Association Between Performance Measures and Glycemic Control Among Patients With Diabetes in a Community-wide Primary Care Cohort

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Background: Performance measures are used for assessing quality of care. Higher performance shown by these measures is expected to reflect better care, but little is known whether they predict better patient outcomes.

Objective: To assess the predictive value of performance measures of glucose management on glycemic control, and evaluate the impact of patient characteristics on this association.

Research Design: Cohort study (2007–2009).

Subjects: A total of 15,454 type 2 diabetes patients (mean age, 66.5 y; 48% male) from the GIANTT cohort.

Measures: We included performance measures assessing frequency of HbA1c monitoring, glucose-lowering treatment status, and treatment intensification. Associations between performance and glycemic control were tested using multivariate linear regression adjusted for confounding, reporting estimated differences in HbA1c with 95% confidence intervals (CI). Impact of patient characteristics was examined through interactions.

Results: Annual HbA1c monitoring was associated with better glycemic control when compared with no such monitoring (HbA1c −0.29%; 95% CI −0.37, −0.22). This association lost significance in patients with lower baseline HbA1c, older age, and without macrovascular comorbidity. Treatment status was associated with better glycemic control only in patients with elevated baseline HbA1c. Treatment intensification after elevated HbA1c levels was associated with better glycemic control compared with no intensification (HbA1c −0.21; 95% CI −0.26, −0.16).

Conclusions: Performance measures of annual HbA1c monitoring and of treatment intensification did predict better patient outcomes, whereas the measure of treatment status did not. Predictive value of annual monitoring and of treatment status varied across patient characteristics, and it should be used with caution when patient characteristics cannot be taken into account.

Key Words: quality of care, quality assessment, performance measurement, diabetes

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Adequate blood glucose management is considered essential for diabetes care to prevent long-term complications.[1,2] Performance measures have been developed to assess whether patients are receiving the recommended care.[3–6] They are used by policy makers for pay for performance and by health care providers for quality improvement.[7,8] Currently, there is an ongoing debate on the development of new or improved diabetes performance measures.[9] An important requirement for measuring performance is credible evidence linking higher performance estimates to better patient outcomes.[9–11] For comparing practices, the measures should not be sensitive to common variations in patient populations. Variation in sociodemographics and clinical characteristics can influence diabetes performance and outcomes,[10–14] but there is limited knowledge about how these variations affect the utility of specific performance measures.[15]

Commonly used measures for glucose management assess simple care processes in the diabetes population: whether HbA1c is tested,[3,16] or whether diabetes patients are being treated with glucose-lowering drugs.[3,5] The rationale behind these measurements is based on recommendations found in guidelines stipulating that all diabetes patients need regular monitoring and that most need medication treatment. The association between HbA1c monitoring and glycemic control has been tested,[17–20] but the results are inconclusive.[21]

As these measures include all diabetes patients in the denominator, variations in the study population may influence the outcomes. There is no consensus on the recommended frequency of testing.[22] More frequent monitoring is recommended in uncontrolled patients.[2] Therefore, the utility of this performance measure may be limited to such patients.

Evidence linking performance measures of current treatment with patient outcomes is lacking.[21] In recent years,

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treatment intensification measurements have been proposed as more meaningful performance measures.[9,15,23] They measure clinical action by assessing whether medication has been started or intensified in patients with elevated HbA1c levels. These measurements have shown positive associations with better glycemic control in longitudinal studies.[24–28] Nevertheless, there is debate concerning the HbA1c thresholds used in these.[9,29] The objective of our study is to evaluate the utility of the various performance measures of glucose management to predict glycemic control and to understand the extent to which this depends on patient characteristics.

METHODS

An observational cohort study was conducted using data from 2007 to 2009, including patients with type 2 diabetes registered in 150 general practices (GPs) in the province of Groningen, The Netherlands. All patients with diabetes diagnosed before January 1, 2008, and managed by the GP were included. Around 85% of Dutch diabetes patients are managed by the GP. Dutch patients irrespective of their socioeconomic status have a mandatory basic insurance allowing for primary diabetes care without restrictions. The population in the Groningen region consisted in 2008 of 89% individuals of West European origin, with an average gross income of €25,500 (US$ ~ 38,250).

