

Does Medicare Managed Care Reduce Racial/Ethnic Disparities in Diabetes Preventive Care and Healthcare Expenditures?

Elham Mahmoudi, PhD; Wassim Tarraf, PhD; Brianna L. Maroukis, BS; and Helen G. Levy, PhD

Disparities in healthcare are a persistent national problem, and reducing them has been the goal of various national healthcare policies for decades.^{1,2} In particular, racial/ethnic disparity in diabetes care is coupled with a rapid increase in the prevalence of this illness among older minorities.³ Between 1994 and 2001, there was a 37% increase in the number of individuals 67 years or older who were diagnosed with diabetes, with the highest rates among minorities.⁴ If their health is not properly managed, individuals with diabetes are at risk of serious and costly adverse events.^{3,5} Additionally, minority groups report lower rates of recommended preventive health services for diabetes, such as influenza vaccinations⁶ and cholesterol screenings.⁷

Over the past 20 years, managed care plans have rapidly increased in size and influence, mainly as solutions to enduring problems of quality and cost in US healthcare.⁸ Similarly, Medicare Managed Care (MMC) plans were intended to address these issues by providing lower costs and better quality care for beneficiaries.⁹ Evidence is mixed on whether MMC plans have consistently achieved these goals.⁹ We have summarized some of the main differences between traditional Medicare fee-for-service (MFFS) and MMC plans in **eAppendix A** (eAppendices available at www.ajmc.com).¹⁰⁻¹² Certain characteristics of MMC plans—including having a mandatory primary care physician; offering more preventive services, such as eye exams; and capping out-of-pocket (OOP) spending—may reduce disparities in quality of care by making valuable services more accessible to vulnerable populations.^{9,12} Diabetes-specific preventive care, diabetes screening, and self-management training are covered under both MFFS and MMC plans. MMC plans, however, cap OOP spending, usually have lower deductible rates than MFFS plans, and charge co-pays (fixed amounts) instead of coinsurance (percentages).^{10,11} On the other hand, by applying gate-keeping policies, MMC plans might worsen access to care among racial/ethnic minorities by restricting their access to providers who might be geographically closer or linguistically or culturally more trusted.¹³ Whether enrollment into MMC versus traditional MFFS would worsen or

ABSTRACT

OBJECTIVES: Large and persistent racial/ethnic disparities exist in diabetes care. Considering the rapid rate of growth of Medicare Managed Care (MMC) plans among minority populations, our aim was to investigate whether disparities in diabetes management and healthcare expenditures are smaller in MMC versus Medicare fee-for-service (MFFS) plans. We hypothesized that racial/ethnic disparities in diabetes care and in health expenditures would be less pronounced in MMC compared with MFFS plans.

STUDY DESIGN: Nationally representative data from the 2006 to 2011 Medical Expenditure Panel Survey on white, African American, and Hispanic seniors with diabetes were analyzed.

METHODS: We examined 4 measures of diabetes care—regular foot check, eye exam, cholesterol check, and flu vaccine—and total and out-of-pocket (OOP) healthcare expenditures. We implemented the Institute of Medicine's definition of disparity, applied propensity score weighting to adjust for potential differential selection, and used a difference-in-differences generalized linear framework to estimate outcome measures.

RESULTS: For African Americans, MMC was associated with a \$1183 ($P < .036$) reduction and a \$547 ($P < .001$) increase in disparities in total and OOP healthcare expenditures, respectively. For Hispanics, disparities in foot exam, flu shot, and cholesterol check decreased by 5, 10, and 7 percentage points ($P < .001$); additionally, disparities in total and OOP healthcare expenditures were reduced by \$3588 and \$276 ($P < .001$), respectively. MMC plans spend less on everyone, including whites.

CONCLUSIONS: Hispanic/white disparities in diabetes management and healthcare expenditures were smaller in MMC than in MFFS plans. African American/white disparities were not consistently larger in 1 setting than the other.

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ameliorate racial/ethnic disparities in access to diabetes care is not known.

Additionally, research indicates the possibility of nonrandom selection into MMC by: a) differential selection by health and geographic location¹⁴ and/or b) differential selection by race/ethnicity.¹⁴ There is a possibility that beneficiaries with lower incomes and less education (mostly minorities) choose MMC plans mainly because of lower OOP costs, not because of higher levels of care received. Considering the literature on the existence of selection bias towards healthier individuals (with lower risks) among MMC plans,¹⁴ chronically ill minorities may be worse off in MMC plans compared with nonrestricted, traditional MFFS.¹⁵

Using a nationally representative sample of Medicare beneficiaries diagnosed with diabetes, our specific aims were to: a) examine differences in racial/ethnic disparities between MMC and MFFS enrollees in 4 American Diabetes Association-recommended measures of diabetes management, and b) assess differences between MMC and MFFS in annual total and OOP healthcare expenditures. We hypothesized that MMC plans would reduce racial/ethnic disparities in diabetes management.

METHODS

Data

We used the Household Component files of the 2006 to 2011 Medical Expenditure Panel Survey (MEPS).¹⁶ The MEPS is a nationally representative survey of the US noninstitutionalized population.¹⁷ The Agency for Healthcare Research and Quality (AHRQ) conducts the survey and verifies the survey information. We limited our analysis to Medicare beneficiaries 65 years or older who reported being diagnosed with diabetes and reported being (non-Hispanic) African American, Hispanic, or (non-Hispanic) white. Our sample included 3735 individuals (MMC = 1235; MFFS = 2500) (Figure 1). Although the variable-specific nonresponse rate was less than 3%, without the imputation of missing values, we would have lost 13% of the initial sample size in our regression models. Thus, we used a multiple imputation technique (with 5 complete sets) to estimate missing values for independent variables.^{18,19}

Dependent Variables

We used a total of 6 dependent variables. We examined diabetes management across 4 domains during the year: 1) whether feet were checked for sores, 2) whether individuals had a dilated eye exam, 3) whether individuals had their cholesterol checked, and 4) whether individuals had a flu vaccination. Additionally, we examined annual total and OOP healthcare expenditures. Dollar values were inflated, using the 2013 all-items Consumer Price Index.

TAKE-AWAY POINTS

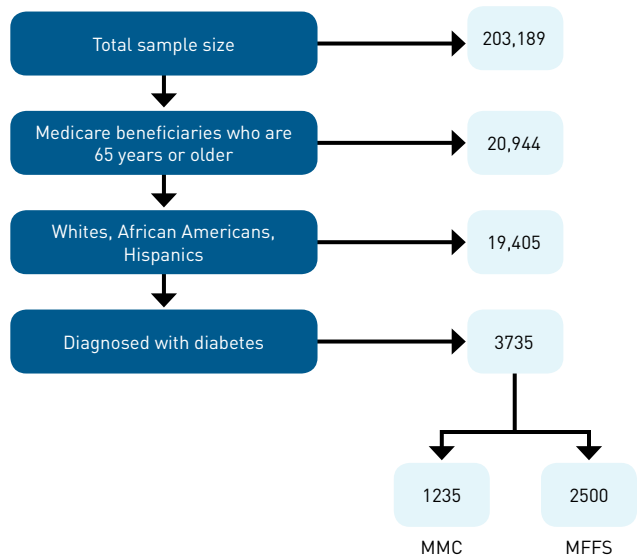
Disparities in care and rising healthcare costs continue to plague our healthcare system. Our study indicates that:

- ▶ Compared with fee-for-service, Medicare managed care (MMC) spent less on every patient, regardless of race/ethnicity and had substantially reduced Hispanic/white disparities in diabetes care.
- ▶ MMC had mixed effects on African American/white disparities, which may be explained by the degree of market penetration and geographic variations of MMC plans.
- ▶ Promoting some MMC strategies—for instance, incentivizing the use of preventative services, promoting organized outreach programs, mandating a primary care provider, and monitoring patients with chronic conditions—may reduce racial/ethnic disparities in diabetes care and lower healthcare expenditures.

