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GENDER AND RACIAL DISPARITIES IN THE MANAGEMENT OF DIABETES MELLITUS AMONG MEDICARE PATIENTS

Ann F. Chou, PhD, MPH[a]*, Arleen F. Brown, MD, PhD[b], Roxanne E. Jensen[c], Sarah Shih, MPH[d], Greg Pawlson, MD, MPH[d], Sarah Hudson Scholle, DrPH, MPH[d]

[a]*Department of Health Administration and Policy, College of Public Health and College of Medicine, University of Oklahoma,*
[b]*Division of General Internal Medicine and Health Services Research, University of California,*
[c]*Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health,*
[d]*The National Committee for Quality Assurance 2000 L St., Suite 500, Washington, DC*

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Background: **Racial/ethnic disparities in diabetes care have been demonstrated in several settings, but few studies have evaluated whether racial/ethnic differences vary by gender. The objective of this study is to understand gender and racial effects on diabetes care for Medicare managed care beneficiaries.**

Methods: **Using data from: (1) Healthcare Effectiveness Data and Information Set (HEDIS®); (2) Medicare Enrollment Files; and (3) U.S. Census, hierarchical generalized linear analyses were conducted to model the six HEDIS comprehensive diabetes care quality indicators, including processes of care and intermediate outcome measures, as a function of gender and race/ethnicity.**

Results: **Women were more likely to have received HbA_{1c} screening or eye examination, but less likely to have LDL control at <100 mg/dL, compared to men. Racial disparities favored whites in five measures, where African Americans were less likely to have received HbA_{1c} screening, eye examination, cholesterol screening, or achieve adequate HbA_{1c} control or LDL control at <100 mg/dL. Enrollees in managed care plans where African Americans constituted more than 20% of their insured population tended to have lower likelihood of meeting the HbA_{1c} screening, HbA_{1c} control, and eye examination measures.**

Conclusions and Discussion: **Gender and racial disparities in performance indicators were present among persons enrolled in Medicare managed care. White women were more likely to have met the performance measures related to process of care, but African Americans fared worse in both process of care and intermediate health outcome measures, compared to their white counterparts. Poor performance in cholesterol control observed in women of both races suggests the possibility of less intensive cholesterol treatment in women. The differences in the pattern of care demonstrate the need for interventions tailored to address gender and race/ethnicity.**

Background

Several studies have demonstrated less than optimal management of diabetes mellitus in the United States (McGlynn et al., 2003). Data from the 1999-2000 National Health and Nutrition Examination Surveys (NHANES) showed that only 37% of adults with diabetes achieved the recommended goals of Hemoglobin A_{1c} (HbA_{1c}) level, blood pressure, and cholesterol level (Saydah, Fradkin, & Cowie, 2004). McGlynn and colleagues documented only 24% of adults with diabetes had undergone three or more HbA_{1c} testing over a two-year period (McGlynn et al., 2003). These problems are often exacerbated when groups of vulnerable patients, such as women and racial/ethnic minorities, experience disparities in the quality of care, and the consequences may result in adverse implications on their health. For example, Correa-de-Araujo et al. reported that 28.9% of women versus 33.9% of men who had diabetes have received all five recommended services (i.e., HbA_{1c} testing, lipid profile, influenza immunization, eye and foot

* Corresponding Author: Ann F. Chou. Department of Health Administration and Policy, College of Public Health and College of Medicine, University of Oklahoma, 801 NE 13th St., CHB 355, Oklahoma City, OK 73120, Phone: 405-271-2115; Fax: 405-271-1868; E-mail: ann-chou@ouhsc.edu

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examination) in the appropriate time frame (Correa-de-Araujo, McDermott, & Moy, 2006). While racial disparities for process of care outcomes may have slightly improved over time, Trivedi et al. showed that these disparities did not decrease for intermediate health outcomes such as HbA_{1c} control (Trivedi et al., 2005). These trends are particularly concerning as women are at higher relative risk than men of having complications related to diabetes, including diabetic ketoacidosis and cardiovascular disease (CVD), and African Americans have higher rates than whites of having microvascular complications, including end-stage renal disease (ESRD) and lower extremity amputation (AHRQ, 2004; Cowie et al., 1989; Karter et al., 2002; Lavery, van Houtum, Ashry, Armstrong, & Pugh, 1999; Rostand, Kirk, Rutsky, & Pate, 1982).

African American women have higher rates of diabetes than white women and they may be at particularly high risk for inferior care and poor outcomes for the cardiovascular complications of diabetes. For example, a study using clinical vignettes found that among patients with identical clinical presentations, African American women were referred less often for cardiac catherization than white women or African American or white men (Schulman et al., 1999). Moreover, African American women have a higher risk of CVD than white women. Studies have shown that African American women were less likely to receive appropriate preventive therapy and adequate risk factor control than white women (Jha et al., 2003). Nonetheless, there is some recent evidence showing improvement in quality of care among enrollees of managed care plans and racial disparities in achieving these clinical performance standards have improved as well (Jencks et al., 2000; Jha et al., 2003; Jha, Perlin, Steinman, Peabody, & Ayanian, 2005; Trivedi, Zaslavsky, Schneider, & Ayanian, 2005). Trivedi et al. (2005) showed that the gap between white and African American Medicare beneficiaries narrowed for several measures from the Healthcare Effectiveness Data and Information Set (HEDIS®), although the rates of racial disparities were increasing for glucose control in patients with diabetes and cholesterol control in patients with heart disease (Trivedi et al., 2005).

