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RESEARCH BRIEF

Assessing Diabetes Care Disparities with Ambulatory Care Quality Measures

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Objective. To identify and describe racial/ethnic disparities in overall diabetes management.

Data Source/Study Setting. Electronic health record data from calendar year 2010 were obtained from all primary care clinics at one large health system in Minnesota (n = 22,633).

Study Design. We used multivariate logistic regression to estimate the odds of achieving the following diabetes management goals: A1C <8 percent, LDL cholesterol <100 mg/dl, blood pressure <140/90 mmHg, tobacco-free, and daily aspirin.

Principal Findings. Blacks and American Indians have higher odds of not achieving all goals compared to whites. Disparities in specific goals were also found.

Conclusions. Although this health system has above-average diabetes care quality, significant disparities by race/ethnicity were identified. This underscores the importance of stratifying quality measures to improve care and outcomes for all.

Key Words. Diabetes, racial/ethnic disparities, minority health, cardiovascular risk factors, composite quality measures

Diabetes is the seventh leading cause of death in the United States and a major contributor to cardiovascular disease (CVD), including heart disease and stroke (Centers for Disease Control and Prevention 2011). Diabetes management involves a delicate balance between lifestyle management and pharmacological treatment of major risk factors. To reduce the risk of debilitating health complications (such as kidney failure, nontraumatic lower limb amputations, and blindness) and CVD events, optimal control of risk factors is crucial for patients with diabetes (Centers for Disease Control and Prevention 2011; Egede et al. 2011; Minnesota Community Measurement 2011; American Diabetes Association [ADA], 2012).

Optimally managed diabetes involves achieving recommended goals for Hemoglobin A1C (HbA1C), blood pressure, LDL cholesterol, tobacco, and aspirin use (Minnesota Community Measurement 2011). We combine

these risk factors into a composite measure to evaluate overall diabetes management of CVD risk factors; this measure will be referred to as optimal diabetes care (ODC) in this paper (Minnesota Community Measurement 2011). The ODC measure, along with other quality measures, is reported annually by health care organizations in Minnesota to Minnesota Community Measurement (MNCM), a nonprofit organization that publicly reports these data for quality improvement efforts. MNCM measures were developed by a committee that includes health care providers and health plans and are informed by national standards. The ODC measure is endorsed by the National Quality Forum. MNCM has recently begun to report disparities through its *Health Care Disparities Report.* However, racial/ethnic ODC disparities are not currently reported (Minnesota Community Measurement 2011).

Identifying and addressing disparities in ODC are important due to evidence of racial/ethnic disparities in diabetes prevalence, complications, diabetes-related hospital admissions, and readmissions in minority populations (Lanting et al. 2005; Russo, Andrews, and Coffey 2006; Jiang, Russo, and Barrett 2009; Agency for Healthcare Research and Quality 2012; Johnson, Ghildayal, and Wheeler 2012). With the projected diabetes burden increase in the United States in part due to "increasing numbers of members of higher risk minority groups in the population," continued evaluation and documentation of disparities is still needed today (Boyle et al. 2010). Although disparities have gained national attention over the past decade, documentation is still relevant particularly as an example for health systems that are not currently evaluating disparities using their quality metrics (Trivedi et al. 2006).

Studies have documented racial/ethnic disparities in individual ODC risk factors (Campbell et al. 2012). However, few studies have used a composite measure of risk factors to evaluate disparities in overall management. Without a composite measure, we cannot assess whether a patient who has met the HbA1C goal has also met the other goals. It is therefore unclear whether a particular patient has optimally managed diabetes. The few studies that have used composite measures were conducted in specific populations, or used different

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criteria, and included limited racial and ethnic groups (Jackson, Edelman, and Weinberger 2006; Selby et al. 2007; Duru et al. 2009; Egede et al. 2011). Our study expands on these previous studies by including more racial/ethnic groups in a broader patient population and including additional risk factors to assess overall diabetes management.