Independent Variables

In addition to race/ethnicity, sociodemographic variables including age, sex, marital status, location based on 4 US Census regions, and living in a metropolitan statistical area were obtained at the time of survey completion. Education was measured using a 4-category variable (less than high school, high school, college degree, or other professional degree) with high school degree set as the reference category. Household income was measured based on percentage relative to the federal poverty level (FPL), using 5 mutually exclusive categories (poor or <100% of the FPL; near poor or 100%-125% of the FPL; low or 125%-199% of the FPL; middle or 200%-399% of the FPL; and high or ≥400% of the FPL), with the middle-income group

FIGURE 1. Schematic Flow Diagram of Sample Selection^a



MFFS indicates Medicare fee-for-service; MMC, Medicare Managed Care.

^aMultiple imputation performed to impute missing values among independent variables.

Source: The Household Component files of the 2006 to 2011 Medical Expenditure Panel Survey.¹⁶

serving as the reference category. For health insurance, we included 2 variables that measured whether an individual reported being enrolled in: a) MMC (vs MFFS) and b) whether an individual reported being enrolled in Medicaid (dual eligible). All individuals in our sample reported being enrolled in Medicare. For health-related variables, we accounted for 2 measures of self-rated physical and mental health, coded as “fair” or “poor” versus “good,” “very good,” or “excellent.” We also controlled for 4 reported chronic conditions: asthma, high blood pressure, any heart problems, and arthritis. Finally, we adjusted for whether an individual reported having a usual source of care. We checked for multicollinearity among our independent variables and did not find any strong correlations.

Statistical Analysis

First, we used propensity score weighting (PSW) to adjust for any potential selection bias into MMC versus MFFS. We used all independent variables (listed in [Table 1](#)) to estimate an inverse probability of treatment weighting; we then generated “synthetic” MMC and MFFS Medicare groups with distributional equivalence.²⁰ Second, we applied the Institute of Medicine (IOM) conceptual framework in our analysis. In its 2002 report, *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*, the IOM defines disparity as “a difference in access or treatment provided to members of different racial or ethnic groups that is not justified by the underlying health conditions or treatment preferences of patients.”²¹

Quantifying the IOM Definition of Racial/Ethnic Disparities

In order to implement the IOM definition of a racial/ethnic disparity, we applied the rank-and-replace techniques recommended by Cook and colleagues.²² A full discussion of the rank-and-replace method has been described in detail elsewhere.²³⁻²⁵ Briefly, we applied a 4-step method to estimate the IOM disparities. First, we ran a multivariable difference-in-differences regression model for each of our outcome variables ([eAppendices B and C](#)). For all 4 dichotomous diabetes management measures, we used logistic regression models. For the continuous spending measures, we used generalized linear regression models.²⁶ First, we applied the rank-and-replacement method to replace minorities' health distributions with those of whites. To do so, we created a health index for each white and minority individual based on the sum of multiplications of the health variables' coefficients and the actual health values in regression models described in step 1. Second, we ranked the health index values for whites and minorities, separately. Third, we replaced the proportionately ranked values of whites with those of minorities. Finally, using the original fitted regression models from step 1 and transformed health index values of minorities from step 3, we predicted the counterfactual outcome values for minorities and real values for whites.²³ The differences in predicted averages between racial/ethnic groups were calculated within MMC and MFFS groups. Standard errors of all estimated measures were

calculated using bootstrapping techniques applied in the context of complex survey design (replicated 100 times with replacement).²⁷ We describe the IOM method in detail in [eAppendix D](#).

We used Stata version 13 (StataCorp LP, College Station, Texas) for all analyses and adjusted for the clustered and stratified complex survey design of the MEPS.²⁸ We weighted all estimates using the AHRQ-supplied and propensity score-adjusted diabetes weights.²⁸

RESULTS

Table 1 reports the population characteristics of Medicare patients diagnosed with diabetes stratified by race and insurance type. Compared with whites, among both MFFS and MMC enrollees, certain characteristics persist: a) African Americans had a higher proportion of female enrollees and a lower rate of being married, b) African Americans and Hispanics had lower incomes and were less educated, c) African Americans and Hispanics had higher prevalence of hypertension and lower prevalence of stroke (Hispanics only) and emphysema, and d) significant geographic variation exists among minorities between MMC and MFFS. For example, in the West, MMC had greater penetration than MFFS among whites (29% compared with 13%; $P < .001$) and Hispanics (44% compared with 34%; $P = .008$). In contrast, in the South, MFFS had greater penetration than MMC among all population groups. Additionally, regardless of race, more MMC enrollees (by 13 percentage points; $P < .001$) live in large metropolitan areas compared with MFFS enrollees. To summarize, although there are differences within racial/ethnic groups between those enrolled in MMC and those enrolled in MFFS, the data did not present a clear pattern on differential selection based on race/ethnicity into MMC.

[Figure 2](#) shows the unadjusted averages for utilization rates of diabetes management, and OOP and total healthcare costs, stratified by race/ethnicity and enrollment in MMC versus MFFS. In the context of white/African American differences, rates of flu shot, cholesterol check, and dilated eye exam were 12, 4, and 5 percentage points higher for whites than African Americans enrolled in MFFS, respectively. For MMC enrollees, the prevalence of getting a flu shot was 15 percentage points higher for whites than African Americans. In the context of white/Hispanic differences, the rate of flu shots was higher by 11 percentage points among white MFFS enrollees than Hispanics. For MMC enrollees, the rate of eye exams was 10 percentage points higher for whites than Hispanics. Both minority groups enrolled in MMC and MFFS had lower OOP costs than whites, with no significant difference in total healthcare cost by race/ethnicity.

Additional differences in outcomes across groups emerge once we adjust statistically for the differences in enrollees' other characteristics, as described earlier. [Figure 3](#) shows the adjusted predicted probabilities for utilization rates of diabetes management and predicted averages for total and OOP healthcare expenditures by race/ethnicity and type of insurance (applying PSW and the IOM defini-

TABLE 1. Characteristics of Medicare Beneficiaries With Diabetes, 65 Years or Older, Stratified by Health Insurance and Race/Ethnicity (2006-2011)

