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GENDER DISPARITIES IN THE QUALITY OF CARDIOVASCULAR DISEASE CARE IN PRIVATE MANAGED CARE PLANS

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Background. **Studies have shown that women with cardiovascular disease (CVD) are screened and treated less aggressively than men and are less likely to undergo cardiac procedures. Research in this area has primarily focused on the acute setting, and there are limited data on the ambulatory care setting, particularly among the commercially insured. To that end, the objective of this study is to determine if gender disparities in the quality of CVD care exist in commercial managed care populations.**

Methods. **Using a national sample of commercial health plans, we analyzed member-level data for 7 CVD quality indicators from the Healthcare Effectiveness Data and Information Set (HEDIS®) collected in 2005. We used hierarchical generalized linear models to estimate these HEDIS measures as a function of gender, controlling for race/ethnicity, socioeconomic status, age, and plans' clustering effects.**

Results. **Results showed that women were less likely than men to have low-density lipoprotein (LDL) cholesterol controlled at <100 mg/dL in those who have diabetes (odds ratio [OR], 0.81; 95% confidence interval [CI], 0.76 – 0.86) or a history of CVD (OR, 0.72; CI 95%, 0.64 – 0.82). The difference between men and women in meeting the LDL control measures was 5.74% among those with diabetes (44.3% vs. 38.5%) and 8.53% among those with a history of CVD (55.1% vs. 46.6%). However, women achieved higher performance than men in controlling blood pressure (OR, 1.12; 95% CI, 1.02–1.21), where the rate of women meeting this quality indicator exceeded that of men by 1.94% (70.8% for women vs. 68.9% for men).**

Conclusions. **Gender disparities in the management and outcomes of CVD exist among patients in commercial managed care plans despite similar access to care. Poor performance in LDL control was seen in both men and women, with a lower rate of control in women suggesting the possibility of less intensive cholesterol treatment in women. The differences in patterns of care demonstrate the need for interventions tailored to address gender disparities.**

Cardiovascular disease (CVD) is the leading cause of death in the United States for both men and women (American Heart Association [AHA], 2003; Panel on DHHS Collection of Race and Ethnic Data, 2004; Sheifer, Escarce, & Schulman, 2000). Nevertheless, among individuals with established CVD, there is

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some evidence that women are more likely to suffer CVD-related morbidity and mortality (Hollenbeak, Weisman, Rossi, & Ettinger, 2006; Schulman et al., 1999; Sheifer et al., 2000). The greater adverse outcomes experienced by women may be partially related to the gender differences in the management of CVD. For example, women are screened and treated less aggressively than men and are less likely to undergo cardiac procedures (Brown, Giles, Greenlund, & Croft, 2001; Correa-de-Araujo et al., 2006; Davis, Cogswell, Rothenberg, & Koplan, 1998; Gardner, Winkleby, & Fortmann, 2000; Harrold et al., 2003; Hollenbeak et al., 2006; Legato, 2000; Mosca et al., 2005; Pearson, 2000; Sheifer et al., 2000). For those with known CVD, women have been shown to have a worse prognosis compared with men. They tend to achieve lower control than men for blood pressure (Hendrix, Lackland, & Egan, 2003) and lipids (Massing et al., 2004; Maviglia, Teich, Fiskio, & Bates, 2001; Mosca et al., 2005; Pearson, Laurora, Chu, & Kafonek, 2000; Persell, Maviglia, Bates, & Ayanian, 2005; Qureshi, Suri, Guterman, & Hopkins, 2001) and were less likely to have recommended cholesterol testing (Hippisley-Cox, Pringle, Crown, Meal, & Wynn, 2001; Sloan et al., 2001) and β-blocker treatment (Mehta et al., 2001). In persons with diabetes mellitus, where less than optimal management of the disease may lead to increased risk of CVD (Hu, 2003; LIPID Study Group, 1998; Sheifer et al., 2000), studies have also reported lower cholesterol screening and control rates for women (Nau & Mallya, 2005; Correa-de-Araujo, McDermott, & Moy, 2006; Correa-de-Araujo, Miller, Banthin, & Trinh, 2005).

Although a large body of research has found gender disparities in CVD prevention and treatment services, this prior research has focused primarily on hospital populations or relied on limited sample sizes (Kim, Kerr, Bernstein, & Krein, 2006; Mosca et al., 2005). Moreover, although gender gaps reported in hospital-based, acute care setting have been closing, there is no evidence about whether these trends exist in the ambulatory setting. The purpose of this study is to evaluate gender disparities across multiple CVD-related performance measures in enrollees of a national sample of commercial managed care plans. Given the demographic heterogeneity within each gender category in this population, we also examined gender disparities among persons stratified by socioeconomic status (SES) and race/ethnicity.

Methods

Data and Sample Selection

We used data reported by health plans in conjunction with those from Healthcare Effectiveness Data and Information Set (HEDIS®). HEDIS is a comprehensive performance measurement program administered by the National Committee for Quality Assurance (NCQA). Health plans report quality of care data based on data derived from administrative claims (billing records) and chart reviews (NCQA, 2005). The NCQA invited all health plans that reported HEDIS in 2005 to submit member-level performance measures related to CVD care in addition to their standard plan-level reporting. In all, 31 plans submitted member level performance data for at least one measure (Table 1). The process of obtaining individual patient-level data represented a significant burden for health plans because HEDIS typically requires only plan-level reporting.