The data were collected from the Groningen Initiative to Analyze Type 2 diabetes Treatment (GIANTT) database. This longitudinal database contains anonymous data from electronic medical records, including full prescription data, comorbidity and event data, routine laboratory test results, and physical examinations. Data are extracted using validated, automatic procedures, including semiautomated quality checks of data used in this study.[30] Prescription data include information on the drugs' dosages, daily use, and prescribed quantity, enabling the assessment of dosage increases and decreases, as well as switches between drugs. Comorbidity and major clinical events are documented on "problem lists" in the medical records. These consist of the International Classification of Primary Care (ICPC) codes[31] or short text descriptions, which were coded to ICPC or a separate code for conditions not covered, such as left ventricular hypertrophy or bypass grafting.

In The Netherlands, according to the Code of Conduct for the use of data in Health Research ("Gedragscode gezondheidsonderzoek" approved in 2004 by the Dutch College for Protection of Personal Data, taking into account Article 25 of the Dutch Act on the Protection of Personal Data) no ethics committee approval was required for this research using data from anonymous medical records.

Performance Measures Linked to Glycemic Control

We included commonly used or suggested performance measures of glucose management, which assess quality of the following processes of care: (1) HbA1c monitoring (monitoring); (2) current status of glucose-lowering treatment (treatment status); and (3) glucose-lowering treatment intensification when indicated (treatment intensification). We evaluated clinical performance for the year 2008.

To test the predictive value of "monitoring", we assessed (a) whether undergoing at least 1 HbA1c test in the year 2008 was associated with better glycemic control compared with no tests, and (b) whether undergoing 2 or more HbA1c tests resulted in better glycemic control compared with a single test. Only patients having a baseline HbA1c in 2007 and an outcome HbA1c in 2009 were included for this assessment (Table 1).

To test the predictive value of "treatment status," we assessed whether being on any glucose-lowering treatment was associated with better glycemic control compared with the absence of such treatment. A patient was considered as being on treatment when a prescription or refill for a glucose-lowering drug was recorded within the last 3 months of 2008.[5]

To test the predictive value of "treatment intensification," we assessed whether receiving glucose-regulating treatment intensification after an elevated HbA1c was associated with better glycemic control compared with no intensification. Similarly, we assessed this association for treatment intensification in patients having 2 repeatedly elevated HbA1c values, as doctors may wait for a confirmation test before acting. An HbA1c > 7% was used as primary threshold in accordance with the Dutch guideline.[2] As higher threshold levels for performance measures have been suggested to allow for patients not in need of strict control,[15,24–26] we also evaluated these measures of "treatment intensification" using a threshold HbA1c > 8.5% that is considered to constitute poor control for most patients in primary care. Treatment intensification was defined as the start or addition of a new drug class or a dosage increase occurring within 120 days after an elevated HbA1c. The time period of 120 days takes into account possible delays until the next regular visit because of competing demands or clinical uncertainty.[32,33] Switches from one drug to another or dosage increases coinciding with dosage decreases within a 7-day time window were not classified as treatment intensification. However, a switch to insulin was always considered intensification. Patients already on insulin at baseline were excluded from the intensification measurements, because intensification of insulin regimen cannot be reliably estimated from available prescription data. Drug classes included were: biguanides, sulfonylureas, α-glucosidase inhibitors, thiazolidinediones, dipeptidyl-peptidase-4-inhibitors, insulins, and other blood glucose–lowering drugs.

Glycemic Control Outcome

Glycemic control was defined by means of the HbA1c values recorded at baseline and after the care process assessed by each performance measure. For "HbA1c monitoring," the outcome was the first HbA1c value in 2009. For "treatment status" and "treatment intensification," the outcome was the first HbA1c value within a period of 21–120 days after the prescription date of the treatment or treatment intensification. This is the period in which an effect from the treatment can be expected.[33] For patients without glucose-lowering treatment or treatment intensification, glycemic control was assessed similarly after a random date drawn from the observed distribution of prescription dates in patients with glucose-lowering treatment or treatment intensification.

