



Higher Predictive Value Positive for MMA Than ACA MTM Eligibility Criteria Among Racial and Ethnic Minorities: An Observational Study

INQUIRY: The Journal of Health Care Organization, Provision, and Financing
Volume 55: 1–11
© The Author(s) 2018
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/0046958018795749
journals.sagepub.com/home/inq



Yanru Qiao, MS¹, Christina A. Spivey, PhD¹, Junling Wang, PhD¹ ,
Ya-Chen Tina Shih, PhD², Jim Y. Wan, PhD¹, Julie Kuhle, BS³,
Samuel Dagogo-Jack, MD¹, William C. Cushman, MD¹, and
Marie A. Chisholm-Burns, PharmD, MPH, MBA¹

Abstract

The objective of this study was to examine positive predictive value (PPV) of medication therapy management (MTM) eligibility criteria under Medicare Modernization Act (MMA) and Affordable Care Act (ACA) in identifying patients with medication utilization issues across racial and ethnic groups. The study analyzed Medicare data (2012–2013) for 2 213 594 beneficiaries. Medication utilization issues were determined based on medication utilization measures mostly developed by Pharmacy Quality Alliance. MMA was associated with higher PPV than ACA in identifying individuals with medication utilization issues among non-Hispanic blacks (blacks) and Hispanics than non-Hispanic whites (whites). For example, odds ratio for having medication utilization issues to whites when examining MMA in 2013 and ACA were 1.09 (95% confidence interval [CI] = 1.04–1.15) among blacks, and 1.17 (95% CI = 1.10–1.24) among Hispanics, in the main analysis. Therefore, MMA was associated with 9% and 17% higher PPV than ACA in identifying patients with medication utilization issues among blacks and Hispanics, respectively, than whites.

Keywords

Patient Protection and Affordable Care Act, Medicare Prescription Drug and Modernization Act of 2003, medication therapy management, drug utilization, predictive value of tests, efficiency, continental population groups, ethnic groups, Hispanic Americans

What do we already know about this topic?

Minorities are less likely to obtain preventive and specialty services such as medication therapy management (MTM) and are more likely to have higher health care costs due to worse health outcomes partly caused by medication utilization issues.

How does your research contribute to the field?

This study compared the positive predictive value (PPV), or efficiency of MTM eligibility criteria, under Medicare Modernization Act (MMA) and Affordable Care Act (ACA) in identifying individuals with medication utilization issues across racial and ethnic groups, and found that MMA eligibility criteria were more efficient than ACA among non-Hispanic blacks and Hispanics than non-Hispanic whites.

What are your research's implications toward theory, practice, or policy?

Given the critical role played by MTM in improving health outcomes among older patients with chronic diseases, the findings of the current study provide evidence that may assist policy makers in improving efficiency of Medicare Part D MTM eligibility criteria and reducing disparities associated with MTM services.

¹The University of Tennessee Health Science Center, Memphis, USA

²The University of Texas MD Anderson Cancer Center, Houston, USA

³Pharmacy Quality Alliance, Alexandria, VA, USA

Received 28 November 2017; revised July 24 2018; revised manuscript accepted 26 July 2018

Corresponding Author:

Junling Wang, The University of Tennessee Health Science Center, 881 Madison Avenue, Room 221, Memphis, TN 38163, USA.
Email: jwang26@uthsc.edu



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons

Attribution-NonCommercial 4.0 License (<http://www.creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

Introduction

Eliminating racial and ethnic disparities has been a top national agenda item exemplified by Federal efforts such as Healthy People 2010 and 2020.^{1,2} Research consistently demonstrate that, compared with non-Hispanic whites (whites), non-Hispanic blacks (blacks) and Hispanics are more likely to lack comprehensive health insurance coverage, encounter discrimination by professionals in clinical settings, and have problems accessing high-quality health care.³ As a result of this and other factors, minorities are less likely to obtain preventive and specialty services or experience improved health outcomes.^{4,5} They are also more likely to have higher health care costs due to worse health outcomes caused by medication utilization issues.^{6,7}

Racial and ethnic disparities in medication therapy management (MTM) eligibility criteria provide an example of institutionalized disparities in health care access.⁸⁻¹⁸ According to the Medicare Prescription Drug and Modernization Act (MMA) of 2003, Medicare prescription drug (Part D) plans are required to offer MTM to patients with multiple chronic conditions, using multiple Part D drugs, and likely to incur annual costs for covered Part D drugs that exceed a prespecified threshold.¹⁹ Minorities could particularly benefit from MTM services because they are more likely than whites to have certain chronic conditions (eg, diabetes, hypertension) targeted by MTM programs and undergo medical procedures that are indicators of poor management of these conditions.^{6,7} MTM services are perfectly positioned to reduce these health outcome disparities, as the purpose of MTM is to ensure optimal therapeutic outcomes from covered Part D medications prescribed to targeted beneficiaries.¹⁹

Despite the importance of MTM for racial and ethnic minorities, a series of studies found that minorities are less likely to be eligible for MTM services than whites.⁸⁻¹⁸ Such findings are not surprising because MTM eligibility criteria are predominantly utilization-based, and racial and ethnic minorities typically use fewer prescription medications and incur lower prescription drug costs than do whites.²⁰⁻²⁴ Further aggravating racial and ethnic disparities is the fact that Part D plans have the flexibility to determine their own MTM eligibility thresholds within the legislative framework, and these Part D plans typically set their thresholds using the highest possible minimum. For example, during 2017, slightly more than 84% of Part D plans set their threshold as at least 3 chronic conditions (range, 2-3 conditions), and approximately 66% selected a minimum threshold of at least 8 drugs (range, 2-8 drugs), with the threshold for annual drug cost set at \$3919 in 2017 by Centers for Medicare & Medicaid Services (CMS).²⁵ Besides disparity issues associated with MTM eligibility criteria, low participation in MTM is also a challenge. While CMS has a goal of covering at least 25% of Medicare beneficiaries, currently only approximately 10% of Part D beneficiaries are enrolled in MTM.²⁶

Although less well-known, the Patient Protection and Affordable Care Act (ACA) also laid out a set of MTM

eligibility criteria for organizations to target patients in demonstration programs.²⁷ ACA suggested that patients with the following characteristics should be targeted: (1) taking at least 4 prescribed medications (including dietary supplements and over-the-counter medications); (2) taking high-risk medications; (3) having at least 2 chronic diseases; OR (4) having experienced a care transition, or other factors, that are likely to cause a high risk of medication utilization issues.²⁷ Note that these criteria are less restrictive than eligibility criteria under the MMA. Furthermore, MMA requires patients to meet all eligibility criteria while ACA does not. A study by Wang et al found the MTM eligibility rate under ACA MTM eligibility criteria could be over 80% if applied to Part D enrollees.¹⁶ CMS stressed the importance of analyzing the MTM eligibility criteria in ACA because such analysis can solidify the evidence base for improving the Medicare Part D MTM program.²⁶ The objective of this study was to examine positive predictive value (PPV) of MTM eligibility criteria under MMA and ACA in identifying patients with medication utilization issues across racial and ethnic groups.