While racial and ethnic disparities in diabetes care have been demonstrated in several settings, only a few studies have evaluated whether racial/ethnic differences vary by gender (Correa-de-Araujo, McDermott, & Moy, 2006; Schneider et al., 2001; Trivedi et al., 2005; Tseng et al., 2006). Moreover, some previous studies have small sample sizes, biases related to self-reported data, or have not detected significant differences. Furthermore, research documenting racial disparities in diabetes management has focused on incidence of diabetes-related complications (Karter et al., 2002), which could be biologically determined, rather than related to differential treatment of risk factors that are more directly controlled by clinicians. Nevertheless, these studies have provided the basis for our investigation (Correa-de-Araujo, McDermott, & Moy, 2006). In this study, we assessed the effect of race and gender on both processes of care and intermediate outcome measures related to the provision of comprehensive diabetes care from the HEDIS set in a nationally representative sample of Medicare beneficiaries enrolled in managed care.

Methods

Data and Sample Selection

This study employed three data sources: (1) Member-level HEDIS data submitted by 160 Medicare managed care plans from 2004; (2) Centers for Medicare and Medicaid Services (CMS) Enrollment Files; and (3) The U.S. Census Data. HEDIS is a comprehensive performance measurement program administered by the National Committee for Quality Assurance (NCQA). The program evaluates the quality of care delivered under managed care, with measures that are considered industry standard used by most Health Maintenance Organizations to report performance to private and public purchasers, including CMS and various state agencies. HEDIS reporting covers about 90% of managed care enrollees across the country, representing more than 90 million Americans. The reporting uses data derived from administrative claims, such as billing records, and chart reviews. In addition to submitting plan-level aggregate data, CMS requires all health plans participating in the Medicare Advantage Program to report member-level HEDIS quality indicators. We linked these indicators with the demographic profiles in the CMS Enrollment Files. Zip codes were extracted to match the average household income derived from the Census data for persons in the sample.

Prior to the merging of HEDIS member-level data and CMS Enrollment Files, the HEDIS member-level data were validated against HEDIS Health Plan Summary Data. We excluded plans whose member-level data submissions had incongruent performance rates, defined as a 5% differential in denominator sizes between member- and plan-level HEDIS data. These rules led to the exclusion of 1.3% of plans and 5.4% of patients. We linked the HEDIS member-level data to CMS Enrollment Files containing information on age, gender, race/ethnicity and zip code using Medicare program's unique identifier (HICNUM). We excluded those whose overall linkage rate was less than 90%. Furthermore, members with missing age, gender, and residency data were excluded (Figure 1).

CMS Enrollment Files categorize Medicare beneficiaries into racial/ethnic categories of White, African

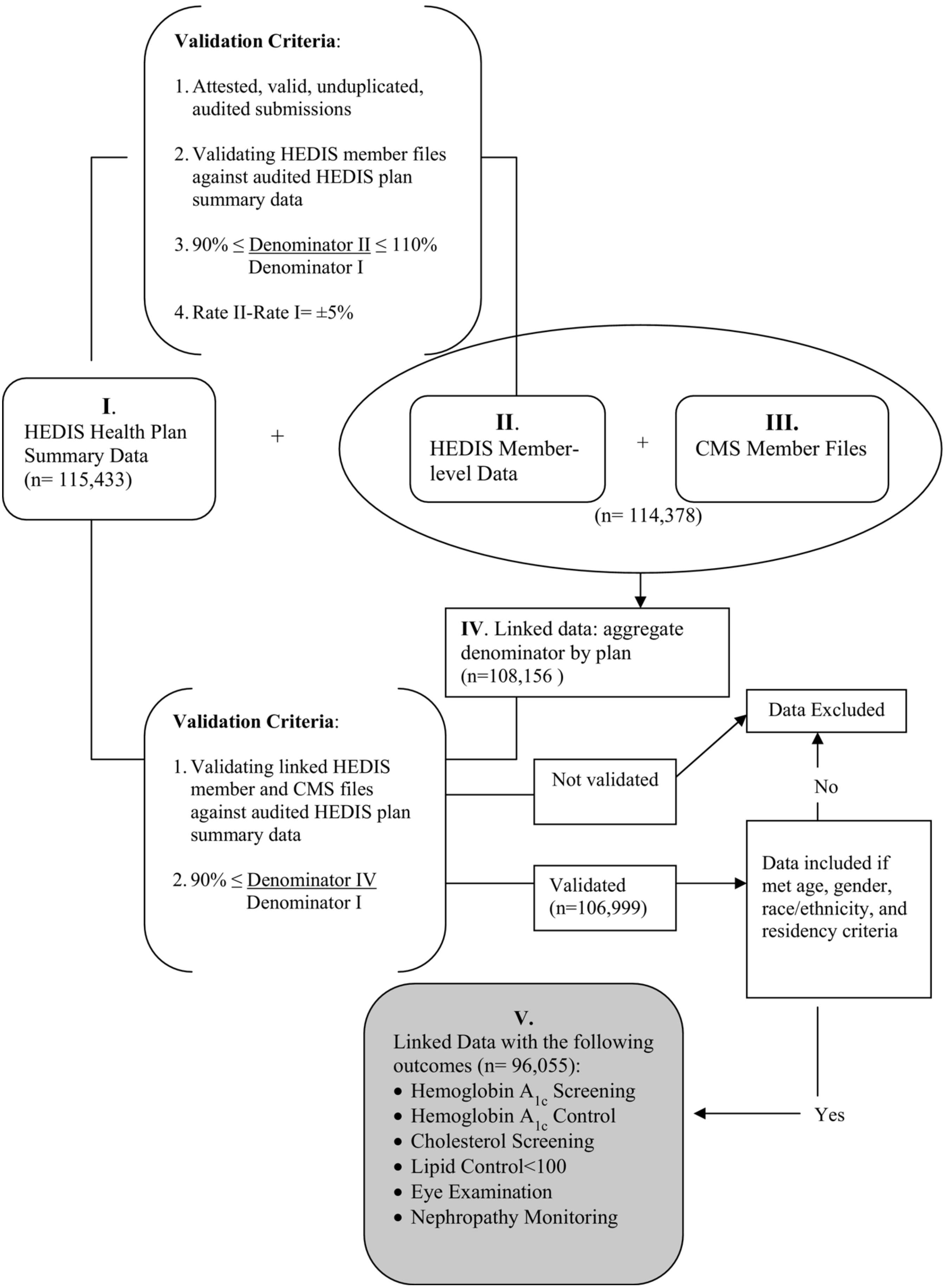

Figure 1. Data Linkage, Validation, and Inclusion Criteria

Table 1. Select HEDIS 2004 Measures for Comprehensive Diabetes Care: Technical Specifications*