METHODS

Research Setting and Data

Data are from the Allina Medical Clinics (AMC). AMC is a system of 42 clinics providing care in the Twin Cities metropolitan area and greater Minnesota. AMC is part of Allina Health, a not-for-profit network of 11 hospitals, 90+ clinics, and various care services in Minnesota and western Wisconsin. All Allina sites are fully integrated through an electronic health record (EHR). With IRB approval, EHR data for all patients with clinic visits in calendar year 2010 were obtained. A single deidentified record for each unique patient with diabetes was constructed. Along with sociodemographic data, the most current 2010 values for each of the five risk factors (HbA1C, blood pressure, LDL cholesterol, tobacco use, and aspirin use) were included in the dataset. This follows the procedure for direct data submission to Minnesota Community Measurement (2010).

Study Population

The dataset contains all patients diagnosed with Type I or Type II diabetes (38,015 patients). In accordance with MNCM ODC inclusion criteria, nonpregnant adult patients ages 18–75, with at least one specialty face-to-face visit (for any reason) in 2010 and at least two diabetes-related visits (ICD-9 codes 250–250.93) in the previous 2 years (January 1, 2009–December 31, 2010) were identified (27,084 patients). Of these patients, 97.6 percent had complete race/ethnicity data. Patients missing covariate data (4,451 patients, approximately 16 percent of the eligible patients) were excluded from the analysis. Among the excluded, approximately 72 percent were missing body mass index (BMI) values, 75 percent were non-Hispanic white, 48 percent were between the ages of 50 and 64, 61 percent were married, 68 percent were born in the United States, 93 percent speak English as their primary language, and 58 percent were male. The final dataset includes $N = 22{,}633$ nonpregnant adult patients, ages 18–75 years, with diabetes.

Measures

The key outcome variable, ODC (Yes/No), is an all-or-none composite indicator variable. ODC is defined as meeting all of the following risk factor goals: HbA1C <8 percent (Yes/No); LDL cholesterol <100 mg/dl (Yes/No); blood pressure <140/90 mmHg (Yes/No); tobacco-free (Yes/No); and aspirin use for patients with diagnosed ischemic vascular disease comorbidity, or documented contraindication (Yes/No). The aspirin goal is not applicable to patients without an ischemic vascular disease diagnosis. These patients are coded as meeting the aspirin goal, allowing their ODC status to depend on the other four component measures. Indicator variables for each of the component measures were also created as outcome variables. If one or more of the goals were not met, or values were not documented in the EHR, this is treated as an unmet goal, and therefore not achieving ODC.

The key independent variable is race/ethnicity, which we classified as non-Hispanic white, black, American Indian/Alaska Native (AI/AN), Asian/Native Hawaiian and Other Pacific Islander (A/NHOPI), and Hispanic. Race/ethnicity data were self-reported by patients during registration with the health system. Patients were asked to report all race categories that apply (i.e., white, black, American Indian, Asian, Native Hawaiian and Other Pacific Islanders). They were additionally asked whether they identified as Hispanic/Latino or not. Those who identified as Hispanic, regardless of race, were included in the Hispanic group. The proportion of multiracial patients in the study sample was too small and comprised numerous multirace combinations to obtain any meaningful results. Thus, those who identified with more than one race category were allocated to a single category according to the "deterministic whole assignment" smallest group method, suggested by the Office of Management and Budget (2000). This entails assigning each multirace person to the self-reported race group that has the fewest number of individuals. Covariates include age (18–29, 30–49, 50–64, 65–75 years), sex (male, female), BMI defined following the Centers for Disease Control and Prevention guidelines (underweight, normal, overweight, obese), primary language (English, non-English), country of origin (U.S.-born, foreign-born), and marital status (married, partner, single, separated, divorced, widowed).

Statistical Analyses

Descriptive characteristics of the patient population were summarized by race/ethnicity. Bivariate analyses of each outcome (ODC and each

component measure) by race/ethnicity were evaluated using chi-square tests. Tukey Honestly Significant Difference (HSD) tests were run to evaluate differences in percentages between specific racial/ethnic groups. Each of the minority groups' percentages were compared with the white group's percentages. A series of multiple logistic regression models were run to estimate the odds of not achieving ODC and the odds of not achieving each specific risk factor goal. Logistic regression models were adjusted for all covariates defined above (age, sex, BMI, primary language, country of origin, and marital status). All analyses were conducted with Stata SE version 12.1.