TABLE 1. Definition of Performance Measures and Related Baseline and Outcome Measurements, With Numbers of Patients Included; in Total, 15,454 Diabetes Patients are Included in the Study Population

Performance Measures (No. Patients Eligible for Inclusion)	Baseline Measurement	Definition of Performance	Glycemic Control Outcome
Diabetes patients who received HbA1c test(s) in the measurement period (n = 12,826 who had baseline test in 2007)	Last HbA1c test in 2007	≥ 1 vs. 0 tests ≥ 2 vs. 1 tests in 2008	First HbA1c test in 2009 (n = 11,844) (n = 11,353)
Diabetes patients who are treated with glucose-lowering drugs (n = 13,582 who had a baseline test in 2008)	First HbA1c test in 2008	Glucose-lowering drug prescription within last 3 mo of 2008	First HbA1c test in a period of 21–120 d after the drug prescription date (n = 8921)
Diabetes patients not on insulin with HbA1c > 7% receiving glucose-lowering treatment intensification (n = 5189 of the 13,582 who had a test in 2008)	First HbA1c test in 2008, if >7%	Glucose-lowering drug start or dosage increase within 120 d after baseline test	First HbA1c test in a period of 21–120 d after date of intensification (n = 3620)
Diabetes patients not on insulin with HbA1c > 8.5% receiving glucose-lowering treatment intensification (n = 875 of the 13,582 who had a test in 2008)	First HbA1c test in 2008, if >8.5%		First HbA1c test in a period of 21–120 d after date of intensification (n = 550)
Diabetes patients not on insulin with 2 sequential HbA1c > 7% receiving glucose-lowering treatment intensification (n = 3623 of the 10,413 who had at least 2 tests in 2008)	First HbA1c test >7% in 2008	Glucose-lowering drug start or dosage increase within 120 d after baseline test	First HbA1c test in a period of 21–120 d after date of intensification (n = 3027)
Diabetes patients not on insulin with 2 sequential HbA1c > 8.5% receiving glucose-lowering treatment intensification (n = 515 of the 10,413 who had at least 2 tests in 2009)	First HbA1c test >8.5% in 2008		First HbA1c test in a period of 21–120 d after date of intensification (n = 406)

Confounding and Effect Modification

As the likelihood of receiving care may depend on patient characteristics, which could partly explain differences in HbA1c levels, we adjusted for possible confounders. In addition, we evaluated whether patient characteristics modified the effect of performance measures on the HbA1c outcome. We included the following characteristics as possible confounders and effect modifiers[13,34–36]: (1) age, sex, and diabetes duration; and (2) comorbidity, including (a) diabetes-related macrovascular comorbidity, (b) diabetes-related microvascular comorbidity, and (c) mental comorbidity. Macrovascular comorbidity included: transient cerebral ischemia (ICPC-code K89),[31] heart failure (K77), stroke (K90), atherosclerosis (K91), myocardial infarction (K75 and K76), angina (K74), coronary artery bypass grafting, percutaneous transluminal coronary angioplasty, and left ventricular hypertrophy. Microvascular comorbidity included: diabetes neuropathy (N94.2), retinopathy (F83), renal failure (U99.1), renal hyperplasia/hydronephrosis (U99.2 and U99.3), terminal dialysis, kidney transplantation, diabetes foot, and related amputations. Mental comorbidity was identified by the codes for psychological disorders ranging from dementia (P70) to other psychological disorders (P99).[31] Comorbidity was scored as the presence or absence in the preceding 10 years.

Statistical Analysis

We used descriptive statistics and independent *t* tests to compare groups at baseline. We assessed the predictive value of each of the performance measures on glycemic control in separate analyses adjusting for confounding. We conducted multilevel linear regression with random intercept to estimate the impact of the GP cluster level on the associations between the performance measures and glycemic control. The proportion of variance that was accounted for by the GP level was calculated for each model through intraclass correlation coefficients (ICCs). As the ICC was <0.01 for all the tested associations, we present our results at patient level using multivariate linear regression models.

The relationship between performance measures and glycemic control was investigated by evaluating the effect sizes (β), reflecting the estimated differences in outcome HbA1c levels for patients with or without the recommended care. Effect modification was examined by evaluating interactions between the performance measure and the baseline patient characteristics in the fully adjusted models.

