The Effect of a PPO Pay-for-Performance Program on Patients With Diabetes

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Since the publication of several Institute of Medicine reports that recommended quality-based incentive programs to improve healthcare quality, many health plans have adopted pay-for-performance programs (P4Ps).[1,2] More than one-half of the physicians practicing in commercial health maintenance organizations and approximately one-quarter of all physicians in other settings participate in some form of P4P contract.[3,4] Moreover, the Centers for Medicare & Medicaid Services[5] have invested $21 million in P4Ps nationwide and plan to adopt P4Ps for health plans and physicians. Despite the wide use of P4Ps to improve the quality of care, few evaluations of the effectiveness of P4Ps are available in the literature, and most of these evaluations are published shortly after the P4P implementation, before the P4P can change physician behavior. In addition, the existing literature is mixed on the effect of P4Ps on physician behavior.[6-11] Some studies[12-14] found no effect or minimal effect, while other studies[15-17] found that P4Ps were effective in improving the quality of care.

Moreover, because most P4Ps provide monetary rewards to physicians for the achievement of quality-of-care processes (eg, obtaining laboratory testing) and not for outcomes (eg, hospitalization rates), few studies have assessed the ability of P4Ps to significantly improve patient outcomes. One study[18] found that, after the implementation of a P4P in a large network of federally qualified health centers, patients with diabetes mellitus were more likely to receive 2 glycosylated hemoglobin (A1C) tests per year, as recommended by the American Diabetes Association; however, this improvement in process did not contribute to better blood glucose control.

The objectives of this study were as follows: (1) to investigate the effectiveness of a P4P in a preferred provider organization (PPO) setting on increasing the frequency of measured diabetes quality-of-care processes and (2) to assess the effect of receiving these quality-of-care processes on outcomes (ie, hospitalization rates) over an 8-year period.

METHODS

P4P Background

The P4P, implemented by a large provider of healthcare coverage in Hawaii, provides participating physicians with financial incentives (an additional 1.5%-7.5% of their base professional fees) to perform quality-of-care processes (eg,

Objectives: To investigate the effectiveness of a pay-for-performance program (P4P) to increase the receipt of quality care and to decrease hospitalization rates among patients with diabetes mellitus.

Study Design: Longitudinal study of patients with diabetes enrolled in a preferred provider organization (PPO) between January 1, 1999, and December 31, 2006.

Methods: We used multivariate analyses to assess the effect of seeing P4P-participating physicians on the receipt of quality care (ie, glycosylated hemoglobin and low-density lipoprotein cholesterol testing) and on hospitalization rates, controlling for patient characteristics.

Results: Patients with diabetes who saw P4P-participating physicians were more likely to receive quality care than those who did not (odds ratio, 1.16; 95% confidence interval, 1.11-1.22; *P* <.001). Patients with diabetes who received quality care were less likely to be hospitalized than those who did not (incident rate ratio, 0.80; 95% confidence interval, 0.80-0.85; *P* <.001). During 1 year, there was no difference in hospitalization rates between patients with diabetes who saw P4P-participating physicians versus those who did not. However, patients with diabetes who saw P4P-participating physicians in 3 consecutive years were less likely to be hospitalized than those who did not (incident rate ratio, 0.75; 95% confidence interval, 0.61-0.93; *P* <.01).

Conclusions: A P4P can significantly increase the receipt of quality care and decrease hospitalization rates among patients with diabetes in a PPO setting. Although it is possible that the differences observed between P4P-participating physicians and non–P4P-participating physicians were due to selection bias, we found no significant difference in the receipt of quality care between patients with diabetes who saw new P4P-participating physicians versus non–P4P-participating physicians during the baseline year. Further research should focus on defining the effect of P4Ps on intermediate outcomes such as glycosylated hemoglobin and low-density lipoprotein cholesterol levels.

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Take-Away Points / e12
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Take-Away Points

A pay-for-performance program in a preferred provider organization setting may significantly increase the receipt of quality care and decrease hospitalization rates among patients with diabetes.

■ Without concurrent quality improvement interventions such as diabetes disease management programs, a pay-for-performance program may increase quality-of-care processes but fail to improve outcomes.

■ Further research should focus on defining the effect of pay-for-performance programs on intermediate outcomes such as glycosylated hemoglobin and low-density lipoprotein cholesterol levels and on quantifying the additional benefits of quality improvement activities such as diabetes disease management programs.

