

Do Patient or Provider Characteristics Impact Management of Diabetes?

Erin S. LeBlanc, MD, MPH; A. Gabriela Rosales, MS; Sumesh Kachroo, PhD; Jayanti Mukherjee, PhD; Kristine L. Funk, MS; and Gregory A. Nichols, PhD

Despite recommendations from the American Diabetes Association,¹ only 53% of persons with diabetes in the United States between 2007 and 2010 had glycated hemoglobin (A1C) levels of less than 7%.² As a progressive disease, type 2 diabetes requires ongoing treatment intensification to achieve and maintain glycemic control.³ Although there are several therapeutic guidelines for managing hyperglycemia,^{4,6} previous studies suggest that approximately 50% to 60% of patients with A1Cs above goal are not being prescribed a change in therapy or are actually having their therapy decreased.^{7,8} One factor driving this problem is “clinical inertia”—defined as a clinician recognizing a problem but failing to act⁹—which occurs often in the management of diabetes.¹⁰

Identifying patient and provider characteristics associated with poor glycemic control and/or delayed therapeutic intensification is essential to improving the health of persons with diabetes. Delays in treatment intensification not only lead to long periods of hyperglycemia, ranging from 1 to 7 years, but also to less likelihood of therapeutic success once therapy is intensified.¹¹⁻¹⁶ The causes of these long delays in therapy intensification during diabetes management are not clear. Current guidelines suggest that patient characteristics such as older age, frailty, or multiple comorbidities may be legitimate reasons for delaying therapy intensification,^{1,17,18} but previous models showing the influence of such patient characteristics on glycemic control have had limited predictive power.¹¹ Moreover, although some studies have found that diabetes specialists may opt to intensify patients' treatment sooner than primary care providers (PCPs),^{8,10} there has been little examination of specific provider characteristics that may contribute to delays in diabetes therapy intensification.

To further understand reasons for inaction in the context of elevated A1Cs, we examined the extent to which clinician and patient characteristics were associated with glycemic control and treatment intensification after loss of glycemic control.

ABSTRACT

Objectives: Patients with diabetes often exceed desired glycated hemoglobin (A1C) levels for months prior to medication adjustments. To determine if provider and patient characteristics predict glycemic control and treatment intensification.

Study Design: Observational retrospective cohort study using electronic medical record data.

Methods: We studied 149 Kaiser Permanente Northwest primary care providers of 14,430 patients with diabetes, of whom 5823 (40.4%) were in optimal control (all A1Cs <7%) and 2446 (17%) were in poor control (at least 1 A1C >9%) in 2011. We also identified a subset of 107 primary care providers of 912 patients with diabetes who were initially in optimal control (A1C <7%) but had a subsequent A1C >7.5% from 2010 to 2011. We used hierarchical linear modeling to assess both patient and provider characteristics as predictors of glycemic control and treatment intensification after incident hyperglycemia.

Results: Patient characteristics associated with optimal control included older age, lower baseline A1C, shorter diabetes duration, and not using insulin ($P < .001$ for all). The inverse of these variables predicted poor control. No provider characteristics were associated with glycemic control or intensification. Older patients with a greater change in A1C were more likely to have therapy intensified after loss of glycemic control.

Conclusions: Patient, but not provider characteristics, predicted glycemic control and therapy intensification. Improving systems of care such as disease management services may be a better use of resources than focusing on individual providers.

Am J Manag Care. 2015;21(9):597-606

Take-Away Points

- In a single integrated health maintenance organization, individual provider characteristics did not predict glycemic control or likelihood of treatment intensification; however, there was little variability between providers.
- These data suggest that systems of care may contribute more to glycemic control among patient populations compared to individual provider characteristics.
- Improving systems of care, such as disease management services, may be a better use of resources than focusing on individual providers.

METHODS

The study was reviewed and approved by the institutional review board of Kaiser Permanente Northwest.

Setting

KPNW is a nonprofit, group-model health maintenance organization that provides integrated comprehensive medical care to about 490,000 individuals in a 75-mile radius around Portland, Oregon. PCPs include physicians, nurse practitioners, and physician assistants of Internal Medicine and Family Practice departments. Patients are assigned a personal PCP, though they also visit other primary care clinicians for short-notice appointments or when their personal clinician is not available. A group of patients assigned to a provider is called a “panel.” To assist providers in caring for their patients with diabetes, KPNW provides evidence-based guidelines based on American Diabetes Association recommendations.¹⁹

Identification and Follow-up of Patients With Diabetes

KPNW uses healthcare utilization data to track and facilitate operations. An electronic medical record—in use since 1996—allows providers to record *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis codes at each patient contact and to update an electronic problem list (which also utilizes ICD-9-CM codes). A single regional laboratory processes most KPNW outpatient laboratory tests, and the results are stored in a searchable database. A pharmacy is located in each medical office, and most members have a pharmacy benefit, ensuring almost complete capture of data describing pharmaceutical dispenses.

Subjects were members of the KPNW electronic diabetes registry, established in 1989.²⁰ Patients are automatically added to the registry at the first indication of diabetes. Criteria include physician-entered inpatient or outpatient diagnoses of diabetes (ICD-9-CM code 250.xx), dispensing of an antihyperglycemia agent, an A1C $\geq 7\%$ (lowered to

6.5% in 2010), or a fasting plasma glucose >125 mg/dL. Clinicians may remove patients from the registry if their inclusion is subsequently determined to be erroneous.

