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Potential effects of racial and ethnic disparities in meeting Medicare medication therapy management eligibility criteria

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Abstract

Objective—Medication therapy management (MTM) has the potential to play an instrumental role in reducing racial and ethnic disparities in health care. However, previous research has found that Blacks and Hispanics are less likely to be eligible for MTM. The purpose of the current study was to examine the potential effects of MTM eligibility criteria on racial and ethnic disparities in health outcomes.

Methods—The current study is a retrospective cross-sectional analysis of the Medicare Current Beneficiary Survey Cost and Use files for the years 2007 and 2008. A difference-in-differences model was used to compare disparities in outcomes between ineligible and eligible beneficiaries according to MTM eligibility criteria in 2010. This was achieved by including in regression models interaction terms between dummy variables for Blacks/Hispanics and MTM eligibility criteria. Interaction terms were interpreted on both multiplicative and additive terms. Various regression models were used depending on the types of variables.

Key Findings—Whites were more likely to report self-perceived good health status than Blacks and Hispanics among both MTM-eligible and MTM-ineligible populations. Disparities were greater among MTM-ineligible than MTM-eligible populations (e.g., on additive term, difference in odds=1.94 and $P<0.01$ for Whites and Blacks; difference in odds=2.86 and $P<0.01$ for Whites and Hispanics). A few other measures also exhibited significant patterns.

Conclusions—MTM eligibility criteria may exacerbate racial and ethnic disparities in health status and some measures of health services utilizations and costs and medication utilization. Future research should examine strategies to remediate the effects of MTM eligibility criteria on disparities.

Keywords

race; ethnicity; medication therapy management services; Medicare; eligibility criteria

Introduction

According to the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (MMA), in 2006, the Centers for Medicare and Medicaid Services (CMS) established outpatient prescription drug (Part D) benefits for Medicare beneficiaries, the majority of whom are adults aged 65 years or older.^[1] At the same time, MMA included a requirement that prescription drug plans provide medication therapy management (MTM) services to eligible beneficiaries.^[1] MMA stipulated three utilization-based MTM eligibility criteria: multiple Part D-covered drugs, multiple chronic conditions, and incurring at least \$4,000 in annual drug costs in 2006.^[1,2] In 2010, CMS modified the original MTM eligibility criteria by lowering eligibility threshold ceilings. Part D plans had the discretion to set their minimum eligibility thresholds at or below 8 Part D-covered drugs and 3 chronic conditions, with an annual drug cost threshold of \$3,000.^[3]

An MTM service program entails five core elements: comprehensive medication review, personal medication record, medication-related action plan, intervention and/or referral, and documentation and follow-up.^[4] The value of MTM has been widely recognized in the scientific literature. Landmark studies such as the Asheville Project and the Diabetes Ten City Challenge have demonstrated the positive clinical and economic benefits of pharmacist-administered MTM services, with participants showing significant improvements in clinical indicators, resulting in reduced total health care costs.^[5–11] The value of MTM services has also been recognized by the 2010 Patient Protection and Affordable Care Act (PPACA).^[12] Additionally, CMS has indicated its intention to increase awareness of MTM programs among Medicare beneficiaries and their health care providers, thereby expanding enrollment for MTM services from 10–12% to a quarter of the Medicare population.^[3]

MTM services may play an instrumental role in reducing racial and ethnic disparities because racial and ethnic minorities are more likely to have MTM-targeted chronic conditions such as diabetes and hypertension and experience worse outcomes from medication utilization than their non-Hispanic White counterparts.^[13–17] However, previous research has found that Blacks and Hispanics are less likely to be eligible for MTM services among the Medicare population.^[18] While frustrating, this pattern is not surprising because Blacks and Hispanics tend to use fewer medications and incur lower drug costs than Whites given the same health status.^[19–23] The purpose of the current study was to examine the potential effects of MTM eligibility criteria on racial and ethnic disparities in health outcomes.

Methods

Data source and study sample

The current study is a retrospective cross-sectional analysis of the Medicare Current Beneficiary Survey (MCBS) Cost and Use files for the years 2007 and 2008 (Centers for Medicare and Medicaid Services 2013A).^[24] The MCBS is a continuous, multipurpose survey of a nationally representative sample of the Medicare population that collects information on beneficiaries' sociodemographic characteristics, health status, health insurance, and health care utilizations. The Cost and Use files link Medicare claims to survey-reported events and provide complete medical expenditures and source of payment data on all health care services, including those not covered by Medicare. Years 2007 and 2008 were the two most recent years available at the time of the analysis.