HEDIS Measures	Numerator (Quality Indicators for Analysis)	Denominator (eligible population)
Comprehensive Diabetes Care**	• Hemoglobin A_{1c} (HbA_{1c}) Testing: One or more HbA_{1c} tests conducted during the measurement year identified through either administrative data or medical record review. • Poor HbA_{1c} Control: The most recent HbA_{1c} level (performed during the measurement year) is >9.0%, as documented through automated laboratory data or medical record review. If there is no HbA_{1c} level during the measurement year, the level is considered to be >9.0% (i.e., no test is counted as poor control). For this indicator, a lower rate indicates better performance. • Eye Examination: An eye screening for diabetic retinal disease. This includes those diabetics who had a retinal or dilated eye exam by an eye care professional in the measurement year (optometrist or ophthalmologist), as documented through either administrative data or medical record review. The managed care organization (MCO) is also allowed to count toward the numerator a negative retinal exam (an examination by an eye-care professional with no evidence of retinopathy) performed in the year prior to the measurement year if the member meets both the following criteria, where the member('s): • was not prescribed or dispensed insulin during the measurement year, and • most recent HbA_{1c} level is <8.0% • Monitoring for Diabetic Nephropathy: Screening for nephropathy or evidence of nephropathy, as documented through either administrative data or medical record review. This measure is intended to assess if diabetic patients are being monitored for nephropathy. The MCO is allowed to count toward the numerator, members who: • Have been screened for microalbuminuria, or • Have nephropathy, as demonstrated by either evidence of medical attention for nephropathy, visit to nephrologists or a positive macroalbuminuria test • Cholesterol Screening: A low-density lipoprotein cholesterol (LDL-C) test done during the measurement year or prior year as determined by claim/encounter or automated laboratory data or medical record review. • Lipid control (LDL-C) <100 mg/dL: The most recent LDL-C level performed during the measurement year or prior year is 100 mg/dL, as documented through automated laboratory data or medical record review.	Members who are 18-75 years of age and continuously enrolled in the managed care plan as of December 31 of the measurement year. They may be identified either as having diabetes or having been dispensed insulin or oral hypoglycemics/antihyperglycmics during the measurement year or year prior to measurement year.

*NCQA, Technical Specifications, 2004
**The description of the measure development process and criteria can be found on www.ncqa.org

American, Latino, Asian, or other race, based on data collected from the member at the time of enrollment in Social Security. However, we limited our sample to members who were identified as African American or white for two reasons. First, proportions of Asians and Latinos in the sample identified in the CMS file were small. In our sample, Asians and Latinos constituted 3% and 2.6% of available population, respectively. Previous reports have also noted underreporting of Latino ethnicity and Asian race, resulting in too small a sample size to conduct separate analyses (Virnig et al., 2002). Second, reporting of enrollees who were Asians, Latinos, or others, was inconsistent and could not be further verified (Escarce & McGuire, 2003; Virnig et al., 2002). While CMS data for race and ethnicity categorization have changed over time, the categorization of African Americans and whites have been shown to be the most consistent. In addition, we excluded observations with missing race data. The final dataset for analysis yielded 96,055 members in 148 health plans.

Measures

Dependent variables. Six quality indicators related to the provision of comprehensive diabetes care from the HEDIS set served as dependent variables. The quality indicators include both processes of care and intermediate outcome measures: (1) Hemoglobin A_{1c} (HbA_{1c}) screening; (2) Poor HbA_{1c} control (>9.0 %); (3) Eye examination; (4) Cholesterol screening; (5) Low-density Lipoprotein (LDL) cholesterol control at <100 mg/dL; and (6) Nephropathy monitoring (Table 1)(NCQA, 2004). The dependent variables were dichotomized, where responses for members who received the recommended screening or had control levels equal to or below the level specified in the measures were assigned the value one.

As optimal diabetes care should include adequate control in both HbA_{1c} and LDL, we combined the two intermediate outcome measures to create a binary variable where the value one describes Medicare beneficiaries who did not have poor HbA_{1c} control and achieved adequate LDL control, and the value zero were assigned to those who had poor control in both outcome measures.

Explanatory variables. Race and gender were the two main covariates. The value, one, was assigned to African Americans and women. To explore the effect of race associated with health plans, we created a binary variable where Medicare managed care beneficiaries who enrolled in health plans where greater than 20% of their enrollees were African Americans were assigned the value one.

Control variables. Several demographic variables were entered into the model at the first level. Using those aged 65–69 as the reference group, we compared the referent to those who were aged (1) less than 65 years; and (2) 70–75. For this analysis, we limited the age to those below 75 years in accordance to national guidelines. We also controlled for possible geographic variations by creating eight categories of regions where members reside, using the categories of the U.S. census, including Pacific, Mountain, West North Central, East North Central, South Central, South Atlantic, Mid Atlantic, with Northeast as the comparison. Northeast was the designated reference group as this region usually demonstrates the highest performance in HEDIS measures. As the information on socioeconomic status for individual members was unavailable, we used the average household income for ages 65 or older by zip code as a proxy. Household income was stratified into four groups: (1) less than $15,000; (2) $15,000-$30,000; (3) $30,000-$45,000; and (4) greater than $45,000 as the reference group. At the second level of our modeling, we controlled for health plan size using the enrollment number, where a binary variable was created with plans that had more than 50,000 members assigned the value of one.