In addition, plans submitted separate data on member demographic information such as age, gender, last name, and address including ZIP codes. Racial/ethnic and SES information for each member was then derived using previously validated methods for geocoding and surname analyses. To identify African-American race and SES, geocoding at the census block level was performed (Fremont et al., 2005; Massey & Denton, 1989). Surname analyses, which use an individual's last name to estimate the likelihood that they belong to a particular racial/ethnic group, were employed to determine the race/ethnicity of Latinos and Asians (Fremont et al., 2005), for whom there are well-developed surname dictionaries (Abrahamse, Morrison, & Bolton, 1994; Panel on DHHS Collection of Race and Ethnic Data, 2004).

Results from plans enrolled in this study appear to be generalizable to all plans that report HEDIS quality data to NCQA. Plans that submitted data for this study were similar to all plans reporting HEDIS data in plan type (64.3% were organized as Independent Practice Association or network models) and geographic region (28% were in the Northeast, 16% in the Midwest, 44% in the South, and 12% in the West), and they had similar performance on all but 1 of the 7 measures. Plans in our study tended to be larger plans than all those that report HEDIS data. This may be because larger plans may have more resources to meet the burden of the data submission process.

Measures

Dependent variables. Seven quality indicators related to cardiovascular care from the HEDIS 2005 set served as dependent variables (Table 1). One measure captured blood pressure control and 5 measures addressed quality of care post a cardiac event: 1) β-blocker treatment; 2) persistence of β-blocker treatment; 3) cholesterol screening; and 4) low-density lipoprotein (LDL) cholesterol control at <100 mg/dL (Table 1). The same cholesterol screening and control measures were collected for persons with diabetes (NCQA, 2005). The dependent variables were dichotomized, where responses for members who received the rec-

Table 1. Select HEDIS 2005 measures for data collection by gender

	2005 HEDIS Cardiovascular Disease Measures	Numerator (Quality Indicators for Analysis)	Denominator (eligible population)
1.	β-Blocker treatment after a heart attack	An ambulatory prescription for β-blockers rendered within 7 days (inclusive) after discharge.	Members who are ≥35 years of age as of December 31 of the measurement year and discharged alive from an inpatient setting with an AMI from January 1–December 24 of the measurement year.
2.	Persistence of β-blocker treatment after a heart attack	A 180-day course of treatment with β-blockers.	Members who are ≥35 years of age as of December 31 of the measurement year and discharged alive from an acute inpatient setting with an AMI between July 1 of the year prior to the measurement year through June 30 of the measurement year.
3.	Controlling high blood pressure	Both the systolic and diastolic blood pressure is ≤140/90 for adequate control.	Members who are 46–85 years of age, hypertensive, and continuously enrolled in the managed care plan as of December 31 of the measurement year.
4&5.	Cholesterol management after acute cardiovascular events (AMI, CABG, PTCA)	• *Screening*: An LDL-C screening performed on or between 60 and 365 days after discharge for an acute cardiovascular event as determined by administrative data or medical record review. • *Lipid control* (LDL-C) <100 mg/dL: Any LDL-C level of <100 mg/dL on or between 60 and 365 days after discharge for an acute cardiovascular event.	Members who are 18–75 years of age as of December 31 of the measurement year and continuously enrolled in the managed care plan for 365 days after the member has been discharged alive for an AMI, CABG, or PTCA. All PTCA cases should be included regardless of setting. AMI and CABG cases should be from inpatient setting only.
6&7.	Comprehensive diabetes care	• *Screening*: An 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/antihyperglycemics during the measurement year or year prior to measurement year.

Abbreviations: AMI, acute myocardial infarction; CABG, coronary artery bypass grafting; HEDIS, Healthcare Effectiveness Data and Information Set; LDL-C, low-density lipoprotein cholesterol; PTCA, percutaneous transluminal coronary angiography.

ommended screening or met control thresholds were assigned a value of 1.

Explanatory variables. Gender is dichotomized (female = 1; male = 0). Two binary variables were included for race/ethnicity—African American and Latino—with white serving as the referent group. The African-American variable was assigned a value of 1 if the member lived in a predominantly African-American block group where >66% of residents in the neighborhood are African Americans (Fremont et al., 2005; Nerenz, Bonham, Green-Weir, Joseph, & Gunter, 2002). Latino members were identified via surname analyses. Asians constituted <2% of the sample, and this group was excluded from all analyses.

Living in neighborhoods with poverty was used as a proxy for SES, which was defined, using geocoding, as a block group where >20% of its residents have an income below the federal poverty level (Fremont et al., 2005). Age was dichotomized into 2 groups, where those who were aged ≥65 were assigned a value of 1, and all those <65 serving as the reference group. Age was entered into the model as a control variable.

Statistical Analysis

Descriptive statistics were compiled to describe the sample. We calculated unadjusted rates for men and women who met the HEDIS performance measures to present the absolute female–male differences for each measure. We also generated unadjusted rates for men and women within each SES and racial/ethnic groups to examine gender disparities within each subgroup. We limited these calculations to the population under the age of 65 as those 65 and older may have dual coverage, where they may have obtained services that were not reflected in these data.