Selection of Participants

We identified 178 PCPs who were continuously employed during 2011 (Figure 1).

Of these, 149 (83.7%) had at least 10 patients with diabetes in their panel of patients, and were thus caring for a total of 14,430 diabetics. The outcomes of interest were the probability that patients were in optimal glycemic control (outcome 1A: all A1C values $<7\%$; N = 5823 [40.4%]) or poor control (outcome 1B: at least 1 A1C $\geq 9\%$; N = 2446 [17%]) in 2011. We chose a value of $<7\%$ based on the American Diabetes Association’s position statement that for many patients with diabetes, a reasonable glycemic goal is A1C $<7\%$.¹⁹

We identified a subset of the above population consisting of 107 PCPs with at least 4 patients with diabetes on their panel who were initially in optimal control ($<7\%$) but had a subsequent A1C $\geq 7.5\%$ from 2010 to 2011 (912 patients). Patients were required to have 1 year of follow-up available after the elevated A1C. We assessed the probability of treatment intensification, defined as the addition of a new antihyperglycemic medication (oral agent or insulin) or an increase in dosage of a current oral medication, within 90 days of the elevated A1C (outcome 2). We were unable to capture increases in insulin dosage among those already on insulin.

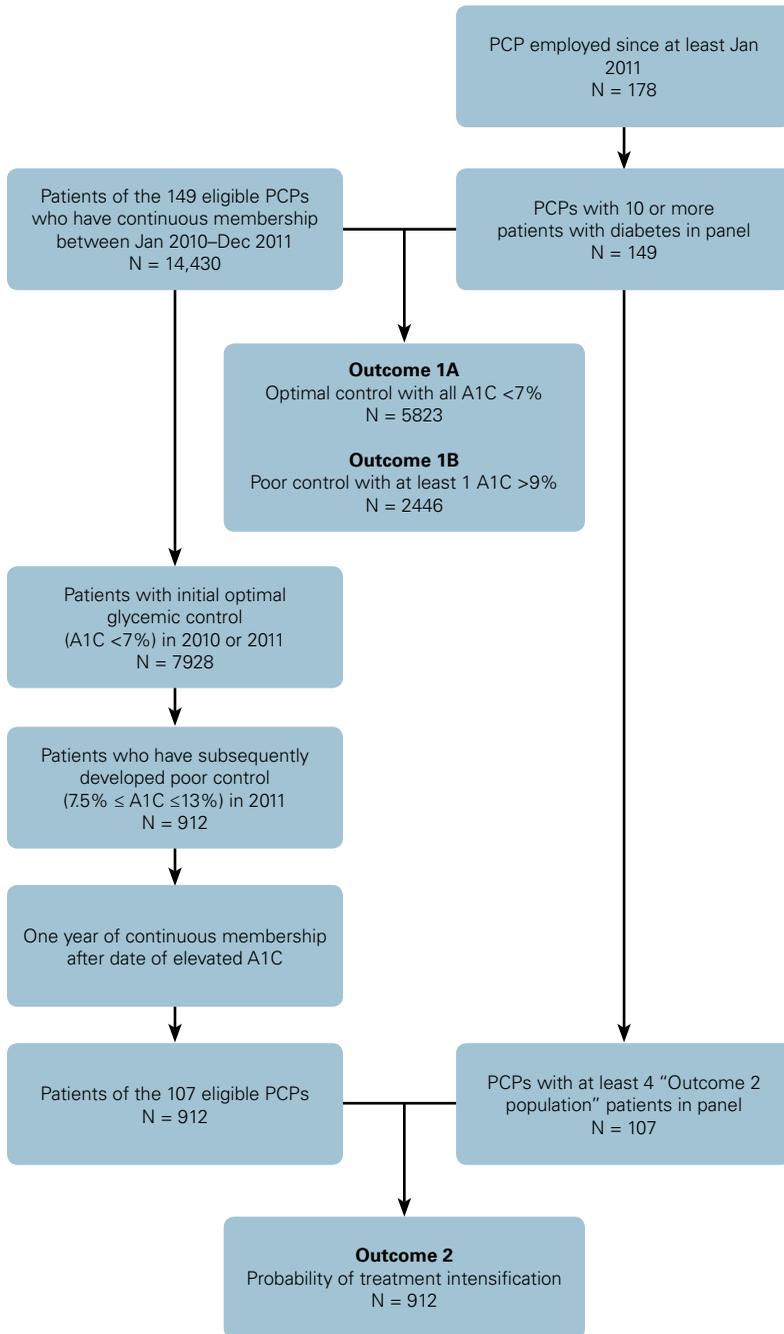
Patient and Provider Characteristics

We examined the demographics of both patients and PCPs. For patients, we also examined time in the KPNW diabetes registry (which has been shown in previous analyses to be a proxy for duration of diabetes), the most recent A1C prior to the observation period, and insulin use. We determined whether patients had a visit to any PCP (not just their own PCP), an endocrinologist, or a specialist during the observation period, and we determined the Deyo-adaptation of the Charlson comorbidity index.²¹ PCP characteristics included duration of employment at KPNW, primary care training (internal medicine vs family practice), and degree (MD vs nurse practitioner/physician assistant). We also examined the total number of patients and percentage of patients with diabetes on their panels.

