Mitigating case mix factors by choice of glycemic control performance measure threshold

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Running title: Choice of HbA1c performance measure threshold

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**Objective:** Performance measures are tools for assessing quality of care, but may also be influenced by patient factors. We investigated how currently endorsed performance measures for glycemic control in diabetes may be influenced by case mix composition. We assessed differences in HbA1c performance measure threshold attainment by case mix factors for HbA1c >9% and examined how lowering the threshold to HbA1c >8% or >7% changed these differences.

**Research Design and Methods:** Using data from the 1999-2002 National Health and Nutrition Examination Survey for 843 adults self-reporting diabetes, we computed the mean difference in HbA1c threshold attainment of >9%, >8%, and >7% by various case mix factors. The mean difference is the average percentage point difference in threshold attainment for population groups compared to the overall population.

**Results:** Diabetes medication was the only factor for which the difference in threshold attainment increased at lower thresholds, with mean differences of 5.7 percentage points at HbA1c >9% (reference), 10.1 at HbA1c >8% (p<0.05), and 14.1 at HbA1c >7% (p<0.001).

**Conclusions:** As 87% of U.S. adults have HbA1c <9%, a performance measure threshold of >9% will not drive major improvements in glycemic control. Lower thresholds do not exacerbate differences in threshold attainment for most factors. Reporting by diabetes medication use may compensate for heterogeneous case mix when using a performance measure threshold of HbA1c > 8% or lower.
The implementation of performance measures to provide public accountability and financial incentive for quality health care represents a major shift in the approach to improving population health within the U.S. (1) The movement to measure quality diabetes care involves establishing standards related to glycemic control, eye and foot examinations, urine protein screening, and management of lipids and blood pressure. (2) The performance measure threshold for glycemic control has been controversial. More stringent measures may encourage overzealous treatment of individuals to which more general guidelines don’t apply. Conversely, providers may mistake less stringent performance measures for guidelines that have been carefully developed by a number of medical organizations to assist physicians in setting therapeutic targets for their patients. (3)

The most commonly cited guidelines are those of the American Diabetes Association, which state that while certain patient groups (e.g., the elderly, those with co-morbidity) may not benefit from stringent glycemic targets, maintaining a glycosylated hemoglobin (HbA1c) of <7% is a reasonable goal for individuals with diabetes. (4) After decades in which less than half of Americans reached the target of HbA1c <7%, (5) national data have shown improved glycemic control in those with diabetes with 56% achieving HbA1c <7% in 2003-4. (6; 7) Even before these improvements, some stakeholders questioned whether linking pay for performance programs to a >9% threshold would encourage adequate glycemic control for individual patients or propel declines in HbA1c at the national level. (8) With only 13% of Americans with diagnosed diabetes having a HbA1c of 9% or greater in 2003-4, a performance measure of >9% may have limited ability to drive population-wide quality improvement.

In contrast to clinical practice guidelines for glycemic control, such as the ADA guideline, which address goals for individual patients, performance measures are designed to indicate overall health care quality delivered across a population of patients. (9) A HbA1c performance measure for holding providers accountable may foster improvement in population-level glycemic control, although experts debate how to define an optimal measure of health care quality. (10; 11) This debate has led to different thresholds established by different organizations and used for different purposes. The National Diabetes Quality Improvement Alliance (NDQIA), a consortium of stakeholders interested in diabetes care, has established two categories of performance measures. The first category of measures is intended for quality improvement efforts within an organization and describes HbA1c values across the range of <6.0 to >10.0%. The second set of measures is that to which providers and health plans will be accountable for public reporting and on which performance-based reimbursements will be based. The glycemic control performance measure that the NDQIA recommends for public reporting is HbA1c >9% to indicate poor control. (12) The NDQIA has a good control measure of HbA1c <7% under “active consideration,” but states that “before such a measure can be put forward, appropriate means for considering case mix must be specified.” The National Quality Forum (NQF), whose mission is to improve health care through national performance standards, has adopted the NDQIA benchmarks, including the HbA1c >9% threshold for public reporting. In contrast, the National Committee for Quality Assurance (NCQA) adopted a Health Plan Employer Data and Information Set (HEDIS) measure...
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RESEARCH DESIGN AND METHODS