A1C and lipid testing), with a maximum payout cap ranging from $10,000 to $16,000 per physician annually. In 2001, an improvement bonus was introduced allowing the physician to earn up to an additional $6000 for improvement over the previous year's performance. The physicians receive an annual graphic and tabular report comparing their performance with that of their peers. Accompanying this report is a check award for their performance. Physicians who believe that an error was made in calculating their performance can request reconsideration. An annual review of the clinical measures and measurement algorithms is performed by the health plan, with clinical advisory board input to ensure accuracy and clinical relevance of the performance measures. More characteristics of this P4P have been described previously in detail.[17,19] Because participation in the P4P is voluntary, a proportion of physicians elect not to participate in the program each year. This program option enabled us to compare the probability of receiving the measured quality-of-care processes (eg, A1C and lipid testing) for patients with diabetes who saw only P4P-participating physicians versus those who saw only non–P4P-participating physicians.

Data and Sample

The study used demographic, pharmacy, inpatient, and outpatient administrative medical claims data from January 1, 1999, through December 31, 2006. The study sample consisted of patients with diabetes aged 18 to 75 years, as defined by a 2006 Healthcare Effectiveness Data and Information Set (HEDIS) algorithm, who saw P4P-participating physicians or non–P4P-participating physicians exclusively. We excluded patients who saw both P4P-participating and non–P4P-participating physicians (10.0% of the total sample) to create 2 distinct groups for a clean comparison. However, results that included and excluded this group of patients were found to be consistent in a sensitivity analysis before exclusion of these patients.

Dependent Variable

The outcomes of interest in this study were the number of hospitalizations from all causes and the receipt of quality care. Before choosing the number of hospitalizations from all causes as the dependent variable, we performed a sensitivity analysis using diabetes-specific hospitalization (ie, hyperglycemia or hypoglycemia, infection, amputation, and cardiovascular events) and found no significant differences between these results and those using hospitalizations from all causes. The receipt of quality care was defined as claims for at least 2 A1C tests and 1 low-density lipoprotein cholesterol (LDL-C) test during 1 year. Patients who had fewer than 2 A1C tests or less than 1 LDL-C test during 1 year were not considered to have received quality care. In assessing the effect of the receipt of quality care on hospitalization rates, the number of hospitalizations was the dependent variable, and the receipt of quality care was the primary independent variable.

Independent Variables

The primary independent variables in this study were P4P status (ie, whether the patient saw P4P-participating physicians vs non–P4P-participating physicians during the year) and the receipt of quality care (yes or no). To investigate the hypothesis that seeing P4P-participating physicians and receiving quality care in consecutive years would have a stronger and more significant effect on outcomes, dichotomous variables assessing whether a patient saw P4P-participating physicians in 3 consecutive years (ie, 2004-2006) and received quality care in 3 consecutive years (ie, 2004-2006) were constructed.

Covariates

Covariates used in this study included age, sex, comorbidity index, the number of outpatient visits during 1 year, the number of distinct primary care physicians (ie, internal medicine, family medicine, and geriatrics) seen during 1 year, visit to an endocrinologist (yes or no), insulin dependence (yes or no), and calendar year (ie, 1999-2006). The comorbidity index was calculated using the algorithm by Elixhauser et al[20] that is specifically adapted for administrative data sets, which has been shown to predict various patient outcomes, including mortality and hospital length of stay, as well as hospital charges. Current coding for the comorbidity index was downloaded from the Agency for Healthcare Research and Quality.[21] The comorbidity index was run using baseline hospital and physician claims. Because this study focuses on patients with diabetes, "diabetes without chronic complications" was excluded as a comorbid condition. The comorbidity index was

calculated as the sum of comorbid conditions present. A comorbidity index of 0 indicates no other comorbid diseases (besides simple uncomplicated diabetes), and a higher score on the comorbidity index indicates a greater burden of comorbid disease. Because of the skewed distribution of the variables, we created categorical variables for age (<45, 45-55, 56-60, 61-65, 66-70, and >70 years), the number of outpatient visits during 1 year (<6, 6-10, and >10), comorbidity index (1, 2, 3, and >3), and the number of distinct primary care physicians seen during 1 year (1, 2, and >2). The number of outpatient visits during 1 year was included as a covariate because patients who had more visits to physicians may have more opportunities to receive the indicated quality care and may have higher severity of illness. The number of distinct primary care physicians seen during 1 year was included as a proxy for healthcare continuity and coordination. We hypothesized that patients who saw multiple distinct primary care physicians would receive less coordinated and continued care. Insulin dependence, a variable used to capture the severity of diabetes, was defined as receiving more than a 60-day supply of insulin (captured using the appropriate National Drug Codes) during 1 year.