This study included three racial and ethnic groups: non-Hispanic Whites (referred to hereafter as Whites), non-Hispanic Blacks (referred to hereafter as Blacks), and Hispanics. Racial disparities were examined by comparing Whites and Blacks, while ethnic disparities were examined by comparing Whites and Hispanics. The sample sizes of other racial and ethnic groups were too small to produce reliable estimates of meaningful differences. Medicare beneficiaries younger than 65 were excluded to maintain homogeneity of the study population. The final sample included non-institutionalized Medicare beneficiaries aged 65 years or older who were not enrolled in a Health Maintenance Organization (to ensure availability of detailed claims data).

MTM eligibility criteria

To analyze MTM eligibility criteria, the following thresholds were examined based on actual thresholds used by Part D plans in 2010: 2 to 8 (median=5) drugs covered by Part D plans; 2 to 3 (median=3) chronic conditions; and annual Part D drug cost of at least \$3,000.^[3] To capture the wide range of eligibility thresholds used by Part D plans, the study examined upper and lower limits and the median as representative values for number of drugs and number of chronic conditions; thus, 6 ($3 \times 2 \times 1$) different combinations of MTM eligibility thresholds were examined. The 2010 cost threshold of \$3,000 was converted to 2007 and 2008 dollars using the Consumer Price Index for medical care expenditure.^[25] The main analysis included the median values of the eligibility thresholds (5 drugs, 3 chronic conditions, and \$3,000 in annual Part D drug costs). The remaining five threshold combinations were included in sensitivity analyses.

Determining eligibility for the number of drugs and drug costs criteria was based on information directly available in MCBS. All prescription drugs were included because of the variety of formularies of Part D plans and unavailability of the information. The determination of eligibility according to number of chronic conditions was based on a raw count among a list of 25 chronic conditions. This list was put together by Daniel and Malone as chronic conditions applicable to Medicare beneficiaries.^[26] To identify chronic conditions, we used existing free software, Clinical Classification Software (CCS), developed by the Agency for Healthcare Research and Quality which aggregates medical conditions and illnesses into 285 mutually exclusive categories.^[27] The most current version of CCS is valid for the period from January 1980 to September 2009. CCS has been widely used by health services researchers.^[27]

Aspects of disparities

To determine the disparity implications of MTM eligibility criteria, three outcome measures were examined: health status, health services utilizations and costs, and medication utilization patterns. These measures were selected based on disparities previously reported in the literature.^[28–30] Disparities in health status were measured using self-perceived good health status, number of chronic diseases, number of activities of daily living (ADLs), and instrumental activities of daily living (IADLs). Self-perceived good health status is a binary variable categorized as good or poor (good consisted of the responses excellent, very good, and good, and poor consisted of the responses fair and poor).

Medication utilization patterns were analyzed using two measures: whether patients used at least two potentially inappropriate high-risk medications based on the Beers criteria, and generic dispensing ratio.^[31] These are two medication utilization measures developed by the Pharmacy Quality Alliance, a non-profit organization initiated by CMS with the charge to standardize performance measurement related to medication utilization. The current study used the 2003 version of the Beers criteria list when determining high-risk medications since it was the most recently available during the time period analyzed.^[32] Due to a lack of robust dosage- and dosage form-related information in the database, only 39 of the 49 criteria were able to be operationalized to determine the appropriateness of medications. The final analysis included 2,333 unique drugs and drug combinations that were reported by

beneficiaries in 2007 and 2008. The generic dispensing ratio, or the proportion of generic prescription medications of all the prescription medications dispensed, was estimated by linking the MCBS data to the Food and Drug Administration's Orange Book to determine whether the prescription drugs consumed by Medicare enrollees were brand or generic.^[33] For medications without an exact match in the Orange Book, a pharmacist manually reviewed the list to determine whether the prescribed medications were brand or generic. Finally, health services utilization and cost measures included the number and cost of physician visits, emergency room (ER) visits, and hospitalizations, as well as total health care costs.

Theoretical framework

The current study used Andersen's Behavioral Model for Health Services Utilization when analyzing health services utilizations and costs and medication utilization, and Iezzoni's risk adjustment model when analyzing health status.^[34,35] In accordance with Andersen's Model, which aims to understand determinants of health care utilization, the following independent variables were included in the study: predisposing factors (race and ethnicity, age, gender, and marital status), enabling factors (education, income, and two location variables: geographic region and metropolitan statistical area [MSA]), and need factors (self-perceived health status and a risk adjustment score).^[34] The analysis on health status based on Iezzoni's risk adjustment model included all variables in Andersen's Model, with the exception of self-perceived health status.^[35] The risk adjustment summary score was derived from the Diagnostic Cost Group/Hierarchical Coexisting Condition (DCG/HCC) model.^[36] The software for carrying out this risk adjustment is available for free from the CMS website. DCG/HCC was developed to risk adjust payments to Medicare Advantage plans using 189 homogeneous collections of medical conditions that can be identified using diagnostic information from inpatient, outpatient, and physician claims. This risk adjustor has been validated as a measure for controlling for confounding in studies of health services research.^[37]

Statistical analyses

The current study used a difference-in-differences analytic estimation to compare racial and ethnic disparity patterns in health status, health services utilizations and costs, and medication utilization patterns between MTM-ineligible and MTM-eligible beneficiaries. Racial and ethnic disparities were examined separately. For example, when examining racial disparities, regression models included dummy variables for Blacks and MTM eligibility status, and an interaction term between Blacks and MTM eligibility. Computing the regression coefficient associated with the interaction term is analogous to first calculating the difference in outcomes between Blacks/Hispanics and Whites among MTM-ineligible beneficiaries, followed by the difference among MTM-eligible beneficiaries, and finally calculating the difference between these two differences. Positive and significant interaction terms would suggest there were greater disparities among the MTM-ineligible population than the MTM-eligible population.