Statistical Analyses

We report summary statistics to describe the characteristics of patients and PCPs. Continuous variables were summarized by medians and interquartile ranges and cat-

■ **Figure 1. Participant Selection**



A1C indicates glycosylated hemoglobin; PCP, primary care physician.

egorical variables by numbers and percentages. We used 2-level hierarchical linear models to assess patient and provider characteristics as predictors of glycemic control and treatment intensification after incident hyperglycemia. The first and second levels of the hierarchical linear models included patient and provider characteristics, respectively. We

performed the following process for each of the 3 outcomes: first, we assessed bivariate associations within each of the 2 levels of the model. Secondly, we put together the level-1 patient variables that were statistically significant at a $P < .10$ level and that had enough variability to explain the outcome across almost all (99%) providers in the model. Third, we added all the level-2 provider variables as predictors of the intercept coefficient and evaluated if the provider variables explained additional variance in the outcomes above and beyond the patient characteristics. This last assessment was based on a χ^2 test of the deviance difference of the models with and without the provider variables. Laplace estimations were used in all models due to the binary outcomes. Analyses were conducted using SAS version 9.2 (SAS Institute, Cary, North Carolina) and HLM version 7 for Windows (Scientific Software International, Inc, Lincolnwood, IL).

RESULTS

Baseline Characteristics

Patients had a median age of 63 years for outcome 1 (prevalent optimal and poor glycemic control) and 62 years for outcome 2 (probability of treatment intensification), and slightly more than half were men (Table 1). Patients had been in the KPNW diabetes registry for an average of 5 years. Glycemic control was $<7\%$ for more than half of all patients; close to one-fourth were using insulin. Most saw a PCP, but very few ($<2\%$) saw an endocrinologist.

About half of the PCPs for these patients with diabetes were men, with about an even split between internal medicine and family practice. The majority were MDs and they had worked at KPNW for a median of 6 to 8 years. They had a median of 1200 to 1300 patients on their panels, 8% to 9% of whom had diabetes.

Patient and PCP Characteristics Associated With Optimal Glycemic Control (all A1Cs $<7\%$)

In bivariate analyses, patients who were older and who had at least 1 visit to a specialist other than an endocri-

Table 1. Patient and Clinician Characteristics of Study Samples

Characteristics Median (IQR) or N (%)	Study Samples	
	Glycemic Control Outcomes N = 14,430	Treatment Intensification Outcomes N = 912
Patients		
Age, years	63 (55.0-71.0)	62 (54.0-69.0)
Male gender	7572 (52.5)	494 (54.2)
Time with diabetes at KPNW, years	5.4 (2.2-9.8)	5.2 (2.0, 9.5)
Baseline A1C	6.9 (6.4-7.8)	6.7 (6.5-6.8)
Change in A1C	–	1.3 (0.9-1.9)
Charlson comorbidity index	2.0 (1.0-3.0)	1.0 (1.0-3.0)
Use of insulin	3320 (23.0)	191 (20.9)
At least 1 visit to any primary care provider	13,685 (94.8)	697 (76.4)
At least 1 visit to an endocrinologist	248 (1.7)	4 (0.4)
At least 1 visit to a specialist other than an endocrinologist	5477 (38.0)	255 (28.0)
Clinicians	Glycemic Control Outcomes N = 149	Treatment Intensification Outcome N = 107
Age, years	46.9 (39.4-52.8)	48.8 (42.2-54.6)
Male gender	72 (48.3)	59 (55.1)
Time working at KP, years	6.4 (2.6-12.4)	8.3 (4.2-16.3)
Internal medicine (vs family practice)	71 (47.7)	53 (49.5)
MD (vs nurse practitioner/physician assistant)	127 (85.2)	100 (93.5)
Number of patients assigned to provider	1199 (930-1519)	1314 (1069-1627)
Percentage of empaneled patients with diabetes	8.1 (5.7-10.5)	8.9 (7.4-11.4)
Mean Charlson comorbidity index of empaneled patients	2.5 (2.1-2.8)	1.8 (1.3-2.3)

A1C indicates glycosylated hemoglobin; IQR, interquartile range; KP, Kaiser Permanente; KPNW, Kaiser Permanente Northwest; MD, medical doctor.

nologist were more likely to be in optimal glycemic control (Table 2). On the other hand, male patients with higher A1Cs at baseline, longer duration of diabetes, and insulin use were less likely to have optimal control. Patients with at least 1 visit to an endocrinologist were less likely to be in control; however, only 101 of the 149 PCPs had a mix-

ture of patients who did and did not see an endocrinologist. Having a visit to a specialist other than an endocrinologist was associated with increased odds of being in optimal control. No PCP characteristics were associated with optimal control in the bivariate models. When we examined the patient characteristics in a multivariable model, older patients

Table 2. Patient and Clinician Characteristics Associated With Optimal Glycemic Control: All A1Cs <7%