Statistical Analysis

Descriptive statistics were compiled to describe the overall sample. We also generated unadjusted rates for gender, race, and the interaction of gender and race, and conducted significance testing among the subgroups.

To assess disparities, we estimated the probability of meeting individual diabetes management HEDIS performance measures for each patient using a hierarchical generalized linear model (HGLM). The HGLM model accommodates the nested data structure and gives each level of the data its own submodel, taking into account bias due to differences attributed to health plans (Raudenbush & Bryk, 2002; Raudenbush, Bryk, Cheong, & Congdon, 2004). The HGLM analyses modeled HEDIS measures as functions of gender and race, controlling for socio-demographic characteristics, enrolling in a health plan with more than 20% minority population, and region of residence at the first level, and plan size at the second level. Adjusted rates of meeting the HEDIS performance measures were calculated based on the HGLM estimates, with a 95% confidence interval. All analyses were conducted using SAS software v9.1 [SAS Institute, Cary, NC].

Table 2. Characteristics of the Medicare Sample Population

Demographic characteristic	N (96,055)	%
Gender		
Female	47,724	49.7
Male	48,331	50.3
Race/Ethnicity		
African American	12,889	13.4
White	83,166	86.6
Age		
<65	11,737	12.2
65-69	33,000	34.4
70-75	51,318	53.4
Household Income		
<$15,000	1,353	1.4
$15,000-$30,000	32,683	34.0
$30,000-$45,000	45,039	46.9
>$45,000	16,980	17.7
Region of Member Residence		
Northeast	3,020	3.1
Mid-Atlantic	16,997	17.7
Mountain	5,741	6.0
Pacific	37,317	38.9
South-Atlantic	7,701	8.0
South Central	9,063	9.4
West North Central	4,179	4.4
East North Central	12,037	12.5
Enrollee of a plan that has at least 20% African American enrollees	8,444	8.8

Results

Table 2 presents sample characteristics of 96,055 Medicare managed care beneficiaries. The sample consisted of 49.7% women and 13.4% African Americans. More than 50% were older than age 70, and most of the sample, at 46.9%, resided in areas where the average income range is between $30,000 and $45,000. The Pacific region has the highest number of Medicare managed care beneficiaries with 38.9%; the Northeast region has the lowest number of Medicare managed care beneficiaries with 3.1%. Eight-point-eight-percent beneficiaries were in plans that had greater than 20% enrollees who were African Americans.

Table 3 presents descriptive statistics by gender and race. Eight-percent of the total sample were African American women and 5.4% were African American men. Age and region of residence distributions in each of the four gender and race subgroups were comparable. However, close to half of the white men and

Table 3. Characteristics of the Medicare Sample Population

Demographic characteristic	African American Women (%)	White Women (%)	African American Men (%)	White Men (%)	Chi-square testing	
N	7,702	40,022	5,187	43,114	χ^2	p-value
Age						
<65	16.0	10.9	18.3	12.0	374.5	<0.0001
65-69	34.0	34.4	34.7	34.3		
70-75	50.0	54.7	47.0	53.7		
Household Income						
<$15,000	5.6	0.8	3.9	0.9	3595.3	<0.0001
$15,000-$30,000	52.4	32.4	47.8	30.6		
$30,000-$45,000	31.7	49.3	34.9	48.8		
>$45,000	10.4	17.5	13.4	19.7		
Region of Member Residence						
Northeast	1.1	3.6	1.0	3.4	1940.4	<0.0001
Mid-Atlantic	25.8	16.7	24.2	16.4		
Mountain	2.0	6.6	2.9	6.5		
Pacific	30.6	39.1	34.6	40.6		
South-Atlantic	13.5	6.8	12.7	7.6		
South Central	12.0	9.3	12.1	8.8		
West North Central	3.5	4.7	3.0	4.3		
East North Central	11.5	13.2	9.6	12.4		
Plan has at least 20% African American enrollees						
Yes	33.2	5.4	28.7	5.2	9541.0	<0.0001
No	66.8	94.6	71.3	94.8		

women had a household income of $35,000-$45,000, while about half of African American men and women had an income level of $15,000-$30,000. In addition, one-third of African American women and over a quarter of African American men were enrolled in health plans that had greater than 20% of African American enrollees.

Unadjusted Rates of Performance

The unadjusted rates showed that the rates of achieving adequate LDL control were low for the entire sample, at well below 50%. In comparing rates between gender and racial groups, we found statistically significant gender disparities in four of the six measures, racial disparities in all six measures, and that

Table 4. Unadjusted HEDIS Measure Results by Gender, Race, and Gender-Race Interaction

	HbA_{1c} testing		Poor HbA_{1c} control		Eye examination		Cholesterol screening		LDL control <100 mg/dL		Nephropathy monitoring	
	N	%	N	%	N	%	N	%	N	%	N	%
Gender												
Female	42558	89.2	10520	22.0	32842	68.8	44240	92.7	18381	38.5	27483	57.6
Male	42399	87.7	10726	22.2	32094	66.4	44739	92.6	22076	45.7	28451	58.9
t-statistic	−7.03****		0.56		−7.99****		−0.78		22.54****		4.02****	
Race												
African American	11027	85.6	3740	29.0	8356	64.8	11550	89.6	4434	34.4	7616	59.1
White	73930	88.9	17506	21.1	56580	68.0	77429	93.1	36023	43.3	48318	58.1
t-statistic	11.05****		−20.32****		7.23****		14.13****		19.11****		−2.12*	
Gender*Race												
African American Female	6693	86.9	2134	27.7	5170	67.1	6955	90.3	2516	32.7	4504	58.5
White Female	35865	89.6	8386	21.0	27672	69.1	37285	93.2	15865	39.6	22979	57.4
African American Male	4334	83.6	1606	31.0	3186	61.4	4595	88.6	1918	37.0	3112	60.0
White Male	38065	88.2	9120	21.1	28908	67.0	40144	93.1	20158	46.7	25339	58.7
Chi-square statistic	194.8****		430.7****		141.6****		213.0****		814.4****		22.21****	

*p≤0.05
**p≤0.01
***p≤0.005
****p≤0.0001

the pattern of disparity varied by race (Table 4). The largest disparities were observed in measures related to intermediate health outcomes. The difference in rates of adequate LDL control at <100 mg/dL between men and women was 7.2% in favor of men. Differences in the rates for LDL control between African Americans and whites were even greater, at 8.9% in favor of whites. In addition, the rate of poor HbA_{1c} control for African Americans was 7.9% greater than that for their white counterparts.