The types of regression models were determined based on the types of dependent variables. Dummy variables including self-perceived good health status and the use of high-risk

medications were analyzed using a logistic regression model. Count variables including number of chronic conditions, ADLs and IADLs, and number of physician office visits, ER visits, and hospitalizations were analyzed using a negative binomial model. All cost variables were analyzed using a generalized linear model with log link function and Gamma distribution. When examining the generic dispensing ratio, an ordinary least-squares regression was used.

When estimating the effect of the interaction between the race and ethnicity variables and MTM eligibility in non-linear regressions, the interaction term was interpreted on both the multiplicative term and the additive term. The multiplicative term takes into account the baseline effect among each group compared, whereas the additive term takes into account only the baseline effect among the reference group (for example, 'Whites' for race/ethnicity group and 'ineligible' for MTM eligibility status).^[38] Both of these interpretations are accurate representations of the effect of MTM eligibility criteria and are deemed acceptable interpretations of interaction effects in the research community. All data analyses took into account the complex survey design of MCBS, including primary sampling units, strata, and personal weights, by using survey data analysis procedures in SAS 9.3 (SAS Institute Inc., Cary, NC) and STATA 12.0 (StataCorp LP, College Station, TX). The statistical significance level was set *a priori* at 0.05. This study was deemed exempt by the Institutional Review Board at the lead author's institution.

Results

The sample consisted of 12,966 Medicare beneficiaries aged 65 years or older (weighted to 51,635,149). Of these, 11,161 were White [weighted number (%) = 44,264,118 (85.73%)], 930 were Black [weighted number (%) = 3,734,991 (7.23%)] and 875 were Hispanic [weighted number (%) = 3,636,039 (7.04%)]. With the exception of gender, the differences between Whites and racial and ethnic minorities were significant ($P < 0.05$; Table 1). In comparison to Whites, minorities were more likely to belong to younger age groups, less likely to be married, less likely to have higher education, more likely to belong to lower income categories, more likely to have Medicaid, and more likely to perceive poorer health status.

Based on the descriptive analyses, both Blacks and Hispanics had lower proportions of beneficiaries who were eligible for MTM services; however, only the differences between Whites and Hispanics were sometimes significant (Table 2). For example, in the main analysis (with eligibility thresholds of 5 drugs, 3 chronic conditions, and \$3,000 in drug costs), the difference between Whites and Hispanics was significant (19.53% vs. 16.36%; $P = 0.04$) but not the difference between Whites and Blacks (Table 2). In the adjusted multivariate analysis, Blacks and Hispanics were found to have lower likelihood of being eligible for MTM services. For example, in the main analysis, significant disparities in MTM eligibility were found between both Blacks and Whites (OR: 0.61; 95% CI: 0.50–0.75) and Hispanics and Whites (OR: 0.65; 95% CI: 0.50–0.83; Table 3). Similar patterns were found in the sensitivity analyses.

Implications of racial disparities in MTM eligibility

Based on the main analysis (Table 4), the difference in the proportions of Whites and Blacks who reported having self-perceived good health status among MTM-ineligible beneficiaries was 9.06% (85.45% vs. 76.39% for Whites and Blacks, respectively; $P<0.0001$). Among MTM-eligible beneficiaries, this difference was 11.9% (62.91% vs. 51.01% for Whites and Blacks, respectively; $P=0.001$). The difference in differences between MTM-ineligible and MTM-eligible beneficiaries was -2.84% ($P=0.74$). In the multivariate logistic regression analyses, the multiplicative effect was not significant on the multiplicative term (OR: 1.07; $P=0.77$) but was significant on the additive term (difference in odds = 1.94; $P<0.01$). Similar results were observed in the sensitivity analyses. These results indicated that for Blacks and Whites, the disparity patterns in self-perceived good health status may be greater among MTM-ineligible beneficiaries than MTM-eligible beneficiaries. Concerning other health status measures, the analysis of ADLs and IADLs produced significant findings while no significant results were found for the number of chronic conditions. Whites had a lower number of ADLs than Blacks both among the MTM-ineligible and MTM-eligible populations, although the difference in these differences was not significant (Table 4). After adjusting for confounding factors, the difference in differences was significant on the multiplicative term (incidence rate ratio=1.45; $P=0.03$; Table 5) and the additive term (difference in incidence rate=0.62; $P=0.03$; Table 5). This also suggests greater disparities among MTM-ineligible than MTM-eligible groups. Sensitivity analyses produced similar patterns. The patterns for IADLs were similar except that the difference in differences was only significant on the additive term.