	Fee-for-Service (%)						Medicare Managed Care (%)					
	White		African American		Hispanic		White		African American		Hispanic	
N = 3735	1501		611		388		614		329		292	
Explanatory Variables^a	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Age, years	74	0.23	73	0.35	73	0.42	74	0.38	73	0.42	73 ^b	0.49
Female	49	0.02	63 ^b	0.03	56	0.04	53	0.02	73 ^b	0.03	55	0.04
Married	59	0.02	35 ^b	0.03	49 ^b	0.04	54	0.03	34 ^b	0.04	53	0.04
Education												
Less than high school	22	0.01	42 ^b	0.03	71 ^b	0.04	18	0.02	47 ^b	0.04	65 ^b	0.04
High school	54	0.02	43 ^b	0.03	19 ^b	0.03	58	0.02	41 ^b	0.04	22 ^b	0.03
College degree	19	0.02	12 ^b	0.02	6 ^b	0.02	17	0.02	7 ^b	0.02	10 ^b	0.03
Other degree	6	0.01	3	0.01	4	0.01	7	0.01	6	0.02	3	0.02
Family income												
Poor	9	0.01	22 ^b	0.02	26 ^b	0.04	6	0.01	16 ^b	0.02	13 ^b	0.03
Near poor	6	0.01	9 ^b	0.01	11 ^b	0.02	6	0.01	14 ^b	0.02	14 ^b	0.02
Low income	15	0.01	26 ^b	0.02	25 ^b	0.03	22	0.02	29 ^b	0.03	26	0.03
Middle income	34	0.02	25 ^b	0.02	28	0.04	36	0.02	27 ^b	0.03	32	0.03
High income	37	0.02	18 ^b	0.02	10 ^b	0.03	30	0.02	14 ^b	0.03	15 ^b	0.03
Medicaid	5	0.01	23 ^b	0.02	46 ^b	0.05	4	0.01	19 ^b	0.03	29 ^b	0.04
Health status												
Good health	67	0.02	63	0.02	49 ^b	0.04	70	0.02	62 ^b	0.03	54 ^b	0.04
Good mental health	87	0.01	84	0.02	81 ^b	0.02	89	0.02	83	0.03	79 ^b	0.03
Chronic conditions												
Asthma	11	0.01	11	0.02	10	0.02	13	0.02	14	0.02	10	0.03
High blood pressure	84	0.01	94 ^b	0.01	82	0.03	84	0.02	95 ^b	0.01	84	0.03
Any heart problem	50	0.02	39 ^b	0.02	42 ^b	0.04	49	0.03	42	0.04	40	0.04
Arthritis	64	0.02	66	0.03	60	0.04	65	0.03	70	0.03	61	0.04
Region												
Northeast	20	0.02	14 ^b	0.03	18	0.03	19	0.02	20	0.04	14	0.03
Midwest	28	0.02	20 ^b	0.03	6 ^b	0.02	20	0.02	19	0.04	5 ^b	0.02
West	13	0.02	6 ^b	0.01	34 ^b	0.04	29	0.03	8 ^b	0.03	44 ^b	0.05
South	39	0.02	59 ^b	0.04	42	0.05	32	0.03	53 ^b	0.05	37	0.05
MSA	73	0.03	84 ^b	0.03	87 ^b	0.03	86	0.02	89	0.02	95 ^b	0.02
English-speaking	100	0.00	100 ^b	0.00	44 ^b	0.06	100	0.00	100	0.00	51 ^b	0.05

MSA indicates metropolitan statistical area; SE, standard error.

^aThe variables listed are the explanatory variables in the estimated regression models, presented in the eAppendix.

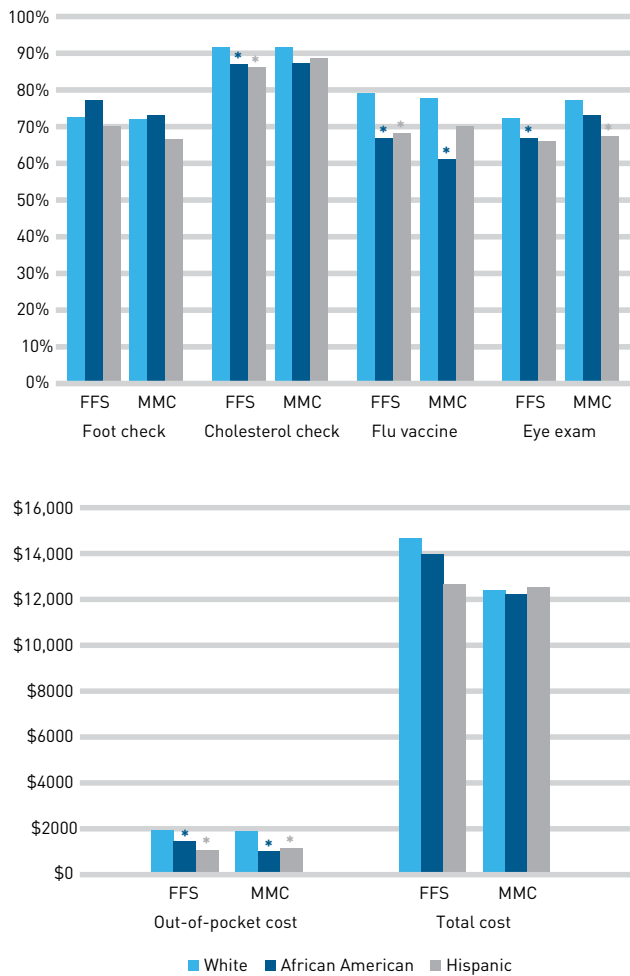
^bThe mean significantly differs between individuals with fee-for-service and individuals with Medicare Managed Care at the alpha = .05 level.

Source: The Household Component files of the 2006 to 2011 Medical Expenditure Panel Survey.¹⁶

tion of disparities—see eAppendices B and C). In MFFS, African American enrollees were 4 percentage points more likely to report a foot exam than white enrollees. However, African American MFFS enrollees were less likely to use the other 3 diabetes management tests compared with white MFFS enrollees. Disparities in flu shots, cholesterol checks, and eye exams were estimated to be 11, 6, and 7 percentage points ($P < .001$ for all), respectively. Additionally, Afri-

can American MFFS enrollees spent \$1176 and \$483 less in total and OOP on healthcare compared with white MFFS enrollees. Among MMC enrollees, we found that African Americans had flu shot, cholesterol check, and eye examination rates that were respectively 12, 5, and 5 percentage points ($P < .001$) lower than those of whites. As with MFFS enrollees, African Americans had higher rates of foot examinations than did whites ($P < .05$). Although there was no

FIGURE 2. Unadjusted Average of Diabetes Management Utilization Rates and Out-of-Pocket and Total Healthcare Costs, Stratified by Race/Ethnicity and Insurance^{a,b}

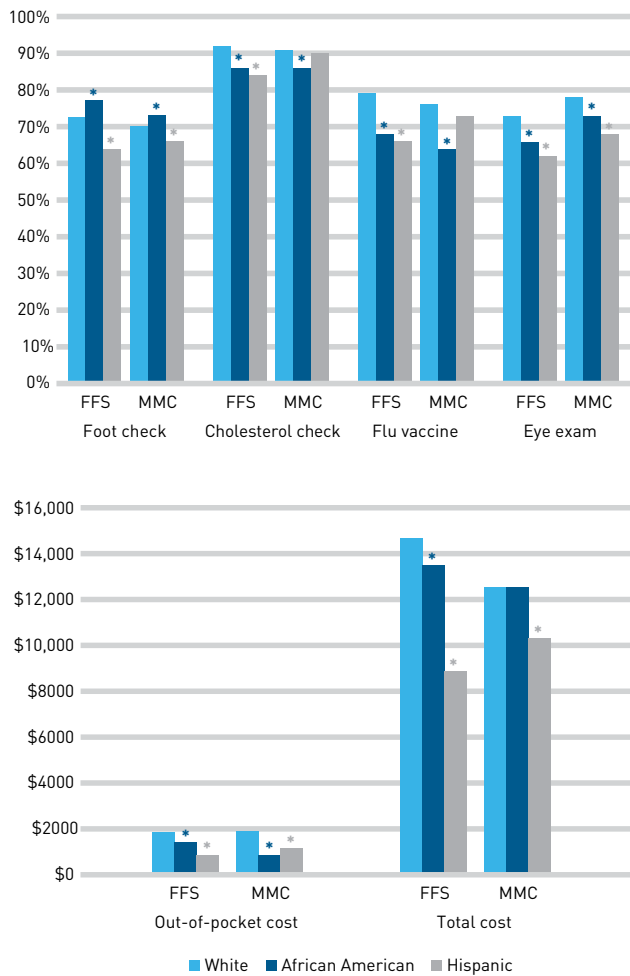


MFFS indicates Medicare fee-for-service; MMC, Medicare Managed Care.
^aEstimates are based on unadjusted average for white, African American, and Hispanic patients with diabetes, 65 years or older, who enrolled in Medicare MFFS or MMC.
^b*** indicates significantly different from whites at the alpha = 0.05 level.
 Source: The Household Component files of the 2006 to 2011 Medical Expenditure Panel Survey.¹⁶

