

Impact of Self-Reported Patient Characteristics Upon Assessment of Glycemic Control in the Veterans Health Administration

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OBJECTIVE — The purpose of this article was to evaluate the impact of self-reported patient factors on quality assessment of Veterans Health Administration medical centers in achieving glycemic control.

RESEARCH DESIGN AND METHODS — We linked survey data and administrative records for veterans who self-reported diabetes on a 1999 national weighted survey. Linear regression models were used to adjust A1C levels in fiscal year 2000 for socioeconomic status (education level, employment, and concerns of having enough food), social support (marital status and living alone), health behaviors (smoking, alcohol use, and exercise level), physical and mental health status, BMI, and diabetes duration. Medical centers were ranked by deciles, with and without adjustment for patient characteristics, on proportions of patients achieving A1C <7 or <8%.

RESULTS — There was substantial medical center level variation in patient characteristics of the 56,740 individuals from 105 centers, e.g., grade school education (mean 15.3% [range 2.3–32.7%]), being retired (38.3% [19.9–59.7%]) or married (65.2% [43.7–77.8%]), food insufficiency (13.9% [7.2–24.6%]), and no reported exercise (43.2% [31.1–53.6%]). The final model had an R^2 of 7.8%. The Spearman rank coefficient comparing the thresholds adjusted only for age and sex to the full model was 0.71 for <7% and 0.64 for <8% ($P < 0.0001$). After risk adjustment, 4 of the 11 best-performing centers changed at least two deciles for the <7% threshold, and 2 of 11 changed two deciles for the <8% threshold.

CONCLUSIONS — Adjustment for patient self-reported socioeconomic status and health impacts medical center rankings for glycemic control, suggesting the need for risk adjustment to assure valid inferences about quality.

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Performance measurement is an integral part of health care management. Because intermediate health outcome measures are closely linked to morbidity and mortality (1), they are

increasingly being used to assess the quality of care (2–4), despite concerns over possible unintended consequences of performance measurement and “pay-for-performance” (5).

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Abbreviations: LVHS, Large Veterans Health Survey; NCQA, National Committee for Quality Assurance; VHA, Veterans Health Administration.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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Assessment of glycemic control in individuals with diabetes exemplifies the need for and difficulty in development of meaningful and fair intermediate outcome measures for public reporting. Diabetes affects >20 million Americans and is a major risk factor for chronic kidney disease, lower extremity complications, visual loss, cardiovascular disease, and death (6). Landmark efficacy studies have demonstrated that achieving and maintaining A1C levels <7% substantially decrease diabetes-related complications in individuals (7,8). This threshold has long been recommended for internal quality improvement by organizations that develop (9) and endorse (4) measures for diabetes.

Resulting from concerns over the lack of widely accepted methods for risk adjustment for A1C (9), the national voluntary consensus (3) accountability measure for glycemic control (4) is an assessment of poor glycemic control (>9%). More recently, however, an accountability measure of <7% for all individuals with diabetes between 18 and 75 years of age has been adopted by the National Committee for Quality Assurance (NCQA) for public reporting by health care plans (10). Implementation of this measure has moved forward without consideration of patient-level factors that can influence glycemic control but are largely or completely outside the control of health care providers or health plans (11). For example, an overwhelming body of research has indicated that socioeconomic status, specifically poverty, is an important influence on glycemic control (12). How such characteristics impact health plan rankings using A1C thresholds <9% has not been reported.

Our objective in this study was to evaluate the impacts of patient self-reported socioeconomic status, health status, and health behaviors on the assessment of Veterans Health Administration (VHA) medical center performance in achieving A1C levels <7%, as proposed by the NCQA, and <8%, which was the American Diabetes Association threshold

to “take action” during the study period. Using a combination of survey and administrative data, we developed a regression model to adjust A1C levels. Results from this model were used to risk adjust VHA medical center level rankings based upon the proportion of individuals achieving A1C thresholds of <8 and $<7\%$. We hypothesized that patient-level variables would vary sufficiently among VHA medical centers to result in substantial changes in rankings with and without risk adjustment.