New Contribution

PPV is a widely used measure in evaluation of lab tests, which has been increasingly used in policy evaluations. PPV determines the extent of true positives, when patients with a positive lab test truly have the disease of interest. In the context of MTM, an examination of PPV can help to determine the efficiency of MTM eligibility criteria in identifying patients with medication utilization issues. Economic considerations of disparity reduction strategies have gained increased attention in recent years due to limited resources and tightened health care budget.^{28,29}

Methods

Study Design, Population, and Data Sources

This retrospective study analyzed Medicare databases in 2012-2013 of 3 million Medicare beneficiaries linked to the Area Health Resource File (AHRF).^{30,31} In Medicare databases, Part D Prescription Drug Event (PDE) file, Master Beneficiary Summary File (MBSF), and Medicare Parts A & B claims were used. The AHRF was linked with the Medicare databases to provide characteristics of Medicare beneficiaries' residence at the county level. Patient inclusion criteria used in this study were (1) 65 years or older at the beginning of 2012 (to increase population homogeneity); (2) alive at the end of 2013; and (3) enrolled in Medicare throughout 2013 with continuous Parts A, B, and D coverage. The study included 3 major racial and ethnic groups: whites, blacks, and Hispanics. Racial and ethnic disparities were examined by comparing whites with blacks and Hispanics, respectively. Data from 2013 were used for most analyses except when 2012 data were used to determine patients' health insurance status in the year before the study year to define some independent variables.

Table 1. Medication Utilization Measures.

Measure	Definition
High-risk medication use in the elderly	Whether a patient received 2 or more prescription fills for a high-risk medication
Inappropriate treatment of hypertension in persons with diabetes	Whether a patient who was dispensed a medication for diabetes and hypertension received an angiotensin-converting-enzyme inhibitor, angiotensin receptor blocker, or direct renin inhibitor medication
Proportion of days covered (PDC) <80% for any of the 3 drug classes: renin-angiotensin system antagonists, cholesterol medications among adults with coronary artery disease, and oral diabetes medications	Numerator was individuals with PDC<80%; denominator was all individuals with at least 2 fills of the medications of interest.
Drug-drug interactions	Whether a patient received a prescription for a target medication during the measurement period and also received a concurrent prescription for a precipitant medication
Excessive doses of oral diabetes medications	Whether the dispensed dose exceeded the US Food & Drug Administration–approved dosing guidelines
PDC <90% for HIV antiretroviral medications	Whether PDC<90%
Chronic use of atypical antipsychotics by elderly beneficiaries in a nursing home	Whether a patient who is continuously enrolled in a nursing home received at least a 90-day supply of atypical antipsychotic medications
PDC <80% for any drug classes: β -blockers, calcium-channel blockers, and nonwarfarin oral anticoagulants	Whether PDC <80% for any drug class
Antipsychotic use in persons with dementia	Whether an individual received an antipsychotic medication without evidence of a psychotic disorder or related condition

Conceptual Framework

Andersen's Behavioral Model for Health Services Utilization was used in this study as a conceptual framework because the study outcomes are predominantly based on the utilization of pharmaceutical products. Both individual and community (county)-level factors were included in the model.³² Three classes of variables were included: predisposing (factors that predispose patients for health services utilization), enabling (factors that enable health services utilization), and need factors (measures for patient health care needs). Specifically, predisposing factors included age, gender, race and ethnicity (based on Research Triangle Institute race code instead of traditional race code), and the county-level information of percentage of nonwhite population, percentage of married-couple families, per capita income, percentage of population living in poverty, percentage of various educational achievements among 25 years or older, percentage of population eligible for Medicaid, percentage of unemployed population, and percentage of population without health insurance. Enabling factors included metropolitan statistical area, census regions, and whole/part of county as a health professional shortage area (HPSA) for primary care. Need factors included the Deyo-adapted Charlson Comorbidity Index, and a risk adjustment summary score developed by CMS.^{33,34} Deyo-adapted Charlson Comorbidity Index was used instead of other indices because it has been widely used.³³ The risk adjustment summary score was calculated based on diagnostic

information from claims and was developed to risk-adjust payments to Medicare Advantage plans.³⁴

Dependent Variable

Having medication utilization issues was the dependent variable, which was defined based on the most current medication safety and adherence measures in 2013/2014 at the time of this study developed by the Pharmacy Quality Alliance.³⁵ Pharmacy Quality Alliance (PQA) is an organization established to develop and maintain quality measures related to medication utilization.³⁶ Several measures developed by PQA are now used in CMS's Star Ratings system and are tied to bonus payments to Part D plans.³⁷ Patients were deemed to have medication utilization issues if they had any issues determined by the following 9 measures (Table 1)^{35,37}: (1) high-risk medication use in the elderly; (2) inappropriate treatment of hypertension in persons with diabetes (this measure has been retired for clinical reasons and is no longer used); (3) proportion of days covered (PDC) <80% for any of the 3 drug classes: renin-angiotensin system antagonists, cholesterol medications among adults with coronary artery disease, and oral diabetes medications; (4) drug-drug interactions; (5) excessive doses of oral diabetes medications; (6) PDC <90% for HIV antiretroviral medications; (7) chronic use of atypical antipsychotics by elderly beneficiaries in a nursing home; (8) PDC <80% for β -blockers, calcium-channel blockers, and nonwarfarin oral anticoagulants; and (9) antipsychotic use in persons with dementia. Note that all measures except 8 and 9 were Star Ratings measures at the time of this study.^{35,37}

Independent Variables

MMA MTM eligibility criteria. The study examined the 2009, 2013, and proposed 2015 MTM eligibility criteria.^{26,38,39} The year 2010 is an important time point because CMS significantly lowered the eligibility thresholds that Part D plans were allowed to use with a purpose to reduce variability in MTM eligibility and increase MTM participation in 2010.²⁶ The MTM eligibility thresholds in 2009 represent the most recent MTM eligibility thresholds before 2010. The 2013 thresholds represent the most current thresholds employed by CMS at the time of this study. CMS proposed even lower MTM eligibility thresholds for 2015 to further increase MTM participation but these were not implemented due to stakeholders' concerns over other proposed Part D reforms along with the MTM provision. Employing 3 sets of thresholds in the analysis allowed comprehensive assessment of MMA eligibility thresholds.