Table 2. Members characteristics of participating health plans

	β-Blocker Treatment After a Heart Attack n (%)	Persistence of β-Blocker Treatment After a Heart Attack n (%)	Controlling High Blood Pressure n (%)	Comprehensive Diabetes Care n (%)	Cholesterol Management n (%)
Total number of plans	28	29	29	31	31
Total eligible members (n)	3,824	2,096	10,545	11,813	7,386
Female	869 (22.7)	487 (23.2)	5,118 (48.5)	5,221 (44.2)	1,615 (21.9)
Race/ethnicity					
African American	161 (4.6)	112 (5.3)	754 (7.2)	1,008 (8.5)	320 (4.3)
Latino	246 (6.4)	139 (6.6)	510 (4.8)	913 (7.7)	365 (4.9)
White/other	3,082 (80.6)	1,671 (79.7)	8,406 (79.7)	8,812 (74.6)	6,108 (82.7)
Community characteristics					
Living in poverty area	309 (8.1)	182 (8.7)	915 (8.7)	1,212 (10.3)	515 (7.0)
Age (yrs)					
≥65	528 (13.8)	222 (10.6)	976 (9.3)	788 (6.7)	1,017 (13.8)
45–64	2,907 (76.0)	1,618 (77.2)	9,569 (90.7)	8,578 (72.6)	5,865 (79.4)

To assess gender disparities, we estimated the probability of meeting a HEDIS CVD-related performance measure for each individual member using a hierarchical generalized linear model (HGLM). We employed the HGLM to adjust for the clustering of members within health plans (Raudenbush & Bryk, 2001). The HGLM analyses modeled HEDIS measures as functions of gender, controlling for race/ethnicity, age, and SES at the first level, and the plan's clustering effects on the second. The effect size of the independent gender variable was estimated by odds ratios (ORs) from the HGLM. Adjusted rates were derived from the HGLM analyses, controlling for age, race/ethnicity, and SES. All analyses were conducted using SAS software v9.1 (SAS Institute, Cary, NC).

Results

Table 2 describes the characteristics of sampled managed care plan members who were eligible for each of the CVD measures. The number of members eligible for each measure varied from 2,096 for persistence of β-blocker treatment to 11,813 for management of diabetes. Across all measures, the proportion of eligible women ranged from 21.9%–48.5%, and 4.3%–8.5% of the sample populations were African American and 4.8%–7.7% were Latino. The sampled populations between the ages of 45 and 64 years ranged from 72.6%–90.7%. Seven percent to 10% of the sample lived in neighborhoods where 20% of the residents have income below the federal poverty line.

Unadjusted Rates of Performance on CVD Quality Measures Across Gender Subgroups

In unadjusted data limited to those <65 years old, we found statistically significant gender disparities in 6 of the 7 measures. However, some of these differences were small in magnitude and the pattern of disparity varied by race and SES (Table 3). The male–female differences in lipid control were the largest in magnitude. Among members with diabetes, 43.3% of the men compared with 37.7% of the women achieved LDL control at the <100 mg/dL level, representing a disparity of 5.6 percentage points. Among those with CVD, 55.0% of the men had adequate LDL control versus 45.3% of women, yielding a disparity of 9.7 percentage points. Only rates related to the controlling of high blood pressure measure favored women, albeit with a very small disparity of 1.8 percentage points (70.8% for women vs. 68.9% for men). The remaining measures showed only small differences, around 3 percentage points or lower, in performance between men and women.

In general, African Americans had lower rates of achieving performance standards compared with Whites, but differences in rates observed between African-American females and males were similar to those observed between White males and females. However, the patterns of care for Latinos were different. African American women with diabetes were less likely to have LDL controlled at <100 mg/dL level compared to African-American men (29.9% vs. 36.1%), with a disparity of 6.2%. The pattern was similar but not significant for LDL control among patients with CVD. In contrast, the unadjusted rates of LDL control were similar for Latino men and women. For other CVD measures, including persistence of β-blocker treatment and blood pressure control, African-American women appeared to be at an advantage over men, although the differences in rates of achievement of measures were not significant, possibly due in part to the limited sample size.

The unadjusted results showed generally lower rates of quality among persons residing in impoverished neighborhoods with similar gender disparities in LDL control favoring men. For example, there was a 5.5% difference favoring men for controlling LDL at <100 mg/dL among those with diabetes (47.2% for

Table 3. Unadjusted HEDIS measure results by gender and gender subgroups for members under age 65

