Effect of Quality Improvement on Racial Disparities in Diabetes Care

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Background: Racial disparities in care are well documented; information regarding solutions is limited. We evaluated whether generic quality improvement efforts were associated with changes in racial disparities in diabetes care.

Methods: Using insurance claims and electronic medical record data, we identified 5101 whites and 1987 blacks with diabetes mellitus receiving care within a multispecialty group practice from 1997 to 2001. We assessed rates of annual low-density lipoprotein cholesterol level testing, low-density lipoprotein cholesterol level control (<130 mg/dL [<3.37 mmol/L]), statin therapy, annual glycosylated hemoglobin level testing, glycosylated hemoglobin level control (<7.0%), and annual dilated eye examinations. We used logistic regression models with generalized estimating equations to adjust for race, year, race × year interactions, age, and sex.

Results: Rates of annual low-density lipoprotein cholesterol level testing increased from 39% to 64%, while the white-black disparity decreased from 14% to 4%; rates of low-density lipoprotein cholesterol level control increased from 15% to 43%, while the white-black disparity decreased from 9% to 6% (P<.001 for both race × year interactions). Statin therapy rates increased from 20% to 37%; however, black patients remained less likely than white patients to receive therapy. The 1997 rates of annual glycosylated hemoglobin level testing (76%) and annual eye examinations (74%) were high, and there was no white-black disparity over time. Rates of glycosylated hemoglobin level control remained low (31%), and the white-black disparity remained constant at 10%.

Conclusions: Racial disparities were diminished in some aspects of diabetes care following variably successful quality improvement, but differences in the use of statins and glycemic level control persisted. Reducing disparities may require a focus on minority health.

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STUDY SETTING

Harvard Vanguard Medical Associates is a multispecialty group practice consisting of 14 ambulatory health centers in the Boston area, with 110 primary care physicians caring for approximately 250,000 adult patients. Harvard Vanguard Medical Associates has historically served as a principal care provider for patients insured by Harvard Pilgrim Health Care, whose patients constitute most of the HVMA patient population. Harvard Vanguard Medical Associates has a long history of use of electronic systems for patient management, and from 1997 to 1999, the organization implemented a fully functional electronic medical record system (http://www.epicsystems.com). The system supports computerized ordering of medications and laboratory tests, decision support tools for chronic disease care, and electronic generation of specialty referrals by primary care physicians. All outpatient encounters are entered into the medical record, including clinician notes, diagnostic codes, procedure codes, and all laboratory results. This system also facilitates the creation of disease registries to monitor and improve care.

QUALITY IMPROVEMENT PROGRAM

Beginning in 1999, HVMA began using its clinical information systems to organize centralized outreach programs for patients with DM through the creation of computerized patient registries. An electronic registry of patients with DM and their associated quality measures was developed using automated data collected from the electronic medical record system. Patients overdue for specific screening services received personalized letters recommending the needed service (eg, cholesterol testing or dilated eye examinations) on a quarterly basis. In the case of overdue laboratory testing, these letters served as laboratory orders that the patient could bring to any HVMA laboratory to have the test performed. In addition, electronic reminders were created within the electronic medical record system to prompt clinicians to provide overdue DM care for patients during office encounters. Physicians received training on the use of the electronic medical record system and associated tools, such as reminders, from consultants working for the vendor company. These reminders were presented to clinicians in a manner that required acknowledgment before any further actions could be taken within the electronic medical record. No provider incentives were tied to these clinical reminders for DM care, and physicians did not receive reports on the percentage of patients within their panel who were achieving targeted goals during the study period. In addition, no specific attempts were made during this quality improvement initiative to focus on minority populations.

STUDY COHORT

We studied adult patients 18 years and older with at least 24 months of continuous enrollment in Harvard Pilgrim Health Care who received care within HVMA as identified by the HVMA patient registration system from 1997 to 2001. Using Harvard Pilgrim Health Care insurance claims and HVMA electronic medical record encounter diagnoses, we identified patients with nongestational DM meeting at least 1 of the following criteria: (1) at least 1 hospital discharge diagnosis of DM, (2) at least 2 outpatient diagnoses of DM, or (3) dispensing of a drug for the treatment of DM (insulin or an oral hypoglycemic agent). We excluded women having a diagnosis of gestational DM based on insurance claims or electronic medical record encounter data. This method is consistent with the recommendations of the National Committee for Quality Assurance for collection of quality data reported in the Health Plan Employer Data and Information Set.13 We assembled a rolling annual cohort of patients with DM from 1997 to 2001 by restricting membership in the cohort for a given year to those patients having continuous membership for the entire current calendar year and having a diagnosis of DM before the start of that calendar year. This rolling cohort definition allows at least 1 year for patients with DM to receive recommended health services before evaluation of the performance measure. We collected patient age, sex, and race from the electronic medical record system and further restricted our analysis to white or black patients. Race is usually ascertained by HVMA at the time of initial patient registration within the system.