	Optimal Control Bivariate Associations		Optimal Control Multivariable Associations ^a	
	Odds ratio (95% CI)	P	Odds ratio (95% CI)	P
Patients				
Age	1.024 (1.021-1.028)	<.001	1.023 (1.017-1.03)	<.001
Male gender	0.90 (0.83-0.98)	.013	0.92 (0.82-1.03)	.153
A1C ≥7% prior to year of observation	0.06 (0.05-0.064)	<.001	0.07 (0.06-0.08)	<.001
Time with diabetes at KPNW	0.92 (0.91-0.93)	<.001	0.93 (0.92-0.95)	<.001
Use of insulin	0.25 (0.22-0.28)	<.001	0.49 (0.42-0.58)	<.001
Charlson comorbidity index	0.99 (0.97-1.01)	.166		
At least 1 visit to any primary care provider ^b	0.85 (0.72-1.00)	.054		
At least 1 visit to an endocrinologist ^b	0.56 (0.41-0.78)	.001		
At least 1 visit to a specialist other than an endocrinologist	1.13 (1.04-1.22)	.004	1.01 (0.90-1.14)	.866
Clinicians				
Age	0.999 (0.994-1.005)	.943		
Male gender	0.96 (0.88-1.05)	.327		
Time working at KP	1.002 (0.996-1.008)	.515		
Number of patients empaneled to provider	0.999 (1.00-1.00)	.403		
Percentage of empaneled patients with diabetes	1.00 (0.99-1.02)	.505		
Mean Charlson comorbidity index of empaneled patients	1.07 (0.96-1.20)	.194		
Internal medicine (vs family Practice)	0.97 (0.89-1.05)	.462		
MD (vs nurse practitioner/physician assistant)	1.07 (0.89-1.28)	.479		
A1C indicates glycated hemoglobin; KP, Kaiser Permanente; KPNW, Kaiser Permanente Northwest; MD, medical doctor. ^a Variables included were statistically significant at $P < .10$ at the bivariate level. ^b Variable not included in multivariable analysis because not all primary care providers had patients who did and did not have a visit.				

were still more likely to be in optimal control while patients with higher A1Cs at baseline, longer duration of diabetes, and insulin use were less likely to be in optimal control. For example, each additional year of age increased the odds of being in optimal control by 2% (odds ratio [OR], 1.023; 95% CI, 1.017-1.03; $P < .001$). Having a baseline A1C ≥7% decreased the odds of being in optimal glycemic control by

93% (OR, 0.07; 95% CI, 0.06-0.08; $P < .001$), and for each additional year with diabetes, it decreased by 7% (OR, 0.93; 95% CI, 0.92-0.95; $P < .001$). Users of insulin were almost half as likely to be in optimal control as nonusers of insulin (OR, 0.49; 95% CI, 0.42-0.58; $P < .001$). Adding provider characteristics to the multivariable model did not improve the predictive power of the models.

Table 3. Patient and Clinician Characteristics Associated With Poor Glycemic Control: At Least 1 A1C ≥9%

	Poor Control Bivariate Associations		Poor Control Multivariable Associations ^a	
	Odds ratio (95% CI)	P	Odds ratio (95% CI)	P
Patients				
Age	0.955 (0.951-0.959)	<.001	0.956 (0.949-0.962)	<.001
Male gender	1.21 (1.10-1.33)	<.001	1.19 (1.04-1.37)	.015
A1C ≥7% prior to year of observation	16.09 (13.09-19.78)	<.001	12.40 (9.64-15.94)	<.001
Time with diabetes at KPNW	1.04 (1.03-1.05)	<.001	1.03 (1.01-1.05)	<.001
Use of insulin	3.43 (3.06-3.85)	<.001	2.14 (1.82-2.50)	<.001
Charlson comorbidity index	0.96 (0.94-0.99)	.005	1.02 (0.97-1.06)	.460
At least 1 visit to any primary care provider	1.08 (0.86-1.37)	.504		
At least 1 visit to an endocrinologist ^b	2.31 (1.69-3.16)	<.001		
At least 1 visit to a specialist other than an endocrinologist	0.73 (0.65-0.82)	<.001	0.80 (0.68-0.95)	0.011
Clinicians				
Age	0.998 (0.991-1.005)	.530		
Male gender	1.08 (0.96-1.21)	.195		
Time working at KP	0.993 (0.986-1.000)	.052		
Number of patients empaneled to provider	1.00 (1.00-1.00)	.594		
Percentage of empaneled patients with diabetes	0.99 (0.97-1.00)	.132		
Mean Charlson comorbidity index of empaneled patients	0.89 (0.75-1.06)	.181		
Internal medicine (vs family practice)	0.98 (0.87-1.10)	.692		
MD (vs nurse practitioner/physician assistant)	0.78 (0.60-1.02)	.064		

A1C indicates glycated hemoglobin; KP, Kaiser Permanente; KPNW, Kaiser Permanente Northwest; MD, medical doctor.

^aVariables included were statistically significant at $P < .10$ at the bivariate level.

^bVariable not included in multivariable analysis because not all primary care providers had patients who did and did not visit an endocrinologist.