RESULTS

Characteristics of Study Population

Table 1 presents the distribution of patients with diabetes across various sociodemographic categories. The study population was predominantly non-Hispanic white (89.3 percent), male (52.4 percent), between the ages of 50 and 64 years (46.9 percent), and obese (67.5 percent). However, characteristics varied significantly across racial/ethnic groups. For example, most racial/ethnic groups were close to 70 percent obese, while only 32.1 percent of A/NHOPIs were obese. Similarly, the majority of patients was U.S.-born (93.6 percent) and spoke English as the primary language (96.9 percent); yet 90.7 percent of A/NHOPI and 41.7 percent of Hispanic patients were foreign-born, with 31 percent of A/NHOPI and 26.3 percent of Hispanic patients having a primary language that is not English.

Bivariate Analyses

Table 2 presents the bivariate analyses of ODC, and each component measure by race/ethnicity. Overall, there are significant differences in percentages achieving ODC and each of the component measures by race/ethnicity ($p < .001$), with the exception of aspirin use. Pairwise comparisons indicated that black, AI/AN, and Hispanic rates of ODC were significantly lower compared to whites. Pairwise comparisons also indicated that the percentages of blacks and Hispanics achieving the HbA1C goal were significantly lower than whites and the percentages of blacks and AI/ANs achieving the LDL goal were significantly lower than whites. Pairwise comparisons of the blood pressure goal indicated no significant differences for any group compared to whites. The percentage of AI/ANs achieving the tobacco goal were

Table 1: Selected Characteristics of Adult Patients with Diabetes (%), 2010

	White 89.3% n = 20,199	*Black* 4.9% n = 1,099	*AI/AN* 0.8% n = 180	*A/NHOPI* 2.4% n = 536	*Hispanic* 2.7% n = 619	*Total* 100% N = 22,633
Sex						
Female	46.9	54.9	57.8	51.7	49.6	47.6
Male	53.1	45.1	42.2	48.3	50.4	52.4
Age group						
18–29	2.3	3.5	1.1	3.0	4.5	2.4
30–49	19.5	34.9	31.7	32.5	39.7	21.2
50–64	47.4	44.3	45.0	41.2	38.9	46.9
65–75	30.8	17.4	22.2	23.3	16.8	29.5
BMI category						
Underweight	0.3	0.2	0.6	0.6	0.3	0.3
Normal	7.8	9.1	7.2	28.4	7.6	8.3
Overweight	23.4	25.8	23.9	39.0	25.0	23.9
Obese	68.6	64.9	68.3	32.1	67.0	67.5
Origin						
Foreign-born	2.1	23.7	6.7	90.7	41.7	6.4
U.S.-born	97.9	76.3	93.3	9.3	58.3	93.6
Language						
English	98.6	91.1	97.8	69.0	73.7	96.9
Non-English	1.4	8.9	2.2	31.0	26.3	3.1
Marital status						
Married	65.9	40.6	41.7	75.4	57.5	64.5
Partner	0.5	0.6	1.7	0.2	1.0	0.5
Single	18.2	37.9	31.1	14.2	25.9	19.4
Separated	0.9	2.7	4.4	2.1	2.9	1.1
Divorced	8.8	11.3	13.3	3.0	7.8	8.8
Widowed	5.8	6.8	7.8	5.2	5.0	5.8

Note. Numbers are in percentages.
AI/AN = American Indian/Alaska Native; A/NHOPI = Asian/Native Hawaiian and Other Pacific Islander.

significantly lower compared to whites, while A/NHOPIs had a significantly higher percentage that achieved this goal compared to whites.