Statistical Analysis

Univariate analyses were performed to describe the data and the outcomes of interest. To explore the effect of seeing P4P-participating physicians on the receipt of quality care, this study first fitted a random-effects logit model, controlling for age, sex, comorbidity index, the number of distinct primary care physicians seen during 1 year, visit to an endocrinologist, insulin dependence, and calendar year. Of note, the number of outpatient visits during 1 year was omitted from the multivariate model because of high collinearity with the comorbidity index. To further explore the effect of exclusively seeing P4P-participating physicians in 3 consecutive years, a separate logit model was used with the receipt of quality care in 2006 as the dependent variable and all covariates as already described (except calendar year).

Separate random-effects negative binomial models were used to assess the effect of seeing P4P-participating physicians and receiving quality care on hospitalization rates. Of note, sensitivity analyses were performed using Poisson and zero-inflated models, and the results were consistent. The first model assessed the effect of the receipt of quality care during the prior year on the number of hospitalizations in the following year for all patients with diabetes, controlling for age, sex, comorbidity index, the number of outpatient visits during 1 year, visit to an endocrinologist, the number of distinct primary care physicians during 1 year, insulin dependence, and calendar year. To further explore the effect of receiving quality care in 3 consecutive years (ie, 2004-2006) on the number of

hospitalizations, the second model used the number of hospitalizations in 2006 as the dependent variable, controlling for all covariates as already described (except calendar year). The third model assessed the effect of seeing P4P-participating physicians in the baseline year on the number of hospitalizations in the following year. The fourth model assessed the effect of seeing P4P-participating physicians in 3 consecutive years (ie, 2004-2006) on the number of hospitalizations in 2006.

All random-effects models were clustered at the patient level to account for the intracluster correlation between observations in the same patient. Results for logit models are presented as odds ratios (ORs) with 95% confidence intervals (CIs), and results for negative binomial models are presented as incident rate ratios (IRRs) with 95% CIs. SAS proprietary software (release 9.1; SAS Institute, Cary, NC) and Stata (version 8.0; StataCorp LP, College Station, TX) were used for all statistical analyses.

RESULTS

Table 1 gives the sample size, demographic profile, and clinical characteristics of the patients with diabetes by calendar year. The number of patients with diabetes in the health plan increased from 19,573 in 1999 to 32,365 in 2006. The percentage of patients who saw P4P-participating physicians also increased from 78.7% in 1999 to 94.6% in 2006. Similarly, the percentage of patients who received quality care increased from 42.3% in 1999 to 67.1% in 2006. The number of hospitalizations ranged from a low of 134 per 1000 patients with diabetes in 2002 to a high of 157 per 1000 patients with diabetes in 1999. The mean age of the patients ranged from 57.4 to 59.5 years. Almost one-half were female, with a mean comorbidity index ranging from 1.7 to 2.0. The percentage of patients with insulin dependence ranged from a low of 12.0% in 2002 to a high of 14.5% in 2006.

Patients who saw P4P-participating physicians were significantly more likely to receive quality care compared with patients who saw non–P4P-participating physicians (OR, 1.16; 95% CI, 1.11-1.22; P <.001) (Table 2). Similarly, patients who saw P4P-participating physicians continuously between 2004 and 2006 were significantly more likely to receive quality care compared with patients who did not see P4P-participating physicians during all 3 years (OR, 1.20; 95% CI, 1.05-1.37; P <.01). In addition, male patients, patients with insulin dependence, patients with a visit to an endocrinologist, patients with a higher comorbidity index, and patients with more outpatient visits were significantly more likely to receive quality care. Patients who saw multiple distinct primary care physicians were significantly less likely to receive quality care.