Participants: Data for this cross-sectional analysis come from the 1999-2002 National Health and Nutrition Examination Survey (NHANES). This ongoing survey conducted by the National Center for Health Statistics (NCHS) uses a stratified, multistage, probability cluster design that results in a nationally representative sample of the noninstitutionalized, civilian U.S. population. The sampling design oversamples non-Hispanic blacks, Mexican Americans, individuals aged 60 years and older, and low-income individuals to provide more precise estimates for these specific groups. We included 843 adults aged ≥20 years with valid measures of HbA1c who were not pregnant and who reported during interview that a health care professional had told them they have diabetes. The NHANES 1999-2002 underwent institutional review board approval and obtained written informed consent.

Measures: Sociodemographic characteristics and information on diabetes, health and insurance status were ascertained during interviews. Age groups were based on approximate quintiles of the analytic sample. Race/ethnicity was based on self-identified race and Hispanic origin. Income-to-poverty ratio was defined as the ratio of reported total family income to the U.S. Census bureau poverty threshold. Diabetes medication was categorized as use of insulin (with or without oral agents), use of oral agents only, and no use of diabetes medication.

Weight and height were measured during a physical examination. Body mass index (BMI) was calculated as weight (kg) divided by the square of height (m), and weight status was categorized as under- or normal weight, overweight, obese, and severely obese with BMI cutoffs of <25, 25-29.9, 30-39.9, and ≥ 40 kg/m². HbA1c was assessed by Boronate Affinity High Performance Liquid Chromatography using Primus CLC330 and Primus CLC 385.
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(Primus Corporation, Kansas City, MO) and standardized according to the method of the Diabetes Control and Complications Trial,(18; 19) yielding interassay coefficients of variation of <3.0%.

Data Analysis: The mean difference provides a measure of disparity among different groups within a population.(20) We used the mean difference to assess differences in HbA1c threshold attainment by various population groups within potential case mix factors. For each factor, we calculated a mean difference to provide a summary of the difference in proportion of people with diabetes whose HbA1c exceeded 7%, 8%, and 9%. The mean difference is expressed in percentage points, across any number, \( p \), of population groups. The referent for each threshold, \( r_{\text{ref}} \), was selected as the proportion exceeding the threshold among the overall population. These referent proportions are constant at a given threshold and provide an intuitive standard from which to gauge differences across groups. For each population group, \( j \), we calculated the proportion, \( r_j \), exceeding the threshold, and the absolute difference in that proportion from that of the referent, \( r_{\text{ref}} \). For each factor, the mean difference was calculated using Equation 1.

\[
\text{Mean difference} = \frac{\sum_{j=1}^{p} |r_j - r_{\text{ref}}|}{p}
\]

All calculations were made using Wesvar version 5 (Westat, Rockville, MD) using the 4-year examination sample weights to account for the sample design and non-response. Sampling variance was calculated using the jackknife procedure, appropriate for the complex, multi-stage sample design.(21) 95% confidence limits were calculated by taking the natural logarithm of the mean difference, estimating the standard error of the transformed estimate, deriving confidence limits, and back-transforming the confidence limits via exponentiation. This transformation results in asymmetric confidence limits, but improves their validity.(22) T-tests were used to test whether the differences between the mean differences for the 7% and 8% thresholds relative to the 9% threshold were equal to zero.

RESULTS

The proportion of individuals whose HbA1c exceeded 9%, 8%, and 7% are presented by various patient factors (Table 1). Frequency distributions for each factor across the overall population are provided for reference. Of the overall (unstratified) population, 18.4% exceeded a HbA1c threshold of 9%, 32.8% exceeded a HbA1c of 8% and 52.6% exceeded the ADA recommended target HbA1c of 7%. These proportions provide the referent to which subgroup threshold attainment is compared. We first present differences in threshold attainment within factors, and then describe the effects on these differences of lowering the HbA1c threshold.