QUALITY MEASURES

We collected quality measures that are consistent with the definitions used by the American Diabetes Association,14 the Diabetes Quality Improvement Project,15 and the National Cholesterol Education Program Adult Treatment Panel.16 Process measures included annual low-density lipoprotein (LDL) cholesterol level testing, annual glycosylated hemoglobin (HbA1c) level testing, and annual dilated eye examinations. We focused on these measures of DM quality because they were the specific target of the generic quality improvement initiatives occurring within HVMA during the study period. Annual dilated eye examinations were risk adjusted according to Diabetes Quality Improvement Project recommendations to accommodate biennial screening examinations in low-risk patients with HbA1c control less than 8.0% and no prescriptions for insulin therapy during the measurement year. Outcome measures included achieving LDL cholesterol level control lower than 130 mg/dL (<3.37 mmol/L) and HbA1c level control less than 7.0%. Patients without a recorded LDL cholesterol level or HbA1c level in the measurement year were considered not to have that outcome measure under control. To further characterize the management of hypercholesterolemia, we assessed the proportion of patients being treated with a hydroxy-methylglutaryl–coenzyme A reductase inhibitor (statin). We obtained these quality measures from the HVMA electronic medical record system using outpatient Current Procedural Terminology codes as defined by the Health Plan Employer Data and Information Set14 and using unique codes for laboratory testing and practice specialty (eg, ophthalmology examinations) within the electronic medical record. Data from this medical record system have been used extensively in prior analyses of disease management18,19 and quality of care.20,21 We used Harvard Pilgrim Health Care pharmacy claims to identify statin use based on codes available within the National Drug Code directory.21 A patient was classified as having been treated with a statin during a calendar year if a prescription was filled in that year.

STATISTICAL ANALYSIS

We compared baseline differences in age and sex between white and black patients using the χ² and t tests. For each year from 1997 to 2001, we calculated the proportion of patients receiving appropriate care for each quality measure in the entire population and for white patients and black patients separately. We report absolute differences between white and black patients as opposed to relative differences to allow for interpretation of the clinical importance of the disparities. We fit multivariate logistic regression models with generalized estimating equations to assess baseline racial differences in receipt of each recommended health service in 1997, after
adjusting for patient age, sex, and clustering within the 14 health centers. To assess the relationship between quality improvement and racial disparities, we fit multivariate logistic regression models with independent variables, including race, year, and a race × year interaction term. The coefficient and P value for the race × year interaction term in these models indicate the direction of change in racial differences in quality of care and whether this change is significant. These models also used generalized estimating equations to account for clustering of patients within each of the 14 health centers and used repeated measures among the same patients from year to year. We stratified longitudinal analyses of racial differences in DM management by sex to assess for potential differences in racial disparities between men and women. All analyses were performed using SAS version 8.02 (SAS Institute, Cary, NC). This study was approved by the Harvard Pilgrim Health Care Institutional Review Board, Boston.

**RESULTS**

We identified 7088 patients with DM, including 5101 white patients (72%) and 1987 black patients (28%). Black patients were significantly younger than white patients (53.8 vs 60.2 years) and less likely to be male (41% vs 52%) (P < .001 for both) (**Table 1**). The population was stable, with nearly three quarters of the patients receiving care at HVMA for most of the study period, and there was no significant difference between white patients and black patients in this characteristic.

**CHOLESTEROL LEVEL MANAGEMENT**

Overall rates of annual LDL cholesterol level testing were low in the baseline year (**Table 2**), and black patients were significantly less likely than white patients to undergo this testing (29% vs 43%, P < .001). From 1997 to 2001, overall rates of annual LDL cholesterol level testing increased from 39% to 64%, and the white-black difference in testing rates decreased from 14% to 4% (P < .001 for race × year interaction).