Among measures of health services utilizations and costs, a few exhibited significant patterns. For example, Blacks had a similar number of ER visits compared to Whites among MTM-ineligible individuals but a higher number of ER visits among MTM-eligible individuals according to descriptive analyses (Table 4). For example, in the main analysis, after adjusting for confounding factors, the difference in differences was significant both on the multiplicative term (incidence rate ratio=1.67; $P=0.02$) and the additive term (difference in incidence rates=0.12; $P=0.03$; Table 5). This again suggests greater disparities among the MTM-ineligible than MTM-eligible group.

Analyses on health services utilizations and costs and medication utilizations produced complicated findings. Concerning costs of physician visits, while Whites had higher costs than Blacks among both MTM-ineligible and MTM-eligible individuals, the difference in differences was not significant according to the main analysis. However, the difference in differences was significant after adjusting for confounders according to sensitivity analyses 1 (with eligibility thresholds of 2 drugs, 2 chronic conditions and \$3,000 in drug costs) and 3 (with eligibility thresholds of 5 drugs, 2 chronic conditions and \$3,000 in drug costs) but not other sensitivity analyses. According to sensitivity analysis 1, the difference in differences was only significant on the additive term (difference in differences= -1047.77 ; $p=0.019$), suggesting that disparities were lower among MTM-ineligible than the MTM-eligible population. Sensitivity analysis 3 produced similar pattern. Concerning generic dispensing ratio, the main analysis produced no significant findings, but sensitivity analyses 1 and 3 found significant interaction effects. Being Black was associated with higher generic

dispensing ratio among MTM-eligible group than MTM-ineligible group (e.g., coefficient=0.06, $P=0.02$ for sensitivity analysis 1). No significant results were obtained for the remaining measures of health services utilizations, costs, or medication utilization patterns.

Implications of ethnic disparities in MTM eligibility

In analyzing the main MTM eligibility criteria (Table 4), the difference in the proportions of Whites and Hispanics who reported having self-perceived good health status among MTM-ineligible beneficiaries was 10.81% (85.45% vs. 74.64; $P<0.001$). For MTM-eligible beneficiaries, this difference was 8.0% (62.91% vs. 54.91% for Whites and Hispanics, respectively; $P=0.04$). The difference in differences between the MTM-ineligible and MTM-eligible groups was 2.81% ($P=0.09$). In the adjusted multivariate model for the main analysis, the multiplicative effect for the interaction was not significant (OR: 1.74; $P=0.06$; Table 5). However, on the additive term, the interaction was significant (difference in odds: 2.86; $P<0.01$; Table 5), indicating that ethnic difference in the proportion of beneficiaries who report self-perceived good health status was greater among MTM-ineligible than MTM-eligible beneficiaries. The patterns were similar in the sensitivity analyses. Concerning other health status measures, the number of chronic conditions but not ADLs or IADLs exhibited significant patterns. Whites had a higher number of chronic conditions than Hispanics among both MTM-ineligible and MTM-eligible groups. After adjusting for confounding factors, the difference in differences was significant according to the multiplicative term (incidence rate ratio=1.15; $P=0.01$; Table 5) but not the additive term (difference in incidence rate=0.26; $P=0.14$; Table 5). This indicates that these disparities were greater among the MTM-ineligible than the MTM-eligible group.

Analyses on health services utilization and costs and medication utilization produced consistent findings. Whites had a higher number of physician visits than Hispanics among both MTM-ineligible and MTM-eligible individuals (Table 4). After adjusting for confounders, the difference in differences was significant on the multiplicative term (incidence rate ratio=1.40; $P<0.01$; Table 5) but not the additive term ($P=0.27$; Table 5). Similar patterns were found in sensitivity analyses. Regarding costs of physician visits, Whites had higher costs than Hispanics among MTM-ineligible and MTM-eligible populations. After adjusting for confounders, the interaction effect was significant on the multiplicative term (coefficient estimate=0.37; $P=0.02$; Table 5) but not the additive term in the main analysis ($P=0.56$; Table 5). Sensitivity analyses produced similar results. A similar pattern was also found for hospitalizations according to sensitivity analysis 5 (with eligibility thresholds of 8 drugs, 3 chronic conditions, and \$3,000 in drug costs) but not the main analysis and other sensitivity analyses. The analyses of total health care costs produced the same patterns as the costs of physician visits. These findings suggest greater ethnic disparities among the MTM-ineligible population than the MTM-eligible population. No significant results were obtained for other health services utilization and costs measures or medication utilization patterns.