RESEARCH DESIGN AND METHODS

Data sources and cohort identification

The Large Veterans Health Survey (LVHS), a weighted national representative survey of about 1,400,000 VHA enrollees was conducted in the summer of 1999 (13) with a response rate of 63.1% ($n = 887,775$). In this survey 190,374 individuals reported being told by a doctor that they had diabetes. We merged utilization and laboratory data available in VHA administrative databases for this cohort as previously described (14). Briefly, inpatient and outpatient utilization data and ICD-9 codes were obtained from the National Patient Clinical Dataset (Austin, TX), and laboratory data were obtained from the VA Healthcare Analysis Information Group.

To approximate NCQA criteria for indemnity plan member inclusion in Healthcare Employee Data Information Set reporting (15), we included only veterans who had at least two diabetes-related (250.x diagnostic code) visits with a clinician in the VHA health care system in fiscal year 1998 and/or fiscal year 1999 and excluded individuals whom we identified as being deceased before 1 October 1999, using the VHA Beneficiary Identification and Records Locator System and the Medicare Denominator File (13). We identified 132,076 subjects who met these criteria.

To minimize any impact of difference in A1C methodologies, we eliminated medical centers that used A1C methodologies in fiscal year 2000 that were not certified by the National Glycohemoglobin Standardization Program as previously described (16). Although the Health Plan Employee Data and Information Set (HEDIS) measures for glycemic control count A1C not measured as being greater than the threshold value, we also ex-

cluded individuals at remaining medical centers who did not have laboratory tests performed in the VHA both to focus our study upon the influence of patient characteristics on glycemic control and because administrative data could not capture laboratory tests performed outside the VHA and recorded in progress notes. This resulted in exclusion of 54,460 subjects.

Of the remaining 77,616 individuals, we excluded 20,876 who did not answer questions on the LVHS that were included in our analysis (Table 1). Our final study population consisted of 56,740 VHA clinical users with diabetes at 105 medical centers. We compared baseline characteristics of veterans with diabetes in our final study cohort with those who were excluded as described above. The VA New Jersey Healthcare System Institutional Review Board approved this study.

Model development

Variables used in risk adjustment. We selected LVHS variables that reflect characteristics largely outside the control of a health care plan yet are known to be associated with adherence to intensive treatment and improved outcomes (12). Demographic variables included age and sex. Health status variables included physical health and mental health component scores measured by the Veterans Short Form-36. Health behavior included smoking, alcohol use, and exercise level. Social support variables included marital status and living arrangements (living alone or not). Socioeconomic status variables included education level, employment, and extreme economic hardship. The latter was assessed by a food sufficiency question that asks “In the past 30 days have you been concerned about having enough food for you or your family?” with yes or no responses. Other variables included duration of diabetes and height and weight (enabling calculation of BMI).

Modeling. We used general linear regression models to develop a risk adjustment model for individual A1C levels. We retained variables that were significant at the $P < 0.05$ level in the final model. Our comparison model included only age and sex (17) to evaluate the marginal impact of the variables of interest upon glycemic control and medical center level performance.

Medical center profiling. We evaluated the impact of risk adjustment on medical center profiling, separately for each of two A1C thresholds (<7 and $<8\%$), by comparing ranks from before and after risk

adjustment. Whereas the $<7\%$ threshold has always been considered the target goal for glycemic control, the 8% level was consistent with 1999–2000 American Diabetes Association Clinical Practice Recommendations (18) for taking action. An individual subject met adherence criteria to an individual measure if the last A1C level achieved in fiscal year 2000 was below the threshold.