■ **Table 1.** Descriptive Statistics

Variable	1999 (n = 19,573)	2000 (n = 21,636)	2001 (n = 22,195)	2002 (n = 25,512)	2003 (n = 27,770)	2004 (n = 29,076)	2005 (n = 30,870)	2006 (n = 32,365)
Primary Independent Variables and Outcomes								
Saw P4P-participating physicians, %	78.7	83.6	82.6	87.4	90.4	92.2	94.3	94.6
Receipt of quality care, %	42.3	45.6	49.7	59.5	57.9	60.5	66.9	67.1
Hospitalizations per 1000 patients	157	155	135	134	148	141	146	142
Covariates								
Age, mean (SD), y	59.5 (11.2)	58.2 (11.3)	58.0 (11.2)	57.7 (11.3)	57.5 (11.2)	57.4 (11.2)	57.5 (11.1)	57.5 (11.1)
Female sex, %	47.5	47.7	47.4	46.9	47.0	47.2	47.3	47.2
Comorbidity index, mean (SD)[a]	1.7 (1.4)	1.7 (1.5)	1.7 (1.4)	1.8 (1.5)	1.9 (1.5)	1.9 (1.6)	2.0 (1.7)	2.0 (1.7)
No. of outpatient visits during 1 y, %								
<6	29.9	31.7	32.3	32.8	33.3	33.8	33.3	33.5
6-10	37.7	37.4	37.9	37.0	36.7	36.6	36.1	36.3
>10	32.4	30.9	29.8	30.2	30.0	29.6	30.9	28.7
No. of distinct primary care physicians seen during 1 y, %								
0-1	84.5	82.6	83.9	82.1	79.3	77.5	70.0	71.6
2	12.5	13.8	13.3	14.2	15.4	17.0	22.6	21.4
>2	3.0	3.6	2.8	3.7	5.3	5.5	7.4	7.0
Visit to an endocrinologist, %	8.0	8.1	8.5	9.9	10.1	10.0	10.6	10.4
Insulin dependence, %	12.5	12.1	12.1	12.0	12.3	12.7	13.4	14.5

P4P indicates pay-for-performance program.
[a]Calculated using the method by Elixhauser et al,[20] which measures the effect of 30 different comorbid conditions. Current coding for this method was downloaded from the Agency for Healthcare Research and Quality Web site (http://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp).

Patients who received quality care were significantly less likely to be hospitalized in the following year compared with patients who did not receive quality care (IRR, 0.80; 95% CI, 0.78-0.83; P <.001) (**Table 3**). Similarly, patients who received quality care continuously between 2004 and 2006 were significantly less likely to be hospitalized in 2006 compared with patients who did not receive quality care during all 3 years (IRR, 0.67; 95% CI, 0.61-0.75; P <.001). Of note, the effect of receiving quality care during all 3 years on hospitalization rates was greater than the effect of receiving quality care in just 1 year. In addition, patients with insulin dependence, patients who saw multiple distinct primary care physicians, patients with 4 or more comorbid conditions, and patients with 6 or more outpatient visits were significantly more likely to be hospitalized.

During 1 year, patients who saw P4P-participating physicians had no difference in hospitalization rates compared with patients who saw non–P4P-participating physicians (IRR, 1.00; 95% CI, 0.95-1.05; P = .27) (**Table 4**). Patients who saw P4P-participating physicians continuously between 2004 and 2006 were significantly less likely to be hospitalized in 2006 compared with those who did not (IRR, 0.75; 95% CI, 0.61-0.93; P <.01).

DISCUSSION

This study supports previously published literature[15-17] by showing that patients may be more likely to receive quality-of-care processes after a P4P implementation, especially processes rewarded and incentivized by the P4P. Unlike the results of a prior study[18] suggesting that improvement in quality-of-care processes may not necessarily translate into improvement in clinical outcomes, this study showed a robust, consistent, significant, and positive association between increased receipt of appropriate laboratory monitoring of A1C and LDL-C levels and decreased hospitalization rates.

Tighter control of blood glucose and lipid levels is significantly associated with decreased morbidity and mortality.[22,23]

■ **Table 2.** Effect of Seeing P4P-Participating Physicians on the Receipt of Quality Care