disparity between whites and African Americans in total healthcare expenditure, African Americans paid \$1030 less OOP ($P < .001$).

White/Hispanic comparisons showed that Hispanics in MFFS had rates of foot examinations, flu shots, cholesterol checks, and eye examinations that were, respectively, 9, 13, 8, and 11 percentage points lower than those of their white counterparts ($P < .001$ for all). Additionally, Hispanic MFFS enrollees spent \$5815 and \$1013 less than white enrollees in total and OOP healthcare expenditures, respectively ($P < .001$). We also found differences between white and Hispanic MMC enrollees in rates of foot exams, flu shots, and eye examinations: 4,

FIGURE 3. Predicted Adjusted Average of Diabetes Management Utilization Rates and Out-of-Pocket and Total Healthcare Costs, Stratified by Race/Ethnicity and Insurance^{a,b}



MFFS indicates Medicare fee-for-service; MMC, Medicare Managed Care.
^aEstimates were based on adjusted average for white, African American, and Hispanic patients with diabetes, 65 years or older, who enrolled in Medicare MFFS or MMC.
^b*** indicates significantly different from whites at the alpha = 0.05 level.
 Source: The Household Component files of the 2006 to 2011 Medical Expenditure Panel Survey.¹⁶

3, and 10 percentage points, respectively, with whites having a higher probability of using the services ($P < .001$). White and Hispanic MMC enrollees did not differ in their adherence to cholesterol checks. Additionally, Hispanics spent \$2227 and \$737 less than white enrollees in total and OOP healthcare expenditures, respectively ($P < .001$).

In Table 2 we compare the adjusted estimated racial/ethnic disparities in diabetes management and healthcare costs. The disparity values represent absolute differences between minority groups and whites (calculated by deducting average adjusted predictive values for whites from average adjusted predictive values for minorities).

Negative values indicate lower use of services or lower healthcare expenditures for minorities. For African Americans, enrollment in MMC did not have any effects on disparities in utilization of the 4 screening services. On the expenditures end, due to lower OOP payments among African Americans enrolled in MMC, white/African American disparity in OOP spending was higher by \$547 among MMC enrollees.

Compared with MFFS enrollees, white/Hispanic disparities in foot exams, flu shots, and cholesterol checks among MMC enrollees were lower by 5 ($P < .05$), 10 ($P < .001$), and 7 ($P < .001$) percentage points, respectively. Additionally, white/Hispanic disparities in OOP and total costs were lower by \$3588 and \$276, respectively, among MMC enrollees compared with MFFS enrollees. In summary, white/African American disparities in healthcare costs among MMC enrollees compared with MFFS enrollees were mixed; however, white/Hispanic disparities among MMC enrollees compared with MFFS enrollees were substantially lower.

Sensitivity Analysis

As a sensitivity analysis (eAppendix E), we compared our methods, using the IOM measure of disparity and applying PSW, with 4 other methods: 1) unadjusted average, 2) regression adjusted, 3) regression adjusted using PSW, and 4) using the IOM measure of disparity without applying PSW. When we used basic regressions and PSW adjusted regressions, the 2 models respectively showed \$638 and \$631 increases, respectively, in white/African American disparity in OOP costs among MMC enrollees compared with MFFS enrollees. Applying the IOM definition without PSW between MMC and MFFS enrollees showed that white/African American disparities in probability of foot exam and in OOP cost were higher among MMC enrollees by 3 percentage points and by \$493, respectively; disparity in total healthcare cost, however, was lower among MMC enrollees by \$1024.

For white/Hispanic disparities, using the IOM approach without applying PSW indicates a decrease in disparities among MMC enrollees compared with MFFS enrollees in receiving flu shots and cholesterol checks by 9 and 5 percentage points, and OOP and total healthcare costs by \$196 and \$3296, respectively.

Finally, because the greatest urgency for cholesterol screening is among patients with existing cardiovascular disease (CVD), we examined the probability of cholesterol tests among diabetes patients with strokes, blood pressure, or any heart problems. Among individuals 65 years or older, about 90% of diabetes patients reported

having CVD. Thus, the predicted probabilities of cholesterol tests, stratified by race/ethnicity and MMC enrollment, were not statistically different from our findings, using the complete sample.

DISCUSSION

We examined the effect of enrollment in MMC versus MFFS among white, African American, and Hispanic Medicare beneficiaries who reported having diabetes on 4 measures of diabetes management and on healthcare expenditures. Our findings indicate that white/Hispanic disparities in diabetes management were lower among MMC enrollees compared with MFFS enrollees more consistently than were white/African American disparities. Second, disparities in total healthcare spending between both minority populations and whites were lower among MMC enrollees.

MMC plans are attractive to minorities in the United States as they provide financially reasonable alternatives for beneficiaries with lower incomes and fewer financial resources.²⁹ However, not all MMC plans are equal regarding the financial accessibility and

TABLE 2. Adjusted Predicted Disparities^a Between Minorities and Whites in Diabetes Management and Healthcare Expenditures

	Foot Exam (%)	Flu Shot (%)	Cholesterol Check (%)	Eye Exam (%)	Total Cost (\$)	OOP Cost (\$)
MFFS^b						
White	73	79	92	73	14,721	1867
African American	77	68	86	66	13,545	1384
Hispanic	64	66	84	62	8906	854
African American vs white	4 ^c	-11 ^c	-6 ^c	-7 ^c	-1176 ^c	-483 ^c
Hispanic vs white	-9 ^c	-13 ^c	-8 ^c	-11 ^c	-5815 ^c	-1013 ^c
MMC^d						
White	70	76	91	78	12,563	1889
African American	73	64	86	73	12,570	859
Hispanic	66	73	90	68	10,336	1152
African American vs white	3 ^c	-12 ^c	-5 ^c	-5 ^c	7	-1030 ^c
Hispanic vs white	-4 ^c	-3	-1	-10 ^c	-2227 ^c	-737 ^c
Effect of MMC on disparity:						
African American vs white	-1	-1	1	2	1183 ^c	-547 ^c
Hispanic vs white	5 ^c	10 ^c	7 ^c	1	3588 ^c	276 ^c
N ^e	3631	3658	3646	3660	3735	3735

MFFS indicates Medicare fee-for-service; MMC, Medicare Managed Care; OOP, out-of-pocket.