	β-Blocker Treatment After a Heart Attack		Persistence of β-Blocker Treatment After a Heart Attack		Controlling High Blood Pressure		Cholesterol Screening for Patients With Diabetes		Lipid Control <100 mg/dL for Patients With Diabetes		Cholesterol Screening for Patients in Cholesterol Management		Lipid Control <100 mg/dL for Patients in Cholesterol Management	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Gender														
Female	719	94.7	422	62.3	4676	70.8	4931	91.6	4931	37.7	1389	76.8	1317	45.3
Male	2577	97.0	1452	65.2	4893	68.6	6094	92.7	6094	43.3	4980	79.9	4763	55.0
t-Statistic	2.91**		1.07		−2.43*		2.13*		6.04****		2.53*		6.22****	
African American														
Female	47	89.4	37	67.6	398	61.1	519	90.6	519	29.9	99	65.7	79	34.2
Male	92	94.6	61	49.2	302	54.3	424	87.7	424	36.1	176	64.2	145	44.8
t-Statistic	1.12		−1.79		−1.79		−1.39		2.03*		−0.24		1.55	
Latino														
Female	53	90.6	32	53.1	227	73.6	380	95.0	380	34.7	77	79.2	76	50.0
Male	156	96.8	92	62.0	238	73.1	481	92.9	481	35.6	247	76.1	241	52.3
t-Statistic	1.84		0.87		−0.11		−1.25		0.25		−0.56		0.35	
White/other														
Female	550	96.0	322	63.4	3672	72.6	3596	91.5	3596	39.4	1094	77.6	1047	46.2
Male	2105	97.0	1169	66.1	3948	69.8	4622	93.2	4622	44.9	4160	80.8	4002	55.4
t-Statistic	1.19		0.93		−2.69**		2.84**		5.05****		2.32*		5.31****	
Living in poverty area														
Female	71	93.0	48	64.6	476	61.3	592	92.1	592	30.6	111	74.8	109	36.7
Male	195	95.9	113	46.0	366	62.3	540	88.7	540	36.1	342	74.3	324	47.2
t-Statistic	0.98		−2.17*		0.28		−1.92		1.98*		−0.11		1.92	
Not living in poverty area														
Female	578	95.2	342	63.6	3854	72.7	3953	91.7	3953	39.1	1167	77.2	1101	47.0
Male	2182	97.0	1224	67.0	4185	69.5	5081	93.3	5081	44.3	4287	80.4	4105	55.6
t-Statistic	2.15*		1.53		−3.08**		2.87**		5.08****		2.37*		5.14****	

*$p \le .05$; **$p \le .01$; ***$p \le .001$; ****$p \le .0001$.

men vs. 36.7% for women). On the other hand, women residing in poor neighborhoods were more likely than their male counterparts to have received recommended β-blocker treatment and cholesterol screening. In this population, there was an 18.6% difference favoring women in meeting the persistence of β-blocker treatment standard and 92.1% of the women with diabetes met the cholesterol screening measure comparing to 88.7% of men. However, by comparison, women who did not reside in neighborhoods with poverty lagged behind their male counterparts in all measures related to cholesterol screening and control.

Gender Disparities in Cardiovascular Care

HGLM results showed that gender disparities identified in the unadjusted data persisted after controlling for age, race, ethnicity, and SES in 4 of the 7 CVD quality indicators (Table 4). Women were significantly less likely to meet the performance indicators for cholesterol control compared to men. For example, women with diabetes were only 0.81 times (95% confidence interval [CI], 0.76–0.86) and those who had a cardiac event were 0.72 times (95% CI, 0.64–0.82) as likely as men to achieve adequate LDL control. The gender disparity was also significant in cholesterol screening, although the impact was small. In contrast, women were more likely then men to achieve blood pressure control with an odds ratio of 1.12 (95% CI, 1.02–1.21). When adjusted for sociodemographic characteristics, we saw that the disparities in rates for meeting medication and screening measures were around 2% in either direction (Table 5). However, the largest disparities in the adjusted rates were observed in both LDL control measures where the gender difference between men and women with diabetes was 5.8% in those with diabetes (44.3% for men vs. 38.5% for women) and 8.5% in those with CVD (55.1% for men vs. 46.6% for women).

In addition, the multivariate analyses demonstrated that race, ethnicity, age, and SES all had statistically significant and independent influences on cardiovascular care (Table 4). We were unable to test for interactions between gender and these covariates because of sample size limitations. Compared with Whites, African Americans were less likely to have met the performance standards for controlling blood pressure (OR, 0.72; 95% CI, 0.58–0.89), cholesterol screening and control among those with diabetes (OR, 0.69; 95% CI, 0.52–0.92 and OR, 0.74; 95% CI, 0.60–0.91, respectively), LDL control among patients with acute cardiac event (OR, 0.71; 95% CI, 0.51–0.98). Latinos were less likely to have met the LDL control measures for those with diabetes (OR 0.73; 95% CI, 0.61–0.88) and to receive screening for cholesterol management (OR, 0.79; 95% CI, 0.65–0.96), compared with whites. Furthermore, members from impoverished neighborhoods had poorer performance than

Table 4. Predictors of HEDIS measures related to cardiovascular care (odds ratios and 95% confidence intervals)[a]

	β-Blocker Treatment After a Heart Attack	Persistence of β-Blocker Treatment After a Heart Attack	Controlling High Blood Pressure	Cholesterol Screening for Patients With Diabetes	Lipid Control <100 mg/dL for Patients With Diabetes	Cholesterol Screening for Patients in Cholesterol Management	Lipid Control <100 mg/dL for Patients in Cholesterol Management
Gender (Male)							
Female	0.72 (0.44, 1.17)	0.94 (0.75, 1.17)	1.12* (1.02, 1.21)	0.88 (0.76, 1.02)	0.81**** (0.76, 0.86)	0.88* (0.79, 0.99)	0.72**** (0.64, 0.82)
Race/ethnicity (White/other)							
African American	0.54 (0.22, 1.34)	0.81 (0.58, 1.14)	0.72** (0.58, 0.89)	0.69* (0.52, 0.92)	0.74** (0.60, 0.91)	0.88 (0.64, 1.20)	0.71* (0.51, 0.98)
Latino	0.79 (0.53, 1.17)	0.88 (0.68, 1.14)	1.06 (0.87, 1.28)	1.13 (0.89, 1.43)	0.73** (0.61, 0.88)	0.79* (0.65, 0.96)	0.87 (0.69, 1.10)
SES (without poverty)							
With poverty	0.97 (0.60, 1.57)	0.60** (0.43, 0.83)	0.75*** (0.64, 0.87)	0.85 (0.69, 1.03)	0.83** (0.73, 0.94)	0.78** (0.65, 0.92)	0.75** (0.62, 0.92)
Age (<65 yrs)							
≥65	1.05 (0.55, 2.02)	1.73** (1.17, 2.55)	0.91 (0.79, 1.06)	1.10 (0.85, 1.42)	1.52**** (1.28, 1.80)	1.03 (0.88, 1.21)	1.26** (1.07, 1.48)

Reference groups are in parentheses.