To determine the ranks for unadjusted A1C values among medical centers, we first identified individuals at each medical center whose A1C values were below the unadjusted A1C threshold (the “observed”). We then used the total number with diabetes at that medical center to generate a proportion and ranked medical centers on these proportions of observed patients (19). To determine the ranks using adjusted A1C values, we used two different models: Model 1 included only age and sex as independent variables; model 2 included all the variables described above. For each of the models, we performed the following steps. First, we calculated the percentage of individuals in the entire study population (105 medical centers) with A1C values below the threshold of observed A1C. Next, we identified individuals with adjusted A1C values at or below the corresponding population-level percentage for each threshold. Of these individuals, we then counted the number of individuals at each medical center (the “expected”). This information was used to generate observed-to-expected ratios for each medical center, and medical centers were then ordered on these ratios to obtain risk-adjusted ranks. We repeated this process for both 8 and 7% thresholds of A1C. For each medical center, six unique ranks were possible: by both 7 and 8% thresholds, ranking based on unadjusted ratios and ranking based on two adjusted models with age and sex in the first and all socioeconomic self-reported variables already described.

Because the use of best and worse decile rankings is one industry standard for identifying best and worse health plans (2), we ranked VHA medical centers into deciles and used league tables to determine the degree of ranking movement for medical centers in the best and worse two deciles for both the <7 and $<8\%$ threshold after risk adjustment. The degree of movement was evaluated by shifts in decile ranks. We reported the number of medical centers that changed decile ranks and the magnitude of the change.

RESULTS— The individuals in the study sample with complete data were mostly male (mean 98%) and elderly (mean age 64.6 years). Individuals who were included in the analysis were slightly younger than those who were excluded (19.7 vs. 15.2% <55 years of age), more likely to be married (65.5 vs. 60.3%), and better educated (Table 1).

There were marked differences in the socioeconomic status and health-related characteristics of the patient populations among VHA medical centers (Table 2). For example, there were substantial variations in having completed only grade school education (mean 15.3% [range 2.3–32.7%]), being retired (38.3% [19.9–59.7%]) or married (65.2% [43.7–77.8%]), reporting concern about food sufficiency (13.9% [7.2–24.6%]), or reporting no exercise (43.2% [31.1–53.6%]). There was also variation in self-reported health status as assessed by the mental health component score (43.8 [38.7–48.9]) and the physical health component score (31.4 [27.6–36.4]) of the Veterans Short Form-36. Mean medical center levels of A1C varied from 7.14 to 8.58%, and the proportion of individuals achieving A1C levels <7 and <8% varied from 23 to 56% and from 44 to 79%, respectively.

Variables and interaction terms that contributed significantly to variations in A1C and were retained in the final model included age, marital status, BMI, duration of diabetes, education level, employment status, concern for food sufficiency, smoking frequency, and exercise frequency (Table 2). The R^2 of this model was 7.8%. Being older, being female, having a higher education level, and exercising more frequently were associated with having lower A1C levels. Longer duration of diabetes and higher BMI were associated with higher A1C levels.

Medical center rankings from the <7 and <8% thresholds were highly correlated (Spearman rank coefficient unadjusted 0.89 [$P < 0.001$] and adjusted 0.85 [$P < 0.001$]). Medical center rankings using unadjusted and adjusted values were also highly correlated, although somewhat less so (Spearman rank coefficient 0.71 [$P < 0.001$] for <7% and 0.64 [$P < 0.0001$] for <8%).

There were changes in medical center ranks when the models using all available variables were compared with the age- and sex-adjustment models. For example, the top and bottom 20% (two deciles each) had 21 medical centers ranked. For

the <7% threshold (Fig. 1A), 4 medical centers that initially ranked in the best decile in the model with age and sex moved down two deciles, no longer ranked in the best decile after adjustment using the full model. On the lower end, two medical centers ranked in the worst decile when using the age- and sex-adjusted model improved by one decile as a result of using the full model. For the 8% threshold (Fig. 1B), two medical centers moved from the best decile (shifting two deciles) and three medical centers moved from the worst decile (also shifting one decile) using the full model compared with using the age- and sex-adjusted model only.

