Appointment Adherence and Disparities in Outcomes Among Patients with Diabetes

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BACKGROUND: Successful control of diabetes mellitus requires lifelong adherence to multiple self-management activities in close collaboration with health professionals. We examined the association of such control with appointment keeping behavior in a rural health system.

METHODS: Among 4,253 predominantly lower socioeconomic status patients with diabetes, the association of metabolic control (most recent A1c <7% or >9% in two models of respectively 'good' and 'poor' control) with 'missed appointment rate' over a 3-year period was examined using multiple logistic regression.

MAIN RESULTS: For each 10% increment in missed appointment rate, the odds of good control decreased 1.12× ($p<0.001$) and the odds of poor control increased 1.24× ($p<0.001$). The missed appointment rate was substantially higher among African-American patients (15.9% vs. 9.3% for white patients, $p<0.001$). Controlling for the missed appointment rate and insurance status in multivariate analysis attenuated the racial association with good control, and the racial association with poor control was no longer significant. Older, white patients with health insurance tended to have significantly better metabolic control. There was no independent association of metabolic control with patient income, gender, or number of primary care visits.

CONCLUSION: Adherence to appointments, independent of visit frequency, was a strong predictor of diabetes metabolic control. We hypothesize that missed appointment behavior may serve as an indicator for other diabetes adherence behaviors and associated barriers that serve to undermine successful diabetes self-management.

KEY WORDS: appointment adherence; a1c; diabetes mellitus.

J Gen Intern Med 23(10):1685–7

DOI: 10.1007/s11606-008-0747-1

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INTRODUCTION

Successful control of diabetes mellitus requires lifelong adherence to multiple self-management activities in close collaboration

with health professionals. Lack of adherence to such activities has been demonstrated to be associated with unfavorable diabetes outcomes. For instance, prescription refill adherence to diabetes medications correlates with improved hemoglobin A1c results.^{1,2} Similarly, adherence to blood sugar self-monitoring is also associated with lower A1c levels^{3–5} as is adherence to diet and lifestyle change.^{6,7} However, clinician awareness of these measures of adherence is generally achieved by patient self-report, a method of assessment whose accuracy is variable. We sought to determine the association between the missed appointment rate for clinician appointments and metabolic control since this is an objective adherence measure that can easily be ascertained.

METHODS

The study was conducted in a public university-based health system serving a large predominantly lower socioeconomic status rural population in central Virginia. The health system provides subsidized healthcare that includes ambulatory, inpatient, and pharmacy services to individuals and families with incomes <200% of the federal poverty level based on a sliding fee scale (copayments of 1–75%). The clinical-administrative database was utilized to retrospectively gather data on all patients over age 18 seen at three separate primary care internal medicine clinics of the health system with a clinician-assigned diagnosis of diabetes mellitus and an A1c level >5%. The study database was not able to accurately distinguish patients with type 1 versus type 2 diabetes, though 95% were type 2 based on prior studies in this population. The dataset was limited to patients with at least 3 appointments over the study interval (2004 through October 2007).

Of 4,922 eligible patients, complete data were available on 4,253 included in the final multivariable analyses. We examined the association of metabolic control (most recent A1c < 7% or > 9% in two models of respectively 'good' and 'poor' control) with appointment-keeping behavior. We calculated the 'missed appointment rate' of each patient (operationalized as the number of primary care physician visits scheduled but not attended and not canceled during the study period divided by the total number of visits scheduled) and used multiple logistic regression to examine the association with metabolic control, controlling for socio-demographic variables (age, gender, race, income, insurance) as well as number of attended primary care visits and clinic site. Patient/family income was dichotomized at 200% of the federal poverty level, the threshold for financial assistance from the health system. Health insurance was based on primary payer and initially categorized as Medicare, Medicaid, Commercial, or self-pay and subsequently consolidated to insured versus self-pay in the final analysis. For race,

Received April 18, 2008

Revised June 17, 2008

Accepted July 2, 2008

Published online July 26, 2008

Table 1. Demographic and Clinical Characteristics of the Study Sample

Characteristics	Mean (SD)
Age (years)	58.5 (14)
# of kept 1 st care appointments in study interval	13.3 (11)
Missed appointment rate (%)	10.6% (14)
Hemoglobin A1c (last in interval)	7.7% (2.0)
LDL in mg/dl (last in interval)	96 (41)
Gender	N (%)
Female	2,717 (55%)
Male	2,205 (45%)
Race	
White	2,983 (61%)
African-American	1,789 (36%)
Other	150 (3%)
Income	
<100% poverty	1,698 (35%)
100–200% poverty	579 (12%)
>200% poverty	2,519 (52%)
Insurance	
Medicare	2,474 (50%)
Medicaid	375 (8%)
Commercial	1,180 (24%)
None	893 (18%)

only the contrast for white versus African-American is shown given the small proportion self-described as Hispanic, Asian, or other races in this population. The missed appointment rate distribution was skewed, but a log transformation did not materially alter the demonstrated associations and the untransformed results are herein reported. A two-tailed p-value of 0.05 was the criterion for statistical significance.