Multivariate Analyses

Table 3 presents five separate logistic regression analyses representing the odds of not achieving ODC and each component goal by race/ethnicity, adjusted for the sociodemographic factors listed in Table 1. ODC was the outcome in the first regression; results indicated that compared to whites, the odds of not achieving ODC are significantly higher for blacks

Table 2: Achievement of Optimal Diabetes Care (ODC) and Component Goals by Race/Ethnicity (%), 2010

	White	*Black*	*AI/AN*	*A/NHOPI*	*Hispanic*	*Total*	*p-value*
All 5 component goals achieved							
ODC	51.0	37.2*	36.7*	50.9	41.8*	49.9	<.001
Individual component goals achieved							
HbA1C	80.8	70.4*	74.4	78.5	64.9*	79.8	<.001
LDL cholesterol	75.1	64.8*	66.1*	70.7	70.0	74.3	<.001
Blood pressure	89.9	86.2	87.2	92.5	90.0	89.7	<.001
Tobacco	85.9	81.3	71.7*	92.7*	89.2	85.8	<.001
Aspirin	99.8	99.7	99.4	99.8	99.8	99.8	.871

Note. Numbers are in percentages.
*Significantly different compared to white group, using Tukey HSD Test.
AI/AN = American Indian/Alaska Native; A/NHOPI = Asian/Native Hawaiian and Other Pacific Islander.

(OR = 1.4) and AI/ANs (OR = 1.5). Each of the risk factor goals that were significant in the bivariate analyses (HbA1C, LDL cholesterol, blood pressure, tobacco) were the outcomes in the four subsequent regressions. Results of the four subsequent models indicate that blacks have significantly higher odds (20–50 percent) of not achieving any of the component goals compared to whites. Hispanics have significantly higher odds of not achieving the HbA1C goal compared with whites (OR = 1.8, 95 percent CI: 1.5–2.2). AI/ANs have significantly higher odds (OR = 2.0, 95 percent CI: 1.4–2.8), while A/NHOPI have significantly lower odds (OR = 0.7, 95 percent CI: 0.5–1.0) of not achieving the tobacco-free goal compared with whites.

DISCUSSION

This particular health care delivery organization achieved higher than average ODC rates in the state of Minnesota; however, the results of our analyses demonstrate that ODC varies significantly by race/ethnicity in this patient population. The largest disparity is seen among the black patients, where disparities are present in aggregate and specific risk factor goals; in fact, disparities are present in four of the five goals. Optimal diabetes care and achievement of the tobacco-free goal are also lower among the American Indian/Alaska Native patients. The results also indicate that the Hispanic patients have higher odds of poor HbA1C control compared to white patients. Other studies have also

Table 3: Odds of NOT Achieving Optimal Diabetes Care (ODC) and Component Goals by Race/Ethnicity (n = 22,633), 2010

	ODC			*HbA1C*			*LDL Cholesterol*			*Blood Pressure*			*Tobacco*		
	OR	*95% CI*		*OR*	*95% CI*		*OR*	*95% CI*		*OR*	*95% CI*		*OR*	*95% CI*	
Race/ethnicity															
White (Ref.)	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–
Black	**1.44**	**1.26**	**1.64**	**1.48**	**1.28**	**1.71**	**1.34**	**1.17**	**1.54**	**1.49**	**1.23**	**1.79**	**1.20**	**1.01**	**1.41**
AI/AN	**1.54**	**1.13**	**2.10**	1.28	0.91	1.80	1.35	0.98	1.84	1.28	0.82	1.99	**2.03**	**1.44**	**2.84**
A/NHOPI	0.93	0.75	1.16	1.12	0.86	1.45	0.97	0.77	1.22	1.03	0.70	1.51	0.68	0.46	1.00
Hispanic	1.17	0.98	1.40	**1.85**	**1.53**	**2.23**	1.00	0.83	1.21	1.09	0.82	1.45	0.77	0.59	1.02
Sex															
Female (Ref.)	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–
Male	0.96	0.91	1.01	1.14	1.07	1.22	0.76	0.72	0.81	1.19	1.09	1.30	1.18	1.09	1.28
Age group															
18–29	3.28	2.68	4.02	5.92	4.87	7.18	2.58	2.13	3.12	0.27	0.16	0.43	2.58	2.05	3.25
30–49	2.29	2.12	2.48	2.83	2.56	3.13	1.92	1.76	2.10	0.76	0.66	0.86	3.18	2.83	3.58
50–64	1.44	1.36	1.54	1.63	1.49	1.78	1.33	1.23	1.44	0.91	0.82	1.00	1.92	1.73	2.14
65–75 (Ref.)	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–
BMI category															
Underweight	1.53	0.92	2.57	1.26	0.71	2.22	0.50	0.26	0.96	0.95	0.43	2.09	6.38	3.83	10.62
Normal	1.23	1.11	1.36	1.18	1.04	1.32	1.07	0.96	1.19	0.61	0.50	0.73	2.09	1.85	2.37
Overweight	1.00	0.94	1.07	0.93	0.86	1.01	1.03	0.96	1.11	0.74	0.67	0.83	1.39	1.26	1.52
Obese (Ref.)	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–
Origin															
Foreign-born (Ref.)	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–
U.S.-born	1.18	1.01	1.37	1.24	1.04	1.49	0.89	0.76	1.05	1.26	0.98	1.63	1.85	1.45	2.37