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$; ****$p \leq .0001$.

[a]The odds ratios were derived from the HGLM analyses.

Table 5. Adjusted rates of meeting HEDIS measures by gender[a]

	β-Blocker Treatment After a Heart Attack	Persistence of β-Blocker Treatment After a Heart Attack	Controlling High Blood Pressure	Cholesterol Screening for Patients With Diabetes	Lipid Control <100 mg/dL for Patients With Diabetes	Cholesterol Screening for Patients in Cholesterol Management	Lipid control <100 mg/dL for Patients in Cholesterol Management
Women (*n*)	791	455	4,737	4,816	4,816	1,487	1,487
Men (*n*)	2,725	1,485	5,048	6,076	6,076	5,364	5,364
Adjusted rates, % (95% CI)							
Women	95.8 (93.0, 97.4)	64.5 (57.3, 71.1)	70.8 (67.69, 73.8)	91.9 (90.3, 93.2)	38.5 (36.1, 41.0)	75.8 (66.9, 82.9)	46.6 (42.2, 51.0)
Men	97.0 (95.5, 98.0)	66.3 (61.0, 71.2)	68.9 (65.5, 72.0)	92.9 (91.5, 94.1)	44.3 (41.8, 46.8)	78.2 (70.18, 84.5)	55.1 (51.7, 58.5)
Difference[b]	−1.2	−1.8	1.9	−1.0	−5.8	−2.4	−8.5

[a]The rates were derived from the HGLM analyses, adjusted for age, race/ethnicity, and SES.
[b]The difference in rates is calculated by subtracting the rate for men from that for women. Therefore, the negative sign denotes difference in favor of men.

members from nonimpoverished neighborhoods on 5 of the 7 measures: persistent β-blocker treatment, controlling blood pressure, LDL control at <100 mg/dL for persons with diabetes, cholesterol screening, and LDL control at <100 mg/dL for those who had a cardiac event.

Discussion

Our study found generally low rates of achieving adequate lipid control in both men and women, with a lower rate of control in women suggesting the possibility of less intensive cholesterol treatment in women. Lipid control is an important indicator of the quality for CVD care among commercially insured managed care populations and the low rates of meeting these LDL control measures is concerning given this is a population at high risk owing to CVD and diabetes. Several national guidelines, such as those by the National Cholesterol Education Program Adult Treatment Panel (NCEP ATP) and AHA, recommend lipid control at least the <100 mg/dL level for both men and women with these conditions (Mosca et al., 2004; Smith, 1998; Smith et al., 2006). The overall low rates of LDL control in both men and women demonstrated that the need for improvement remains 6 years after the NCEP ATP and AHA guidelines were first implemented. Attaining optimal LDL levels requires the concerted efforts of providers and patients, and strategies to facilitate effective patient–provider interaction must be identified.

The unadjusted rates of meeting HEDIS standards stratified by gender showed significant disparities in all CVD care measures, except in persistent β-blocker treatment, but differences in measures related to screening and medication prescriptions were small. Women were more likely to receive recommended care than men on only 1 measure of CVD care—blood pressure control—although this difference was only about 2%. The smaller differences observed in measures related to screening and medication prescription may be because the initiation of medication or assessment can be more easily accomplished by providers, most of whom have been shown to advance therapy appropriately, as compared with measures that address attainment of intermediate outcomes, which depend largely on patient self-efficacy and therapeutic adherence, and may be much more difficult to achieve (Kim et al., 2006). In addition, it may be easier to prescribe β-blockers at a salient moment, such as hospitalization for a heart attack, than continuing this therapy over time in an outpatient setting.

We found clinically important and statically significant gender disparities in lipid control in our multivariate analysis as well as in unadjusted and adjusted rates. The findings related to lipid control are consistent with Mosca et al.'s (2005) report, which showed one third of women received recommended drug therapy and by the study's completion, almost one third of the high-risk women attained the goal of LDL<100 mg/dL, compared with the 17% who did so at baseline (Mosca et al., 2005). However, our study focused on a nationally representative sample from multiple health plans, whereas Mosca et al.'s study population was from a single large managed care plan in the Southeast region of the United States. These findings also add to Mosca's evaluation of preliminary data in LDL control, which was conducted 1 year after the NCEP ATP and AHA guideline change in 1999. In the 5 years since Mosca et al.'s study, our findings demonstrated an improvement in the rates of achieving optimal lipid level compared to those reported by Mosca et al., although these rates are still far from ideal. Both our study and Mosca et al.'s differed from the epidemiologic study by Goff et al. (2006), which reported that men were less likely to be treated and had LDL controlled. The contradictory findings are likely due to the fact that Goff et al. (2006) used a sample drawn from 6 large urban and multiethnic communities in the United States that included subjects who agreed to participate in a longitudinal study, where there may be differential participation by healthier women and gender differences in insurance coverage and health-seeking behaviors. Our study focused on the population with elevated risk factors for CVD from a sample of managed care enrollees where variations in insurance benefits and access to services are likely to be smaller than in a general population.