On the other hand, the rates for process of care measures were fairly comparable between men and women as well as between African Americans and white. Gender disparities in process of care measures were mostly small in magnitude, where the differences were 1.5% in HbA_{1c} testing and 2.4% in eye examination in favor of women, and 1.3% in nephropathy monitoring in favor of men. All racial differences in process of care measures were in favor of whites, with the exception of nephropathy monitoring. Racial differences in rates for meeting the HbA_{1c} screening, cholesterol screening, and eye examination standards ranged from 3.2-3.5% in favor of whites. Albeit extremely small, the 1% difference in the rates for nephropathy screening was the only difference observed in favor of African Americans, who as a cohort has well-documented elevation in ESRD risk that care providers may recognize and take action (Cowie et al., 1989; Cowie, Harris, Silverman, Johnson, & Rust, 1993; Cowie, Port, Rust, & Harris, 1994; Karter et al., 2002; Young, Maynard, Reiber, & Boyko, 2003).

The rates for race and gender interactions show that race effects dominated in measures related to HbA_{1c} screening and control, while both race and gender effects are strong for LDL control. Among the four gender/race groups, African American men fared the worst on HbA_{1c} control. African American men had a rate that exceeded white men by 10.0 percentage points and African American women had a rate that exceeded white women by 6.7%. The rates for white men and women were similar and the difference between those of African American men and women was 3.3%. In contrast, African American women were at the greatest disadvantage on the LDL control measure. Among both African Americans and whites, men were better off than women (a 7.1-point difference between white men and women and 4.3-point difference between African American men and women). The difference between African American women and white men was 14%.

Similar racial disparities are observed in the two process of care measures. African American men and women were less likely to have received HbA_{1c} and cholesterol screening compared to white men and women, but within each racial group, the performance for women exceeded that of men. Across the four gender/racial groups, white women had the highest rates of getting HbA_{1c} screening (89.6%), followed by white men at 88.2%, African American women at 86.9 %, and African American men at 83.6%. Similar trends among the four groups were observed for cholesterol screening.

Gender effects were apparent for the eye examination measure, in that white women had the highest rate of having eye examinations, followed by African American women. The difference in rates in obtaining eye examination between African American and white women was only 2% in favor of white women. However, in comparing gender effects within each racial group, the difference in rates between African American men and women was 5.7% in favor of African American women and the difference between white men and women was 2.1% in favor of white women.

HGLM Results of Gender and Race in the Management of Diabetes Mellitus

Table 5 presents the odds ratios (OR) for both gender and race based on the HGLM results. While gender differences for most measures were small or not present, there were substantial gender differences in LDL control. Women were statistically more likely than men to have received HbA_{1c} screening and eye examinations but the differences were small (OR=1.17, 95% Confidence Interval [CI]: 1.05, 1.30 and OR=1.12, 95% CI: 1.06, 1.19 respectively). However, women were only 0.75 times as likely to have achieved adequate LDL control at <100 mg/dL compared to men (95% CI: 0.71, 0.80). No gender differences were observed for HbA_{1c} control, cholesterol screening, or nephropathy monitoring.

Racial disparities in favor of whites were present in all but one measure. Compared to whites, African American Medicare managed care beneficiaries were less likely to have received HbA_{1c} screening (OR=0.77, 95% CI: 0.70, 0.84), eye examination (OR=0.94, 95% CI: 0.88, 0.99), and cholesterol screening (OR=0.66, 95% CI: 0.60, 0.72). African Americans were also 44% more likely to have poor HbA_{1c} control (95% CI: 1.36, 1.52) and less likely to achieve adequate LDL control (OR=0.69, 95% CI: 0.63, 0.76). No difference between African Americans and whites was observed in the nephropathy monitoring measure.

To further examine the effect of race on performance, we compared Medicare managed care beneficiaries who were enrolled in plans where greater than 20% of the plan's enrollees were African Americans. We found that those who enrolled in plans with greater than 20% of African American enrollees were 21% less likely to have received HbA_{1c} screening (OR= 0.79, 95% CI: 0.63, 0.99) and 25% less likely to have received an eye examination (OR=0.75, 95% CI: 0.61, 0.94). These enrollees were also 34% more likely to have poor HbA_{1c} control. No significant differences

Table 5. Predictors of HEDIS Measures Related to Comprehensive Diabetes Care (Odds Ratios and 95% Confidence Intervals)§