The wide range of eligibility thresholds for the numbers of Part D drugs and chronic conditions were accounted for by considering the minimum, median, mode, and maximum of these thresholds. For example, the MTM eligibility thresholds used by Part D plans in 2009 exhibited the following pattern: number of chronic conditions ranged from 2 to 5 (both median and mode = 3), number of Part D drugs ranged from 2 to 15 (median = 6, mode = 8), and drug cost threshold was \$4000.³⁸ Therefore, $4 \times 3 \times 1 = 12$ different combinations of representative thresholds were examined, where 4, 3, and 1 are the number of unique representative thresholds for each eligibility criterion. The main analysis examined the modal values: 3 chronic conditions, 8 covered medications, and \$4000 drug costs. The other 11 combinations of eligibility thresholds were examined in sensitivity analyses. There was only one combination of 2015 eligibility criteria: 2 chronic conditions (at least one is a core chronic disease, including cardiovascular disease, diabetes, dyslipidemia, respiratory disease, bone disease—arthritis, mental health, Alzheimer disease, and end-stage renal disease), 2 Part D-covered drugs, and \$620 in annual drug costs.²⁶

The drug cost thresholds were adjusted to dollars in study years based on the consumer price index for medical care.⁴⁰ Number of Part D drugs and Part D drug costs were calculated using PDE file. To determine number of chronic conditions, a list of chronic conditions applicable to the Medicare population assembled by Daniel and Malone was applied.⁴¹ These conditions include all chronic conditions targeted by MTM programs as required by CMS.²⁶ Chronic conditions for each participant were identified using a free Clinical Classification Software developed by the Agency for Healthcare Research & Quality, which aggregates medical conditions and illnesses into 285 mutually exclusive categories.⁴²

ACA MTM eligibility criteria. Under ACA, the criteria of taking at least 4 prescribed medications and having at least 2 chronic diseases are based on the same aspects of patient characteristics

as the criteria under MMA.²⁷ Therefore, patient eligibility was determined using methods similar to the MTM eligibility thresholds under MMA. Over-the-counter medications and dietary supplements were considered only when they were included in the PDE file. The last eligibility criterion is based on a transition of care or "other factors." Because "other factors" were not explicitly defined in the regulatory document, the study focused on "transition of care," which was defined as patient transition from one health care setting to another, including home. "Transition of care" was determined based on patients' health services records. For a community-dwelling individual, any record of a hospitalization or admission to other facilities, including nursing homes, was considered a transition of care.^{16,43} Individuals were considered facility-dwelling if they had claims for nursing homes, assisted living and related facilities, long-term hospitals, mental health centers, and various other long-term care settings. For individuals dwelling in facilities, any record of services in another health care setting excluding physician visits and outpatient visits was considered a transition of care.⁴⁴ To provide a comprehensive policy recommendation, 15 combinations were analyzed each representing a unique combination of the eligibility criteria in ACA. One main analysis (combination of all 4 eligibility criteria) and 14 sensitivity analyses were conducted.

Statistical Analysis

The study included descriptive, multivariate, and disease-specific analyses. For the descriptive analysis, the proportions of having medication utilization issues for each racial and ethnic group under MMA or ACA MTM eligibility were compared using chi-square test. For multivariate analysis, a logistic regression was conducted to compare the likelihood of having medication utilization issues between the following 4 eligibility categories:

- 1 = Not meeting MTM eligibility criteria under either ACA or MMA;
- 2 = Meeting MTM eligibility criteria under ACA but not MMA;
- 3 = Meeting MTM eligibility criteria under MMA but not ACA;
- 4 = Meeting MTM eligibility criteria under both ACA and MMA.

Category 2 was used as reference group and dummy variables for other categories were included as independent variables. Dummy variables were also included for blacks and Hispanics with whites as the reference group. When interpreting study results, odds ratios (ORs) greater than 1 for the interaction term between the dummy variables for category 3 and blacks, for example, would indicate higher comparative PPV for MMA than ACA among blacks than whites. Since nobody was found in category 3 in this study,

ORs greater than 1 for the interaction term between the dummy variables for category 4 and blacks would indicate greater comparative PPV for MMA than ACA among blacks than whites. The analysis strategy of need-based and demand-based analyses was applied in the study.⁴⁵ When conducting need-based analysis, the variables affecting individuals' need for health care, such as age, gender, and ethnicity, Deyo-adapted Charlson Comorbidity Index, and risk adjustment summary score, were included. When conducting demand-based analysis, variables that might affect health care demands (ie, all covariates in the Andersen's Model) were included.

Due to the importance of MTM services for chronic disease management, disease-specific analyses for each of the top 10 MTM-targeted chronic conditions were conducted to produce policy recommendations applicable to patients with specific conditions.²⁶ Data analysis was conducted using SAS 9.4 (SAS Institute Inc, Cary, North Carolina) and STATA 13.1 (STATA Corporation, College Station, Texas). This study was deemed exempt by the Institutional Review Board at the corresponding author's institution (approval number: 13-02788-XM).

Results

A total of 2 213 594 Medicare beneficiaries were included. Within the study sample, 2 052 997 (92.74%) were white, 96 941 (4.38%) were black, and 63 656 (2.88%) were Hispanic. The differences between whites and minorities were significant for all characteristics (Table 2; $P < .05$): minorities were younger than were whites. Compared with whites, counties where minorities lived had higher percentages of nonwhite population, individuals in poverty, individuals eligible for Medicaid, unemployed, and individuals without health insurance. Minorities were more likely to live in the metropolitan statistical area, and to live in an area where either whole or part of the county was an HPSA for primary care. Counties where minorities lived also had lower percentages of married-couple families, lower per capita income, and lower percentage of having high school and higher degrees. Minorities and whites also had different geographic distributions across census regions. Minorities were more likely to have higher Deyo-adapted Charlson Comorbidity Index than whites.