The disparities of 5%–9% in adjusted rates for LDL control and 5%–10% of unadjusted rates for LDL control in those <65 years of age observed in our study may be related to patient-, provider-, or system-level components of care. At the patient level, a lack of regular source of care, awareness of CVD risk, and familiarity with symptoms, are likely to hinder or delay care for women (Mosca, Ferris, Fabunmi, & Robertson, 2004). For example, Nau and colleagues have found that women were more likely than men to underestimate their risks and the severity of CVD (Nau et al., 2005; Nau & Mallya, 2005). In addition, women often see both an internist and an obstetrician-gynecologist and may receive fragmented CVD-related care if such care is not coordinated (Henderson, Weisman, & Grason, 2002). At the provider level, lower perceived risk of CVD in women, compared with men, has been reported and may explain gender difference in lipid management among women at intermediate risk (Mosca et al., 2005). For both the female and minority populations, physician bias and inaction, where physicians may perceive the prevention and management of CVD to be more important in men, have been cited as barriers to adequate care (Kim et al., 2006; Phillips et al., 2005). With regard to health care system factors, there is a need for health care organizations to explore health care delivery arrangements that may increase or decrease the delivery of clinical preventive services for CVD to women. Examples of innovative strategies have included the provision of primary care by a generalist and obstetrician-gynecologist for younger women who routinely seek care from both and delivery of care in a women's health center.

It is important to explore whether the observed difference in lipid control between men and women is in fact based on gender. The Institute of Medicine (IOM) defines *disparity* as differences in the quality of care that are not due to clinical need or patient preferences, but are instead attributable to differences in health care operations and potentially discrimination, biases, stereotyping, and uncertainty. Although women differ in age at onset and presentation of CVD, there is no evidence that treatments for lowering lipid levels are less effective among women than among men. Our data focused on populations where there is overwhelming consensus about the value of lipid control—patients with previous cardiac events (including heart attacks, coronary artery bypass graft survey, and angioplasty) as well as patients with diabetes for whom CVD risk management is particularly important. For this reason, we use the term *gender disparities* rather than *sex differences*, because we are studying differences in how women and men are treated within the health care system based on their gender presentation. This is consistent with the IOM (2003) recommendation for terminology in the study of human subjects (Pinn, 2003). *Disparity* is a more appropriate term than *difference* because we believe that the likelihood of women receiving services in commercial managed care should be comparable to their male counterparts, and hence, disparities would occur if 1 group has a statistical advantage over the other in obtaining treatment or achieving treatment goals.

This study addresses several gaps in current research on disparities in CVD care (Institute of Medicine, 2003) by employing a nationally representative sample from commercial managed care plans. However, several limitations should be noted. We had limited data on individual behaviors, comorbidities, and disease characteristics, which have been suggested to have an association with disparities in outcomes. Although the sample size was large and representative, obtaining racial/ethnic stratified data was challenging. We derived race/ethnicity information from indirect methods of geocoding and surname analyses rather than self-report by plan members. However, Fremont et al. (2005) have found that the accuracy of identifying race/ethnicity via geocoding is comparable to that of self-report. In addition, we did not have sufficient study group sizes to examine interactions between gender and sociodemographic characteristics. For example, our findings related to age showed that those 65 and older were more likely to achieve LDL control in both high-risk populations. One possible explanation may be those 65 and older may better afford medications for LDL control because of additional coverage with Medicare. However, because of the small sample size of those 65 and older, we were unable to test for gender differences in this subpopulation. If Medicare coverage is related to increased medication compliance, it would significantly benefit women, because CVD is likely to manifest in women approximately 10 years later than men.

This research demonstrates that gender disparities in CVD care documented in the literature are supported by HEDIS performance results in commercial managed care. This lends evidence for the need to track quality of care by gender, which may lead to quality improvement efforts in CVD care targeting women. Reducing gender disparities in CVD will require a multilevel intervention, involving health plans, providers, and patients. Educating providers about CVD risk assessment may ameliorate gender gaps in care and outcomes. Patient awareness on CVD-related gender disparity needs to be promoted. Women could be specifically targeted for more education to increase their knowledge about CVD risks and encourage them to seek CVD care. For example, the "Heart Truth Campaign" by the National Institutes of Health and the "Go Red" campaign by the American Heart Association represent efforts on the national level to promote awareness of heart health in women.

CVD in women incurs a large human and financial burden to the health care system (Witt & Roger, 2003). Addressing this problem may require more research in exploring critical organizational and process-of-care variables that may account for the potential gender disparities. Future research should examine and identify causes accounting for these differences at the provider level (e.g., biases, specialty differences, referral patterns) and providers' role in engaging in strategies to eliminate gender disparities in CVD care. Furthermore, continued data collection will be critical to monitor health plans' progress in overall management of all CVD patients and combating disparities in CVD care. Data collection should be broadened to capture additional information on SES, education, cultural/behavioral issues, determinants of health and disease (Correa-de-Araujo & Clancy, 2006). The availability of these data will help to improve our understanding of how these factors interact and allow the development of effective quality improvement efforts.