Patient and PCP Characteristics Associated With Poor Glycemic Control (at least 1 A1C ≥9%)

Patients who were older had a decreased risk of poor control while those who were male, had higher baseline A1Cs, had a longer duration of diabetes, and used insulin had a higher risk of poor control in bivariate models (Table 3). Patients who had at least 1 visit with an endocrinologist

were more likely to be in poor control, while having a visit to a specialist other than an endocrinologist was associated with decreased odds of being in poor control. No PCP characteristics were associated with poor control in the bivariate models. Based on the patient characteristic multivariable model, for each additional year of age, the odds of poor control decreased by about 4% (OR, 0.956;

95% CI, 0.949-0.962; $P < .001$). Having a baseline A1C $\geq 7\%$ increased the odds of poor control by a factor of 12 (OR, 12.4; 95% CI, 9.6-15.9; $P < .001$), and for each year in the diabetes registry, odds of poor control increased by 3% (OR, 1.03; 95% CI, 1.01-1.05; $P < .001$). Users of insulin were more than twice as likely to have poor control than nonusers (OR, 2.1; 95% CI, 1.8-2.5; $P < .001$). Those who had at least 1 visit to a specialist other than an endocrinologist had 20% lower odds of having poor control (OR, 0.80; 95% CI, 0.68-0.95; $P = .011$). When we added PCP characteristics to the multivariable models, the PCP variables did not contribute additional information to the model that just included the significant patient characteristics.

Patient and PCP Characteristics Associated With Treatment Intensification Within 90 Days of Incident Hyperglycemia (elevated A1C $>7.5\%$)

The distribution of the rate of therapy intensification approximated normal (eAppendix Figure, available at www.ajmc.com). Of the 912 patients who were in optimal glycemic control ($<7\%$) followed by an elevated A1C ($>7.5\%$), more than half (58.9%, $n = 537$) had their therapy intensified within 90 days of the elevated A1C. On average, 58.6% of a PCP's patients who had been in optimal glycemic control had their therapy intensified within 90 days of an elevated A1C.

Results of the bivariate and multivariable hierarchical linear models of therapy intensification are displayed in Table 4. A greater change between the A1C below 7% and the subsequent A1C over 7.5% was most strongly associated with the probability of intensification (OR, 1.54; 95% CI, 1.25-1.91; $P < .001$). Older age also increased the probability of intensification (OR, 1.02; 95% CI, 1.00-1.03; $P = .027$) in the multivariable model. PCP characteristics were not associated with the probability of treatment intensification in bivariate models and did not improve the multivariable model.

DISCUSSION

Studies of poor glycemic control that seek to explain clinical inaction among individuals with diabetes have typically focused on patient characteristics because clinician data are rarely available. Those that focus on clinicians rely on surveys that do not link actual clinical data to their patients' levels of glycemia.²²⁻²⁴ Our study may be the first to simultaneously evaluate the association of both patient and provider characteristics, including provider demographics and attributes of provider patient panels, with glycemic control and treatment intensification. We found that patient, rather than provider, characteristics were as-

sociated with the probability of optimal or poor glycemic control and treatment intensification when glycemic control is initially lost. These data suggest that systems of care may contribute more to glycemic control among patient populations than individual provider characteristics.

Patients who were older, started out with better glycemic control, had a shorter duration of diabetes, and did not use insulin were more likely to have better glycemic control. A greater increase in A1C coupled with older age were more likely to lead to treatment intensification. In addition, in bivariate models, having at least 1 visit to an endocrinologist during the observation period was associated with poor glycemic control while a visit to a specialist was associated with optimal glycemic control. Patients having difficulty with diabetes management may be more likely to visit an endocrinologist, which would explain the observed association of endocrinology visits with poor control.

It might seem counterintuitive that patients seeing non-endocrinology specialists had improved glycemia; we had expected that visiting other specialists would be associated with worse glycemic control as such patients would be complex with multiple comorbidities. We hypothesize several possible explanations for this unexpected finding. First, PCPs might have been more able to focus on a patient's diabetes management because other medical problems were being addressed by specialist providers. Another possibility is that having multiple providers encourage lifestyle changes and medication compliance on various encounters may be more effective than just a single provider's advice. Patients under specialist care may also be more willing to modify their diet or exercise or improve medication compliance because they want to improve a more clinically apparent condition (eg, chest pain, painful knee osteoarthritis) than their "silent" diabetes. Finally, patients who have been able to navigate the health system to order to see a specialist might be more concerned about their health.

In our data, nearly 60% of patients who lost glycemic control after experiencing optimal control had treatment intensified within 3 months. This relatively rapid intensification is more aggressive than has been reported in previous research, including studies conducted in the current setting. For example, in a study conducted when A1C $>8\%$ was the trigger for intensification, patients waited an average of 15 to 26 months before their medication was changed, even though 2 to 4 A1C measures were elevated.¹¹ Treatment delays become even longer when the target A1C was $<7\%$. In a recent study from the United Kingdom, it took a median of nearly 3 years for a second medication to be added when A1C was $>7\%$ and over 7 years for a third medication to be added.¹² However, these

Table 4. Patient and Clinician Characteristics Associated With Treatment Intensification When A1C >7.5% After Previous A1C <7%