Sensitivity Analyses

We conducted additional analyses using an HbA1c outcome assessment period of 180 days instead of 120 days to test whether the associations might be biased by restricting them to patients with available HbA1c test within 120 days.

A second set of sensitivity analyses concerned adjustment for other possible confounders in a subset of patients with available additional data, including systolic blood pressure (SBP), low-density lipoprotein cholesterol (LDL-C), and body mass index (BMI). We also conducted additional analyses adjusting on an overall comorbidity score instead of the selected comorbidity clusters. For this, we used the modified Charlson comorbidity score[37] on the basis of the ICPC codes (see Table, Supplemental Digital Content 1, http://links.lww.com/MLR/A391, which illustrates scoring the Charlson comorbidity from the ICPC codes).

RESULTS

A total of 15,454 patients with a type 2 diabetes diagnosis before 2008 were eligible for the study. Baseline characteristics are shown in Table 2. The numbers of patients included were in the range from 406 for "treatment intensification" in patients with 2 sequential HbA1c > 8.5% to

TABLE 2. Patient Characteristics at Baseline in 2008

	No. Patients With Recorded Observation	Mean ± SD or %
Age (y)	15,454	66.5 ± 12.2
Male sex	7336	47.5
Diabetes duration (y)	15,454	4 [2;8]*
HbA1c (%)	13,582	7.0 (1.0)
Systolic blood pressure (mm Hg)	12,969	143.1 ± 20.3
Total cholesterol (mg/dL)	10,591	179 ± 43
LDL cholesterol (mg/dL)	11,134	97 ± 35
Albumin/creatinine ratio (mg/mmol)	8735	4.7 ± 14.2
Body mass index	10,099	30.1 ± 5.5
Macrovascular comorbidity presence	2968	19.2
Microvascular comorbidity presence	777	5.8
Mental comorbidity presence	784	5.1

*Median [25th and 75th percentiles].

11,844 for "HbA1c monitoring" in all patients with diabetes (Table 1). For the 2 "monitoring" measures, 12% of patients were excluded for having no baseline HbA1c test in 2007. For 3 of the treatment measures, 17% of patients were excluded for having no baseline HbA1c test in 2008. For "treatment intensification" after sequential tests, 33% of patients were excluded for not undergoing 2 tests in 2008. In addition, between 8% and 34% of patients were lost because of unavailable follow-up outcome tests within the predefined time periods. Patients without HbA1c tests in 2007–2009 had in some cases slightly higher baseline risk factor levels (see Table, Supplemental Digital Content 2, http://links.lww.com/MLR/A392), which illustrates the baseline characteristics of patients depending on the presence/absence of HbA1c test each year). Mean values of HbA1c at baseline differed in several cases for patients receiving the care or not receiving it, as assessed by the performance measures (Table 3).

Association of Performance Measures and Glycemic Control

Receiving at least 1 HbA1c test compared with no test in the measurement year was associated with better glycemic control (Table 3). The tested association was conditioned by interactions with several patient characteristics (Fig. 1). In patients with higher baseline HbA1c levels, a stronger association was observed between "monitoring" and glycemic control. With older age, in contrast, the association became weaker (Fig. 1, top to bottom panels), and even more so for patients without macrovascular comorbidity (Fig. 1, right panels). Receiving 2 or more HbA1c tests compared with a single test was not significantly associated with glycemic control (Table 3). The association was, however, conditioned by an interaction with the baseline HbA1c level. In patients with a baseline HbA1c of >7%, undergoing 2 or more HbA1c tests compared with a single test was significantly associated with achieving better glycemic control (Fig. 2A).

Being on glucose-lowering treatment was not significantly associated with glycemic control, but an interaction was seen with the baseline HbA1c level. We observed that being on treatment became significantly associated with better control in patients with higher baseline HbA1c values (Fig. 2B).

Intensification of glucose-lowering treatment in cases where there was either 1 or 2 sequential HbA1c tests above 7% was associated with better glycemic control (Table 3).