Sociodemographic Factors: For sociodemographic factors, important differences existed across groups of age, race/ethnicity, and insurance status at each of the HbA1c thresholds, while differences across gender and education were minor. The proportion exceeding a HbA1c of 9% declined steadily with increasing age, such that 32.7% of those aged 20-44 years but only 13.4% of those aged 65-74 and only 5.8% of those aged \( \geq 75 \) years surpassed the threshold. The age gradient was not explained by a shorter reported duration of diabetes or a lower proportion of insulin use among the elderly (data not shown). Comparing each of the five age groups to the overall population, the mean difference in the proportion with HbA1c >9% was 7.8 (95% confidence limits 4.4, 13.9) percentage points. The difference across race/ethnic groups was of similar magnitude.
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to the age difference at this threshold. Among race/ethnic groups, the proportion exceeding any threshold was much lower for non-Hispanic whites than any minority race/ethnic group. Almost one third of those most economically disadvantaged (PIR ≤ 0.8) exceeded HbA1c of 9%, but the proportions of individuals in the other PIR categories exceeding 9% were much lower and ranged from 14.9% to 17.5%, resulting in a mean difference of 5.4 (3.0, 9.8) percentage points. The uninsured were more likely to exceed HbA1c of 9% than those with any insurance. The lower proportion with HbA1c >9% among those with public insurance (and among those with additional private insurance) appears to be explained by the Medicare eligibility of individuals aged ≥65 years who have lower probability of poor control (data not shown).

Lowering the threshold to HbA1c >8% or >7% did not significantly affect most socio-demographic disparities. The age gradient persisted, and mean differences across age and insurance status were modestly reduced as the threshold was lowered from >9% to >7%. Mean differences across race/ethnic groups at the lower thresholds remained substantial. Lowering the threshold to HbA1c >8% did not significantly reduce the disparity across income-to-poverty groups, but lowering the threshold to HbA1c >7% reduced the mean difference to 2.5 (0.7, 9.0) percentage points, a significant decline from the estimate at >9% (p<0.05). While our analysis was framed in terms of what is the effect on the mean difference across various groups of lowering the threshold for poor control, the results are similar if framed in terms of raising the HbA1c threshold for good control.

Health status factors: Among health status factors, the largest difference at the >9% threshold was found across diabetes medication categories. Compared to 18.4% overall, over one quarter of individuals on insulin, 16% of those on oral medications, and 13% of those on no medications were above this level, yielding a mean difference of 5.7 (2.3, 13.8) percentage points. The relation of poor glycemic control by diabetes duration was U-shaped, as a lower proportion exceeded 9% among those with less than five and those with at least 20 years duration; the mean difference was 4.9 (2.2, 11.1) percentage points. The mean difference for weight status was small at 3.3 (1.0, 11.3) percentage points. Only 9.8% of individuals who reported good or excellent health exceeded HbA1c of 9%, while 20% of those reporting good or fair to poor health were above the threshold, yielding a mean difference of 4.2 (2.0, 9.1) percentage points for self-reported health. At HbA1c >9%, mean differences across categories of number of prescription medications, and number of health care interactions and hospitalization in the last year were small, at 3.1 (0.8, 11.9), 4.1 (1.5, 11.1), and 2.1 (0.1, 34.5) percentage points, respectively.