^aDisparity measures are calculated by deducting adjusted predicted average of the outcome variable (eg, foot examination) for whites from adjusted predicted average of the same variable for minorities. Thus, a negative value indicates overuse of the service (or extra expenditure) by whites compared with minorities. A positive value indicates overuse of the service (or extra expenditure) by minorities compared with whites.

^bSample of MFFS consists of individuals, 65 years or older, who reported being enrolled in Medicare fee-for-service.

^cSignificant at the alpha = 0.05 level.

^dSample of MMC consists of individuals, 65 years or older, who reported being enrolled in MMC.

^eWe used the inverse probability weight (balancing weights) in our propensity score weighting method. Therefore, our sample sizes were the same in all models.

Source: The Household Component files of the 2006-2011 Medical Expenditure Panel Survey.¹⁶

range of benefits they provide.³⁰ In areas with higher MMC penetration rates, and therefore higher competition among MMC plans, the financial barriers for enrollment are lower and better benefits are offered.²⁹ In that regard, regional variation in MMC plans tends to favor Hispanic population. More than 64% of all MMC plans are concentrated in the South and the West, where the density of the Hispanic population is relatively higher than that of other minority groups in the United States.³¹ As such, the breadth of coverage, more streamlined services, and enhanced quality of care provided by plans offered in regions with heavy Hispanic populations could have contributed to the more consistent reduction in Hispanic/white disparities in diabetes management care.

Smaller disparities in healthcare spending in MMC may be driven by the fact that MMC plans spend less on everyone—including whites—than do MFFS plans. MMC enrollment had largely muted effects on health spending among Hispanics. Previous research shows that Hispanics spend less on healthcare compared with other groups.³² Socioeconomic and cultural factors could have also contributed to these findings.³³ Older Latinos are more likely to reside in more socially cohesive enclaves with strong networks of family and friends. These networks can mitigate the need for extensive use of medical resources (eg, institutional care vs home care) and can potentially lead to similarity in levels of health spending among Latino respondents, regardless of coverage type.³⁴ As such, our findings that MMC enrollment had minimal effects on reducing healthcare expenditures in this group falls within the purview of a larger body of literature on Latino health and healthcare.³⁵

MMC had mixed association with white/African American disparities in healthcare expenditures, with no effect on disparities in diabetes management. African Americans do not live in highly penetrated MMC areas, and it is plausible that the insurance market was not as competitive as in areas with higher MMC penetration. Most often, African Americans purchase low-performance insurance plans.³⁶ Previous research indicates that for some measures of quality of care, about half of African American/white disparities were related to differences between insurance plans.³⁶ These disparities can be due to low-performance insurance plans and/or due to financial and transportation barriers in accessing quality care.

Compared with MFFS, total healthcare costs were lower for both whites and African American MMC enrollees, and lower OOP spending was particularly more pronounced among African Americans. Research suggests that minorities are more likely to enroll in MMC due to lower OOP costs.¹³ Over half of Medicare beneficiaries who are enrolled in MMC specify listed lower costs (31%) or better benefits (21%) as their number 1 reason for switching to MMC.³⁷

Limitations

This study had a few limitations. First, there was no information regarding different MMC plans and their penetration rates in the MEPS. Other studies have found that required co-payments and benefits

offered by MMC plans vary from one market to another. Additionally, high penetration of MMC in a market may also affect what is offered by a traditional MFFS plan in that market.¹⁴ Second, we were not able to control for the effects of individual preferences/lifestyle on diabetes management. Previous studies show that individual preferences and sociocultural determinants of health are important contributing factors to racial/ethnic disparities in access to care.³⁸

CONCLUSIONS

Racial/ethnic disparities in quality of diabetes care are associated with adverse health events among minority populations.³⁹ For example, research suggests low rates of eye exams among patients with diabetes corresponds with high rates of severe retina problems.⁴⁰ Adverse diabetes health events create long-term clinical and financial burdens for individuals and society.⁴¹ It is important to incentivize delivery of preventive services, particularly among minority populations with diabetes, who are at a higher risk of adverse events. Research shows that these efforts can be successful in decreasing risks of complication and, therefore, long-term costs associated with diabetes.⁴² Although disparity in management of diabetes care is a multifaceted issue associated with health literacy, financial barriers,³⁰ transportation,⁴³ and cultural preferences, some characteristics of MMC plans may ameliorate racial/ethnic disparities in management of diabetes care. For example, most MMC plans mandate having a primary care provider, and many MMC plans offer enhanced monitoring for patients with chronic conditions, as well as organized outreach programs.⁴⁴ These characteristics of a health coverage plan may contribute to greater adherence to recommended diabetes management protocols, particularly among vulnerable populations.

Author Affiliations: Section of Plastic Surgery, University of Michigan Medical School (EM, BLM), Ann Arbor, MI; Institute of Gerontology, Wayne State University (WT), Detroit, MI; Institute for Social Research, University of Michigan (HGL), Ann Arbor, MI.

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Address Correspondence to: Elham Mahmoudi, PhD, University of Michigan Medical School, 2800 Plymouth Rd, NCR Building 16, Rm G024W, Ann Arbor, MI 48109. E-mail: mahmoudi@med.umich.edu.

REFERENCES

1. National healthcare disparities report 2011. Agency for Healthcare Research and Quality website. <http://www.ahrq.gov/research/findings/nhqrdr/nhdr11/nhdr11.pdf>. Published March 2012. Accessed February 15, 2013.
2. American Diabetes Association. Standards of medical care in diabetes—2013. *Diabetes Care*. 2013;36(suppl 1):S11–S66. doi: 10.2337/dc13-S011.
3. Chou AF, Brown AF, Jensen RE, Shih S, Pawlson G, Scholte SH. Gender and racial disparities in the management of diabetes mellitus among Medicare patients. *Women's Health Issues*. 2007;17(3):150–161.