continued

Table 3 *Continued*

	ODC			*HbA1C*			*LDL Cholesterol*			*Blood Pressure*			*Tobacco*		
	OR	*95% CI*		*OR*	*95% CI*		*OR*	*95% CI*		*OR*	*95% CI*		*OR*	*95% CI*	
Language															
English (Ref.)	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–
Non-English	1.43	1.20	1.71	1.48	1.21	1.80	1.24	1.03	1.49	1.24	0.94	1.64	0.73	0.54	0.99
Marital status															
Married (Ref.)	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–	1.00	–	–
Partner	1.15	0.79	1.68	1.40	0.92	2.13	1.08	0.71	1.64	1.15	0.63	2.1	1.37	0.83	2.24
Single	1.33	1.24	1.43	1.24	1.14	1.35	1.14	1.05	1.23	1.28	1.14	1.44	1.74	1.58	1.91
Separated	2.18	1.65	2.88	1.70	1.28	2.25	1.69	1.29	2.20	1.37	0.93	2.02	2.74	2.04	3.69
Divorced	1.69	1.53	1.86	1.42	1.27	1.59	1.21	1.09	1.34	1.36	1.18	1.58	2.26	2.00	2.55
Widowed	1.27	1.13	1.43	1.17	1.00	1.38	1.08	0.94	1.24	1.41	1.18	1.68	1.86	1.56	2.22

OR = adjusted odds ratios. Adjusted for covariates in Table 1.

shown that aggregated high quality does not necessarily equate to low disparities (Trivedi et al. 2006).

Implications

This study underscores the importance of adopting practices that stratify quality measures as a strategy to improve care and health outcomes. Implementing quality improvement initiatives within a health system can reduce racial/ethnic disparities (Fiscella et al. 2000; Aaron and Clancy 2003; Trivedi et al. 2005). Also, general diabetes quality improvement initiatives have demonstrated improvements in ODC and receipt of recommended diabetes care (process measures); however, racial/ethnic disparities in outcome measures tend to remain (Saydah, Fradkin, and Cowie 2004; Trivedi et al. 2005; Mangione et al. 2006; Sequist 2006; Frederick et al. 2013). Because of persistent outcome disparities, continued documentation to inform tailored interventions for patients and/or providers will be important to reduce gaps (Trivedi et al. 2005; Sequist 2006).

As demonstrated in this study, stratifying quality measures can point researchers and providers toward specific clinical areas of intervention to help increase optimal control in minority groups. The next step will be to understand which factors are amenable to intervention and likely to yield success, as there are many combinations of factors that contribute to disparities in health. Contributing factors include patient factors (e.g., socioeconomic status, culture, health behaviors, self-management), community factors (e.g., neighborhood resources and safety, access to health care and healthy food), provider factors (e.g., clinical inertia, communication, bias), and health care system factors (e.g., culturally and linguistically sensitive resources, processes of care, care coordination issues) (Williams and Collins 2001; Kilbourne et al. 2006; Selby et al. 2007; Wilkes 2011). Health systems should take initiative to understand which factors are influencing disparities within the system to inform targeted interventions. Improved data collection, where possible, will be important to achieve this.