Lowering the threshold to HbA1c >8% or >7% had a large and significant effect on the mean difference across categories of diabetes medication. Compared to 32.8% of the overall population, nearly half of those who used insulin exceeded HbA1c of 8%, and compared to 52.6% overall, over 70% of insulin users exceeded 7%. Mean differences were 10.1 (6.5, 15.7) percentage points at HbA1c >8% and 14.7 (10.8, 20.1) percentage points at HbA1c >7% (p<0.05 and p<0.001 respectively, compared with HbA1c >9%). The increase in the mean difference for diabetes medication categories at sequentially lower HbA1c thresholds reflects a differential increase by type of medication in the proportion exceeding the lower thresholds (Figure 1). When lowering the threshold to HbA1c >8%, the proportion of insulin users exceeding the threshold increased by 20 percentage points (to include those with
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HbA1c >8-9%), compared to an increase of 13 and 9 percentage points for those on oral agents and those not using medication, respectively. When lowering the threshold to HbA1c >7%, the increase in the proportion above this threshold was 23 percentage points for the insulin users and those on oral agents (after including those with HbA1c >7-8%), but only six percentage points for those using no medication. The mean differences for the remaining health status factors were not significantly affected by lowering the HbA1c to >8% or >7%.

In Table 2, patient factors were ranked by mean differences at each HbA1c threshold. Considering a mean difference of ≥5 percentage points as noteworthy, important disparities were consistently observed across all three HbA1c thresholds for age, race/ethnicity, insurance, and diabetes medication, but their rank varied by threshold. At HbA1c >9%, insurance, age, and race/ethnicity contributed the greatest mean differences in threshold attainment. At lower thresholds, diabetes medication exhibited the greatest disparity with mean differences of 10 and almost 15 percentage points. The average mean difference across all factors was consistent (4.7-4.8) among all thresholds.

CONCLUSIONS

This study demonstrates the extent to which disparities in glycemic control by patient sub-groups are mitigated or exacerbated by choice of HbA1c thresholds of >9%, >8%, and >7%. For eleven of the thirteen factors examined, choice of HbA1c threshold did not significantly affect the magnitude of population sub-group differences in glycemic control. For example, we observed pronounced race/ethnic differences in achieving glycemic control at all three thresholds, a finding consistent with previous research. (23) We found no evidence, however, that establishing a lower HbA1c cutoff as a performance measure would exacerbate this disparity or that selecting a less stringent threshold would obviate the disparity.

Diabetes medication is the major patient factor for which differences in threshold attainment would be exacerbated by lowering the current NDQIA and NQF glycemic control performance measure of HbA1c >9%. The importance of diabetes treatment for good (HbA1c <7%) glycemic control has been shown to be independent of socio-demographic characteristics, abdominal obesity, and health care access and utilization.(15) The magnitude of this difference at the lower thresholds has implications for pay for performance quality improvement models being considered by the Centers for Medicare & Medicaid Services and other payers. Practices that include a greater proportion of patients on insulin may have proportionately more patients exceeding HbA1c thresholds. A quality improvement system that includes an incentive to achieve a performance measure for glycemic control may not recognize appropriate care given by physicians whose practice includes a larger proportion of people needing insulin for glycemic control, unless the system accounts for this factor. Reporting performance measure attainment specific to diabetes medication use, and particularly insulin use, might be one means to account for this difference in case mix, although implementing this recommendation may not currently be practical under most systems. As health systems move forward with electronic medical records, however, capturing information on medication use will be more feasible. While automated review of electronic medical records may not consistently capture data on prescription medications (24), performance measures stratified by prescription medication may be a viable solution as long as measures receive adequate field testing. (25)
Differences across other patient health factors examined—self-reported health, number of prescription medications taken, and history of hospitalization—were not greatly influenced by choice of glycemic control performance measure threshold. Of the thirteen factors studied, only socioeconomic status (as measured by the income to poverty ratio), had a reduced disparity in threshold attainment with a lower HbA1c threshold.

We observed a sizable difference in threshold attainment by age, with improved glycemic control across increasing age groups. The effect may be one of survivorship bias whereby life-threatening complications are reduced among well-controlled individuals with diabetes, or may reflect milder disease with more beta cell function in the elderly. The poorer control in younger patients is ominous since they will have a longer duration of diabetes and thus greater risk of complications. Our findings also suggest that the current NDQIA and NQF performance measure of HbA1c >9% is unlikely to drive major improvements in glycemic control in the Medicare population since only 13.4% of those age 65-74 and 5.8% of those age ≥75 had HbA1c >9%.