	Odds Ratio (95% Confidence Interval)						
	HbA_{1c} testing	Poor HbA_{1c} control	Eye examination	Cholesterol screening	LDL control <100 mg/dL	Nephropathy monitoring	HbA_{1c} & LDL control#
Female (Male)†	1.17** (1.05, 1.30)	0.97 (0.93, 1.02)	1.12*** (1.06, 1.19)	1.06 (0.99, 1.14)	0.75**** (0.71, 0.80)	0.98 (0.94, 1.01)	0.85**** (0.79, 0.91)
African American (White)	0.77**** (0.70, 0.84)	1.44**** (1.36, 1.52)	0.94* (0.88, 0.99)	0.66**** (0.60, 0.72)	0.69**** (0.63, 0.76)	1.08 (0.90, 1.30)	0.57**** (0.52, 0.62)
African American Female	1.16* (1.03, 1.31)	0.85*** (0.79, 0.93)	1.19**** (1.11, 1.27)	1.20* (1.04, 1.38)	1.13*** (1.06, 1.21)	1.02 (0.94, 1.11)	1.20**** (1.10, 1.32)
Age (65-70 years)							
Under 65	0.73**** (0.65, 0.82)	1.51**** (1.40, 1.62)	0.69**** (0.64, 0.74)	0.71**** (0.64, 0.78)	0.89**** (0.85, 0.93)	1.00 (0.94, 1.07)	0.65**** (0.60, 0.69)
Age 70-75	0.98 (0.94, 1.02)	0.94**** (0.91, 0.97)	1.15**** (1.09, 1.22)	0.87** (0.82, 0.93)	0.95* (0.92, 0.99)	0.94* (0.87, 0.99)	1.10**** (1.06, 1.14)
SES (Income>$45,000)							
Income <$15,000	0.86 (0.72, 1.04)	1.09 (0.96, 1.24)	0.74**** (0.67, 0.83)	0.87**** (0.82, 0.93)	0.95* (0.92, 0.99)	0.94* (0.87, 0.99)	0.84* (0.72, 0.99)
Income $15,000-$30,000	0.93* (0.87, 1.00)	1.07* (1.01, 1.14)	0.80** (0.75, 0.86)	1.10 (0.85, 1.42)	1.52**** (1.28, 1.80)	1.03 (0.88, 1.21)	0.91** (0.85, 0.97)
Income $30,000-$45,000	1.04 (0.98, 1.10)	0.95* (0.92, 0.99)	0.92*** (0.87, 0.97)	0.96 (0.90, 1.01)	0.99 (0.95, 1.02)	0.99 (0.97, 1.02)	1.03 (0.99, 1.08)
Region (Northeast)							
Mid-Atlantic	0.63*** (0.47, 0.86)	1.41 (0.85, 2.32)	0.62*** (0.46, 0.84)	0.63* (0.42, 0.92)	0.88 (0.71, 1.10)	0.81 (0.51, 1.30)	0.67 (0.37, 1.21)
Mountain	0.70 (0.50, 0.97)	1.05 (0.65, 1.70)	0.51**** (0.37, 0.70)	0.65 (0.41, 1.02)	0.89 (0.70, 1.13)	0.90 (0.54, 1.50)	0.91 (0.50, 1.64)
Pacific	0.81 (0.57, 1.15)	0.96 (0.59, 1.57)	0.80 (0.58, 1.10)	0.62* (0.43, 0.90)	0.74* (0.59, 0.93)	0.83 (0.52, 1.34)	0.91 (0.50, 1.67)
South Atlantic	0.71 (0.51, 1.00)	0.95 (0.57, 1.57)	0.65* (0.46, 0.92)	0.65 (0.41, 1.06)	0.88 (0.73, 1.06)	0.75 (0.47, 1.21)	0.91 (0.52, 1.57)
South Central	0.67* (0.49, 0.91)	1.06 (0.66, 1.71)	0.59 (0.42, 0.81)	0.65* (0.43, 0.99)	0.80* (0.66, 0.99)	0.78 (0.49, 1.25)	0.74 (0.41, 1.31)
West North Central	0.75 (0.47, 1.19)	1.03 (0.61, 1.72)	0.79 (0.57, 1.09)	0.46*** (0.28, 0.77)	0.90 (0.67, 1.21)	0.85 (0.53, 1.38)	0.83 (0.46, 1.51)
East North Central	0.74 (0.53, 1.04)	1.10 (0.67, 1.81)	0.62*** (0.45, 0.84)	0.58** (0.38, 0.86)	0.89 (0.72, 1.09)	0.80 (0.50, 1.27)	0.79 (0.45, 1.40)
>20% African American Enrollees	0.79* (0.63, 0.99)	1.34* (1.06, 1.68)	0.75* (0.61, 0.94)	0.81 (0.63, 1.05)	0.93 (0.76, 1.13)	1.04 (0.79, 1.37)	0.75 (0.55, 1.03)

*$p \leq 0.05$
**$p \leq 0.01$
***$p \leq 0.005$
****$p \leq 0.0001$
†Reference groups are in parentheses
§Odds ratios were computed based on parameter estimates generated from the hierarchical linear analysis, modeling each HEDIS measure as a function of gender and race/ethnicity, controlling for age, income, and geographic region.
#This analysis was limited only to individuals who met the performance indicators for both HbA_{1c} and LDL, compared to individuals who had poor control in both outcomes.

Table 6. Adjusted Rates* of HEDIS Measures by Gender, Race, and Gender-Race Interaction in Diabetes Management