According to descriptive analysis for both MMA and ACA, proportions of having medication utilization issues were higher among blacks and Hispanics than whites ($P < 0.05$ for the difference between whites and minorities for all comparisons). For example, for 2013 MMA, proportions of having medication utilization issues were 79.10% to 84.97% (main analysis: 84.97%) for blacks, 76.78% to 80.37% (main analysis: 80.37%) for Hispanics, and 68.20% to 72.70% (main analysis: 72.70%) for whites (Table 3). Findings for comparative PPV were mixed. For example, comparative PPV was higher among MMA than ACA among Hispanics

but not blacks compared with whites according to the main analysis of 2013 MMA and ACA (Table 3). Proportions of patients having medication utilization issues under 2013 MMA were 19.27 percentage points, 22.67 percentage points, and 21.34 percentage points, respectively, higher than ACA among blacks, Hispanics, and whites. The comparative PPV therefore for MMA was 2.07 percentage points lower for blacks than whites, and 1.33 percentage points higher for Hispanics versus whites ($P < .05$).

In the multivariate analysis, evidence was found for higher comparative PPV among MMA and ACA among minorities than whites. Interaction terms for category 4 and blacks were not always significant, but the interaction terms for category 4 and Hispanics were always significant but the point estimates were all greater than 1 (Table 4). For example, in the demand-based model in main analysis for 2013 MMA and ACA, the OR for the interaction terms for category 4 and blacks was 1.09 (95% confidence interval [CI]: 1.04-1.15), and the OR for the interaction term between category 4 and Hispanics was 1.17 (95% CI: 1.10-1.24) in the main analysis of 2013 MMA and ACA. These numbers indicate that comparative PPV for 2013 MMA versus ACA were 9% higher among blacks and 17% higher among Hispanics than whites. However, in need-based and demand-based models, the ORs for the interaction term between category 4 and blacks were 1.03 (not significant with 95% CI = 0.97-1.10), and 1.04 (not significant with 95% CI = 0.98-1.11), in the main analysis of 2009 MMA and ACA.

Disease-specific analysis also had similar findings on comparative efficiency of MMA versus ACA across racial and ethnic groups (Table 5). For instance, in demand-based analysis of 2013 MMA and ACA MTM eligibility criteria, the significant ORs for the interaction terms for category 4 and blacks were for cardiac disease (OR = 1.18, 95% CI = 1.12-1.25), dyslipidemia (OR = 1.08, 95% CI = 1.03-1.15), hypertension (OR = 1.16, 95% CI = 1.11-1.22), chronic obstructive pulmonary disease (COPD; OR = 1.23, 95% CI = 1.12-1.35), osteoporosis (OR = 1.11, 95% CI = 1.04-1.18), rheumatoid arthritis (OR = 1.20, 95% CI = 1.01-1.44), and renal disease (OR = 1.21, 95% CI = 1.10-1.32). These numbers indicate that, among patients with these 7 diseases, the criteria under 2013 MMA were 8% to 21% more efficient than the criteria under ACA in identifying medication utilization issues among blacks than whites. The significant ORs for category 4 and Hispanics versus whites in demand-based analysis of 2013 MMA and ACA MTM eligibility criteria were for diabetes (OR = 1.10, 95% CI = 1.01-1.19), cardiac disease (OR = 1.22, 95% CI = 1.14-1.31), dyslipidemia (OR = 1.14, 95% CI = 1.06-1.21), hypertension (OR = 1.17, 95% CI = 1.10-1.25), COPD (OR = 1.27, 95% CI = 1.13-1.43), osteoporosis (OR = 1.19, 95% CI = 1.10-1.28), asthma (OR = 1.17, 95% CI = 1.01-1.35), depression (OR = 1.14, 95% CI = 1.04-1.25), and renal disease (OR = 1.20, 95% CI = 1.05-1.37). These numbers indicate that, among the patients with these 9 diseases, the MMA criteria were

Table 2. Sociodemographic and County-Level Characteristics Across Racial and Ethnic Groups Among the Study Population.

Variables	Non-Hispanic whites		Non-Hispanic blacks		Hispanics	
	n	%	n	%	n	%
Mean age \pm SD	76.77 \pm 7.28		75.87 \pm 6.99		75.78 \pm 6.72	
Gender						
Male	809,198	39.4	35,397	36.5	27,554	43.3
Female	1,243,799	60.6	61,544	63.5	36,102	56.7
Mean % of nonwhite population \pm SD	22.1 \pm 15.0		39.5 \pm 16.7		30.7 \pm 14.5	
Mean % of married-couple families \pm SD	77.8 \pm 6.0		70.7 \pm 7.0		75.8 \pm 6.7	
Mean per capita income \pm SD	44,105.3 \pm 12,125.4		43,780.8 \pm 12,824.8		43,777.6 \pm 15,380.6	
Mean % of people living in poverty \pm SD	15.3 \pm 5.2		18.3 \pm 6.2		17.5 \pm 6.1	
Mean % of education level for persons 25+ years old \pm SD						
< High school diploma	13.3 \pm 5.3		15.5 \pm 5.3		18.3 \pm 8.0	
\geq High school diploma	86.8 \pm 5.3		84.7 \pm 5.3		81.9 \pm 5.8	
4-year college degree	27.5 \pm 10.6		28.4 \pm 10.5		28.1 \pm 10.3	
Mean % of Medicaid-eligible \pm SD	19.3 \pm 7.6		22.8 \pm 8.6		23.5 \pm 9.8	
Mean % of unemployed \pm SD	7.4 \pm 2.1		8.2 \pm 1.9		8.5 \pm 3.1	
Mean % without health insurance \pm SD	13.3 \pm 4.1		15.0 \pm 3.6		17.9 \pm 6.0	
Metropolitan statistical area	1,547,679	75.4	81,743	84.3	55,541	87.3
Region						
Northeast	391,963	19.1	17,411	18.0	9,967	15.7
Midwest	560,034	27.3	17,146	18.0	7,198	11.3
South	768,105	37.4	56,780	58.6	20,445	32.1
West	330,867	16.1	4,749	4.9	21,043	33.1
Other	2,028	0.1	855	0.9	5,003	7.9
Health professional shortage area	1,803,115	87.8	88,601	91.4	58,533	92.0
Mean Charlson comorbidity index \pm SD	1.80 \pm 2.18		2.32 \pm 2.48		1.95 \pm 1.93	
Mean risk adjustment summary score \pm SD	0.80 \pm 0.65		0.83 \pm 0.70		0.76 \pm 0.63	

Note. $P < .05$ for the difference between non-Hispanic whites and minorities for all variables. SD=standard deviation.

10% to 27% more efficient than ACA in identifying medication utilization issues when comparing Hispanics with whites.