Our analysis of these national data offers a response to a specific health policy question being debated among groups committed to establishing national health care quality measures. Nonetheless, we acknowledge several limitations. Recent evidence suggests that differences in HbA1c by race may reflect physiologic differences such as rates of glycation and red blood cell survival. (26) Fair implementation of threshold-based performance measures will depend on determining whether small differences in HbA1c threshold attainment truly indicate differences in quality diabetes care after adjustment for case mix. Diagnosed diabetes status was assessed with a validated question, that nonetheless has a sensitivity of around 81% and a positive predictive value of around 89%. (27) Another limitation is that our analysis relied heavily on self-reported case mix factors. The NHANES surveys are designed to result in a representative sample of the non-institutionalized U.S. population but may under-represent non-institutionalized persons with mental health and substance abuse conditions, a group shown to have poor glycemic control. (28)

We conclude that implementing a HbA1c performance measure more stringent than the current measure of HbA1c >9% that indicates poor control would not increase disparities across most patient factors including age, race/ethnic group, and socioeconomic status. In order to account for a case mix that includes more insulin users, however, stakeholders considering the selection of a performance measure threshold for glycemic control that is 8% or lower should consider reporting of threshold attainment specific to diabetes medication use. Stratified reporting would allow more rigorous goals for glycemic therapy in groups for which a benefit has been established. In so doing, lowering the HbA1c performance measure threshold may advance the overall quality of diabetes care, without magnifying overall differences among population groups and without discouraging physician acceptance of insulin-requiring patients who are more difficult to manage.

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**Figure 1.** Proportion of people with HbA1c > 9%, >8-9%, and >7-8% by diabetes medication use.
Table 1. Weighted frequency distribution of socio-demographic and health status factors, the proportion of each group exceeding three HbA1c thresholds, and the absolute disparity expressed as the mean difference* in percentage points (95% confidence limits) across groups.