For the <7% threshold measure, we compared the means of age, sex, and self-reported variables for those facilities ($n = 4$) changing two deciles with those for the other facilities ($n = 7$). However, despite considerable differences among facilities, we were unable to demonstrate differences in the group means of any individual variable (data not shown).

CONCLUSIONS— Our study demonstrated that patient characteristics, which can influence glycemic control but are largely outside of the control of health providers or health plans, can change the identification of best- and worse-performing medical centers and thus could potentially change quality assessments by internal and external stakeholders. Self-reported socioeconomic status, health status, and health behaviors varied widely among VHA medical centers but explained only a small proportion of A1C variation. Nonetheless, when these characteristics were used to risk adjust A1C levels at <7 or <8%, about 29 and 24%, respectively, of medical centers initially identified as best and worse medical centers shifted out of these categories. Whereas <7% is considered a threshold for “excellent control” (10), an A1C threshold >8% has been proposed as a threshold by which to assess clinical inertia (20,21). Our findings demonstrate the importance of taking into account socioeconomic position factors when ranking systems of health care for public reporting on the basis of A1C levels lower than the current >9% threshold for poor glycemic control.

Our observations that patient-level factors such as fewer years of completed education, concerns over food sufficiency, less social support (unmarried or living alone), and unemployment were

associated with worse glycemic control in the veteran population are consistent with the literature (12). Similarly, the observation that <10% of the variance in A1C levels could be explained by these variables is also consistent with prior studies demonstrating a poor explanatory value for individual-level variables on glycemic control (22–24). These findings extend recent findings (25) that poorer individuals enrolled in managed health care plans had slightly higher A1C values (8.1%) than those with higher incomes (7.8%). However, in contrast to our findings, there were no differences in glycemic control by education. It is important to note that none of these previous studies evaluated the impact of patient-level socioeconomic characteristics upon quality assessment of different health care plans.

It is unclear how these variables interact to impact glycemic control. For example, socioeconomic barriers could lead to belief systems or attitudes (26) that impact with provider-patient communication regarding glycemic goal setting (27). Alternatively, it may be more difficult to make healthy food choices or have an environment in which to exercise, thus impeding progress in achieving glycemic goals (12). Regardless of the mechanisms, our empirical findings indicate the difficulties in generalizing from landmark clinical trials with activated patients to real-world settings with more heterogeneous populations (28) for the purpose of public reporting and payment.

Our findings are most immediately relevant to the recent decision by NCQA to implement a public reporting measure using a <7% threshold. Although the NCQA groups health care plans into Commercial, Medicaid, and Medicare enrollment status, this level of aggregation is unlikely to be sufficient to control for differences in socioeconomic characteristics among plan enrollees. Whether or not health plans should be further stratified by rural or urban location or patient income and educational status needs to be considered. Geocoding patient addresses from enrollment data to the census block group level could be used as an alternative to individually collected data (29), although this approach is admittedly an approximation. Alternatively, there could be differential weighting of adherence to the <7 and <9% thresholds, as is done in the Bridges to Excellence Program at the physician practice level (30) to reflect the fact that “optimal” control is less under physician control than “poor” control.

Table 1—Baseline (fiscal year 1999) patient characteristics of subjects with a standardized A1C test performed in fiscal year 2000*