Our study serves as an example for health systems, particularly those which do not currently monitor and document quality of care disparities. As a result of this research, the health system in this study has begun taking steps toward health care equity through a number of avenues. Diabetes-specific initiatives within the surrounding community are being explored. For example, a pilot intervention using a clinic/community partnership to provide community-based diabetes self-management support is currently underway. A health

equity stakeholder group comprised of health system leadership and representatives of many departments was developed to foster system-wide collaboration around the issue of disparities. Race/ethnicity filters have been added to all quality measure dashboards where disparities monitoring has begun and report prototypes created to help turn data into actionable next steps. Finally, infrastructure specifically for conducting health equity work has been developed within this health system. These are just some examples of how health systems can begin to document and work toward understanding and addressing disparities. Some of these examples align with qualitative findings on health care interventions aimed at reducing cardiovascular and diabetes racial/ethnic disparities, such as organizational commitment, population health focus, use of data to inform solutions, and patient-centeredness (Jones, Trivedi, and Ayanian 2010).

Limitations

There are limitations to this research that should be considered. First, these results come from a single health system, which may limit generalizability to the broader U.S. population. However, with clinics spread across urban, suburban, and rural areas, this large health system is comprised of a diverse cultural and geographic population. Our study still provides insight to health systems interested in using their quality measures to assess disparities in their patient population. Related to generalizability, aside from the proportion born in the United States and proportion of non-Hispanic whites being smaller among those excluded, most characteristics are similar to those included in the study (Table 1). We cannot assess whether these proportions are actually smaller than the study population due to missing data. Second, adhering to MNCM standards, this analysis does not distinguish between Type I and Type II diabetes. Distinctions between the two types in future research may be useful for clinicians. Third, we used the current method to measure and report ODC in Minnesota (the all-or-none composite measure), which includes the single most recent value recorded for each component. This snapshot however, may not represent overall diabetes control over the course of a year. Subsequent research should consider other composite measure options or longitudinal data to understand patterns over time. Fourth, important variables to fully understand patient characteristics were not in the available dataset, such as health behaviors (e.g., diet, exercise), adherence (e.g., medication use), comorbidities (e.g., hypertension, depression), insurance status, and socioeconomic status (e.g., education). Social factors such as socioeconomic

status are strong determinants of health outcomes that could confound the racial/ethnic effects, although some studies have shown that racial/ethnic disparities persist even after controlling for other social factors (Hayward et al. 2000; Institute of Medicine 2002). Finally, we did not have data on primary care physician or clinic attended to account for potential effects of patient clustering. This may have resulted in an underestimate of the standard errors. Because this health care organization has multiple clinics spread across Minnesota, it will be important to understand how clinic-specific factors such as location (e.g., urban/suburban/rural) and composition of patient population affect ODC outcomes.

Conclusion

As the leading cause of numerous debilitating health complications, and one of the leading causes of death in the United States, the diabetes burden is projected to increase in the United States (Saadine et al. 2008; Shaw, Sicree and Zimmet 2010). This will require health care organizations to implement diabetes prevention initiatives and successful interventions to improve ODC. In addition, racial/ethnic diabetes disparities are an important health equity issue that persists. As health care organizations aim to improve diabetes outcomes, stratifying quality measures by race/ethnicity and other sociodemographic factors can guide them toward targeted interventions and improvement initiatives.

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REFERENCES

Aaron, K. F., and C. M. Clancy. 2003. "Improving Quality and Reducing Disparities: Toward a Common Pathway." *Journal of the American Medical Association* 289 (8): 1033–4.

Agency for Healthcare Research and Quality. 2012. *National Healthcare Disparities Report, 2011*. Rockville, MD: Agency for Healthcare Research and Quality.

American Diabetes Association [ADA]. 2012. "Standards of Medical Care in Diabetes–2012." *Diabetes Care* 35 (Suppl 1): S11–63. doi:10.2337/dc12-s011.

Boyle, J. P., T. J. Thompson, E. W. Gregg, L. E. Barker, and D. F. Williamson. 2010. "Projection of the Year 2050 Burden of Diabetes in the US Adult Population: Dynamic Modeling of Incidence, Mortality, and Prediabetes Prevalence." *Population Health Metrics* 8: 29. doi:10.1186/1478-7954-8-29.