Variable	Odds Ratio (95% Confidence Interval)	
	Receipt of Quality Care (n = 208,997 Patient-Years)[a]	Receipt of Quality Care in 2006 (n = 19,193)[b]
Saw P4P-participating physicians [Reference no]	1.16 (1.11-1.22)	—
Saw P4P-participating physicians continuously between 2004 and 2006 [Reference no]	—	1.20 (1.05-1.37)
Female sex [Reference male sex]	0.86 (0.82-0.89)	0.90 (0.84-0.96)
Age, y [Reference <45 y]		
45-55	1.51 (1.42-1.59)	1.46 (1.30-1.65)
56-60	1.89 (1.78-2.00)	1.69 (1.49-1.92)
61-65	2.04 (1.92-2.17)	1.70 (1.50-1.93)
66-70	1.02 (0.96-1.08)	1.24 (1.09-1.41)
>70	1.03 (0.97-1.10)	1.54 (1.35-1.76)
Comorbidity index [Reference 0][c]		
1	2.18 (2.09-2.27)	1.44 (1.29-1.60)
2	2.64 (2.52-2.77)	1.53 (1.36-1.72)
3	2.67 (2.53-2.82)	1.34 (1.17-1.54)
>3	2.33 (2.19-2.47)	1.14 (0.99-1.31)
No. of outpatient visits during 1 y [Reference <6]		
6-10	2.25 (2.18-2.33)	2.16 (2.00-2.33)
>10	2.64 (2.54-2.74)	2.35 (2.14-2.57)
No. of distinct primary care physicians seen during 1 y [Reference 1]		
2	0.89 (0.86-0.92)	0.91 (0.84-0.99)
>2	0.73 (0.69-0.78)	0.74 (0.65-0.86)
Visit to an endocrinologist [Reference no]	1.80 (1.70-1.91)	1.56 (1.38-1.75)
Insulin dependence [Reference no]	1.29 (1.23-1.36)	1.17 (1.06-1.29)
Calendar year [Reference 1999]		
2000	1.22 (1.16-1.28)	—
2001	1.53 (1.46-1.61)	—
2002	2.89 (2.75-3.04)	—
2003	2.58 (2.46-2.71)	—
2004	2.99 (2.85-3.14)	—
2005	4.57 (4.34-4.80)	—
2006	4.64 (4.41-4.87)	—

P4P indicates pay-for-performance program.
[a]This model assessed the effect of seeing P4P-participating physicians on the receipt of quality care in the same year. There were 57,292 distinct patients over the 8 years.
[b]This model assessed the effect of seeing P4P-participating physicians continuously between 2004 and 2006 on the receipt of quality care in 2006.
[c]Calculated using the method by Elixhauser et al,[20] which measures the effect of 30 different comorbid conditions. Current coding for this method was downloaded from the Agency for Healthcare Research and Quality Web site (http://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp).

However, obtaining glucose and lipid testing is only the first of many steps needed to not only help patients improve their blood glucose and lipid levels but also prevent hospitalization. In addition, improvements in processes of care measured and incentivized by a P4P may not necessarily translate into improved outcomes, as physicians may give disproportionate time and attention to ensure that measured care is performed (eg, obtaining A1C testing for patients with diabetes) to the

■ **Table 3.** Effect of the Receipt of Quality Care on the Number of Hospitalizations

Variable	Incident Rate Ratio (95% Confidence Interval)	
	No. of Hospitalizations (n = 165,636 Patient-Years)[a]	No. of Hospitalizations in 2006 (n = 19,193)[b]
Receipt of quality care in the previous year [Reference no]	0.80 (0.78-0.83)	—
Receipt of quality care continuously between 2004 and 2006 [Reference no]	—	0.67 (0.61-0.75)
Female sex [Reference male sex]	0.92 (0.89-0.95)	0.81 (0.73-0.90)
Age, y [Reference <45 y]		
45-55	0.99 (0.93-1.06)	0.92 (0.73-1.15)
56-60	1.20 (1.12-1.29)	0.99 (0.79-1.25)
61-65	1.37 (1.28-1.47)	1.17 (0.94-1.46)
66-70	1.53 (1.43-1.63)	1.17 (0.93-1.46)
>70	1.86 (1.75-1.99)	1.49 (1.20-1.86)
Comorbidity index [Reference 0][c]		
1	1.18 (1.10-1.26)	0.98 (0.78-1.23)
2	1.50 (1.40-1.60)	1.08 (0.86-1.36)
3	1.99 (1.85-2.14)	1.21 (0.96-1.55)
>3	3.41 (3.17-3.66)	2.14 (1.70-2.70)
No. of outpatient visits during 1 y [Reference <6]		
6-10	1.12 (1.07-1.18)	1.86 (1.56-2.22)
>10	1.48 (1.41-1.55)	5.48 (4.63-6.47)
No. of distinct primary care physicians seen during 1 y [Reference 1]		
2	1.14 (1.10-1.19)	1.86 (1.64-2.10)
>2	1.29 (1.22-1.37)	6.13 (5.33-7.04)
Visit to an endocrinologist [Reference no]	0.87 (0.83-0.92)	1.15 (0.99-1.32)
Insulin dependence [Reference no]	1.63 (1.56-1.70)	1.46 (1.28-1.65)
Calendar year [Reference 1999]		
2000	1.03 (0.97-1.09)	—
2001	0.97 (0.92-1.04)	—
2002	1.00 (0.94-1.06)	—
2003	0.99 (0.94-1.05)	—
2004	0.97 (0.92-1.03)	—
2005	0.90 (0.85-0.96)	—