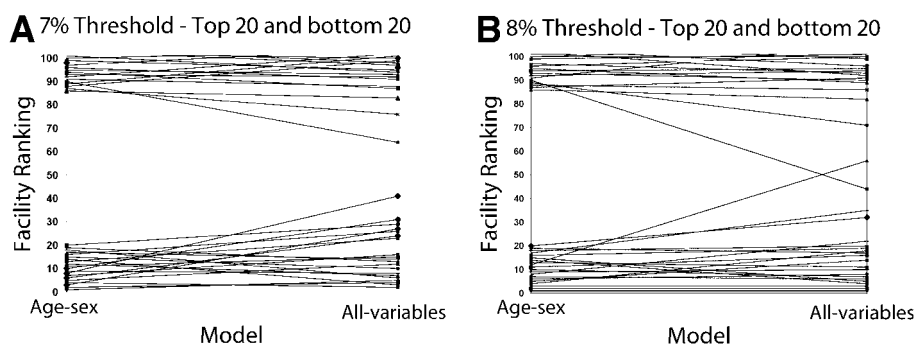
	Included in analysis		Excluded from analysis	
	Frequency	%	Frequency	%
Sex				
Female	1,105	1.9	463	2.2
Male	55,635	98.1	20,413	97.8
Total	56,740		20,876	
Age (years)				
>75	10,244	18.1	4,681	22.4
65–74	21,849	38.5	8,419	40.3
55–64	13,465	23.7	4,611	22.1
<55	11,182	19.7	3,165	15.2
Marital status				
Married	37,169	65.5	12,592	60.3
Separated	1,697	3.0	748	3.6
All other	17,174	31.5	6,861	32.9
Missing	NA		675	3.2
Duration of diabetes				
<1 year	4,576	8.1	1,576	7.6
1–3 years	12,602	22.2	4,209	20.2
4–10 years	19,173	33.8	6,620	31.7
11–20 years	12,479	22.0	4,443	21.3
>20 years	7,910	13.9	2,971	14.2
Missing	NA		1,057	5.1
BMI (kg/m ²)				
<25	8,604	15.2	2,865	13.7
25 to <30	23,946	42.2	7,293	34.9
30 to <35	15,229	26.8	4,320	20.7
35 to <40	6,016	10.6	1,719	8.2
≥40	2,945	5.2	804	3.9
Missing	NA		3,885	18.6
Education				
None/grade school	8,655	15.4	3,150	15.1
Grade 9–11	8,771	15.5	2,971	14.2
High school graduate	18,117	31.9	4,954	23.7
College or more	21,197	37.3	5,099	24.4
Missing	NA		4,702	22.5
Employment status				
Retired and unable to work	22,744	40.1	8,571	41.1
Working	10,400	18.3	2,898	13.9
Retired	21,415	37.7	7,858	37.6
All other combinations	2,181	3.8	1,549	0.1
Food sufficiency				
Yes, worry	8,000	14.1	2,701	12.9
No	48,740	85.9	4,985	63.2
Missing	NA		13,190	23.9
Smoking (time since stopped)				
<1 year	3,992	7.0	1,091	5.2
1–5 years	4,001	7.1	1,022	4.9
>5 years	28,341	50.0	6,892	33.0
Still smoking	6,501	11.5	1,482	7.1
Never smoked regularly	13,905	24.5	3,437	16.5
Missing	NA		6,952	33.3
MCS (average)	43.6	—	42.8	—
PCS (average)	31.2	—	32.2	—
A1C (average)	7.59	—	7.57	—
% with A1C <7%	—	42.6	—	43.9
% with A1C <8%	—	68.1	—	68.7
Exercise	24,965	44.0	7,338	35.2
<1 time/week	9,210	16.2	2,303	11.0
1–2 times/week	9,095	16.0	2,410	11.5
3–4 times/week	7,758	13.7	2,131	10.2
≥5 times/week	5,712	10.1	1,684	8.1
Missing	NA		5,010	24.0

*A1C test performed in a VHA Medical Center using A1C methodology certified by the National Glycohemoglobin Standardization Program. MCS, mental component score; NA, not applicable; PCS, physical component score.