TABLE 3. Numbers of Patients With and Without Recommended Care, Means for Their Baseline Levels and Outcomes, and Effect Sizes for the Associations Between Performance Measures and Glycemic Control

No.	Performance Measures	Total No. Patients (With/Without Recommended Care)	Mean Baseline HbA1c (%)	Mean Outcome HbA1c (%)	Effect Size β (95% CI)	R^2
1	≥1 HbA1c test(s) vs. no test	11,844 (11,353/491)	6.9/6.8*	7.0/7.2	**−0.29 (−0.36, −0.22)**	0.27
2	≥2 HbA1c tests vs. 1 test	11,353 (10,140/1213)	6.9/6.7*	7.0/6.9	−0.02 (−0.07, 0.02)	0.27
3	Treated with glucose-lowering drugs vs. not treated	8921 (8129/792)	7.1/7.0*	7.1/7.0	−0.02 (−0.08, 0.03)	0.36
4	Treatment intensification vs. no intensification in case of HbA1c > 7%	3620 (1113/2507)	7.9/7.9	7.4/7.6	**−0.18 (−0.23, −0.13)**	0.38
5	Treatment intensification vs. no intensification in case of 2 HbA1c > 7%	3027 (895/2132)	8.0/7.9	7.6/7.8	**−0.19 (−0.24, −0.13)**	0.33
6	Treatment intensification vs. no intensification in case of HbA1c > 8.5%	550 (170/380)	9.6/9.5	8.4/8.6	**−0.24 (−0.46, −0.01)**	0.23
7	Treatment intensification vs. no intensification in case of 2 HbA1c > 8.5%	406 (121/285)	9.8/9.5	8.7/9.1	**−0.40 (−0.64, −0.15)**	0.13

*Significant baseline differences (independent *t* test).

β is the estimated differences in HbA1c levels for patients with and without the recommended care, adjusted for age, sex, duration of diabetes, and comorbidity (microvascular, macrovascular, and mental).

Significant associations (linear regression) are indicated in bold.

R^2, coefficient of determination for the fully adjusted model.