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References

Abrahamse, A., Morrison, P., & Bolton, N. (1994). Surname analysis for estimating local concentration of Hispanic and Asians. *Population Research Policy & Review*, 13, 383–398.

American Heart Association (AHA). (2003). *Heart Disease and Stroke Statistics—2004 Update*. Dallas: American Heart Association.

Brown, D. W., Giles, W. H., Greenlund, K. J., & Croft, J. B. (2001). Disparities in cholesterol screening: falling short of a national health objective. *Preventive Medicine*, 33, 517–522.

Correa-de-Araujo, R., & Clancy, C. M. (2006). Catalyzing quality of care improvements for women. *Women's Health Issues*, 16, 41–43.

Correa-de-Araujo, R., McDermott, K., & Moy, E. (2006). Gender differences across racial and ethnic groups in the quality of care for diabetes. *Women's Health Issues*, 16, 56–65.

Correa-de-Araujo, R., Miller, G. E., Banthin, J. S., & Trinh, Y. (2005). Gender differences in drug use and expenditures in a privately insured population of older adults. *Journal of Women's Health*, 14, 73–81.

Correa-de-Araujo, R., Stevens, B., Moy, E., Nilasena, D., Chesley, F., & McDermott, K. (2006). Gender differences across racial and ethnic groups in the quality of care for acute myocardial infarction and heart failure associated with comorbidities. *Women's Health Issues*, 16, 44–55.

Davis, K. C., Cogswell, M. E., Rothenberg, S. L., & Koplan, J. P. (1998). Lipid screening in a managed care population. *Public Health Representative*, 113, 346–350.

Fremont, A. M., Bierman, A., Wickstrom, S. L., Bird, C. E., Shah, M., Escarce, J. J., et al. (2005). Use of geocoding in managed care settings to identify quality disparities. *Health Affairs*, 24, 516–526.

Gardner, C. D., Winkleby, M. A., & Fortmann, S. P. (2000). Population frequency distribution of non-high-density lipoprotein cholesterol (Third National Health and Nutrition Examination Survey [NHANES III], 1988–1994). *American Journal of Cardiology*, 86, 299–304.

Goff, D. C., Jr., Bertoni, A. G., Kramer, H., Bonds, D., Blumenthal, R. S., Tsai, M. Y., et al. (2006). Dyslipidemia prevalence, treatment, and control in the Multi-Ethnic Study of Atherosclerosis (MESA): Gender, ethnicity, and coronary artery calcium. *Circulation*, 113, 647–656.

Harrold, L. R., Lessard, D., Yarzebski, J., Gurwitz, J. H., Gore, J. M., & Goldberg, R. J. (2003). Age and sex differences in the treatment of patients with initial acute myocardial infarction: A community-wide perspective. *Cardiology*, 99, 39–46.

Henderson, J. T., Weisman, C. S., & Grason, H. (2002). Are two doctors better than one? Women's physician use and appropriate care. *Women's Health Issues*, 12, 138–149.

Hendrix, K. H., Lackland, D. T., & Egan, B. M. (2003). Cardiovascular risk factor control and treatment patterns in primary care. *Managed Care Interface*, 16, 21–26.

Hippisley-Cox, J., Pringle, M., Crown, N., Meal, A., & Wynn, A. (2001). Sex inequalities in ischaemic heart disease in general practice: cross sectional survey. *British Medical Journal*, 322, 832.

Hollenbeak, C. S., Weisman, C. S., Rossi, M., & Ettinger, S. M. (2006). Gender disparities in percutaneous coronary interventions for acute myocardial infarction in Pennsylvania. *Medical Care*, 44, 24–30.

Hu, G. (2003). Gender difference in all-cause and cardiovascular mortality related to hyperglycaemia and newly-diagnosed diabetes. *Diabetologia*, 46, 608–617.

Institute of Medicine (IOM). (2003). *Unequal treatment: Confronting racial and ethnic disparities in healthcare*. Washington, DC: National Academies Press.

Kim, C., Kerr, E. A., Bernstein, S. J., & Krein, S. L. (2006). Gender disparities in lipid management: The presence of disparities depends on the quality measure. *American Journal of Managed Care*, 12, 133–136.

Legato, M. J. (2000). Dyslipidemia, gender, and the role of high-density lipoprotein cholesterol: implications of therapy. *American Journal of Cardiology*, 86, 15L–18L.

LIPID Study Group. (1998). Prevention of cardiovascular events and death with pravastatin in patients with coronary heart disease and a broad range of initial cholesterol levels. *New England Journal of Medicine*, 339, 1349–1357.

Massey, D. S., & Denton, N. A. (1989). Hypersegregation in U.S. metropolitan areas: Black and Hispanic segregation along 5 dimensions. *Demography*, 26, 373–391.

Massing, M. W., Foley, K. A., Carter-Edwards, L., Sueta, C. A., Alexander, C. M., & Simpson, R. J., Jr. (2004). Disparities in lipid management for African Americans and Caucasians with coronary artery disease: A national cross-sectional study. *BMC Cardiovascular Disorder*, 4, 15.

Maviglia, S. M., Teich, J. M., Fiskio, J., & Bates, D. W. (2001). Using an electronic medical record to identify opportunities to improve compliance with cholesterol guidelines. *Journal of General Internal Medicine*, 16, 531–537.