Discussion

The goal for the implementation of MTM programs for Medicare beneficiaries under Part D was to establish quality improvement initiatives by ensuring optimum therapeutic outcomes through improved medication use and reducing the risk of adverse events.^[3] In the 2011 National Healthcare Quality and Disparities Report, it was noted that for minorities and low-income groups in particular, health care quality and access are suboptimal and although health care quality is improving, there is little change in disparities in health care.^[39] The findings from the current study provide further evidence of the shortfalls in quality improvement programs such as MTM due to worsening of existing racial and ethnic disparities. To explain further, the current study analyzed the most comprehensive, nationally representative database available for Medicare beneficiaries, and found that Black and Hispanic Medicare beneficiaries had a lower likelihood of being eligible for MTM services than Whites.^[24] Significant racial and ethnic disparities in health status were found, with both Blacks and Hispanics being less likely to report having self-perceived good health status compared to Whites. Disparity patterns in self-perceived good health status were greater among MTM-ineligible beneficiaries than MTM-eligible beneficiaries. All these findings indicate the current design of the MTM program may potentially aggravate existing racial and ethnic disparities in health status.^[30]

Concerning other measures of health status, Blacks were found to have higher numbers of ADLs and IADLs than Whites, and the differences were also greater among the MTM-eligible than the MTM-ineligible group. This suggests Blacks may need to be sicker than Whites to be eligible for MTM services. Whites had a higher number of chronic conditions than Hispanics, and the difference was greater among MTM-ineligible than MTM-eligible individuals. Because number of chronic conditions may be a better proxy for access than for health status, this suggests that Hispanics with access problems likely may be excluded from the MTM program. When analyzing disparities between Whites and Blacks, disparity patterns in ER visits were greater among MTM-ineligible beneficiaries than MTM-eligible beneficiaries. Because ER visits may be a proxy for unmet health needs, this further suggests the Medicare MTM eligibility criteria may aggravate existing racial disparities in health outcomes.^[30]

Current MTM eligibility criteria may also potentially aggravate existing racial and ethnic disparities in health services utilizations and costs and medication utilization patterns.^[28] When examining the costs of physician visits, Whites had higher measures than Blacks and the differences were greater among MTM-eligible than MTM-ineligible patients. This suggests that MTM disparities may not aggravate existing racial disparities in the costs of physician visits. However, this pattern needs to be interpreted cautiously because this is the only health services /costs measure that exhibited such a pattern. When examining medication utilization patterns, Blacks eligible for MTM were associated with higher generic dispensing ratio. This suggests that MTM eligibility criteria may aggravate existing racial disparities in medication utilization quality measures between Whites and Blacks.^[28]

Regarding ethnic disparities, when examining physician visits and costs and total health care costs, Whites had higher measures than Hispanics, and the differences were greater among

MTM-ineligible than MTM-eligible patients. This suggests that existing MTM eligibility criteria may aggravate existing ethnic disparities in health services utilizations and costs.^[28] Additionally, if we consider physician visits as a proxy for access, this again suggests that MTM eligibility criteria may aggravate existing ethnic disparities in access.^[30]

In a previous study using data from 2004–2005 (prior to Part D implementation), Wang and colleagues examined potential impact of the MTM eligibility criteria on the same set of outcome measures.^[40] That study had similar findings on self-perceived good health status, but no significant findings related to other measures. The difference in the findings may have arisen from the effects of Part D implementation on study outcomes.^[41–43]

Multiple stakeholders, including federal, state and local health agencies, hospital and health systems, health care professionals, and researchers, are working collaboratively to address and reduce racial and ethnic disparities in health care quality. The PPACA calls for formation of a National Strategy for Quality Improvement in Health Care that prioritizes the establishment of a national strategy to improve health care delivery and patient health outcomes.^[12] The National Strategy for Quality Improvement in Health Care is intended to ensure among others, the identification of areas for rapid improvements in the quality and efficiency of patient care.^[12] The results of this study may enable policymakers to identify possible shortcomings in Medicare Part D MTM eligibility criteria to ensure that a healthy balance is achieved between economic efficiency, equity, and quality.

This study has some limitations. Due to lack of access to MTM claims data, the analysis is of policy scenarios rather than actual beneficiary enrollment data for MTM services under Part D. However, this study provides timely information on disparity implications of MTM eligibility criteria. Moreover, the comparability of proportions of individuals eligible for MTM in this study with the actual MTM enrollment rates bolsters the validity of our findings. It has been estimated that MTM take-up rates have ranged from 10–12% in the Medicare population, which are lower than proportions found in this study, ranging from 14–23%.^[3] Because the MTM programs used an opt-in option for patients during the study period, the higher proportions of individuals eligible for MTM in this study than the actual MTM enrollment rates were expected.^[9] Finally, the analysis included all prescription drugs as opposed to only Part D-covered drugs. However, since previous studies have documented significant racial and ethnic disparities in prescription drug utilizations and expenditures, it seems highly unlikely that inclusion of only Part D-covered drugs would significantly alter the results.^[19–23]

Conclusions

The findings indicate that MTM eligibility criteria may exacerbate existing racial and ethnic disparities in health status and some measures of health services utilizations and costs and medication utilization. Future research should examine strategies to remediate the effects of MTM eligibility criteria on racial and ethnic disparities.