	Treatment Intensification Bivariate Associations		Treatment Intensification Multivariable Associations ^a	
	Odds ratio (95% CI)	P	Odds ratio (95% CI)	P
Patients				
Age	1.01 (0.99-1.03)	.082	1.02 (1.00-1.03)	.027
Male gender	1.12 (0.82-1.53)	.470		
Change in A1C from <7% to >7.5%	1.49 (1.21-1.83)	<.001	1.54 (1.25-1.91)	<.001
Time with diabetes at KPNW	0.99 (0.97-1.03)	.994		
Use of insulin	0.74 (0.51-1.07)	.105		
Charlson comorbidity index	1.07 (0.97-1.18)	.193		
At least 1 visit to any primary care provider ^b	0.68 (0.47-0.99)	.046		
At least 1 visit to a specialist other than an endocrinologist	0.93 (0.65-1.33)	.686		
Clinicians				
Age	0.99 (0.98-1.01)	.441		
Male gender	1.13 (0.81-1.59)	.457		
Time working at KP	0.99 (0.98-1.02)	.903		
Number of patients empaneled to provider	1.00 (1.00-1.00)	.098		
Percentage of empaneled patients with diabetes	0.98 (0.94-1.02)	.323		
Mean Charlson comorbidity index of empaneled patients	1.09 (0.86-1.39)	.492		
Internal medicine (vs family practice)	0.93 (0.70-1.24)	.613		
MD (vs nurse practitioner/physician assistant)	1.72 (0.80-3.69)	.163		

A1C indicates glycated hemoglobin; KP, Kaiser Permanente; KPNW, Kaiser Permanente Northwest; MD, medical doctor.

^aVariables included were statistically significant at *P* < .10 at the bivariate level.

^bVariable not included in the multivariable analysis because not all primary care providers had patients who did and did not visit a primary care provider.

prior studies considered only changes from one therapy to another, while our analyses included dosage increases as intensification efforts. This assessment of dosage changes of oral hyperglycemic therapies was a unique strength of this study. Because dosage changes are often not included in studies of treatment intensification, it is not surprising that we found a higher and likely more accurate rate of treatment intensification.

Our study design also required that patients be in optimal control at the start of the observation period and to subsequently experience a minimum of a 0.5 percentage point change in A1C to be eligible for intensification. Thus, we were observing an “incident” loss of glycemic control that was relatively large. Such a change in A1C may be an important trigger for intensifying therapy. Indeed, we found that a change in A1C exhibited the stron-

gest association with treatment intensification. In any event, it seems that chronic hyperglycemia, rather than “incident” loss of control that we studied, may account for much of the long delay in treatment intensification that has been reported elsewhere.

By studying patients with an apparent incident loss of glycemic control, we may have inadvertently included patients who were relatively early in their progression of dysglycemia and, thus, had less comorbidity. This is an important consideration for 2 reasons: first, previous research has shown that among patients with A1C >7%, each additional medical concern raised by the patient reduced the probability of a medication change by 49%.²⁵ Second, among patients on 1 to 3 oral medications who are in a more advanced stage of their disease, insulin may not be initiated for an average of 6 to 7 years after an elevated A1C,¹² with an average A1C at insulin initiation of 9.8%.^{26,27} Once on insulin, patients still experience low rates of therapy intensification even though insulin can be titrated up to achieve the desired A1C; 70% and 40% of patients on insulin have been shown to have A1C levels above 7% and 8%, respectively.^{2,28}

A unique strength of our study was the ability to assess comprehensive characteristics of clinicians as well as patients and to link those characteristics to glycemic control. To our knowledge, ours is the first such study. We did not find associations between provider characteristics and glycemic level of treatment intensification. This could have been the result of the organizational structure of the study site. Although we are unable to measure it, we know that there is considerable “sharing” of patients across providers. Providers often see other providers’ patients for urgent visits or cover urgent issues when a provider is not available. In the treatment intensification model, the variability in the outcome *within* PCPs was greater or equal to the variability *between* providers, illustrating that variability in the outcome is attributable mostly to patients.

Previous studies suggest that such a lack of variability among providers also exists in other health systems. A study of the Veteran Affairs system found there was almost no provider-level variation in indicators of glycemic control²⁹; rather, most of the variation was attributable to the facility level (patient factors were not examined). This has implications for quality measurement. If little of the variation in diabetes quality measures is attributable to providers, provider quality scores will be inaccurate unless the number of patients with diabetes on a provider’s panel is large. The focus of quality improvement should be on facility-level performance variations.

The lack of provider variability and the lack of an association between provider characteristics and glycemic outcomes also suggest that system level factors may have more influence over the glycemic level of the population than individual provider characteristics. Improving glycemia may be best done by developing indicators or programs that promote systemwide clinical actions such as institutional glycemic targets or protocols for support staff outreach for dysglycemia. For example, KPNW supplements the electronic medical record with a panel support tool that includes an alert to clinicians when individual patients exceed a prespecified A1C goal. Clinicians also have online point-of-care access to internal diabetes guidelines to assist their treatment decision making. More health systems should consider implementing such systemwide programs and future research should focus on how these and other system level factors influence glycemic outcomes.

Limitations

Our study had several limitations. First, we were unable to account for insulin dosage changes, as these cannot be measured in electronic dispensing data. Because we could not detect increases in insulin dosage among patients on insulin therapy, the number who received intensification was likely higher than we report. Second, the organizational structure of KPNW may limit practice variation such that PCP characteristics that would otherwise be predictive of patient glycemic control or treatment intensification are obfuscated. Third, KPNW has a limited formulary and our findings might have been different in other systems that allow clinicians more access to newer therapies. Current guidelines suggest a patient-centered approach to glycemic management that takes advantage of new therapies³⁰; however, we were unable to evaluate whether more formulary choices would positively influence clinical inertia.