Overall rates of LDL cholesterol level control (<130 mg/dL [<3.37 mmol/L]) were low in 1997 (15%), and black patients were less likely than white patients to achieve this control (9% vs 17%, P < .001) (**Table 2**). During the study period, overall rates of control rose to 43%, and the white-black difference in LDL cholesterol level control rates decreased from 9% to 6% (P < .001 for race × year interaction).

Statin prescriptions were filled for 20% of patients with DM in 1997, and black patients were less likely than white patients to receive this treatment (15% vs 22%, P < .001) (**Table 2**). Although overall use of statins increased to 38% of the population in 2001, the white-black difference in statin use did not decrease from 1997 (7%) to 2001 (9%) (P = .23 for race × year interaction). Racial differences in statin use did not differ by sex in stratified analyses (data not shown).

White men and white women received annual LDL cholesterol level testing at higher rates than black men and black women in 1997 (**Figure**), although the racial disparity among men (absolute difference, 17%) was larger than that among women (absolute difference, 12%) (P < .001 for both). These differences were

### Table 2. Baseline Patient Characteristics by Race*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>White Patients (n = 5101)</th>
<th>Black Patients (n = 1987)</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD, y</td>
<td>60.2 ± 13.9</td>
<td>53.8 ± 12.5</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Male sex</td>
<td>2626 (51.5)</td>
<td>823 (41.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Long-term enrollment‡</td>
<td>3776 (74.0)</td>
<td>1453 (73.1)</td>
<td>.44</td>
</tr>
</tbody>
</table>

*Data are given as number (percentage) unless otherwise indicated.
†Reflects proportion of patients enrolled in Harvard Vanguard Medical Associates for at least 3 of the 5 study years.

Abbreviation: LDL, low-density lipoprotein.

*Data are given as percentages unless otherwise indicated.
†Adjusted for age, sex, and race × year interaction using logistic regression models and generalized estimating equations.
‡Defined as less than 130 mg/dL (<3.37 mmol/L).
Health care organizations and physician groups have an increasing responsibility to address racial disparities in quality of care among their patients.\textsuperscript{2,3} This study serves as a model for how group practices can use electronic data to measure existing racial disparities and to monitor the effect of organizational initiatives on these differences in care. We studied a population of patients receiving DM care within a large multispecialty group practice and found significant racial disparities in cholesterol level management and glycemic level control at baseline. Significant improvement in cholesterol level management occurred during the study period through the use of electronic reminders and patient mailings, and this was associated with a substantial reduction in the racial disparity in annual LDL cholesterol level monitoring but with a less marked, although statistically significant, decrease in the racial disparity in LDL cholesterol level control. The less substantial effect on differences in LDL cholesterol level control was likely due in part to the persistent racial disparity in the use of statin therapy throughout the study period. In addition, persistent disparities in cholesterol level management were also attributable to higher levels of annual LDL cholesterol level monitoring and LDL cholesterol level control among white men.

White and black patients were similarly likely to receive annual HbA\textsubscript{1c} level testing and annual dilated eye examinations, services that were being performed at high rates at baseline. However, rates of glycemic level control remained low throughout the study period, and significant racial disparities in this measure persisted.

Consistent with our findings, a recent analysis of the Medicare managed care program also demonstrated a reduction in racial disparities in quality of care associated with overall quality improvement.\textsuperscript{4} This study also noted persistent racial disparities in HbA\textsubscript{1c} level and LDL cholesterol level control among patients with DM, whereas racial differences in HbA\textsubscript{1c} level and LDL cholesterol level testing were almost eliminated. In the Medicare end-stage renal disease program, generic quality improvement efforts were associated with diminished racial disparities in receiving an adequate hemodialysis dose during 8 years.\textsuperscript{5} A disease management program for congestive heart failure also resulted in a reduction in racial disparities in New York Heart Association functional status.\textsuperscript{27} Similarly, a randomized quality improvement trial for depression management resulted in a reduction in preexisting racial disparities in mental health.\textsuperscript{28}

This study adds to an expanding evidence base demonstrating that generic quality improvement may represent an effective strategy to address some racial disparities in quality of care. However, our study also highlights important limitations to this strategy. Although better overall quality was associated with minimal or no disparities in process measures, including LDL cholesterol level screening, HbA\textsubscript{1c} level monitoring, and dilated eye examinations, racial disparities in intermediate outcome measures were reduced less
substantially for LDL cholesterol level control or not at all for HbA1c level control. More complex interventions with a specific focus on minority populations will likely be required to eliminate differences in these outcome measures.