Table 2—Medical center variation in population socioeconomic status and health

	Mean	Minimum	P10	P25	P50	P75	P90	Maximum
Sex								
Female	2.0	0.5	1.1	1.4	1.9	2.4	3.3	5.1
Male	98.0	94.9	96.7	97.6	98.1	98.6	98.9	99.5
Age (years)								
>75	18.1	9.1	12.1	15.6	18.3	20.9	23.2	26.8
65–74	38.3	17.4	32.9	35.4	38.0	40.8	44.0	50.0
55–64	23.8	16.2	19.1	20.8	23.9	26.1	28.4	37.9
<55	19.8	11.6	14.2	16.0	20.0	22.6	25.6	36.6
Marital status								
Married	65.2	43.7	58.0	61.6	66.1	69.7	72.7	77.8
Separated	2.9	0.5	1.3	1.8	2.8	3.7	4.5	9.8
All other	31.9	19.9	24.9	27.1	31.6	35.9	38.7	49.9
Duration of diabetes								
<1 year	8.1	5.0	6.4	7.1	8.1	9.0	9.9	12.1
1–3 years	22.2	18.0	19.4	20.7	22.1	23.5	25.0	29.4
4–10 years	33.8	26.2	31.3	32.5	33.8	35.2	36.7	41.1
11–20 years	22.0	16.3	18.9	20.5	22.2	23.4	25.4	27.1
>20 years	13.9	6.8	11.2	12.2	14.1	15.3	16.4	21.0
BMI (kg/m ²)								
<25	15.2	9.4	11.4	13.4	15.4	16.8	18.3	21.3
25–30	42.3	28.8	38.2	39.9	42.2	44.6	46.2	50.0
30–35	26.8	19.5	23.8	25.1	26.7	28.2	30.0	34.5
35–40	10.6	6.2	8.0	9.2	10.5	11.9	13.1	19.7
>40	5.1	1.1	3.2	4.2	5.2	6.1	6.8	10.6
Education								
None/grade school	15.3	2.3	7.8	11.3	14.6	18.8	22.9	32.7
Grade 9–11	15.4	6.1	11.1	12.6	14.8	17.5	21.3	28.7
High school graduate	31.8	22.4	26.7	28.4	31.2	34.6	37.7	45.4
College or more	37.5	16.9	25.9	31.2	35.9	43.5	51.8	65.2
Employment status								
Retired and unable to work	39.2	18.7	28.7	33.4	38.4	44.8	50.5	60.6
Working	18.6	10.1	13.8	15.5	18.1	20.5	24.0	31.8
Retired	38.3	19.9	29.3	32.0	38.3	43.2	48.5	59.7
All other combinations	3.9	1.5	2.2	2.8	3.6	4.7	5.7	10.3
Food sufficiency								
Yes, worried about	13.9	7.2	9.3	11.2	13.5	16.1	19.5	24.6
Smoking (time since stopped)								
<1 year	7.1	3.8	5.1	5.9	7.1	8.0	9.1	10.6
1–5 years	7.1	3.7	5.2	6.0	7.2	7.8	8.7	11.9
>5 years	50.0	37.3	45.0	47.3	50.0	52.8	55.2	60.5
Still smoking	11.6	6.3	9.5	10.2	11.6	13.1	14.2	18.7
Never smoked regularly	24.3	15.4	20.5	22.0	23.8	26.5	28.6	37.5
MCS (average)	43.8	38.7	41.2	42.3	43.9	45.2	46.2	48.9
PCS (average)	31.4	27.6	28.6	29.9	31.3	33.1	34.2	36.4
A1C (average)	7.6	7.1	7.3	7.4	7.6	7.8	7.9	8.6
% with A1C <7%	42.0	23.0	33.1	37.0	42.5	46.6	50.1	55.7
% with A1C <8%	67.3	44.4	59.3	64.1	67.7	71.5	74.9	79.1
% with A1C <9%	83.2	65.1	77.4	81.2	83.6	86.2	88.6	92.7
Exercise								
None	43.2	31.1	36.1	40.1	43.6	46.9	49.1	53.6
<1 time/week	16.6	11.6	13.7	15.0	16.5	18.1	18.9	25.2
1–2 times/week	16.2	10.8	13.3	14.8	16.2	17.5	18.3	24.2
3–4 times/week	13.7	8.4	11.0	12.2	13.3	15.1	17.2	22.7
≥5 times/week	10.3	5.5	7.8	8.7	9.9	11.8	13.3	18.6

MCS, mental component score; PCS, physical component score.



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