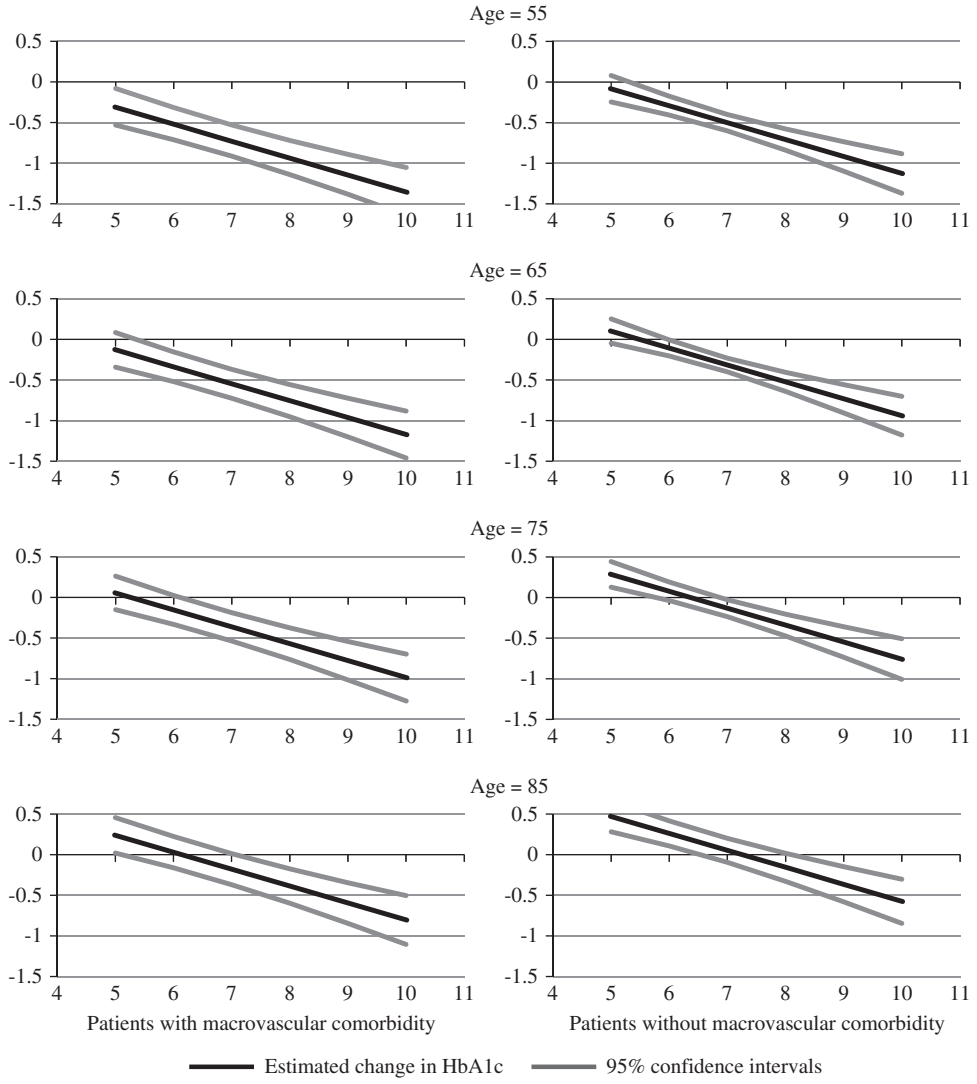

FIGURE 1. Predictive value of annual HbA1c monitoring (≥ 1 vs. 0 tests) across varying patient characteristics. The estimated differences in HbA1c level are presented on the *y*-axis and increasing baseline HbA1c levels on the *x*-axis. Panels from top to bottom show that with increasing age the association becomes nonsignificant for patients with lower baseline HbA1c and from left to right for patients with or without macrovascular comorbidity.

The estimated difference in glycemic control was largest after treatment intensification in cases where there were 1 or 2 HbA1c tests above 8.5%. The associations were conditioned by an interaction with the baseline HbA1c level, showing that in patients with higher baseline levels, "treatment intensification" was associated with a greater difference in glycemic control (Fig. 2C).

Sensitivity analyses using the extended time period of 180 days for assessing glycemic control did not change the findings of our study. Using the Charlson comorbidity score to adjust for confounding or including additional risk factors (SBP, LDL-C, and BMI) as confounders also resulted in almost identical estimates for the studied association (see Tables, Supplemental Digital Content 3, http://links.lww.com/MLR/A393,, which illustrates the sensitivity analyses).

DISCUSSION

Our study shows that annual HbA1c monitoring predicts better glycemic control in the overall diabetes population, whereas more frequent monitoring was only predictive in insufficiently controlled patients. The impact of annual HbA1c monitoring was influenced by patient characteristics. When patients were well controlled in combination with older age and no macrovascular comorbidity, annual monitoring was not associated with better glycemic control. Measures of "treatment intensification" were strongly predictive of better glycemic control, whereas this was not observed for measures of "treatment status." Such measures, assessing whether or not patients receive glucose-regulating treatment, only predicted better glycemic control in insufficiently controlled patients. These findings imply that commonly used simple diabetes performance measures