For example, persistent differences in cholesterol level control are likely related to the differential use of statin therapy, which was not a target of the HVMA quality improvement initiatives. We focused on statin use, and not other lipid-lowering agents, because statins are recommended as first-line therapy for the treatment of hypercholesterolemia,17 and almost 95% of the patients treated for hyperlipidemia report using statins.29 These findings of racial differences in rates of LDL cholesterol level control and drug therapy are consistent with prior studies in this area30-32 and are not likely to be related to differences in insurance coverage because all patients were members of the same health plan receiving care within the same physician practice group. Differential filling of prescriptions may have been because of differential prescribing practices by physicians or to racial differences in patient-related factors such as the ability to afford medication costs or fear of medication adverse effects.

In addition, the guidelines for cholesterol level control among patients with DM have changed substantially since 1997, with increasingly stringent LDL cholesterol level control targets set by the National Cholesterol Education Program.17 The adoption of these more aggressive treatment targets by clinicians may have differed according to patient race and contributed to our finding of differential rates of LDL cholesterol level control. White men were not significantly more likely to receive statin therapy than white women, yet they achieved greater levels of LDL cholesterol level control, perhaps because of more aggressive intensification of statin therapy once this treatment was initiated.32 Future research efforts will need to focus on the underlying mechanisms of differences in treatment of hypercholesterolemia, such as racial differences in dose intensification of statin therapy or patient treatment preferences.

The fact that low rates of HbA1c level control, and associated racial disparities in this outcome, were not alleviated with the use of physician reminders and patient mailings further highlights the complex nature of chronic disease management and suggests that more innovative or targeted efforts may be required to achieve desired outcomes. The lack of success associated with the quality improvement efforts for HbA1c level management is in stark contrast to the results achieved for cholesterol management. Glycemic level control depends on different factors, including a potentially complex medication regimen, diet, and physical activity. These factors are not as easily addressed as a finding of hypercholesterolemia, which can often be well controlled with a single medication. Additional quality improvement research in this area should focus on trends in intensification of therapy for glycemic control and on how this intensification differs between white and black patients. These analyses could include measures of medication prescribing and adherence, the frequency of outpatient visits to health care providers, the availability of cultural competency training for the providers, and the composition, demographic makeup, and communication skills of the care team.

Our study was strengthened by its rigorous identification of an eligible cohort of patients with DM and the availability of complete insurance claims and electronic medical record data, which allowed us to include process and outcome measures of quality of care. However, our study has some limitations. First, our study included patients from a single multispecialty practice using an integrated electronic medical record and may not be generalizable to other health care systems. However, HVMA is a large group practice that includes 14 health centers and serves a diverse patient population in the greater Boston area. In addition, the quality improvement efforts being undertaken by HVMA incorporate elements of the chronic disease model that are being implemented by many physician groups across the country.32 Second, our study is limited by the lack of a randomized design. Therefore, we are unable to determine the independent effect of physician reminders and patient mailings on quality, and the observed reduction in racial dis-

Table 3. Racial Differences in Glycemic Level Management*

<table>
<thead>
<tr>
<th>Variable</th>
<th>1997 (n = 4799)</th>
<th>1998 (n = 5258)</th>
<th>1999 (n = 5517)</th>
<th>2000 (n = 5249)</th>
<th>2001 (n = 4472)</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual HbA1c level testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>76.4</td>
<td>76.4</td>
<td>74.8</td>
<td>75.8</td>
<td>76.5</td>
<td>.38</td>
</tr>
<tr>
<td>White</td>
<td>75.6</td>
<td>75.1</td>
<td>73.8</td>
<td>75.5</td>
<td>76.3</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>78.5</td>
<td>80.0</td>
<td>77.4</td>
<td>76.1</td>
<td>77.0</td>
<td></td>
</tr>
<tr>
<td>Absolute difference</td>
<td>-2.9</td>
<td>-4.9</td>
<td>-3.6</td>
<td>-3.6</td>
<td>-0.7</td>
<td></td>
</tr>
<tr>
<td>HbA1c level control‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30.9</td>
<td>32.3</td>
<td>34.8</td>
<td>31.8</td>
<td>32.8</td>
<td>.47</td>
</tr>
<tr>
<td>White</td>
<td>33.6</td>
<td>34.7</td>
<td>37.2</td>
<td>33.7</td>
<td>35.5</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>24.0</td>
<td>25.8</td>
<td>28.5</td>
<td>26.9</td>
<td>26.0</td>
<td></td>
</tr>
<tr>
<td>Absolute difference</td>
<td>9.6</td>
<td>8.9</td>
<td>8.7</td>
<td>6.8</td>
<td>9.5</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: HbA1c, glycosylated hemoglobin.

