regions. The

Figure 1. Quintiles of performance on HEDIS measure of quality of drug prescribing, according to hospital-referral region. Note: lower rates indicate better quality.

results for the use of two or more HRMs were similar and are therefore not shown here.

COMMENTS

In 2009, of the 6,204,824 eligible Medicare Advantage enrollees included in this population-based, cross-sectional analysis, 21.5 % received at least one HRM and 4.8 % received at least two, as defined by the HEDIS quality measures. In fully adjusted analyses, females had a 10.6 higher percentage point rate of receipt of at least one HRM (95 % CI: 10–11.2) compared to males. Persons residing in the West South Central, East South Central and South Atlantic census divisions had a percentage point rate of 10 or higher of receiving HRMs compared with those residing in New England. We observed increased rates of use of HRMs among white enrollees, individuals with low personal income, and those residing in areas of lower socioeconomic status.

The direction of the gender difference was not surprising, as some of the medications categorized as high risk by

HEDIS are prescribed only to women (e.g. oral estrogens), or are treatments for conditions that are more prevalent in women. Examples include psychopharmacologic agents such as long-acting benzodiazepines,²⁴ analgesics,²⁵ and anticholinergics.^{26,27} Previous work examining use of HRMs in the community-dwelling elderly has also consistently identified males as having decreased risk of receipt of HRM medications.⁹

The magnitude of the gender difference is of particular note. One study that examined the persistent gender differences in utilization of HRMs reported that even after controlling for sociodemographic characteristics, number of medications, and comorbidities, women remained at significantly higher risk of receipt of HRMs.²⁸ That racial minority status is associated with lower use of mental health services may also explain the slightly lower risk of HRM use in blacks and other non-white groups.^{29–31} More research is needed to better elucidate the process by which these gender and racial differences arise.

In addition to gender, region of residence appears to be one of the strongest predictors, with rate differences greater than 10 percentage points for the three Southern census

divisions, as compared to the reference New England division. This finding is reflected in Figure 1, which suggests that geographic variation in HRM use is consistent with patterns described in the Medicare fee-for-service population,²⁰ where the HRR with the highest rate of inappropriate medication use was also Alexandria, Louisiana. The prevailing maxim for the elderly Medicare population that “geography is destiny” seems applicable to the use of HRMs.

The existence of substantial geographic variation in healthcare quality, costs, and delivery has been well established in the literature.³² However, the interpretation of such extensive variation remains controversial. It is uncertain who or what principal actors or agents in the process of prescribing may underlie the geographic disparity of the magnitude seen with these HRM measures. One possible explanation is increased poly-pharmacy among those populations in the Southern region with the highest rates of HRM use. This population may also have a greater prevalence of chronic conditions, including for example obesity,³³ which may precipitate use of such medications.³⁴ Previous research has pointed to both poor health and poly-pharmacy^{9,35} as predictors for receipt of HRMs. However, a recent study of the Medicare fee-for-service population did not find an association between increased HRM use and overall expenditures on prescription drugs.²⁰ Another possible explanation could be prescribing differences mediated organizationally and geographically vis-à-vis clinician training and education. Further, clinician prescribing behavior may reflect differences in patient preferences or formulary structure in health plan prescription drug coverage.^{36,37} Additional qualitative and quantitative research to better understand the causes and potential adverse consequences of this variation is warranted.

The primary strength of this study lies in its inclusion of a broad set of predictors of HRM use in a recent, nationally representative sample of all elderly Medicare managed care enrollees. Prior research studies of HRM use in the elderly have used older data,^{9,38} or focused on specific healthcare settings^{17,39–42} such as nursing homes or home health. In addition, no existing studies have included socioeconomic status and health plan-level variables that may also help explain propensity to receive a HRM. We found that, after accounting for geographic region, the organizational characteristics of health plans are not associated with the likelihood of receiving HRMs.

In 2006, the NCQA reported the use of HRMs among elderly MA enrollees to be 23.1 %.⁴³ In the Medicare fee-for-service population, the rate was estimated at 25.8 % in 2010.²⁰ The relative stability of the estimates over time and across different elderly populations underscores the challenges of changing prescribing behavior, as well as the need

to further emphasize medication management of geriatric patients in clinical training.

Our study has some limitations. HEDIS data lacks information on the number of prescriptions and diagnoses or clinical comorbidities of enrollees; both have been found to be potential predictors of HRM use.⁹ As a result, we were not able to determine whether particular medications account for the majority of the HRM use in the MA population. The most recent research utilizing national survey data to assess HRM use in the community-dwelling elderly determined that the most prevalent HRMs of use include propoxyphene, amitriptyline, antihistamines, diazepam, muscle relaxants, gastrointestinal antispasmodics and indomethacin.³⁵

We were unable to assess whether and to what extent differences in the prevalence of comorbid conditions may account for the geographic variation in HRM use. If, in fact, increased clinical comorbidities may explain the high rates of use of HRMs in the Southern region of the U.S., further efforts to target those populations for more thorough medication management and review should be supported. That there are in many cases alternative medications to those found on the HEDIS list underscores this point.^{44,45} These patients may also be at increased risk for other potentially inappropriate prescribing, including drug–disease interactions and/or drug–drug interactions.

The utility of quality measures of HRM use have been criticized for ignoring contextual factors associated with prescribing by using a “hit list” approach for identifying HRMs.⁴⁶ Some clinicians argue that medications on the HEDIS list are in fact appropriate and safe for a subset of their patients, and therefore, the prevalence of HRM use may overestimate true rates of inappropriate medication use. Empirical evidence definitively linking use of HRMs to adverse health outcomes has also been limited, further mitigating efforts to reduce prescribing of such agents in routine clinical practice.

Despite these challenges, the HEDIS measures allow clinicians, health plans, and policymakers to assess HRM use over time and characterize elderly groups that are more likely to receive medications that may predispose them to increased morbidity and mortality. Moreover, prior studies found significant associations between use of specific HRMs and falls, fractures, and self-reported adverse drug events.^{13–15} Most HRMs also have alternatives that are safer for use in the elderly population.⁴⁵

CONCLUSION

Understanding predictors of HRM use at the population level can inform quality improvement efforts to reduce the use of these agents. This study examined the prevalence and

predictors of HRMs among a national sample of elderly managed care enrollees. We observed wide geographic variation in the use of these medications that were not explained by sociodemographic characteristics, with the Southern region of the United States having markedly higher rates of use of HRMs. Female gender, white race, low SES index score, and low personal income also predicted receipt of HRMs. Efforts to reduce prescribing of these medications among the elderly should consider the role these factors play in predicting their use.

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