Campbell, J. A., R. J. Walker, B. L. Smalls, and L. E. Egede. 2012. "Glucose Control in Diabetes: The Impact of Racial Differences on Monitoring and Outcomes." *Endocrine* 42 (3): 471–82. doi:10.1007/s12020-012-9744-6.

Centers for Disease Control and Prevention. 2011. *National Diabetes Fact Sheet: National Estimates and General Information on Diabetes and Prediabetes in the United States.* Atlanta, GA: U.S. Department of Health and Human Services,, Centers for Disease Control and Prevention [accessed on March 20, 2014]. Available at http://www.cdc.gov/diabetes/pubs/factsheet11.htm

Duru, O. K., R. B. Gerzoff, J. V. Selby, A. F. Brown, R. T. Ackermann, A. J. Karter, S. Ross, W. N. Steers, W. H. Herman, B. E. Waitzfelder, and C. M. Mangione. 2009. "Identifying Risk Factors for Racial Disparities in Diabetes Outcomes: The Translating Research into Action for Diabetes Study." *Medical Care* 47 (6): 700–6.

Egede, L. E., M. Gebregziabher, C. P. Lynch, G. E. Gilbert, and C. Echols. 2011. "Longitudinal Ethnic Differences in Multiple Cardiovascular Risk Factor Control in a Cohort of US Adults with Diabetes." *Diabetes Research and Clinical Practice* 94 (3): 385–94. doi:10.1016/j.diabres.2011.08.003.

Fiscella, K., P. Franks, M. R. Gold, and C. M. Clancy. 2000. "Inequality in Quality: Addressing Socioeconomic, Racial, and Ethnic Disparities in Health Care." *Journal of the American Medical Association* 283 (19): 2579–84.

Frederick, M. L., P. J. Johnson, J. Duffee, and B. McCarthy. 2013. "Coaching of Physicians by RNs to Improve Diabetes Care." *The Diabetes Educator* 39 (2): 171–7.

Hayward, M., T. Miles, E. Crimmins, and Y. Yang. 2000. "The Significance of Socioeconomic Status in Explaining the Racial Gap in Chronic Health Conditions." *American Sociological Review* 65 (6): 910–30.

Institute of Medicine. 2002. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care.* Washington, DC: National Academy Press.

Jackson, G. L., D. Edelman, and M. Weinberger. 2006. "Simultaneous Control of Intermediate Diabetes Outcomes among Veterans Affairs Primary Care Patients." *Journal of General Internal Medicine* 21 (10): 1050–6. doi:10.1111/j.1525-1497.2006.00519.x.

Jiang, H. J., C. A. Russo, and M. L. Barrett. 2009. *Nationwide Frequency and Costs of Potentially Preventable Hospitalizations, 2006.* No. HCUP Statistical Brief #72. Rockville, MD: U.S. Agency for Healthcare Research and Quality.

Johnson, P. J., N. Ghildayal, and P. Wheeler. 2012. "Disparities in Potentially Avoidable Hospital Care." *American Journal of Epidemiology* 175 (11): S27.

Jones, R. G., A. N. Trivedi, and J. Z. Ayanian. 2010. "Factors Influencing the Effectiveness of Interventions to Reduce Racial and Ethnic Disparities in Health Care." *Social Science and Medicine* 70 (3): 337–41.

Kilbourne, A. M., G. Switzer, K. Hyman, M. Crowley-Matoka, and M. J. Fine. 2006. "Advancing Health Disparities Research within the Health Care System: A Conceptual Framework." *American Journal of Public Health* 96 (12): 2113–21. doi:10.2105/AJPH.2005.077628.

Lanting, L. C., I. M. Joung, J. P. Mackenbach, S. W. Lamberts, and A. H. Bootsma. 2005. "Ethnic Differences in Mortality, End-Stage Complications, and Quality of Care among Diabetic Patients: A Review." *Diabetes Care* 28 (9): 2280–8.