RESULTS

Table 1 describes the population vis-à-vis the demographic and other variables modeled in the analysis. Almost half (47.2%) of the patients had good diabetes control (A1c < 7%), 32.3% had fair control (A1c between 7–9%), and 20.5% had poor control (A1c ≥ 9%) as of their last measurement during the study period. Table 2 confirms that age, missed appointment rate, and insurance status independently predicted both good and poor metabolic control, while race was independently associated with good but not poor control. Older, white patients with health insurance tended to have significantly better metabolic control. Though low patient income was associated with poor control in the bivariable model, it was not independently

predictive. Controlling for the actual visit frequency during the study period, the adjusted mean A1c of the 2646 patients who missed an appointment on fewer than 5% of occasions was 7.35%, 7.64% for the 622 patients with missed appointment rate 5–10%, 7.88% for the 783 patients with a missed appointment rate of 10–20%, and 8.47% for the 871 patients with missed appointment rate >20%.

In multivariable models excluding missed appointment rate as a predictor (not shown), the association between race and metabolic control was much stronger. The odds of poor control were 1.23× greater for African-Americans, $p=0.009$ (versus 1.12×, $p=0.16$ in full model) and the odds of good control were 0.82× that of white patients, $p<.001$ (versus 0.85×, $p=0.02$ in full model). Correspondingly, the mean missed appointment rate for African-American patients was substantially higher than that of white patients (15.9% vs. 9.3%, $p<0.0001$).

The missed appointment rate was the strongest predictor of metabolic control in our multivariable models based on the Wald chi-square statistic. As shown in Table 2, for each 10% increment in missed appointment rate the odds of good control diminished by 0.89× ($p<0.001$) and the odds of poor control increased 1.24× ($p<0.001$). There was no independent association of metabolic control with patient income, gender, or the number of completed primary care visits during the study period (the institution's income-based sliding fee scale would diminish financial barriers). In separate models, there was no association between the rate of rescheduled or canceled appointments (mean =24%) during the study period and metabolic control, controlling for the same set of independent variables (with or without missed appointment rate included).

CONCLUSIONS

The missed appointment rate to primary care appointments, independent of actual patient visit frequency and socio-demographic characteristics, was found to be a strong predictor of diabetes metabolic control. The association was substantial, with patients that missed appointments more than 20% of the time having average A1c levels more than 1% higher than those who missed appointments fewer than 5% of the time. Interestingly, no such relationship was found between the rate of appointments that were canceled or rescheduled and metabolic control.

Our findings are similar to those reported by Karter et al.,⁸ who studied Kaiser Permanente-insured diabetic patient missed appointment behavior during a one-year period. Sim-

Table 2. Independent Predictors of Good (A1c < 7%) and Poor (A1c ≥ 9%) Diabetes Control

Independent variable (odds comparator)	Dependent variable: A1c <7%				Dependent variable: A1c ≥ 9%			
	Bivariable models		Multivariable model		Bivariable models		Multivariable model	
	Odds	p-value	Odds	p-value	Odds	p-value	Odds	p-value
Age (per 10-year increment)	1.16	<0.001	1.1	<0.001	0.69	<0.001	0.73	<0.001
Gender (for female vs. male)	1.00	0.09	2.02	0.90	1.03	0.69	1.03	0.70
Race (for contrast AA vs. white)	0.79	<0.001	0.85	0.02	1.34	<0.001	1.12	0.16
Income (>200% vs. <200% of poverty level)	1.11	0.07	0.89	0.10	0.77	0.001	0.91	0.30
Insurance (insured vs. self-pay)	1.48	<0.001	1.28	0.001	0.46	<0.001	0.72	0.001
Missed appointment rate (per 10% increment)	0.84	<0.001	0.89	<0.001	1.37	<0.001	1.24	<0.001
# visits (per 5-visit increment in study period)	1.01	0.32	0.98	0.15	0.93	0.0001	1.03	0.20

ilar to our study, they found an independent association of missed appointment proportion as well as age and proxies for patient financial status with metabolic control. They did not examine race or ethnicity and were restricted to a single payer. In our study, the disparity in metabolic outcomes between white and African-American patients diminished after controlling for appointment-keeping behavior and insurance status. This is important given the priority of reducing existing disparities in health outcomes and the need to find leverage points by which to do so.^{9,10} Barriers to care that may be etiologic in outcome disparities could be reflected in missed appointment and other adherence-related behaviors. Indeed, Karter⁸ demonstrated an association between missed appointment behavior and the self-monitoring of blood sugar as well as medication adherence. We and others have demonstrated associations of race with diabetes medication adherence,^{1,2,11,12} glucose self-monitoring,^{13,14} and ultimately with metabolic outcome. We are not suggesting that missed appointments are a cause of poor outcomes rather than they may be a useful and readily measured symptom of other barriers to care that may, in fact, be important in the chain of causation. A detailed exploration for remediable diabetes care barriers may be warranted in patients that miss appointments.¹⁵

Our study is limited by its retrospective observational nature as well as the particular variables available for analysis. Therefore, it is not helpful in determining causation and is subject to confounding by multiple factors that were not controlled for. Nonetheless, the strong association between the missed appointment rate and metabolic control, independent of other socio-demographic factors, corroborates other research and suggests the importance of barriers to care in explaining outcome disparities. Since it is readily measured, appointment-keeping behavior may serve as a useful proxy for other diabetes adherence behaviors and the associated barriers that serve to undermine successful diabetes self-management.

Acknowledgements: An abstract describing this study was presented at the Society of General Internal Medicine 31st Annual National Meeting in Pittsburgh (April, 2008). The study was conducted without external or additional internal funding.

Conflict of Interest: None disclosed.

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