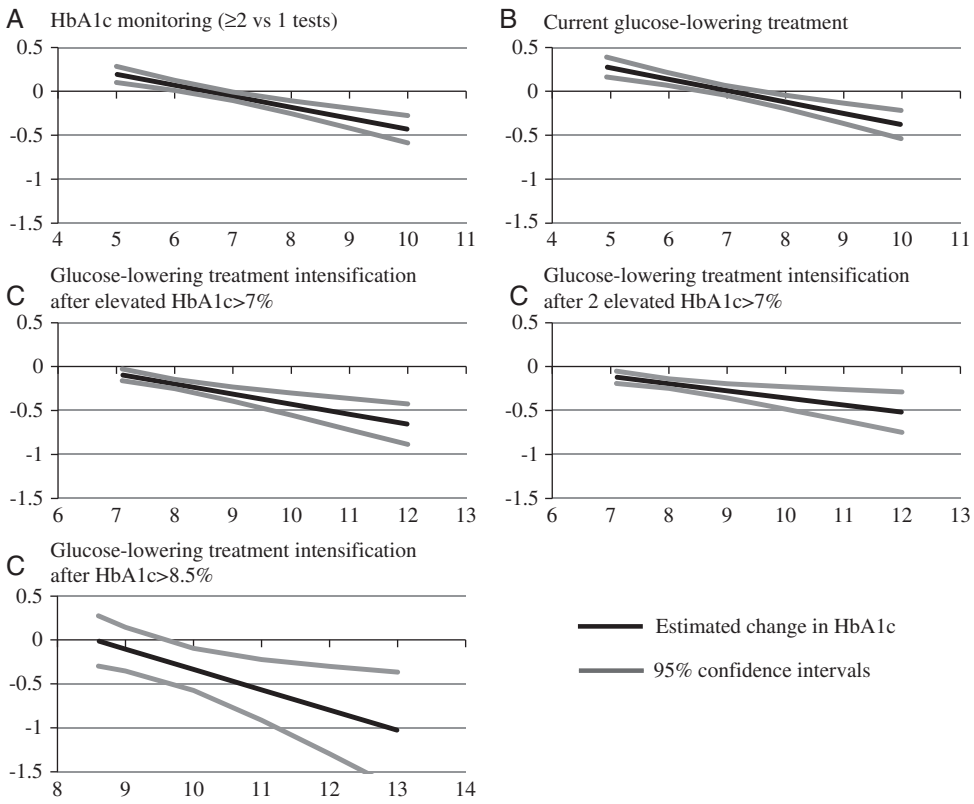

FIGURE 2. Predictive value of performance measures of: (A) more frequent HbA1c monitoring, (B) current treatment, and (C) treatment intensification, across varying baseline HbA1c levels. The estimated differences in HbA1c level are presented on the *y*-axis and increasing baseline HbA1c levels on the *x*-axis. This shows that for more frequent monitoring (A) and current treatment status (B), the associations become nonsignificant or even negative for patients with low baseline HbA1c. For treatment intensification, the association becomes stronger in patients with high baseline HbA1c.

focusing on "monitoring" or "treatment status" should be used with caution when baseline patient characteristics cannot be taken into account.

Annual HbA1c monitoring is included in many performance measure sets for diabetes patients,[2,3,6,16] yet its impact on improving glycemic control was not confirmed in previous longitudinal studies.[21] Although one would expect a relationship between annual monitoring and glycemic control, one should be aware that this will only occur when treatment of patients with elevated HbA1c level is subsequently improved or when patients with adequate levels deteriorate without annual monitoring. We observed a stronger predictive value for annual HbA1c monitoring on glycemic control in patients with elevated baseline levels. This indicates that more action is taken in patients with higher HbA1c levels, as has been observed previously.[38] The weaker predictive value of HbA1c monitoring on glycemic control in older patients with HbA1c levels below 7%–8% may be explained by considering a higher threshold for treatment in elderly patients.[39] The stronger predictive value in patients with macrovascular complications may be explained by more intensive treatment in such patients. This is in line with a recent finding showing higher performance rates on processes of care in patients with more comorbidity.[13] Finally, we did not find that more frequent monitoring in 1 year is predictive of glycemic control in the overall population. More frequent monitoring was, however, predictive in poorly controlled patients, implying that this performance measure has more value when used for patients with elevated HbA1c. In well-controlled patients, in contrast, less frequent monitoring does not seem to lead to deterioration in outcomes.

For assessing the quality of treatment, we evaluated a simple performance measure of "treatment status," which assesses whether any glucose-regulating drug treatment is prescribed in all diabetes patients. This measure is relatively easy to calculate and is included in the Dutch diabetes performance measure set.[5] Our findings, however, showed no predictive value for this measure on glycemic control in the overall population. This may seem surprising but is the result of including many patients being on treatment who are well controlled with no (further) improvement in glycemic control and some who deteriorate because of the lack of treatment intensification. In patients with elevated HbA1c levels, however, this measure showed its predictive value on better glycemic control. This implies that stratification in measurement and reporting is required when using this performance measure. The alternative is to restrict the definition of this measure to include only diabetes patients with an elevated HbA1c level, as has been recommended by the National Quality Forum.[4]

This link between treatment and HbA1c level is taken 1 step further in the performance measures of "treatment intensification," which assess whether treatment action is taken in patients after an elevated HbA1c level. We demonstrated that these performance measures of "treatment intensification" predict better glycemic control. The observed findings are consistent with previous studies.[24–26,28] The estimated difference in glycemic control was greater for patients with highly elevated HbA1c at baseline. This supports the view that using higher HbA1c thresholds for performance measures of treatment will better reflect clinically relevant quality of care.[9] In contrast, if higher thresholds are used, fewer patients are eligible for quality assessment.