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Table 1
Sociodemographic characteristics across racial and ethnic groups among the Medicare population in 2007–2008

Variables	Groups	Non-Hispanic Whites		Non-Hispanic Blacks		Hispanics	
		No.	%	No.	%	No.	%
Age (Years) *†	65–74	4,702	51.77	451	56.42	435	60.39
	75–84	4,337	34.29	325	32.19	283	27.40
	85	2,122	13.94	154	11.39	157	12.21
Gender	Female	6,149	55.43	579	58.59	485	56.25
	Male	5,012	44.57	351	41.41	390	43.75
Marital Status *†	Not married	4,993	41.88	634	64.57	452	48.84
	Married	6,159	58.12	296	35.43	420	51.16
Education *†	Lower than high school	2,379	24.35	446	49.93	456	56.13
	High School	3,553	39.82	233	30.29	185	25.13
	Higher than high School	3,042	35.82	146	19.78	136	18.74
Poverty Status *†	100% FPL††	988	8.28	320	30.20	291	29.97
	100%–149% FPL	1,447	11.95	168	16.76	187	20.93
	150–199% FPL	1,357	11.57	115	13.48	106	13.12
	200%–300% FPL	2,507	22.18	160	17.91	115	14.13
	Higher than 300% FPL	4,862	46.03	167	21.66	176	21.85
Medicaid *†	No	10,236	92.68	614	70.48	511	61.84
	Yes	925	7.32	316	29.52	364	38.16
U.S. Census Region *†	Northeast	1,966	19.55	158	19.33	94	13.56
	Midwest	2,903	25.23	141	14.85	65	8.05
	South	4,544	38.60	560	57.01	264	33.75
Metropolitan Statistical Area *†	West	1,732	16.62	66	8.81	296	44.64
	No	3,507	28.11	195	17.51	99	8.74
Self-Perceived Health Status *†	Yes	7,638	71.89	732	82.49	774	91.26
	Excellent	1,888	18.78	102	11.62	101	12.68
Good	Very Good	3,539	32.24	213	24.46	216	24.04
	Good	3,498	31.02	336	36.83	299	34.13

Variables	Groups	Non-Hispanic Whites		Non-Hispanic Blacks		Hispanics	
		No.	%	No.	%	No.	%
	Fair	1,589	13.07	200	20.62	205	23.23
	Poor	575	4.89	67	6.46	50	5.93

* $P < 0.05$ for the difference between non-Hispanic Whites (Whites) and non-Hispanic Blacks.

[†] $P < 0.05$ for the difference between Whites and Hispanics.

^{††} FPL = Federal Poverty Level.

Numbers and proportions of individuals eligible for medication therapy management services across racial and ethnic groups in 2007–2008 according to 2010 eligibility criteria

Table 2

Analyses	Number of Drugs	Number of Chronic Conditions	Groups	Number eligible	Number eligible weighted	Proportion eligible (%)
Main Analysis*	5	3	Whites	2,459	8,644,373	19.53
			Blacks	200	674,674	18.06
			Hispanics	173	594,712	16.36
Sensitivity Analysis 1	2	2	Whites	2,907	10,299,559	23.27
			Blacks	235	811,766	21.73
			Hispanics	212	730,942	20.10
Sensitivity Analysis 2*	2	3	Whites	2,504	8,807,423	19.90
			Blacks	203	687,726	18.41
			Hispanics	176	604,857	16.64
Sensitivity Analysis 3	5	2	Whites	2,833	10,025,724	22.65
			Blacks	230	792,668	21.22
			Hispanics	209	720,797	19.82
Sensitivity Analysis 4	8	2	Whites	2,362	8,359,397	18.89
			Blacks	185	631,883	16.92
			Hispanics	179	616,011	16.94
Sensitivity Analysis 5	8	3	Whites	2,113	7,442,804	16.81
			Blacks	169	568,099	15.21
			Hispanics	153	528,172	14.53

* $P < 0.05$ for the difference between Whites and Hispanics.