Mehta, R. N., Khan, I. A., Mehta, N. J., Ryschon, K. L., Vasavada, B. C., Sacchi, T. J., et al. (2001). Age-related differences in the use of cardiac medications in patients with coronary artery disease. *American Journal of Therapy*, 8, 225–229.

Mosca, L., Appel, L. J., Benjamin, E. J., Berra, K., Chandra-Strobos, N., Fabunmi, R. P., et al. (2004). Evidence-based guidelines for cardiovascular disease prevention in women. American Heart Association scientific statement. *Arteriosclerosis, Thrombosis, and Vascular Biology*, 24, e29–e50.

Mosca, L., Ferris, A., Fabunmi, R., & Robertson, R. M. (2004). Tracking women's awareness of heart disease: An American Heart Association national study. *Circulation*, 109, 573–579.

Mosca, L., Merz, N. B., Blumenthal, R. S., Cziraky, M. J., Fabunmi, R. P., Sarawate, C., et al. (2005). Opportunity for intervention to achieve American Heart Association guidelines for optimal lipid levels in high-risk women in a managed care setting. *Circulation*, 111, 488–493.

National Committee for Quality Assurance (NCQA). (2005). *HEDIS 2005: Technical Specifications*. Washington, DC: NCQA.

Nau, D. P., Ellis, J. J., Kline-Rogers, E. M., Mallya, U., Eagle, K. A., & Erickson, S. R. (2005). Gender and perceived severity of cardiac disease: evidence that women are "tougher." *American Journal of Medicine*, 118, 1256–1261.

Nau, D. P., & Mallya, U. (2005). Sex disparity in the management of dyslipidemia among patients with type 2 diabetes mellitus in a managed care organization. *American Journal of Managed Care*, 11, 69–73.

Nerenz, D. R., Bonham, V. L., Green-Weir, R., Joseph, C., & Gunter, M. (2002). Eliminating racial/ethnic disparities in health care: Can health plans generate reports? *Health Affairs*, 21, 259–263.

Panel on DHHS Collection of Race and Ethnic Data. (2004). *Eliminating health disparities: Measurement and data needs*. Washington, DC: National Academies Press.

Pearson. T. A. (2000). The under treatment of LDL-cholesterol: Addressing the challenge. *International Journal of Cardiology*, 74 Suppl 1, S23–S28.

Pearson, T. A., Laurora, I., Chu, H., & Kafonek, S. (2000). The lipid treatment assessment project (L-TAP): A multicenter survey to evaluate the percentages of dyslipidemic patients receiving lipid-lowering therapy and achieving low-density lipoprotein cholesterol goals. *Archives of Internal Medicine*, 160, 459–467.

Persell, S. D., Maviglia, S. M., Bates, D. W., & Ayanian, J. Z. (2005). Ambulatory hypercholesterolemia management in patients with atherosclerosis. Gender and race differences in processes and outcomes. *Journal of General Internal Medicine*, 20, 123–130.

Phillips, L. S., Ziemer, D. C., Doyle, J. P., Barnes, C. S., Kolm, P., Branch, W. T., et al. (2005). An endocrinologist-supported intervention aimed at providers improves diabetes management in a primary care site: Improving primary care of African Americans with diabetes (IPCAAD) 7. *Diabetes Care*, 28, 2352–2360.

Pinn, V. W. (2003). Sex and gender factors in medical studies: implications for health and clinical practice. *Journal of the American Medical Association*, 289, 397–400.

Qureshi, A. I., Suri, M. F., Guterman, L. R., & Hopkins, L. N. (2001). Ineffective secondary prevention in survivors of cardiovascular events in the US population: Report from the Third National Health and Nutrition Examination Survey. *Archives of Internal Medicine*, 161, 1621–1628.

Raudenbush, S. W., & Bryk, A. S. (2001). *Hierarchical linear models: Applications and data analysis methods*. Thousand Oaks, CA: Sage.

Schulman, K. A., Berlin, J. A., Harless, W., Kerner, J. F., Sistrunk, S., Gersh, B. J., et al. (1999). The effect of race and sex on physicians' recommendations for cardiac catheterization. *New England Journal of Medicine*, 340, 618–626.

Sheifer, S. E., Escarce, J. J., & Schulman, K. A. (2000). Race and sex differences in the management of coronary artery disease. *American Heart Journal*, 139, 848–857.

Sloan, K. L., Sales, A. E., Willems, J. P., Every, N. R., Martin, G. V., Sun, H., et al. (2001). Frequency of serum low-density lipoprotein cholesterol measurement and frequency of results $<$ or $=$ 100 mg/dl among patients who had coronary events (Northwest VA Network Study). *American Journal of Cardiology*, 88, 1143–1146.

Smith. S. C., Jr. (1998). What is happening in the real world in lipid therapy and is it appropriate? The need for a paradigm shift. *Value Health*, 1, 204–207.

Smith, S. C., Jr., Allen, J., Blair, S. N., Bonow, R. O., Brass, L. M., Fonarow, G. C., et al. (2006). AHA/ACC guidelines for secondary prevention for patients with coronary and other atherosclerotic vascular disease: 2006 update endorsed by the National Heart, Lung, and Blood Institute. *Journal of American College of Cardiologists*, 47, 2130–2139.

Witt, B. J., & Roger, V. L. (2003). Sex differences in heart disease incidence and prevalence: implications for intervention. *Expert Opinion on Pharmacotherapy*, 4, 675–683.

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