Discussion

The purpose of the current study was to examine the comparative PPV of the MTM eligibility criteria under ACA and MMA in identifying patients with medication utilization issues across racial and ethnic groups. Using a national Medicare beneficiary sample, this study analyzed 17 MMA and 15 ACA MTM eligibility threshold combinations and 9 medication safety and adherence measures related to CMS's Star Ratings system. In general, MMA MTM eligibility criteria were more efficient than ACA in identifying beneficiaries with medication utilization issues for blacks and Hispanics compared with whites. Efficiency is an important aspect of policy evaluation due to tightening budget constraint in health care. As Lee et al also suggested, even a 1% increase in PPV could potentially translate to considerable cost savings for Part D plans due to the large size of the Medicare Part D population.⁴⁶

This study documented higher medication utilization issues among minorities than whites among individuals eligible for MTM under MMA and ACA. Such patterns can be

expected because higher medication utilization issues among minorities than whites in general have been documented previously.^{8,47} However, it is harder to pinpoint the reasons for the differential efficiency of MMA and ACA MTM eligibility criteria in identify patients with medication utilization issues across racial and ethnic groups. This may be because MMA MTM eligibility criteria are predominantly based on prescription drug and health services utilization while minorities use fewer medications and health services; when minorities meet stricter MMA MTM eligibility criteria than ACA, they may have worse health status and may experience even worse medication utilization issues than whites.

Our findings also suggest that implementation of ACA's MTM eligibility criteria guidance should involve caution. ACA implementation improved population's health insurance coverage and access to health services.⁴⁸ Racial and ethnic disparities in access have also been reduced significantly.⁴⁸ However, MTM eligibility criteria under ACA were not as efficient as MMA criteria among minorities as whites in targeting patients having medication utilization issues. Wang et al further reported that racial and ethnic minorities may be less likely than whites to be eligible for ACA MTM services, and ACA MTM eligibility criteria may also aggravate existing racial and ethnic disparities in health status.¹⁶ MTM

Table 3. Proportions of Individuals With Medication Utilization Issues Across Racial and Ethnic Groups.

Criteria combination	Drug count	Disease count	Annual drug spending (\$)	% of white MTM eligible	% of black MTM eligible	% of Hispanic MTM eligible
2009 MTM eligibility thresholds under Medicare Modernization Act						
Main analysis	8	3	4,000	74.20	85.53	81.19
Sensitivity 1	2	2	4,000	71.10	82.69	78.35
Sensitivity 2	2	3	4,000	71.50	83.05	78.88
Sensitivity 3	2	5	4,000	72.87	83.84	79.65
Sensitivity 4	6	2	4,000	72.41	84.13	79.65
Sensitivity 5	6	3	4,000	72.65	84.33	79.94
Sensitivity 6	6	5	4,000	73.60	84.73	80.27
Sensitivity 7	8	2	4,000	74.06	85.39	81.08
Sensitivity 8	8	5	4,000	74.82	85.79	81.37
Sensitivity 9	15	2	4,000	81.07	88.92	86.01
Sensitivity 10	15	3	4,000	81.10	88.98	86.01
Sensitivity 11	15	5	4,000	81.22	89.12	86.20
2013 MTM eligibility thresholds under Medicare Modernization Act						
Main analysis	8	3	3,144.25	72.70	84.97	80.37
Sensitivity 1	2	2	3,144.25	68.20	79.10	76.78
Sensitivity 2	2	3	3,144.25	69.10	82.24	77.42
Sensitivity 3	8	2	3,144.25	72.56	84.88	80.18
Proposed MTM eligibility thresholds for 2015 under Medicare Modernization Act						
Main analysis	2	2	620	61.56	76.31	69.46
Criteria combination	Combination among 4 eligibility criteria			% of white MTM eligible	% of black MTM eligible	% of Hispanic MTM eligible
Patient Protection and Affordable Care Act MTM eligibility criteria						
Main analysis ^a	Criterion 1, 2, 3, or 4			51.36	65.70	57.70
Sensitivity 1	Criterion 1			57.34	72.88	65.05
Sensitivity 2	Criterion 2			53.40	68.80	60.01
Sensitivity 3	Criterion 3			52.40	66.64	58.93
Sensitivity 4	Criterion 4			52.90	67.29	59.92
Sensitivity 5	Criterion 1 or 2			57.31	72.76	64.95
Sensitivity 6	Criterion 1 or 3			52.07	66.43	58.58
Sensitivity 7	Criterion 1 or 4			52.58	67.16	59.51
Sensitivity 8	Criterion 2 or 3			52.48	66.63	58.93
Sensitivity 9	Criterion 2 or 4			53.47	67.60	60.46
Sensitivity 10	Criterion 3 or 4			51.46	65.79	57.84
Sensitivity 11	Criterion 1, 2, or 3			52.08	66.42	58.58
Sensitivity 12	Criterion 1, 2, or 4			52.60	67.14	59.50
Sensitivity 13	Criterion 1, 3, or 4			51.35	65.71	57.69
Sensitivity 14	Criterion 2, 3, or 4			51.50	65.79	57.86

Note. $P < .05$ for the difference between non-Hispanic whites and minorities for all comparisons. MTM = medication therapy management.

services are important for Medicare Part D. Previous studies have demonstrated that MTM services result in improved patient outcomes in disease management, patient quality of life, and lower health care costs.^{49,50} For example, Isetts et al reported that for every \$1 spent on MTM, \$12 was saved.⁴⁹ Importantly, these savings are associated with significant improvements in cholesterol and blood pressure control. Wentzlaff et al noted that patients' rate of blood pressure control almost doubled when pharmacists helped manage medications.⁵⁰

The present study found that in populations with cardiac disease, dyslipidemia, hypertension, COPD, osteoporosis, or renal disease, MTM eligibility criteria under MMA are more efficient than ACA in identifying medication utilization issues among both blacks and Hispanics versus whites according to demand-based main analysis of 2013 MMA criteria and ACA criteria. However, MMA were not more efficient among patients with diabetes, asthma, depression, and rheumatoid arthritis based on the same analysis. These findings indicated that efficiency of MMA versus ACA MTM

Table 4. Comparative Positive Predictive Value of MMA and ACA MTM in Identifying Individuals With Medication Utilization Issues across Racial and Ethnic Groups Based on Logistic Regressions.