Table 3
 Racial and ethnic disparities in meeting 2010 eligibility criteria for medication therapy management services based on a logistic regression model (main analysis)*

	Estimate	Standard Error	Wald Chi-Square	P	Odds Ratio (OR)	95% Confidence Interval for Odds Ratio
Intercept	-4.01	0.94	18.00	<.0001	-	-
Non-Hispanic Whites	-	-	-	-	-	-
Non-Hispanic Blacks	-0.49	0.11	21.43	<.0001	0.61	0.50-0.75
Hispanics	-0.44	0.13	11.66	0.0006	0.65	0.50-0.83
Age (Years)	0.01	0.02	0.47	0.4945	1.01	0.98-1.05
Female	-	-	-	-	-	-
Male	-0.33	0.09	15.38	<.0001	0.72	0.61-0.85
Not married	-	-	-	-	-	-
Married	-0.05	0.07	0.45	0.5011	0.95	0.83-1.10
Lower than High School	-	-	-	-	-	-
High School	0.05	0.07	0.55	0.4564	1.06	0.92-1.22
Higher than High School	0.05	0.09	0.25	0.619	1.05	0.87-1.25
100% FPL	-	-	-	-	-	-
100%-149% FPL [†]	0.03	0.12	0.04	0.834	1.03	0.81-1.30
150-199% FPL	-0.12	0.10	1.28	0.2571	0.89	0.72-1.09
200%-300% FPL	0.22	0.12	3.20	0.0737	1.25	0.98-1.59
Higher than 300% FPL	0.22	0.13	3.00	0.0831	1.25	0.97-1.61
Non-Medicaid	-	-	-	-	-	-
Medicaid	0.56	0.17	10.36	0.0013	1.75	1.25-2.46
Northeast	-	-	-	-	-	-
Midwest	0.04	0.09	0.17	0.6814	1.04	0.87-1.25
South	0.12	0.09	1.55	0.2134	1.13	0.94-1.35
West	-0.33	0.09	12.37	0.0004	0.72	0.60-0.86
Non-MSA ^{††}	-	-	-	-	-	-
MSA	-0.15	0.08	3.76	0.0524	0.87	0.75-1.00
Excellent Self-Perceived Health Status	-	-	-	-	-	-

	Estimate	Standard Error	Wald Chi-Square	P	Odds Ratio (OR)	95% Confidence Interval for Odds Ratio
Very Good Self-Perceived Health Status	0.86	0.11	66.95	<.0001	2.36	1.92–2.90
Good Self-Perceived Health Status	1.51	0.11	203.79	<.0001	4.52	3.67–5.56
Fair Self-Perceived Health Status	2.18	0.11	375.19	<.0001	8.88	7.12–11.07
Poor Self-Perceived Health Status	2.31	0.12	360.33	<.0001	10.05	7.92–12.76
Risk Adjustment Summary Score	0.78	0.93	0.71	0.3982	2.19	0.36–13.43

* Eligibility thresholds examined: 5 drugs, 3 chronic conditions, and \$3,000 in drug costs. Wald's statistic: 1159.44 ($P<0.0001$).

[†]FPL=Federal Poverty Level.

^{††}MSA=Metropolitan Statistical Area.

Descriptive results for outcomes across racial and ethnic groups for the MTM-eligible and MTM-eligible beneficiaries based on 2010 eligibility criteria (main analysis)*

Table 4

Variables	MTM Eligibility	Whites	Blacks	Hispanics	Whites-Blacks	Whites-Hispanics
<i>Health Status</i>						
Self-Perceived Good Health Status [§]	MTM-Ineligible	85.45%	76.39%	74.64%	9.06%	10.81%
	MTM-Eligible	62.91%	51.01%	54.91%	11.90%	8.00%
Number of Chronic diseases	MTM-Ineligible	2.67	2.56	2.13	0.11	0.54
	MTM-Eligible	5.06	4.74	4.82	0.32	0.24
Number of Activities of Daily Living	MTM-Ineligible	0.47	0.66	0.81	-0.19	-0.34
	MTM-Eligible	0.99	1.42	1.42	-0.43	-0.42
Number of Instrumental Activities of Daily Living	MTM-Ineligible	0.63	0.97	1.02	-0.33	-0.39
	MTM-Eligible	1.37	1.96	1.83	-0.59	-0.46
<i>Health Services Utilization and Costs</i>						
Number of ER Visits [†]	MTM-Ineligible	0.13	0.12	0.12	0.02	0.01
	MTM-Eligible	0.29	0.36	0.26	-0.07	0.03
ER Costs	MTM-Ineligible	75.20	107.62	43.10	-32.43	32.10
	MTM-Eligible	146.57	191.39	81.21	-44.82	65.37
Number of Physician Visits	MTM-Ineligible	23.43	19.27	17.45	4.16	5.98
	MTM-Eligible	47.56	41.19	46.10	6.38	1.46
Costs of Physicians Visits	MTM-Ineligible	3260.38	2448.71	2780.17	811.67	480.21
	MTM-Eligible	6284.35	5370.91	5678.84	913.44	605.51
Number of Hospitalization	MTM-Ineligible	0.25	0.28	0.20	-0.03	0.04
	MTM-Eligible	0.61	0.59	0.56	0.03	0.05
Hospitalization Costs	MTM-Ineligible	2470.64	3543.45	2206.22	-1072.81	264.42
	MTM-Eligible	5747.36	5543.77	5879.96	203.59	-132.60
Total Costs	MTM-Ineligible	9692.42	9467.63	8081.35	224.79	1611.07
	MTM-Eligible	22124.96	20634.11	23572.98	1490.85	-1448.02
<i>Medication Utilization Patterns</i>						