Mangione, C. M., R. B. Gerzoff, D. F. Williamson, W. N. Steers, E. A. Kerr, A. F. Brown, B. E. Waitfelder, D. G. Marrero, R. A. Dudley, C. Kim, W. Herman, T. J. Thompson, M. M. Safford, and J. V. Selby. 2006. "The Association between Quality of Care and the Intensity of Diabetes Disease Management Programs." *Annals of Internal Medicine* 145 (2): 107–16.

Minnesota Community Measurement. (2010). Data Collection Guide Optimal Diabetes Care 2011 (2010 Dates of Service) [accessed on December 30, 2012]. Available at http://www.mncm.org/site/

Minnesota Community Measurement. (2011). Health Care Quality Report [accessed on December 30, 2012]. Available at http://www.mncm.org/site/

Office of Management and Budget. (2000). Provisional Guidance on the Implementation of the 1997 Standards for Federal Data on Race and Ethnicity. Tabulation Working Group Interagency Committee for the Review of Standards for Data on Race and Ethnicity. [accessed on March 20, 2014]. Available at http://www.whitehouse.gov/sites/default/files/omb/assets/information_and_regulatory_affairs/re_guidance2000update.pdf

Russo, C. A., R. M. Andrews, and R. M. Coffey. 2006. *Racial and Ethnic Disparities in Potentially Preventable Hospitalizations, 2003.* No HCUP Statistical Brief #10. Rockville, MD: Agency for Healthcare Research and Quality.

Saaddine, J. B., A. A. Honeycutt, K. M. Narayan, X. Zhang, R. Klein, and J. P. Boyle. 2008. "Projection of Diabetic Retinopathy and Other Major Eye Diseases among People with Diabetes Mellitus: United States, 2005-2050." *Archives of Ophthalmology* 126 (12): 1740–7. doi:10.1001/archopht.126.12.1740.

Saydah, S. H., J. Fradkin, and C. C. Cowie. 2004. "Poor Control of Risk Factors for Vascular Disease among Adults with Previously Diagnosed Diabetes." *Journal of the American Medical Association* 291 (3): 335–42. doi:10.1001/jama.291.3.335.

Selby, J. V., B. E. Swain, R. B. Gerzoff, A. J. Karter, B. E. Waitzfelder, A. F. Brown, R. T. Ackerman, O. K. Duru, A. Ferrara, W. Herman, D. G. Marrero, D. Caputo, and K. M. V. Narayan. 2007. "Understanding the Gap between Good Processes of Diabetes Care and Poor Intermediate Outcomes: Translating Research into Action for Diabetes (TRIAD)." *Medical Care* 45 (12): 1144–53. doi:10.1097/MLR.0b013e3181468e79.

Sequist, T. D., A. Adams, F. Zhang, D. Ross-Degnan, and J. Z. Ayanian. 2006. "Effect of Quality Improvement on Racial Disparities in Diabetes Care." *Archives of Internal Medicine* 166 (6): 675. doi:10.1001/archinte.166.6.675.

Shaw, J. E., R. A. Sicree, and P. Z. Zimmet. 2010. "Global Estimates of the Prevalence of Diabetes for 2010 and 2030." *Diabetes Research and Clinical Practice* 87 (1): 4–14. doi:10.1016/j.diabres.2009.10.007.

Trivedi, A. N., A. M. Zaslavsky, E. C. Schneider, and J. Z. Ayanian. 2005. "Trends in the Quality of Care and Racial Disparities in Medicare Managed Care." *The New England Journal of Medicine* 353 (7): 692–700. doi:10.1056/NEJMsa051207.

———. 2006. "Relationship between Quality of Care and Racial Disparities in Medicare Health Plans." *Journal of the American Medical Association* 296 (16): 1998–2004.

Wilkes, A. E., K. Bordenave, L. Vinci, and M. E. Peek. 2011. "Addressing Diabetes Racial and Ethnic Disparities: Lessons Learned from Quality Improvement Collaboratives." *Diabetes Management* 1 (6): 653. doi:10.2217/dmt.11.48.

Williams, D. R., and C. Collins. 2001. "Racial Residential Segregation: A Fundamental Cause of Racial Disparities in Health." *Public Health Reports* 116 (5): 404–16.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.