Comparison groups	Non-Hispanic blacks vs non-Hispanic whites		Hispanics vs non-Hispanic whites	
	Odds ratio for interaction term	95% CI	Odds ratio for interaction term	95% CI
2009 MMA and ACA (both main analysis)				
Unadjusted model	1.13	1.06-1.20	1.16	1.08-1.24
Need-based model	1.03	0.97-1.10	1.12	1.04-1.20
Demand-based model	1.04	0.98-1.11	1.15	1.07-1.24
2013 MMA and ACA (both main analysis)				
Unadjusted model	1.16	1.11-1.21	1.19	1.13-1.25
Need-based model	1.08	1.03-1.14	1.14	1.08-1.21
Demand-based model	1.09	1.04-1.15	1.17	1.10-1.24
Proposed 2015 MMA and ACA (both main analysis)				
Unadjusted model	1.13	1.10-1.16	1.08	1.04-1.12
Need-based model	1.10	1.07-1.13	1.05	1.01-1.09
Demand-based model	1.10	1.07-1.14	1.06	1.02-1.10

Note. MMA = Medicare Modernization Act; ACA = Patient Protection and Affordable Care Act; MTM = medication therapy management; CI = confidence interval.

eligibility criteria in targeting medication utilization issues among racial and ethnic minorities would vary depending on different chronic conditions. This adds another layer of complexity when policy makers compare different MTM eligibility criteria.

Although the study showed that MMA eligibility criteria are more efficient for minorities than those under ACA in identifying patients with medication utilization issues, the shortcomings of existing MMA MTM eligibility criteria should be kept in mind. Besides the disparity implications and low participation issues associated with MMA MTM eligibility criteria, effectiveness of these eligibility criteria was also questioned. For example, Stuart et al reported that current MMA MTM eligibility criteria exclude beneficiaries with problematic medication utilization patterns such as low adherence.⁵¹

Using PPV, this current study only examined efficiency of MTM eligibility criteria under MMA and ACA. Future studies need to examine the comparative effectiveness of MMA and ACA MTM eligibility criteria in general and across racial and ethnic groups in specific. Specifically, we need to compare the effectiveness of MMA and ACA MTM eligibility criteria in identifying individuals with medication utilization issues across racial and ethnic groups. This could be measured by using other statistics for lab tests such as sensitivity. In the case of MTM eligibility criteria, sensitivity is the proportion of individuals with positive test results among those with medication utilization issues. After we compare both efficiency and effectiveness of MMA and ACA MTM eligibility criteria, we can make more comprehensive policy suggestions regarding these 2 sets of MTM eligibility criteria. Future studies should also consider changes in Star Ratings

and their possible impact. For example, completion rate for comprehensive medication review as part of MTM services is now a Star Rating measure and may improve Medicare beneficiary access to services such as MTM as pharmacies/providers work to increase patient engagement.³⁷

Since 2017, the MTM enrollment and utilization data have been made available to the research community, so it is finally plausible to examine the real efficiency and effectiveness of MMA MTM eligibility criteria instead of relying on analysis of policy scenarios. However, the analysis of real efficiency and effectiveness of ACA MTM eligibility criteria is still not possible because these eligibility criteria have not been implemented. Currently, CMS is conducting a 5-year demonstrative Enhanced MTM Program, which gives Part D plans complete flexibility in selecting target population instead of limiting these plans with MMA provisions.⁵² While awaiting findings from this demonstration program, researchers still need to explore alternative options for the current Medicare MTM program, to supplement findings from Enhanced MTM for future deliberations of effective MTM reform.

Limitations

This study provides crucial and time-sensitive results in comparative efficiency of MMA and ACA's MTM eligibility criteria in identifying patients with medication utilization issues across racial and ethnic groups based on policy-scenario analysis. This can assist policy makers by identifying the strengths and weaknesses of policies before they are implemented. The main limitation is that this study was based on analyses of policy scenarios instead of MTM

Table 5. Comparative Positive Predictive Value of MMA and ACA in Identifying Individuals With Medication Utilization Issues across Racial and Ethnic Groups According to Demand-Based Logistic Regressions.

Comparison groups	Non-Hispanic blacks vs non-Hispanic whites		Hispanics vs non-Hispanic whites	
	Odds ratio	95% CI	Odds ratio	95% CI
Diabetes				
2009 MMA & ACA	1.00	0.92-1.09	1.11	0.99-1.23
2013 MMA & ACA	1.07	0.99-1.15	1.10	1.01-1.19
2015 MMA & ACA	1.23	1.17-1.29	1.04	0.98-1.10
Cardiac disease				
2009 MMA & ACA	1.11	1.03-1.19	1.24	1.13-1.35
2013 MMA & ACA	1.18	1.12-1.25	1.22	1.14-1.31
2015 MMA & ACA	1.25	1.20-1.31	1.16	1.09-1.22
Dyslipidemia				
2009 MMA & ACA	1.02	0.95-1.10	1.14	1.05-1.24
2013 MMA & ACA	1.08	1.03-1.15	1.14	1.06-1.21
2015 MMA & ACA	1.11	1.07-1.15	1.04	0.99-1.08
Hypertension				
2009 MMA & ACA	1.10	1.03-1.17	1.17	1.08-1.26
2013 MMA & ACA	1.16	1.11-1.22	1.17	1.10-1.25
2015 MMA & ACA	1.19	1.15-1.23	1.10	1.05-1.15
Chronic obstructive pulmonary disease				
2009 MMA & ACA	1.19	1.06-1.33	1.16	1.00-1.34
2013 MMA & ACA	1.23	1.12-1.35	1.27	1.13-1.43
2015 MMA & ACA	1.24	1.13-1.36	1.14	1.01-1.28
Osteoporosis				
2009 MMA & ACA	1.07	0.99-1.16	1.20	1.09-1.32
2013 MMA & ACA	1.11	1.04-1.18	1.19	1.10-1.28
2015 MMA & ACA	1.08	1.03-1.13	1.06	0.99-1.13
Asthma				
2009 MMA & ACA	1.09	0.95-1.26	1.15	0.97-1.38
2013 MMA & ACA	1.08	0.96-1.21	1.17	1.01-1.35
2015 MMA & ACA	1.17	1.03-1.33	0.99	0.84-1.16
Depression				
2009 MMA & ACA	1.02	0.92-1.12	1.04	0.93-1.17
2013 MMA & ACA	1.08	0.99-1.17	1.14	1.04-1.25
2015 MMA & ACA	1.12	1.05-1.19	1.12	1.03-1.21
Rheumatoid arthritis				
2009 MMA & ACA	1.06	0.85-1.33	1.08	0.84-1.40
2013 MMA & ACA	1.20	1.01-1.44	1.07	0.87-1.31
2015 MMA & ACA	1.13	0.95-1.33	1.10	0.89-1.37
Renal disease				
2009 MMA & ACA	1.14	1.02-1.27	1.15	0.98-1.35
2013 MMA & ACA	1.21	1.10-1.32	1.20	1.05-1.37
2015 MMA & ACA	1.39	1.28-1.50	1.27	1.12-1.45

Note. MMA = Medicare Modernization Act; ACA = Patient Protection and Affordable Care Act; CI = confidence interval.