Strength and Limitations

Our study included a large cohort of primary care diabetes patients using a fairly unique regional GP database in The Netherlands. The included population includes mostly individuals of European ethnicity. Variation on levels of performance and glycemic control may be larger in countries where the diabetes population is less well controlled. By looking at the interaction effects with baseline HbA1c levels as presented one could infer the expected predicted value of the performance measures in such populations.

Dutch GPs are obliged to keep adequate medical records including all diagnostic and prescription data but occasional test results or drugs prescribed by specialists might be missed. As we included only patients who were managed by the GP, we do not expect this to be common.

As with any observational research, our study may be limited by confounding. In our analyses, we adjust for a wide range of expected confounders. We conducted sensitivity analysis adjusting for other patient characteristics, which showed no meaningful differences in the observed associations but some unmeasured confounding may still be present.

Our study uses HbA1c values as an outcome. Although HbA1c is considered as a predictor of morbidity and mortality,[40] testing the direct relationship of performance measures to hard outcomes is required to strengthen the current findings. The included population was limited by the need for baseline and outcome HbA1c values. We did not observe large differences in demographics, risk factor levels, or comorbidity between patients with and without HbA1c tests in 2007–2009, indicating that there was no major selection bias on these patient characteristics because of this loss of patients. When extending the period for outcome assessment in our sensitivity analysis, thereby reducing loss of follow-up, we also observed no significant changes in our findings.

When assessing "treatment intensification," we excluded up to 7% of patients already treated with insulin at baseline. This might lead to an underestimation of the predictive value of these measures, as insulin is highly effective at lowering glycemia.

We observed small differences in baseline HbA1c levels of patients with and without measured performance on "monitoring" and "treatment status." Because of differences in regression toward the mean effects, differences in HbA1c level of patients receiving the recommended care could be larger than in those not receiving such care. This implies that the associations for these performance measures might be even smaller than observed.

Finally, comorbidity in primary care records could be incomplete,[41] which would result in partial adjustment on comorbidity. Our comorbidity data were enriched by manually coding text descriptions, resulting in higher comorbidity rates compared with that observed in a previous primary care study conducted in The Netherlands, which was based on only ICPC-coded comorbidity data.[42]

Implications

Our study assessed the predictive value of performance measures of HbA1c monitoring and treatment status on glycemic control in primary care. An important finding of our study is that these measures are not equally informative regarding the quality of care across patients with different characteristics. When annual HbA1c monitoring rates are used for pay for performance or public reporting, adjustment for baseline HbA1c is recommended. The rates of annual monitoring are not very informative in those patients in whom monitoring is not expected to lead to changes in treatment, in particular patients who are already well controlled and elderly. This implies that it is better to present separate monitoring rates for patients under and above treatment targets. Further, when measures are used, which assess whether patients receive treatment or not, stratification is required to differentiate between well-controlled and poorly-controlled patients. Alternatively, one could restrict the definition of such measures to include only diabetes patients with an elevated HbA1c. Performance measures of treatment intensification incorporate such restrictions, and these were not sensitive to other differences in baseline patient characteristics. Such measures can thus be considered valid instruments in assessing the quality of glucose management.

CONCLUSIONS

We showed in a large primary care cohort of type 2 diabetes patients that performance measures of annual HbA1c monitoring and of treatment intensification were predictive of better glycemic control. However, annual monitoring was affected by differences in patient characteristics. The performance measure of treatment status was not predictive of better outcomes in general, but it showed predictive value in patients with elevated HbA1c levels. Performance measures of annual HbA1c "monitoring" and of "treatment status" are therefore more meaningful when restricted to patients with elevated HbA1c level.

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