Variables	MTM Eligibility	Whites	Blacks	Hispanics	Whites-Blacks	Whites-Hispanics
Two or More High Risk Medications	MTM-Ineligible	3.38%	2.60%	1.57%	-2.18% ¶	1.81% ¶
	MTM-Eligible	8.78%	8.00%	5.78%	0.78%	3.00% ¶
Generic Dispensing Ratio	MTM-Ineligible	0.49	0.48	0.44	0.01	0.04 ¶
	MTM-Eligible	0.48	0.50	0.44	-0.02	0.05

* Eligibility thresholds examined: 5 drugs, 3 chronic conditions, and \$3,000 in drug costs.

§ $P < 0.05$ for the difference in differences when comparing racial disparities among individuals ineligible for medication therapy management (MTM) services to racial disparities among individuals eligible for MTM services.

¶ $P < 0.05$.

‡ ER=Emergency Room

Table 5

Interaction effects between racial and ethnic groups and eligibility status for medication therapy management services based on 2010 eligibility criteria (adjusted model for main analysis)*

Comparison Groups	Variables	Multiplicative Effects			Marginal Effects			
		β^e	Exp(β) [‡]	P	β^e	DID [¶]	P	
Whites & Blacks	<u>Health Status</u>							
		Self-Perceived Good Health Status	0.07	1.07	0.77	1.94	<0.01	
		Number of Chronic Conditions	-0.01	0.99	0.87	-0.22	0.19	
		Number of ADLs	0.37	1.45	0.03	0.62	0.03	
		Number of IADLs	0.26	1.29	0.09	0.62	0.03	
Whites & Blacks	<u>Health Services Utilization and Costs</u>							
		Number of ER Visits [†]	0.52	1.67	0.02	0.12	0.03	
		ER Costs	0.66	1.93	0.12	100.11	0.27	
		Number of Physician Visits	0.08	1.09	0.43	-4.27	0.24	
		Costs of Physician Visits	0.11	1.11	0.40	-890.83	0.09	
		Number of Hospitalizations	0.08	1.08	0.70	-0.07	0.52	
		Hospitalization Costs	-0.14	0.87	0.68	-1488.28	0.41	
		Total Costs	0.12	1.12	0.42	-1298.09	0.61	
		<u>Medication Utilization Patterns</u>						
		Two or More High Risk Medications	0.21	1.24	0.55	-0.02	0.47	
	Generic Dispensing Ratio	0.05	--	0.09	--	--		
Whites & Blacks	<u>Medication Utilization Patterns</u>							
		Two or More High Risk Medications	0.21	1.24	0.55	-0.02	0.47	
	Generic Dispensing Ratio	0.05	--	0.09	--	--		
Comparison Groups	Variables	Multiplicative Effects			Marginal Effects			
		β^e	Exp(β) [‡]	P	β^e	DID [¶]	P	
Whites & Hispanics	<u>Health Status</u>							
		Self-perceived Good Health Status	0.55	1.74	0.06	2.86	<0.01	
		Number of Chronic Conditions	0.14	1.15	0.01	0.26	0.14	
		Number of ADLs	-0.31	0.73	0.10	-0.08	0.75	
	Number of IADLs	-0.14	0.87	0.35	0.04	0.86		

Health Services Utilization and Costs

Number of ER Visits [†]	0.18	1.19	0.49	0.02	0.73
ER Costs	0.23	1.25	0.63	-21.21	0.64
Number of Physician Visits	0.33	1.40	<0.01	4.43	0.27
Costs of Physician Visits	0.37	1.45	0.02	404.55	0.56
Number of Hospitalizations	0.43	1.54	0.11	0.01	0.93
Hospitalization Costs	0.20	1.22	0.62	-288.72	0.88
Total Costs	0.37	1.45	0.02	2875.17	0.33
<u>Medication Utilization Patterns</u>					
Two or More High Risk Medications	0.26	1.30	0.55	-0.02	0.29
Generic Dispensing Ratio	0.02	--	0.58	--	--

* Eligibility thresholds examined: 5 drugs, 3 chronic conditions, and \$3,000 in drug costs.

[†] Difference in differences: (Whites-Blacks) among the ineligible individuals-(Whites-Blacks) among the eligible individuals.

[€] β =Coefficient estimate.

[¥] Exp(β)=Exponent of the coefficient estimate.

[‡] ER=Emergency room

--: Not applicable.