^a2015 MMA was proposed but not implemented.

claims data, as MTM participation status under MMA and ACA was not available at the time of this study. Furthermore, the 9 measures related to CMS's Star Ratings may not include all types of medication utilization issues, nor are they the only ways of measuring medication utilization quality; moreover, the goals of MTM are much broader in

scope than just addressing these particular medication utilization issues. The technical specifications for these measures may also have limitations such as excluding patients who fail to fill their first and/or second prescriptions because patients were required to have 2 prescription fills to be included in the calculation of medication adherence.³⁵

However, these technical specifications, which are constantly evolving, represent the current best science in MTM quality measures at the time of this study. Last, while the Research Triangle Institute race code used for race/ethnicity information represents improvement compared with traditional race code in MBSF, Research Triangle Institute race code still has suboptimal sensitivity and specificity.³⁰

Conclusion

This study compared the PPV or efficiency of MTM eligibility criteria under MMA and ACA in identifying individuals with medication utilization issues across racial and ethnic groups. MTM eligibility criteria under MMA were more efficient in identifying patients with medication utilization issues than those under ACA among blacks and Hispanics than whites. Considering the critical role played by MTM in improving health outcomes among older patients with chronic diseases, this comparison could provide evidence to assist policy makers in improving efficiency and reducing disparities associated with MTM services. Further studies should also examine effectiveness of MTM eligibility criteria under MMA and ACA in identifying patients with medication utilization issues.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Research reported in this publication was supported by the National Institute on Aging of the National Institutes of Health under award number R01AG049696. The content of this study is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Junling Wang  <https://orcid.org/0000-0003-3929-6227>

References

- Koh HK. A 2020 vision for healthy people. *N Engl J Med*. 2010;362(18):1653-1656.
- US Department of Health and Human Services. *About Healthy People*. <https://www.healthypeople.gov/2020/About-Healthy-People>. Published December 2, 2010. Updated July 19, 2018. Accessed July 19, 2018.
- Institute of Medicine. Introduction and literature review. In: Snedley BD, Stith AY, Nelson AR, eds. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. Washington, DC: National Academy Press; 2002: 29-79.
- Han PK, Coates RJ, Uhler RJ, Breen N. Decision making in prostate-specific antigen screening. *Am J Prev Med*. 2006;30(5):394-404.
- Sambamoorthi U, McAlpine DD. Racial, ethnic, socioeconomic, and access disparities in use of preventive services among women. *Prev Med*. 2003;37(5):475-484.
- Byrd L, Fletcher A, Menifield C. Disparities in health care: minority elders at risk. *ABNF J*. 2007;18(2):51-55.
- Gornick ME. Disparities in Medicare services: potential causes, plausible explanations, and recommendations. *Health Care Financ Rev*. 2000;21(4):23-43.
- Lu D, Qiao Y, Johnson KC, Wang J. Racial and ethnic disparities in meeting MTM eligibility criteria among patients with asthma. *J Asthma*. 2017;54(5):504-513. doi:10.1080/02770903.2016.1238927.
- Munshi KD, Shih YC, Brown LM, Dagogo-Jack S, Wan JY, Wang J. Disparity implications of the Medicare MTM eligibility criteria: a literature review. *Expert Rev Pharmacoecon Outcomes Res*. 2013;13(2):201-216. doi:10.1586/erp.13.6.
- Wang J, Mullins CD, Brown LM, et al. Disparity implications of Medicare eligibility criteria for medication therapy management services. *Health Serv Res*. 2010;45(4):1061-1082. doi:10.1111/j.1475-6773.2010.01118.x.
- Wang J, Brown LM, Hong SH. Racial and ethnic disparities in meeting Part D MTM eligibility criteria among the non-Medicare population. *J Am Pharm Assoc (2003)*. 2012;52(5):e87-e96.
- Wang J, Qiao Y, Shih YC, et al. Effects of Medicare Part D on disparity implications of medication therapy management eligibility criteria. *Am Health Drug Benefits*. 2014;7(6):346-358.
- Wang J, Qiao Y, Shih YC, et al. Potential effects of racial and ethnic disparities in meeting Medicare medication therapy management eligibility criteria. *J Pharm Health Serv Res*. 2014;5(2):109-118.
- Wang J, Qiao Y, Shih YC, et al. Potential health implications of racial and ethnic disparities in meeting MTM eligibility criteria. *Res Social Adm Pharm*. 2014;10(1):106-125. doi:10.1016/j.sapharm.2013.03.007.
- Wang J, Zhang Z, Spivey CA, Chisholm-Burns M. Historical trend of racial and ethnic disparities in meeting Medicare medication therapy management eligibility criteria in non-Medicare population. *Res Social Adm Pharm*. 2014;10(6):904-917. doi:10.1016/j.sapharm.2014.02.007.
- Wang J, Qiao Y, Shih YC, et al. Potential health implications of the MTM eligibility criteria in the Affordable Care Act across racial and ethnic groups. *J Manag Care Spec Pharm*. 2015;21(11):993-1003.
- Wang J, Qiao Y, Spivey C, et al. Disparity implications of proposed 2015 Medicare eligibility criteria for medication therapy management services. *J Pharm Health Serv Res*. 2016;7(4):209-215.
- Wang J, Qiao Y. Historical trend of disparity implications of Medicare MTM eligibility criteria. *Res Social Adm Pharm*. 2013;9(6):758-769.
- Centers for Medicare & Medicaid Services (CMS). Medicare program; Medicare prescription drug benefit. *Final Rule. Fed Regist*. 2005;70(18):4193-4585.
- Briesacher B, Limcangco R, Gaskin D. Racial and ethnic disparities in prescription coverage and medication use. *Health Care Financ Rev*. 2003;25(2):63-76.
- Schore J, Brown R, Lavin B. Racial disparities in prescription drug use among dually eligible beneficiaries. *Health Care Financ Rev*. 2003;25(2):77-90.