4. McBean AM, Li S, Gilbertson DT, Collins AJ. Differences in diabetes prevalence, incidence, and mortality among the elderly of four racial/ethnic groups: whites, blacks, Hispanics, and Asians. *Diabetes Care*. 2004;27(10):2317-2324.
5. Brancati FL, Kao WL, Folsom AR, Watson RL, Szklo M. Incident type 2 diabetes mellitus in African American and white adults: the Atherosclerosis Risk in Communities Study. *JAMA*. 2000;283(17):2253-2259.
6. Athamneh LN, Sansgiry SS. Influenza vaccination in patients with diabetes: disparities in prevalence between African Americans and whites. *Pharm Pract (Granada)*. 2014;12(2):410.
7. Kenik J, Jean-Jacques M, Feinglass J. Explaining racial and ethnic disparities in cholesterol screening. *Prev Med*. 2014;65:65-69. doi: 10.1016/j.ypmed.2014.04.026.
8. Trivedi AN, Zaslavsky AM, Schneider EC, Ayanian JZ. Trends in the quality of care and racial disparities in Medicare managed care. *N Engl J Med*. 2005;353(7):692-700.
9. McGuire TG, Newhouse JP, Sinaiko AD. An economic history of Medicare Part C. *Milbank Q*. 2011;89(2):289-332. doi: 10.1111/j.1468-0009.2011.00629.x.
10. Greaney TL. Medicare Advantage, accountable care organizations, and traditional Medicare: synchronization or collision? *Yale J Health Policy Law Ethics*. 2015;15(1):37-55.
11. Morfe M. Alternatives to traditional Medicare: Medicare Part C poised to prosper. *Benefits Q*. 2006;22(3):7-9,11-12.
12. Centers for Medicare and Medicaid Services. Your guide to Medicare's preventive services. Medicare.gov website. <https://www.medicare.gov/pubs/pdf/10110.pdf>. Published March 2015. Accessed January 28, 2016.
13. Balsa AI, Cao Z, McGuire TG. Does managed health care reduce health care disparities between minorities and whites? *J Health Econ*. 2007;26(1):101-121.
14. Shimada SL, Zaslavsky AM, Zaborski LB, O'Malley AJ, Heller A, Cleary PD. Market and beneficiary characteristics associated with enrollment in Medicare managed care plans and fee-for-service. *Med Care*. 2009;47(5):517-523. doi: 10.1097/MLR.0b013e318195f86e.
15. McWilliams JM, Meara E, Zaslavsky AM, Ayanian JZ. Differences in control of cardiovascular disease and diabetes by race, ethnicity, and education: US trends from 1999 to 2006 and effects of Medicare coverage. *Ann Intern Med*. 2009;150(8):505-515.
16. Medical Expenditure Panel Survey: household component. Agency for Healthcare Research and Quality website. https://meps.ahrq.gov/mepsweb/survey_comp/household.jsp. Accessed June 15, 2015.
17. Cohen JW, Monheit AC, Beauregard KM, et al. The Medical Expenditure Panel Survey: a national health information resource. *Inquiry*. 1996-1997;33(4):373-389.
18. Groves RM, Dillman DA, Eltinge JL, Little RJA. *Survey Nonresponse*. New York, NY: John Wiley & Sons, Inc; 2002.
19. Little RJA, Rubin DB. *Statistical Analysis With Missing Data*. Hoboken, NJ: John Wiley & Sons, Inc; 2002.
20. Austin PC. Optimal caliper widths for propensity-score matching when estimating differences in means and differences in proportions in observational studies. *Pharm Stat*. 2011;10(2):150-161. doi: 10.1002/pst.433.
21. Nelson A. Unequal treatment: confronting racial and ethnic disparities in health care. *J National Med Assoc*. 2002;94(8):666-668.
22. Cook B, McGuire TG, Zuvekas SH. Measuring trends in racial/ethnic health care disparities. *Med Care Res Rev*. 2009;66(1):23-48. doi: 10.1177/1077558708323607.
23. Mahmoudi E, Jensen GA. Has Medicare Part D reduced racial/ethnic disparities in prescription drug use and spending? *Health Serv Res*. 2014;49(2):502-525. doi: 10.1111/1475-6773.12099.
24. Cook B, Manning WG. Measuring racial/ethnic disparities across the distribution of health care expenditures. *Health Serv Res*. 2009;44(5, pt 1):1603-1621. doi: 10.1111/j.1475-6773.2009.01004.x.
25. Cook B, McGuire TG, Zuvekas SH. Measuring trends in racial/ethnic health care disparities. *Med Care Res Rev*. 2009;66(1):23-48. doi: 10.1177/1077558708323607.
26. Deb P, Manning WG, Norton EC. Preconference course: modeling health care costs and counts. Presented at the iHEA World Congress; 2013; Sydney, Australia. http://harris.uchicago.edu/sites/default/files/iHEA_Sydney_minicourse.pdf. Accessed July 15, 2015.
27. Kolenikov S. Resampling variance estimation for complex survey data. *Stata Journal*. 2010;10(2):165-199.
28. Cohen SB. Design strategies and innovations in the medical expenditure panel survey. *Med Care*. 2003;41(suppl 7):III5-III12.
29. Shavers VL, Brown M, Klabunde CN, et al. Race/ethnicity and the intensity of medical monitoring under 'watchful waiting' for prostate cancer. *Med Care*. 2004;42(3):239-250.
30. Brown AF, Gregg EW, Stevens MR, et al. Race, ethnicity, socioeconomic position, and quality of care for adults with diabetes enrolled in managed care: the Translating Research Into Action for Diabetes (TRIAD) study. *Diabetes Care*. 2005;28(12):2864-2870.
31. The Hispanic population: 2010. US Census Bureau website. <http://www.census.gov/prod/cen2010/briefs/c2010br-04.pdf>. Published May 2011. Accessed December 1, 2014.
32. Mahmoudi E, Jensen GA. Exploring disparities in access to physician services among older adults: 2000-2007. *J Gerontol B Psychol Sci Soc Sci*. 2013;68(1):128-138. doi: 10.1093/geronb/gbs105.
33. Derose KP, Escarce JJ, Lurie N. Immigrants and health care: sources of vulnerability. *Health Aff (Millwood)*. 2007;26(5):1258-1268.
34. Bustamante AV, Chen J. Health expenditure dynamics and years of US residence: analyzing spending disparities among Latinos by citizenship/nativity status. *Health Serv Res*. 2012;47(2):794-818. doi: 10.1111/j.1475-6773.2011.01278.x.
35. Mohanty SA, Woolhandler S, Himmelstein DU, Pati S, Carrasquillo O, Bor DH. Health care expenditures of immigrants in the United States: a nationally representative analysis. *Am J Public Health*. 2005;95(8):1431-1438.
36. Schneider EC, Zaslavsky AM, Epstein AM. Racial disparities in the quality of care for enrollees in Medicare managed care. *JAMA*. 2002;287(10):1288-1294.
37. Atherly A, Thorpe KE. Value of Medicare Advantage to low-income and minority Medicare beneficiaries. http://c0540862.cdn.cloudfiles.rackspacecloud.com/Ken_Thorpe_MA_Report.pdf. Published September 20, 2005. Accessed July 15, 2015.
38. Ayanian JZ, Cleary PD, Weissman JS, Epstein AM. The effect of patients' preferences on racial differences in access to renal transplantation. *New Engl J Med*. 1999;341(22):1661-1669.
39. Heister M, Smith DM, Hayward RA, Krein SL, Kerr EA. Racial disparities in diabetes care processes, outcomes, and treatment intensity. *Med Care*. 2003;41(11):1221-1232.
40. Walker EA, Basch CE, Howard CJ, Zybert PA, Kromholz WN, Shamoon H. Incentives and barriers to retinopathy screening among African-Americans with diabetes. *J Diabetes Complications*. 1997;11(5):298-306.
41. Sloan FA, Bethel MA, Ruiz D Jr, Shea AH, Feinglos MN. The growing burden of diabetes mellitus in the US elderly population. *Arch Intern Med*. 2008;168(2):192-199. doi: 10.1001/archinternmed.2007.35.
42. Schneider EC, Zaslavsky AM, Epstein AM. Racial disparities in the quality of care for enrollees in Medicare managed care. *JAMA*. 2002;287(10):1288-1294.
43. Baicker K, Chandra A, Skinner JS. Geographic variation in health care and the problem of measuring racial disparities. *Perspect Biol Med*. 2005;48(suppl 1):S42-S53.
44. Feldstein AC, Vollmer WM, Smith DH, et al. An outreach program improved osteoporosis management after a fracture. *J Am Geriatr Soc*. 2007;55(9):1464-1469. ■

eAppendix A

Table. Main Differences Between Traditional Medicare Fee-for-Service (MFFS) and Medicare Managed Care (MMC)