| Frequency Distribution (%) | Proportion (%) exceeding HbA1c threshold |
|----------------------------|-----------------------------------------|
|                            | >9%          | >8%          | >7%          |
| **Overall Population**     | (100)        | 18.4         | 32.8         | 52.6         |
| **Sociodemographic Factors** |                                |                |                |
| **Age (years)**            |                            |                |                |
| 20-44                      | (17.4)        | 32.7         | 45.7         | 63.5         |
| 45-54                      | (21.5)        | 23.7         | 37.9         | 52.3         |
| 55-64                      | (23.2)        | 16.4         | 32.8         | 51.1         |
| 65-74                      | (21.9)        | 13.4         | 28.0         | 55.5         |
| 75+                        | (16.0)        | 5.8          | 18.2         | 39.4         |
| Mean difference            | 7.8 (4.4, 13.9) | 7.5 (3.7, 15.1) | 5.7 (2.9, 11.4) |
| **Race/Ethnicity**         |                                |                |                |
| Non Hispanic White         | (62.7)        | 13.5         | 28.7         | 48.4         |
| Non Hispanic Black         | (15.2)        | 25.6         | 38.8         | 60.7         |
| Mexican American           | (7.0)         | 26.8         | 41.9         | 61.4         |
| Other race, other Hispanic, multi-racial | (15.2) | 27.8 | 39.2 | 57.8 |
| Mean difference            | 7.4 (4.7, 11.9) | 6.4 (3.5, 11.8) | 6.6 (3.4, 12.8) |
| **Income to Poverty Ratio**|                                |                |                |
| <=0.8                      | (10.7)        | 32.4         | 40.2         | 58.0         |
| 0.8-2                      | (36.1)        | 14.9         | 29.5         | 51.1         |
| 2-4                        | (30.6)        | 17.5         | 34.5         | 51.2         |
| >4                         | (22.6)        | 15.1         | 27.1         | 51.1         |
| Mean difference            | 5.4 (3.0, 9.8) | 4.5 (1.7, 12.2) | 2.5† (0.7, 9.0) |
| **Insurance Status**       |                                |                |                |
| Uninsured                  | (10.3)        | 38.0         | 50.6         | 59.4         |
| Private insurance          | (39.9)        | 21.3         | 34.3         | 57.7         |
| Public or government insurance | (32.0) | 12.6 | 28.4 | 45.7 |
| Both public and private insurance | (17.9) | 11.5 | 25.9 | 49.3 |
| Mean difference            | 8.8 (5.2, 15.0) | 7.6 (3.7, 15.6) | 5.6 (2.1, 14.9) |
| **Gender**                 |                                |                |                |
| Male                       | (50.5)        | 20.2         | 32.8         | 54.8         |
| Female                     | (49.5)        | 16.7         | 32.7         | 50.3         |
| Mean difference            | 1.8 (0.3, 9.7) | 0.0 (0.0, ‡) | 2.2 (0.4, 11.3) |
| Education                  | Frequency Distribution (%) | Proportion (%) exceeding HbA1c threshold |  >9% | >8% | >7% |
|----------------------------|-----------------------------|-----------------------------------------|------|-----|-----|
| < High School              | (36.4)                      |                                         | 21.4 | 34.7 | 54.8 |
| High School graduate       | (25.1)                      |                                         | 15.9 | 33.2 | 48.2 |
| >High School               | (38.6)                      | Mean difference                         | 2.2 (0.4, 12.0) | 1.5 (0.1, 16.3) | 2.4 (0.4, 15.8) |
| Health Status Factors      |                             |                                         |      |     |     |
| Diabetes medication        |                             |                                         |      |     |     |
| Use of insulin             | (26.1)                      |                                         | 27.5 | 48.3 | 71.4 |
| Use of oral agents only    | (55.5)                      |                                         | 16.0 | 29.2 | 52.0 |
| No use of medications      | (18.4)                      | Mean difference                         | 5.7 (2.3, 13.8) | 10.1 (6.5, 15.7) | 14.7 (10.8, 20.1) |
| Diabetes duration (years)  |                             |                                         |      |     |     |
| <5                         | (35.4)                      |                                         | 15.9 | 29.1 | 46.7 |
| 5-<10                      | (20.8)                      |                                         | 25.5 | 39.8 | 58.4 |
| 10-<15                     | (13.5)                      |                                         | 22.3 | 39.8 | 62.8 |
| 15-<20                     | (7.5)                       |                                         | 23.6 | 38.2 | 62.6 |
| >=20                       | (22.8)                      | Mean difference                         | 4.9 (2.2, 11.1) | 5.8 (2.7, 12.3) | 7.2 (4.2, 12.3) |
| Weight Status              |                             |                                         |      |     |     |
| Under or normal weight     | (16.6)                      |                                         | 25.0 | 36.6 | 54.6 |
| Overweight                 | (31.5)                      |                                         | 19.1 | 28.6 | 50.8 |
| Obese                      | (38.1)                      |                                         | 17.0 | 38.8 | 54.9 |
| Severely obese             | (13.9)                      | Mean difference                         | 3.3 (1.0, 11.3) | 6.1 (3.3, 11.3) | 1.8 (0.1, 27.9) |
| Self-reported Health       |                             |                                         |      |     |     |
| Excellent or Very Good     | (18.8)                      |                                         | 9.8  | 25.6 | 46.9 |
| Good                       | (36.6)                      |                                         | 20.0 | 31.4 | 49.7 |
| Fair or Poor               | (44.6)                      | Mean difference                         | 4.2 (2.0, 9.1) | 4.2 (1.3, 14.0) | 4.5 (1.4, 14.3) |
| Number of prescription medications |                 |                                         |      |     |     |
| 0-1                        | (19.4)                      |                                         | 25.6 | 39.5 | 55.5 |
| 2-3                        | (27.4)                      |                                         | 17.0 | 31.0 | 52.2 |
| 4-6                        | (29.7)                      |                                         | 16.3 | 28.6 | 49.0 |
| >=7                        | (23.5)                      |                                         | 16.7 | 34.3 | 54.7 |
| Frequency Distribution (%) | Proportion (%) exceeding HbA1c threshold |
|---------------------------|----------------------------------------|
|                           | >9%         | >8%         | >7%         |
| Mean difference           | 3.1 (0.8, 11.9) | 3.5 (1.0, 12.6) | 2.2 (0.4, 11.3) |
| Number of health care interactions |            |            |            |
| 0-1                       | (10.2)      | 23.7       | 36.0       | 48.8       |
| 2-3                       | (22.4)      | 24.0       | 37.9       | 61.1       |
| 4-9                       | (39.1)      | 13.6       | 30.1       | 50.5       |
| >=10-12                   | (28.3)      | 19.0       | 31.4       | 50.5       |
| Mean difference           | 4.1 (1.5, 11.1) | 3.1 (0.4, 22.0) | 4.1 (1.5, 11.7) |
| Hospitalization in last year |            |            |            |
| Yes                       | (24.4)      | 21.6       | 35.1       | 54.8       |
| No                        | (75.6)      | 17.4       | 32.0       | 51.9       |
| Mean difference           | 2.1 (0.1, 34.5) | 1.6 (0.1, 25.3) | 1.4 (0.0, ‡) |