22. Wang J, Noel JM, Zuckerman IH, Miller NA, Shaya FT, Mullins CD. Disparities in access to essential new prescription drugs between non-Hispanic whites, non-Hispanic blacks, and Hispanic whites. *Med Care Res Rev*. 2006;63(6):742-763.
23. Wang J, White-Means SI, Hufstader MA, Walker GD. The economic implications of the racial and ethnic disparities in the use of selective serotonin reuptake inhibitors. *Curr Med Res Opin*. 2007;23(4):853-863.
24. Wang J, Zuckerman IH, Miller NA, Shaya FT, Noel JM, Mullins CD. Utilizing new prescription drugs: disparities among non-Hispanic whites, non-Hispanic blacks, and Hispanic whites. *Health Serv Res*. 2007;42(4):1499-1519.
25. Centers for Medicare & Medicaid Services (CMS). *Medicare Part D Medication Therapy Management (MTM) Programs*. <https://www.cms.gov/Medicare/Prescription-Drug-Coverage/PrescriptionDrugCovContra/Downloads/CY2017-MTM-Fact-Sheet.pdf>. Published August 16, 2017. Accessed July 18, 2018.
26. Centers for Medicare & Medicaid Services (CMS). Medicare program; contract year 2015 policy and technical changes to the Medicare Advantage and the Medicare Prescription Drug Benefit programs. Proposed rule. *Fed Regist*. 2014;79(7):1917-2073.
27. Office of the Legislative Counsel, US House of Representatives. *Compilation of Patient Protection and Affordable Care Act*. <http://housedocs.house.gov/energycommerce/ppacacon.pdf>. Published May 1, 2010. Accessed July 19, 2018.
28. Baquet CR, Carter-Pokras O, Bengen-Seltzer B. Healthcare disparities and models for change. *Am J Manag Care*. 2004;10:SP5-SP11.
29. Wang J, Dong Z, Hong SH, Suda KJ. A comparison of direct medical costs across racial and ethnic groups among children with cancer. *Curr Med Res Opin*. 2008;24(3):847-858.
30. Research Data Assistance Center. *Find a CMS Data File*. <http://www.resdac.org/cms-data>. Published 2017. Accessed July 19, 2018.
31. Health Resources and Services Administration. *Area Health Resources Files (AHRF)*. <https://datawarehouse.hrsa.gov/topics/ahr/ahrf.aspx>. Published 2017. Accessed July 19, 2018.
32. Gelberg L, Andersen RM, Leake BD. The Behavioral Model for Vulnerable Populations: application to medical care use and outcomes for homeless people. *Health Serv Res*. 2000;34(6):1273-1302.
33. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992;45(6):613-619.
34. Centers for Medicare & Medicaid Services (CMS). *Risk Adjustment*. <https://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Risk-Adjustors.html>. Published 2013. Accessed July 19, 2018.
35. Pharmacy Quality Alliance. *Technical Specifications for PQA Approved Measures*. Alexandria, VA: Pharmacy Quality Alliance; 2013.
36. Pharmacy Quality Alliance. PQA Mission and Strategic Goals. <https://pqaalliance.org/about/default.asp>. Published 2017. Accessed July 18, 2018.
37. Centers for Medicare & Medicaid Services (CMS). *Part C and D Performance Data*. <https://www.cms.gov/Medicare/Prescription-Drug-Coverage/PrescriptionDrugCovGenIn/PerformanceData.html>. Published 2017. Accessed July 19, 2018.
38. Centers for Medicare & Medicaid Services (CMS). *2009 Medicare Part D Medication Therapy Management (MTM) Programs*. <http://www.cms.gov/Medicare/Prescription-Drug-Coverage/PrescriptionDrugCovContra/Downloads/CY2009-CY2012-MTM-Fact-Sheet-.zip>. Published 2010. Accessed July 19, 2018.
39. Centers for Medicare & Medicaid Services (CMS). *Fact Sheet: Summary of 2013 Medicare Part D Medication Therapy Management (MTM) Programs*. <https://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2013-Fact-sheets.html>. Published 2013. Accessed July 19, 2018.
40. Bureau of Labor Statistics. *Consumer Price Index (CPI)*. <https://www.bls.gov/data>. Published 2017. Accessed July 19, 2018.
41. Daniel GW, Malone DC. Characteristics of older adults who meet the annual prescription drug expenditure threshold for Medicare medication therapy management programs. *J Manag Care Pharm*. 2007;13(2):142-154.
42. Elixhauser A, Steiner C, Palmer L. *Clinical Classifications Software (CCS)*. <http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp>. Published 2008. Accessed July 19, 2018.
43. Zuckerman IH, Langenberg P, Baumgarten M, et al. Inappropriate drug use and risk of transition to nursing homes among community-dwelling older adults. *Med Care*. 2006;44(8):722-730.
44. Sato M, Shaffer T, Arbaje AI, Zuckerman IH. Residential and health care transition patterns among older Medicare beneficiaries over time. *Gerontologist*. 2011;51(2):170-178.
45. Escarce JJ, Kapur K. Racial and ethnic differences in public and private medical care expenditures among aged Medicare beneficiaries. *Milbank Q*. 2003;81(2):249-275.
46. Lee JS, Yang J, Stockl KM, Lew H, Solow BK. Evaluation of eligibility criteria used to identify patients for medication therapy management services: a retrospective cohort study in a Medicare Advantage Part D population. *J Manag Care Spec Pharm*. 2016;22(1):22-30.
47. Jamison JJ, Wang J, Surbhi S, et al. Impact of Medicare Part D on racial and ethnic minorities. *Divers Equal Health Care*. 2016;13(5):326-333.
48. Chen J, Vargas-Bustamante A, Mortensen K, Ortega AN. Racial and ethnic disparities in health care access and utilization under the Affordable Care Act. *Med Care*. 2016;54(2):140-146.
49. Isetts BJ, Schondelmeyer SW, Artz MB, et al. Clinical and economic outcomes of medication therapy management services: the Minnesota experience. *J Am Pharm Assoc (2003)*. 2008;48(2):203-211; 3 p following 211.
50. Wentzlaff DM, Carter BL, Ardery G, et al. Sustained blood pressure control following discontinuation of a pharmacist intervention. *J Clin Hypertens (Greenwich)*. 2011;13(6):431-437.
51. Stuart B, Loh E, Miller L, Roberto P. Should eligibility for medication therapy management be based on drug adherence? *J Manag Care Pharm*. 2014;20(1):66-75.
52. Barlas S. CMS to test enhanced medication therapy management model: aims for greater use of pharmacists, cost savings, and better outcomes. *P T*. 2016;41(7):423-441.