*Data are given as percentages unless otherwise indicated.
†Adjusted for age, sex, and race × year interaction using logistic regression models and generalized estimating equations.
‡Defined as less than 7.0%.
parities might be caused by factors other than quality improvement, including regression to the mean or changes in the characteristics of patients in the rolling cohort. However, the fact that we noted consistent findings of persistent disparities among measures with low quality and of reduced disparities among measures with superior quality argues against this effect. Although we did not adjust for patient comorbid conditions, this method is consistent with quality reporting by the National Committee for Quality Assurance in comparisons of health plans and with prior comparisons of racial disparities in quality of care.

Third, we lacked information on individual patient demographic factors, including family structure, social support, income, and education, which are potential mediators of racial differences in quality of care. Fourth, we did not collect patient ratings of care during this period of quality improvement, which is an important aspect of quality and is known to vary by race and ethnicity.

We found a significant reduction in existing racial disparities in annual cholesterol level monitoring with generic quality improvement efforts but a less substantial reduction in disparities in cholesterol level control, possibly related to persistent disparities in the use or dosing of statin therapy. Racial disparities in HbA1c level control persisted following unsuccessful quality improvement efforts in this area. Future research should evaluate the relative merit of more effective generic quality improvement initiatives compared with interventions specifically focused on minority patients as strategies to reduce persistent disparities in quality of care.

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Author Contributions: Dr Sequist had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Financial Disclosure: None.

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Role of the Sponsor: The funding organizations had no role in the design or conduct of the study; collection, management, analysis, or interpretation of the data; or preparation, review, or approval of the manuscript.

Previous Presentation: This study was presented at the 28th Annual Meeting of the Society of General Internal Medicine; May 12, 2005; New Orleans, La.

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REFERENCES


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**Errors in Table.** In the Original Investigation by Shankar et al titled “Association Between Circulating White Blood Cell Count and Cancer Mortality: A Population-Based Cohort Study.” published in the January 23 issue of the *ARCHIVES* (2006;166:188-194), errors occurred in Table 5 on page 192. In that table, the last column heading should have read as follows: “Comparison of Aspirin Intake Categories†.” In addition, the third and fifth sideheadings should have read as follows: “Joint exposure to WBC count and aspirin intake.” The corrected Table 5 is reproduced here.

### Table 5. Effect of High WBC Count and Aspirin Intake on Cancer Mortality*

<table>
<thead>
<tr>
<th>Aspirin Intake Categories</th>
<th>WBC Count Quartiles, Cells/µL</th>
<th>Comparison of Aspirin Intake Categories†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quartiles 1-3 (&lt;7400)</td>
<td>Quartile 4 (≥7400)</td>
</tr>
<tr>
<td>≥3 Times/wk (No. of cases)</td>
<td>496 (19)</td>
<td>190 (15)</td>
</tr>
<tr>
<td>Joint exposure to WBC count and aspirin intake</td>
<td>1.00 (Referent)</td>
<td>1.24 (0.57-2.68)</td>
</tr>
<tr>
<td>&lt;3 Times/wk (including none)</td>
<td>1877 (116)</td>
<td>626 (62)</td>
</tr>
<tr>
<td>No. at risk (No. of cases)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint exposure to WBC count and aspirin intake</td>
<td>1.40 (0.87-2.27)</td>
<td>2.42 (1.46-4.01)</td>
</tr>
<tr>
<td>WBC count quartiles‡</td>
<td>1.00 (Referent)</td>
<td>1.51 (1.14-1.99)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; RR, relative risk; WBC, white blood cell.

*Data are given as RR (95% CI) unless otherwise indicated. All RRs are adjusted for age, sex, education, body mass index, hematocrit level, alcohol intake, physical inactivity, smoking, and diabetes or fasting hyperglycemia status (P = .06 for interaction). Characteristics and aspirin intake categories are described in the “Exposure Measurement” subsection of the “Methods” section.

†Additionally adjusted for weekly aspirin use.

‡Additionally adjusted for WBC count.