Finally, despite the wealth of observational data we considered, unmeasured variables such as patients’ mental health, social support, socioeconomic status, and cultural orientation were not included in our study. We also could not examine provider decision making in response to poor glycemic control based on clinical interactions and individual patient characteristics, needs, beliefs, and attitudes. These characteristics may be critical to understanding glycemic control and treatment intensification.

CONCLUSIONS

Our findings illustrate that individual provider characteristics had limited ability to predict glycemic control or likelihood of treatment intensification. However, there

was little variability between providers in our single, integrated health maintenance organization and likely in other healthcare systems. These data suggest that systems of care may contribute more to glycemic control among patient populations compared with individual provider characteristics. Improving systems of care, such as disease-management services, may be a better use of resources than focusing on individual providers.

Acknowledgments

This study was presented in poster form at the 73rd Scientific Sessions of the American Diabetes Association, Chicago, Illinois, June 21-25, 2013.

Author Affiliations: Kaiser Permanente Center for Health Research NW (ESL, AGR, KLF, GAN), Portland, OR; Bristol-Myers Squibb (SK, JM), Wallingford, CT.

Source of Funding: This study was funded by Bristol-Myers Squibb and AstraZeneca.

Author Disclosures: Dr LeBlanc is an employee of Kaiser Permanente Center for Health Research NW, which received funding from Bristol-Myers Squibb and AstraZeneca for this study. She has also received grant funding from Amgen for an unrelated project and may receive a research grant from Merck for an unrelated project. Dr Nichols has previously received grants from Merck, AstraZeneca, Boehringer-Ingelheim, Incyte, BMS, and Novartis. Drs Mukherjee and Kachroo are employees and stock owners of Bristol-Myers Squibb. Ms Funk and Ms Rosales report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (ESL, KLF, JM, GAN, SK); acquisition of data (AGR); analysis and interpretation of data (ESL, SK, GAN, AGR); drafting of the manuscript (ESL, SK, GAN); critical revision of the manuscript for important intellectual content (ESL, KLF, SK, JM, GAN, AGR); statistical analysis (SK); obtaining funding (JM, GAN); administrative, technical, or logistic support (KLF).

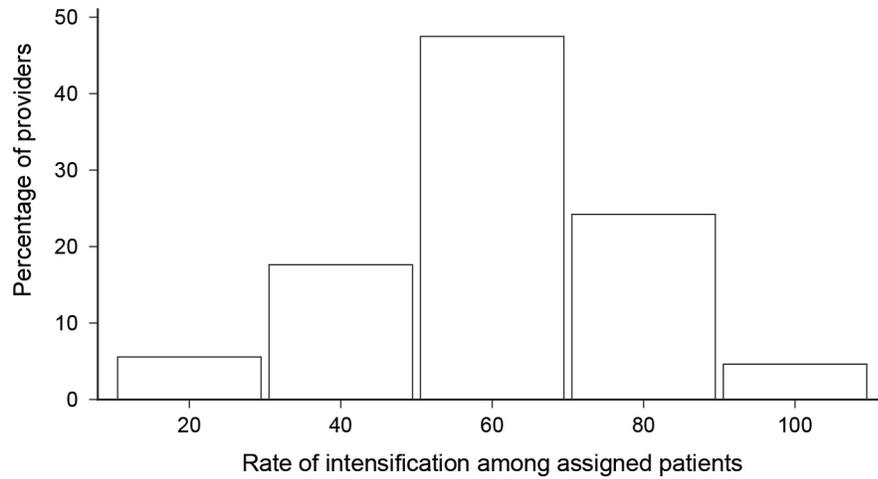
Address correspondence to: Erin S. LeBlanc, MD, MPH, Kaiser Permanente Center for Health Research, 3800 North Interstate Ave, Portland, OR 97227. E-mail: Erin.S.LeBlanc@kpchr.org.