*Mean of the absolute differences between the proportion of the group and that of the total population exceeding the threshold.
†p<0.05 for comparison to mean difference estimate for HbA1c >9%.
‡Calculation of upper confidence limit results in value above theoretical maximum.
§p<0.001 for comparison to mean difference estimate for HbA1c >9%.
Table 2. Socio-demographic and health status factors ranked by their Mean Difference (MD) according to HbA1c threshold.

| Rank | >9%               | MD  | >8%               | MD  | >7%               | MD  |
|------|-------------------|-----|-------------------|-----|-------------------|-----|
| 1    | Insurance Status  | 8.8 | Diabetes medication use | 10.1 | Diabetes medication use | 14.7 |
| 2    | Age Group         | 7.8 | Insurance Status  | 7.7 | Years since diagnosis | 7.2 |
| 3    | Race/Ethnicity    | 7.5 | Age Group         | 7.5 | Race/Ethnicity     | 6.6 |
| 4    | Diabetes medication use | 5.7 | Race/Ethnicity    | 6.4 | Age Group         | 5.8 |
| 5    | Income to Poverty Ratio | 5.4 | Weight Status     | 6.1 | Insurance status  | 5.6 |
| 6    | Years since diagnosis | 4.9 | Years since diagnosis | 5.8 | Self-reported Health | 4.5 |
| 7    | Self-reported Health | 4.2 | Income to Poverty Ratio | 4.5 | No. of health care interactions | 4.1 |
| 8    | No. of health care interactions | 4.1 | Self-reported Health | 4.2 | Income to Poverty Ratio | 2.5 |
| 9    | Weight Status     | 3.3 | No. of prescription medications | 3.5 | Education         | 2.4 |
| 10   | No. of prescription medications | 3.1 | No. of health care interactions | 3.1 | No. of prescription medications | 2.3 |
| 11   | Education         | 2.2 | Hospitalization in last year | 1.6 | Gender            | 2.2 |
| 12   | Hospitalization in last year | 2.1 | Education         | 1.5 | Weight Status     | 1.8 |
| 13   | Gender            | 1.8 | Gender            | 0.0 | Hospitalization in last year | 1.4 |

Average Mean Difference 4.7

Factors in bold italics are those whose mean difference changed significantly with change in HbA1c threshold.