	MFFS	MMC
Administered by	Administered through the federal government	Administered through private insurance companies (types of plans offered: health maintenance organizations, preferred provider organizations, and private fee-for-service [PFFS]); plan availability depends on the state and city where enrollees live
Basic coverage	Covers Part A and Part B	Covers Part A and Part B; some plans offer vision, hearing, and dental coverage
Supplemental coverage	Can buy Medigap	Cannot buy Medigap
Prescription drug coverage	Must buy separate Part D plan	Must be enrolled in a Medicare Advantage Prescription Drug Plan to have Part D included; can buy separate Part D plan only if person has a Medicare Medical Savings Account or a PFFS plan
Providers	Can go to any doctor or hospital that accepts Medicare	Can only go to doctor or hospital that is in plan
Specialists	No referral needed to see a specialist	Must have a referral from primary care provider to see a specialist (the exception is routine preventive women's healthcare screening, which is available without a referral for female enrollees)
Cost	Pay monthly premium, deductibles, and/or coinsurance (percentage of cost of healthcare visit)	Pay Medicare premium and plan premium, deductibles and/or co-pays (fixed cost of healthcare visit); yearly limit on out-of-pocket spending

eAppendix B

Table. Logistic Regressions for Diabetes Care: 2006-2011

Variables	Foot Checks		Flu Vaccine		Cholesterol Check		Eye Exam	
	OR	SE	OR	SE	OR	SE	OR	SE
<i>MMC</i>	0.92	0.14	0.84	0.13	1.00	0.21	1.29*	0.18
<i>Age</i>	1.00	0.01	1.04***	0.01	1.01	0.01	1.01*	0.01
<i>Female</i>	0.78*	0.08	0.81*	0.10	1.25	0.20	1.03	0.11
<i>African American</i>	1.28	0.22	0.60***	0.09	0.73*	0.13	0.92	0.12
<i>Hispanic</i>	0.89	0.16	0.64**	0.12	0.76	0.16	0.98	0.19
<i>African American*MMC</i>	0.86	0.21	1.02	0.27	0.86	0.27	1.03	0.24
<i>Hispanic*MMC</i>	1.04	0.27	1.41	0.41	1.27	0.45	0.82	0.22
<i>Marital status</i>	0.94	0.10	1.34***	0.16	1.58***	0.25	1.42***	0.15
<i>Education</i>								
Less than high school	0.71***	0.08	0.75**	0.10	0.73**	0.11	0.61***	0.07
College degree	0.94	0.14	1.11	0.20	1.41	0.35	1.3*	0.21
Other degree	1.14	0.23	0.71	0.19	1.77	0.70	1.39	0.29
<i>Family income</i>								
Poor	0.86	0.13	1.33**	0.19	0.83	0.16	0.77*	0.11
Near poor	0.94	0.16	0.94	0.17	0.90	0.22	1.19	0.22
Low income	1.04	0.13	1.23	0.19	0.73*	0.14	0.85	0.12
High Income	1.05	0.13	1.05	0.15	0.80	0.16	1.05	0.15
<i>Medicaid</i>	1.48**	0.28	1.06	0.17	1.19	0.24	1.35**	0.20
<i>Have usual source of care</i>	1.46*	0.32	2.56***	0.74	2.43***	0.75	1.29	0.30
<i>Health status</i>								
Good health	0.83	0.11	1.04	0.13	1.35*	0.24	0.82**	0.09
Good mental health	0.89	0.13	1.42**	0.21	1.20	0.23	1.69***	0.22
<i>Chronic conditions</i>								
Asthma	1.23	0.21	1.64***	0.32	1.14	0.24	1.02	0.16
High blood pressure	1.32**	0.16	1.26	0.20	1.59***	0.29	1.23	0.17
Any heart problem	0.93	0.09	1.27**	0.14	1.20	0.17	1.09	0.11
Arthritis	0.94	0.21	1.39***	0.17	1.19	0.19	1.06	0.12
<i>Region</i>								
Northeast	0.27***	0.27	1.21	0.20	1.40	0.31	1.47**	0.25
Midwest	1.19	0.15	0.97	0.14	1.10	0.20	1.36***	0.17
West	0.94	0.12	1.29	0.24	0.96	0.20	1.03	0.14
<i>MSA</i>	1.22	0.16	0.99	0.13	1.47***	0.21	1.36**	0.20

<i>Year</i>								
2007	0.79	0.12	1.02	0.13	1.30	0.33	1.13	0.15
2008	0.88	0.14	0.88	0.14	0.55***	0.13	1.10	0.18
2009	1.01	0.17	0.82	0.13	0.71	0.17	0.96	0.14
2010	1.02	0.17	1.11	0.19	0.78	0.18	1.18	0.17
2011	1.22	0.21	0.87	0.15	0.72	0.17	1.07	0.16
<i>Intercept</i>	1.54	1.00	0.04***	0.03	0.64	0.67	0.25**	0.17
N	3631		3658		3646		3660	

MMC indicates Medicare managed care; MSA, metropolitan statistical area.

*, **, *** Significant at the alpha = 0.10, 0.05, and 0.01 levels, respectively.

Source: Data comes from the Household Component files of the 2006-2011 Medical Expenditure Panel Survey.

Reference values: Education (high school degree); Family Income (middle income); Region (South); Year (2006).

eAppendix C

Table. GLM Regressions for Total Expenditure and Out-of-Pocket Expenditure: 2006-2011

Variables	Total Expenditure		Out-of-Pocket Expenditure	
	β	SE	β	SE
<i>MMC</i>	-0.13*	0.07	0.05	0.08
<i>Age</i>	0.00	0.00	0.01**	0.00
<i>Female</i>	0.02	0.06	0.14**	0.06
<i>African American</i>	-0.05	0.07	-0.09	0.09
<i>Hispanic</i>	-0.13	0.09	-0.09	0.12
<i>African American*MMC</i>	0.08	0.12	-0.47***	0.14
<i>Hispanic*MMC</i>	0.09	0.14	-0.09	0.17
<i>Marital status</i>	-0.05	0.06	-0.05	0.06
<i>Education</i>				
Less than high school	-0.07	0.06	-0.09	0.06
College degree	0.03	0.07	0.17*	0.09
Other degree	0.11	0.13	0.06	0.17
<i>Family income</i>				
Poor	-0.05	0.07	-0.23**	0.12
Near poor	-0.05	0.09	-0.12	0.11
Low income	-0.13*	0.07	-0.23***	0.08
High income	0.05	0.07	0.08	0.08
<i>Medicaid</i>	0.17**	0.07	-0.96***	0.11
<i>Have usual source of care</i>	0.20	0.14	0.30***	0.11
<i>Health status</i>				
Good health	-0.50***	0.06	-0.22***	0.07
Good mental health	0.00	0.06	-0.14*	0.08
<i>Chronic conditions</i>				
Asthma	0.17**	0.08	0.09	0.08
High blood pressure	0.16**	0.07	0.12*	0.07
Any heart problem	0.50***	0.05	0.21***	0.06
Arthritis	0.18***	0.05	0.02	0.06
<i>Region</i>				
Northeast	0.01	0.06	-0.10	0.07
Midwest	0.06	0.07	0	0.07
West	-0.04	0.09	-0.02	0.09
<i>MSA</i>	0.05	0.07	0.04	0.07

<i>Year</i>				
2007	-0.07	0.06	-0.28***	0.07
2008	-0.25***	0.07	-0.32***	0.08
2009	-0.09	0.07	-0.42***	0.09
2010	-0.11	0.08	-0.25***	0.09
2011	-0.22***	0.08	-0.42***	0.09
<i>Intercept</i>	9.07***	0.36	6.80***	0.41

N = 3735 (full sample size)

GLM indicates generalized linear models; MSA, metropolitan statistical area.