	(%, 95% CI)					
	HbA_{1c} testing	Poor HbA_{1c} control	Eye examination	Cholesterol screening	LDL control <100 mg/dL	Nephropathy monitoring
Gender						
Female (48,331)	89.5 (87.2, 91.4)	23.4 (19.5, 27.8)	68.2 (63.6, 72.5)	91.9 (89.7, 93.6)	37.8 (33.6, 42.2)	53.0 (48.1, 57.8)
Male (47,724)	88.0 (85.4, 90.1)	23.9 (20.0, 28.3)	65.5 (60.6, 70.2)	91.4 (89.1, 93.2)	44.7 (40.2, 49.4)	53.5 (48.4, 58.4)
Race						
African Americans (12,889)	85.8 (82.7, 88.4)	30.6 (25.9, 35.6)	64.4 (59.2, 69.2)	88.5 (85.4, 91.1)	33.7 (29.2, 38.5)	54.7 (49.0, 60.3)
White (83,166)	89.2 (86.7, 91.1)	22.6 (18.8, 26.9)	67.3 (62.5, 71.7)	92.1 (90.0, 93.8)	42.5 (38.1, 47.0)	53.0 (48.2, 57.8)
Gender*Race						
African American Female (7,702)	87.2 (84.3, 89.6)	29.0 (24.5, 34.0)	66.7 (61.7, 71.4)	89.4 (86.4, 91.8)	32.2 (28.0, 36.7)	54.6 (48.9, 60.1)
White Female (40,022)	89.9 (87.8, 91.7)	22.3 (18.5, 26.6)	68.5 (63.9, 72.7)	92.3 (90.3, 93.9)	38.9 (34.7, 43.3)	52.7 (47.9, 57.3)
African American Male (5,187)	83.7 (80.4, 86.6)	32.8 (28.0, 38.0)	60.9 (55.5, 66.0)	87.2 (83.8, 89.9)	35.9 (31.0, 41.1)	54.9 (49.0, 60.5)
White Male (43,114)	88.5 (86.1, 90.5)	22.8 (19.1, 27.2)	66.1 (61.2, 70.7)	91.9 (89.8, 93.6)	45.8 (41.3, 50.4)	53.3 (48.4, 58.2)

*Adjusted rates were derived from hierarchical linear analysis results, which estimated each HEDIS measure as a function of gender and race/ethnicity, controlling for age, income, and geographic region.

were observed for nephropathy monitoring, cholesterol screening and control measures.

In addition, our results demonstrated that there were significant barriers for women and African Americans to achieve optimal diabetes care, which includes adequate control in both HbA_{1c} and LDL. In limiting our analysis to those who had and those who had not met both HbA_{1c} and LDL control measures, we found that women were 0.85 times (95% CI: 0.79, 0.91) as likely as men to have achieved adequate control in both outcome measures and African Americans were only 0.57 times (95% CI: 0.52, 0.62) as likely as whites to have done so.

Table 6 illustrates the magnitude of the gender and race disparities by presenting rates based on the regression analyses adjusted for demographic, socioeconomic, and regional variations. The adjusted rates were very similar to the unadjusted rates, with differences generally about or less than a percent.

Specifically among the four subgroups, clinically meaningful differences can be observed in the LDL control measure between white men and both African American men and women. Similar to the results from unadjusted rates computation and the ORs from HGLM analyses, African American women were at the greatest disadvantage in achieving adequate LDL control. The difference between African American women and white men was 13.6% and that between African American and white men was 9.9%.

Discussion

Both gender and racial disparities in performance among Medicare managed care beneficiaries were observed. Our findings showed that women, both white and African American, were disadvantaged compared to men in cholesterol control, and African Americans, both male and female, were disadvantaged compared to whites on the two control measures and three of the four screening measures.

In general, African American men received the lowest rates for processes of care measures with the sole exception of nephropathy screening, where the regression results were not statistically significant. As the unadjusted rates showed, the average disparity between African Americans and whites for screening measures was approximately 3% but the greatest disparities were observed in the control measures. Racial disparity for HbA_{1c} control was 7.9% and the gap in meeting the performance standard was even greater for the cholesterol control measure. Findings related to the rates of meeting screening standards among African American men were similar to those reported by Correa-de-Araujo et al. Although African American women fared better than their male counterparts in most measures, African American women had the poorest LDL control among all beneficiaries. These findings pose serious warnings for the health care community as these poor intermediate health outcomes are likely to lead to the development of devastating long-term complications, increasing the morbidity and mortality as well as cost of care among African Americans.

These analyses suggest that gender and racial gaps are smaller for process of care measures while they are substantially larger for the intermediate outcomes measures. The relative magnitude in gender and racial disparities in the process of care measures may indicate a ceiling effect, as the screening rates for all four groups were fairly high. On the other hand, the paradox of comparable process of diabetes care but racial/ethnic disparities in intermediate health outcomes may be explained by several factors. The process measures assessed in HEDIS may not adequately capture the patient-, provider-, and system-level components of care needed to manage blood sugar concentrations and dyslipidemia (Kerr et al., 2003). Although process of care measures may be useful in targeting specific interventions and addressing gaps in care or quality, they may be so narrowly focused that they do not account for processes important to clinical care, such as "staffing patterns, interdisciplinary communication, supportive infrastructure, and information-technology (Krumholz, Normand, Spertus, Shahian, & Bradley, 2007)." In addition, collecting information for quality measurement can be burdensome and therefore, decisions may be made to trade better information on the effectiveness of the process being measured for the feasibility and efficiency of data collection (Krumholz et al., 2007). Other factors that may contribute to disparities in intermediate diabetes outcomes include racial/ethnic differences in self-care behaviors, differential medication adherence, less intensive physician treatment and possible biologic variation in blood pressure and lipid levels (Bonds et al., 2003; Harris, Sherman, & Georgopoulos, 1999; Harris, Eastman, Cowie, Flegal, & Eberhardt, 1999; Karter et al., 2002; Saaddine et al., 2002). For example, physician knowledge and attitudes may underlie some differences in treatment. Physicians' awareness of the lower risk for myocardial infarction in African Americans who have diabetes and the greater emphasis placed upon blood pressure control may lead physicians to focus more on blood pressure control in African Americans (Karter et al., 2002).

This study examined both racial and gender disparities using a large, nationally representative sample of the Medicare managed care population, with publicly reported and audited quality measures. In addition, these data have a nested structure, with information from both the member and plan level. Therefore, applying the HGLM model, where each of the levels in the data structure is represented by its own sub-model to account for the residual variability at that level, (McCormick, Himmelstein, Woolhandler, Wolfe, & Bor, 2002; Raudenbush et al., 2002) renders a more complete "picture" of what is occurring at the member level while controlling for clustering effects of the plans. The mandatory reporting of health plan data also negates possible selection bias that may arise from voluntary reporting and therefore makes the sample fairly generalizable (McCormick et al., 2002; Trivedi et al., 2005). Furthermore, previous studies in this area have focused on each of the intermediate health outcomes separately. Optimal diabetes management should include adequate control of both HbA_{1c} and LDL and our study contributes to current literature by examining the effects of gender and race on both outcomes simultaneously, where women and African Americans were less likely to adequately manage their diabetes symptoms and CVD risk at the same time.