REFERENCES

- American Diabetes Association. Standards of medical care in diabetes—2013. *Diabetes Care*. 2013;36(suppl 1):S11-S66.
- Stark Casagrande S, Fradkin JE, Saydah SH, Rust KF, Cowie CC. The prevalence of meeting A1C, blood pressure, and LDL goals among people with diabetes, 1988-2010. *Diabetes Care*. 2013;36(8):2271-2279.
- U.K. Prospective Diabetes Study Group. U.K. prospective diabetes study 16. overview of 6 years' therapy of type II diabetes: a progressive disease. *Diabetes*. 1995;44(11):1249-1258.
- Nathan DM, Buse JB, Davidson MB, et al. Medical management of hyperglycemia in type 2 diabetes: a consensus algorithm for the initiation and adjustment of therapy: a consensus statement of the American Diabetes Association and the European Association for the Study of Diabetes. *Diabetes Care*. 2009;32(1):193-203.
- Garber AJ, Abrahamson MJ, Barzilay JI, et al. AACE comprehensive diabetes management algorithm 2013. *Endocr Pract*. 2013;19(2):327-336.
- Qaseem A, Humphrey LL, Sweet DE, Starkey M, Shekelle P; Clinical Guidelines Committee of the American College of Physicians. Oral pharmacologic treatment of type 2 diabetes mellitus: a clinical practice guideline from the American College of Physicians. *Ann Intern Med*. 2012;156(3):218-231.
- Grant RW, Cagliero E, Dubey AK, et al. Clinical inertia in the management of type 2 diabetes metabolic risk factors. *Diabet Med*. 2004;21(2):150-155.
- Shah BR, Hux JE, Laupacis A, Zinman B, van Walraven C. Clinical inertia in response to inadequate glycemic control: do specialists differ from primary care physicians? *Diabetes Care*. 2005;28(3):600-606.
- Phillips LS, Branch WT, Cook CB, et al. Clinical inertia. *Ann Intern Med*. 2001;135(9):825-834.
- Ziemer DC, Miller CD, Rhee MK, et al. Clinical inertia contributes to poor diabetes control in a primary care setting. *Diabetes Educ*. 2005;31(4):564-571.
- Brown JB, Nichols GA, Perry A. The burden of treatment failure in type 2 diabetes. *Diabetes Care*. 2004;27(7):1535-1540.
- Khunti K, Wolden ML, Thorsted BL, Andersen M, Davies MJ. Clinical inertia in people with type 2 diabetes: a retrospective cohort study of more than 80,000 people. *Diabetes Care*. 2013;36(11):3411-3417.
- Nichols GA, Conner C, Brown JB. Initial nonadherence, primary failure and therapeutic success of metformin monotherapy in clinical practice. *Curr Med Res Opin*. 2010;26(9):2127-2135.
- Brown JB, Conner C, Nichols GA. Secondary failure of metformin monotherapy in clinical practice. *Diabetes Care*. 2010;33(3):501-506.
- Nichols GA, Alexander CM, Girman CJ, Kamal-Bahl SJ, Brown JB. Contemporary analysis of secondary failure of successful sulfonylurea therapy. *Endocr Pract*. 2007;13(1):37-44.
- Nichols GA, Kimes TM, Harp JB, Kou TD, Brodovicz KG. Glycemic response and attainment of A1C goals following newly initiated insulin therapy for type 2 diabetes [published online January 25, 2012]. *Diabetes Care*. 2012;35(3):495-497.
- Kirkman MS, Briscoe VJ, Clark N, et al. Diabetes in older adults. *Diabetes Care*. 2012;35(12):2650-2664.
- Sinclair AJ, Paolisso G, Castro M, Bourdel-Marchasson I, Gadsby R, Rodriguez Mañas L; European Diabetes Working Party for Older People. European Diabetes Working Party for Older People 2011 clinical guidelines for type 2 diabetes mellitus. executive summary. *Diabetes Metab*. 2011;37(suppl 3):S27-S38.
- American Diabetes Association. Standards of medical care in diabetes—2012. *Diabetes Care*. 2012;35(suppl 1):S11-S63.
- Brown JB, Nichols GA, Glauber HS. Case-control study of 10 years of comprehensive diabetes care. *West J Med*. 2000;172(2):85-90.
- Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992;45(6):613-619.
- Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? a framework for improvement. *JAMA*. 1999;282(15):1458-1465.
- Peyrot M, Rubin RR, Lauritzen T, Snoek FJ, Matthews DR, Skovlund SE. Psychosocial problems and barriers to improved diabetes management: results of the Cross-National Diabetes Attitudes, Wishes and Needs (DAWN) Study. *Diabet Med*. 2005;22(10):1379-1385.
- Peyrot M, Burns KK, Davies M, et al. Diabetes Attitudes Wishes and Needs 2 (DAWN2): a multinational, multi-stakeholder study of psychosocial issues in diabetes and person-centred diabetes care. *Diabetes Res Clin Pract*. 2013;99(2):174-184.
- Parchman ML, Pugh JA, Romero RL, Bowers KW. Competing demands or clinical inertia: the case of elevated glycosylated hemoglobin. *Ann Fam Med*. 2007;5(3):196-201.
- Nichols GA, Koo YH, Shah SN. Delay of insulin addition to oral combination therapy despite inadequate glycemic control: delay of insulin therapy. *J Gen Intern Med*. 2007;22(4):453-458.
- Calvert MJ, McManus RJ, Freemantle N. Management of type 2 diabetes with multiple oral hypoglycaemic agents or insulin in primary care: retrospective cohort study. *Br J Gen Pract*. 2007;57(539):455-460.
- Nichols GA, Gandra SR, Chiou CF, Anthony MS, Alexander-Bridges M, Brown JB. Successes and challenges of insulin therapy for type 2 diabetes in a managed-care setting. *Curr Med Res Opin*. 2010;26(1):9-15.
- Krein SL, Hofer TP, Kerr EA, Hayward RA. Whom should we profile? examining diabetes care practice variation among primary care providers, provider groups, and health care facilities. *Health Serv Res*. 2002;37(5):1159-1180.
- Inzucchi SE, Bergenstal RM, Buse JB, et al. Management of hyperglycaemia in type 2 diabetes: a patient-centered approach. position statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetologia*. 2012;55(6):1577-1596. ■

eAppendix

Figure. Rate of Therapy Intensification for Previously Optimally Controlled Patients



Distribution of the proportion of a clinician's previously optimally controlled patients with diabetes that received intensified therapy within 90 day of an elevated A1C.