*, **, *** Significant at the alpha = 0.10, 0.05, and 0.01 levels, respectively.

Source: Data comes from the Household Component files of the 2006-2011 Medical Expenditure Panel Survey.

Reference values: Education (high school degree); Family Income (middle income); Region (South); Year (2006).

eAppendix D. The Institute of Medicine (IOM) Method of Estimating Racial/Ethnic Disparity in Access to/Utilization of Care

The IOM has defined a racial/ethnic disparity in healthcare as “a difference in access or treatment provided to members of different racial or ethnic groups that is not justified by the underlying health conditions or treatment preferences of patients.”¹⁻² The IOM definition of disparity is 1 of several disparity definitions found in prior literature.³ To implement the IOM definition, we use a 4-step procedure suggested by Cook and colleagues.^{3,4} First, for each outcome measure, we fit a regression model. The fitted models for this study are presented in eAppendices A and B. Using the IOM approach, we classify covariates other than race/ethnicity into 2 general categories of socioeconomic (SES) variables and health-related variables. In our regression models, SES variables include education, income, insurance, geographic location, speaking English, and marital status. Health-related variables include age, being female, having good health, having good mental health, having asthma, having high blood pressure, having any heart problem, having arthritis, having stroke, having emphysema. Equation number 1 shows a typical fitted model, where “R” represents race/ethnicity variables, “H” represents health-related variables, and “S” represents SES variables.

$$(1) \quad E(Y) = \beta_0 + \beta_1R + \beta_2H + \beta_3S$$

Second, we transform the distribution of health-related variables included in the model for each minority group; therefore, for health-related variables, each minority group has the same distribution as that of whites. We do not change the distribution of other variables included in the model. To transform the distribution of health-related variables for minority groups to be the same as that of whites, we first need to create a health-index score for each individual in the sample. Equation number 2 shows how to estimate the health-index score based on the fitted model described in equation (1) above:

$$(2) \quad E(\text{Health-Index}) = \beta_2H$$

To make the transformation of health-index score among minority groups to be similar to that of whites, we adopted Cook and colleagues’ “rank-and-replace” algorithm.⁴ First, we sort the estimated health-index scores for each race and ethnicity group in the study (for example, in this study, we ranked the health-index scores for whites, African Americans, and Hispanics included in the study). Second, we proportionally replace the values of ranked health-index measures of

whites for minority individuals. For example, if there are 100 whites and 13 African Americans, after we ranked health-index scores for both whites and African Americans separately, we replace the value of the health-index for the first African American with the health-index value of the first ranked white. Then, we replace the health-index for the second African American with the health-index of a white person who ranked 13th among whites. We repeat this loop until the weighted average of all health-index scores for both whites and African Americans are the same. We repeat the same procedure for Hispanics or other minority groups, if included in the sample. This technique is called “rank-and-replacement.”⁴

Third, we replace minorities’ original health-index values in equation (1), the original fitted model, with the transformed health-index values from step 2 of this procedure. This is presented in equation number 3.

$$(3) \quad E(Y) = \beta_0 + \beta_1 R + \beta_2 H_{(\text{transformed})} + \beta_3 S$$

We then estimate the predicted value of the outcome variable based on the transformed value of the health-related values for minority groups and whites’ own health-index values. Finally, we average the adjusted predictive outcome values by population groups, and calculate the IOM disparities in our defined outcome measure(s) as the difference between the average hypothetical value for that utilization measure in the minority group and the average value for that measure among whites. For these IOM predictions, because the estimation of outcome values for minority groups are counterfactual, we cannot use the observed standard errors to determine the statistical significance. To accurately estimate the standard errors of the IOM disparities, we need to use a bootstrapping technique. In this study, we replicated our entire sample 100 times (with replacement) using Stata’s bootstrapping procedure for the case of complex survey design,⁵ re-estimating the IOM disparities with each bootstrapped sample. Using the IOM approach in estimating racial/ethnic disparity, we modify the data to construct comparison minority and white populations that have similar distributions of health-related variables (and patient preferences, if the related variables included in the dataset) but keep all other observed variables (the SES variables) in each subpopulation unchanged.

References

1. McGuire TG, Alegria M, Cook BL, Wells KB, Zaslavsky AM. Implementing the Institute of Medicine definition of disparities: an application to mental health care. *Health Serv Res.* 2006;41(5):1979-2005.
2. Nelson A. Unequal treatment: confronting racial and ethnic disparities in health care. *J Natl Med Assoc.* 2002;94(8):666-668.
3. Cook B, McGuire TG, Lock K, Zaslavsky AM. Comparing methods of racial and ethnic disparities measurement across different settings of mental health care. *Health Serv Res.* 2010;45(3):825-847. doi: 10.1111/j.1475-6773.2010.01100.x.
4. Cook BL, McGuire TG, Zaslavsky AM. Measuring racial/ethnic disparities in health care: methods and practical issues. *Health Serv Res.* 2012;47(3 Pt 2):1232-1254. doi: 10.1111/j.1475-6773.2012.01387.x.
5. Kolenikov S. Resampling variance estimation for complex survey data. *Stata J.* 2010;10(2):165-199.

eAppendix E

Table. Adjusted Predictive Disparities^a Between Minorities and Whites in Diabetes Management and Healthcare Expenditures Using Other Methods (sensitivity analysis)

Disparity (MFFS vs MMC)	Foot Examination (%)	Flu Shot (%)	Cholesterol Check (%)	Eye Examination (%)	Total Expenditures (\$)	Out-of-Pocket Expenditures (\$)
<i>African American vs white</i>						
Unadjusted average	-3	-5	-1	1	532	-424
Regression-based ^b	-2	1	-1	0	1056	-638*
PSW ^c	0	0	0	2	626	-631*
Rank-and-replace ^d	-3*	-2*	-2*	1	1204*	-493*
Rank-and-replace with PSW ^e	-1	-1	1	2	1183*	-547*
<i>Hispanic vs white</i>						
Unadjusted average	-2	3	2	-4	2127	113
Regression-based ^b	1	6	2	-4	1231	-153
PSW ^c	4	6	2	-3	1257	61
Rank-and-replace ^d	1	9*	5*	0	3296*	196*
Rank-and-replace with PSW ^e	5*	10*	7*	1	3588*	276*
N ^f =	3631	3658	3646	3660	3735	3735

MFFS indicates Medicare fee-for-service; MMC, Medicare Managed Care; PSW, propensity score weighting.

^aEffect of MMC on racial/ethnic disparity measures in diabetes management and healthcare expenditures calculated by deducting racial/ethnic disparity measures under MMC from racial/ethnic disparity measures under MFFS. Thus, a negative value indicates that MMC increased the disparity.

^bEstimating disparity based on the original regression models, without further adjustments.

^cEstimating disparity based on PSW of all variables between whites and minorities.

^dEstimating disparity based on the Institute of Medicine definition of disparity.

^eEstimating disparity based on the Institute of Medicine definition of disparity, using PSW to adjust for any potential selection biased.

^fWe used the inverse probability weight (balancing weights) in our PSW method, therefore our sample sizes were the same in all models.

*Significant at the alpha = 0.05 level.

Source: Data comes from the Household Component files of the 2006-2011 Medical Expenditure Panel Survey.