Like all studies, this study has some limitations. First, the dataset does not contain additional individual demographic data such as marital status, individual health status (e.g., body mass index), behavioral and disease characteristics, or plan utilization patterns, which some studies have suggested are associated with disparities in outcomes (de Rekeneire et al., 2003). Second, although the sample size is large and representative, it only captures the segment of the Medicare population that enrolls in managed care plans (Harris, 1999; Harris, 2002). Lastly, this study examined only African American-white comparisons because data on other ethnic/racial groups were scant or incomplete. As our society becomes more diverse, better and more consistent reporting of racial/ethnic identification is warranted and incorporating other racial/ethnic groups into these types of analyses will enhance our understanding of disparities in quality of care and how they change over time.

Monitoring quality of care by race and gender is essential for uncovering disparities and observing whether disparities are improving or decreasing over time. The differences in the pattern of care demonstrate the need for gender- and ethnic/racially-tailored interventions for quality improvement. Specifically, clinical evidence has shown a strong link between self-management and improved outcomes. Given the poor outcomes observed in African Americans in our sample, more action may be warranted to design the infrastructure and allocate resources to enhance self management skills and efficacy, varying strategies to appropriately address gender and racial differences. For example, Correa-de-Araujo et al. advocated for self-management education that is tailored to the lifestyles and beliefs specific to gender and racial groups (Correa-de-Araujo, McDermott, & Moy, 2006; Correa-de-Araujo & Clancy, 2006). The need for focused interventions will only increase with time as elderly women constitute the fastest-growing segment of our society (Sowers, 2004), and by year 2050, nearly one in two Americans will be a person of color (Institute of Medicine, 2003).

The large gap in adequate cholesterol control between men and women is an important example of a situation in which special attention is needed to identify and reduce gender disparities in diabetes care and CVD risk. Although diabetes markedly increases the risk of CVD in both men and women, it has a stronger effect on the risk of coronary heart disease in women than men. Women with diabetes have up to a ten-fold increase in coronary heart disease mortality compared to women without diabetes (Juutilainen et al., 2004; Sowers, 2004), and dyslipidemia and hypertension have an even stronger association with coronary disease mortality in women than men (McFarlane & Sowers, 2005). The lack of statistically significant gender disparities in HbA_{1c} control, but the lower HbA_{1c} control observed among African American women in comparison to white men, suggests that at least white women were receiving care to manage their primary symptoms of diabetes that was similar to their white male counterparts. Notwithstanding this small improvement, the significantly pronounced gender and racial disparities in LDL control suggest missed opportunities for managing CVD risk. Given that the rate of LDL control is modest even for white men, the goal should not be just to reduce gaps between men and women, but to increase the rate of all members in meeting this important quality indicator and at the same time striving to reduce the disparities between men and women and those between African Americans and whites.

Reducing the racial and gender gaps we observed in this study will require a multifaceted approach. First, as mentioned previously, the overall low LDL control rates observed among the four subgroups in our sample demonstrate the need to improve care for all, which may in turn ameliorate the gender and racial gaps. It is important to work with health care providers, managed care organizations, and purchasers to strengthen efforts to monitor progress in this area. This includes educating the health care community about these disparities and their implications for outcomes in populations as well as updating a national database that includes member level information on race, gender and health indicators. Data with gender and race/ethnicity information allow for measurement to assess the effectiveness of interventions in reducing disparities. Second, additional studies are needed to identify and evaluate causes that would explain these differences at the various levels of the health care system. We need to identify also interventions that can be most effectively implemented by clinical practices, health care organizations, other entities, such as CMS, or in coordination with local resources, such as community centers. Finally, 'closing the quality gap' in health care disparities should include educating patients to seek health care that will help them manage their chronic conditions and avoid complications. In particular, educational efforts to alert women about CVD risk and to engage in treatment and those targeting African American men to focus on HbA_{1c} control and other risks for diabetic complications are urgently needed. Collaboration among consumers, health plans, providers, and, community organizations is essential in moving towards achieving the goals of Healthy People 2010 (CDC, 2001), "to eliminate health disparities among segments of the population, including differences that occur by gender, race or ethnicity."

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Author Descriptions

Ann F. Chou, PhD, MPH, is an Assistant Professor in the Department of Health Administration and Policy at the University of Oklahoma College of Public Health and College of Medicine. She is a health services researcher whose interests focus on implementation of best practices and quality of care.

Arleen Brown, MD, PhD, is an Assistant Professor in the Division of General Internal Medicine and Health Services Research at the University of California, Los Angeles. She is a health services researcher with an interest in health disparities and quality of care for older adults with diabetes.

Roxanne Jensen is a doctoral student in the Department of Health Policy & Management at the Johns Hopkins Bloomberg School of Public Health. Her concentration is in Health Services and Outcomes Research.

Sarah Shih, MPH, is a Senior Health Care Analyst in the Department of Research and Analysis at the National Committee for Quality Assurance. Ms. Shih is responsible for the management and implementation of funded health services research projects. She also supports NCQA's development and maintenance of research collaborations.

L. Gregory Pawlson, MD, MPH, is Executive Vice President of NCQA and Clinical Professor of Medicine and Health Care Sciences at George Washington University. He has been involved in a broad range of health services research and policy related to health care quality and the care of older persons.

Sarah Hudson Scholle, MPH, DrPH, is Assistant Vice President for Research at the National Committee for Quality Assurance in Washington, DC. She is a health services researcher, and her current research focuses on quality measurement, women's health, and disparities.