[a]This model assessed the effect of the receipt of quality care in the previous year (eg, 1999) on the number of hospitalizations in the following year (eg, 2000). Therefore, calendar year 2006 was not included as a covariate. There were 48,411 distinct patients over the 8 years.
[b]This model assessed the effect of the receipt of quality care continuously between 2004 and 2006 on the number of hospitalizations in 2006.
[c]Calculated using the method by Elixhauser et al,[20] which measures the effect of 30 different comorbid conditions. Current coding for this method was downloaded from the Agency for Healthcare Research and Quality Web site (http://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp).

point of diverting resources from other important but unmeasured areas of care (eg, foot care and proper diet or exercise for glycemic control).[10,24]

There are 2 primary hypotheses as to why this study showed a significant and positive association between increased receipt of measured quality-of-care processes in the context of a P4P and decreased hospitalization rates. First, a diabetes disease management program was implemented in 2000, shortly after the P4P was launched. All patients with diabetes identified by an administrative-based algorithm (similar to the HEDIS algorithm) were stratified based on risk level and received interventions, including mailings and telephone calls according to their stratification level. Physicians (regardless of P4P participation status) of patients with

■ **Table 4.** Effect of Seeing P4P-Participating Physicians on the Number of Hospitalizations

Variable	Incident Rate Ratio (95% Confidence Interval)	
	No. of Hospitalizations (n = 165,636 Patient-Years)[a]	No. of Hospitalizations in 2006 (n = 19,193)[b]
Saw P4P-participating physicians in the previous year [Reference no]	1.00 (0.95-1.05)	—
Saw P4P-participating physicians continuously between 2004 and 2006 [Reference no]	—	0.75 (0.61-0.93)
Female sex [Reference male sex]	0.92 (0.89-0.96)	0.82 (0.74-0.91)
Age, y [Reference <45 y]		
45-55	0.98 (0.92-1.04)	0.90 (0.72-1.12)
56-60	1.18 (1.10-1.26)	0.94 (0.74-1.19)
61-65	1.35 (1.26-1.45)	1.11 (0.89-1.39)
66-70	1.53 (1.43-1.64)	1.18 (0.94-1.49)
>70	1.88 (1.76-2.00)	1.52 (1.22-1.90)
Comorbidity index [Reference 0][c]		
1	1.15 (1.07-1.22)	0.95 (0.76-1.19)
2	1.44 (1.35-1.55)	1.02 (0.81-1.28)
3	1.92 (1.79-2.06)	1.16 (0.91-1.47)
>3	3.30 (3.07-3.55)	2.05 (1.62-2.58)
No. of outpatient visits during 1 y [Reference <6]		
6-10	1.09 (1.04-1.14)	1.77 (1.49-2.12)
>10	1.44 (1.37-1.50)	5.20 (4.40-6.13)
No. of distinct primary care physicians seen during 1 y [Reference 1]		
2	1.15 (1.10-1.20)	1.90 (1.68-2.15)
>2	1.31 (1.23-1.38)	6.38 (5.54-7.35)
Visit to an endocrinologist [Reference yes]	0.86 (0.81-0.91)	1.11 (0.96-1.61)
Insulin dependence [Reference yes]	1.62 (1.55-1.69)	1.42 (1.25-1.61)
Calendar year [Reference 1999]		
2000	1.00 (0.95-1.07)	—
2001	0.96 (0.91-1.03)	—
2002	0.96 (0.91-1.01)	—
2003	0.93 (0.88-0.99)	—
2004	0.93 (0.87-0.98)	—
2005	0.87 (0.82-0.92)	—

P4P indicates pay-for-performance program.
[a]This model assessed the effect of seeing P4P-participating physicians in the previous year (eg, 1999) on the number of hospitalizations in the following year (eg, 2000). Therefore, calendar year 2006 was not included as a covariate. There were 48,411 distinct patients over the 8 years.
[b]This model assessed the effect of seeing P4P-participating physicians continuously between 2004 and 2006 on the number of hospitalizations in 2006.
[c]Calculated using the method by Elixhauser et al,[20] which measures the effect of 30 different comorbid conditions. Current coding for this method was downloaded from the Agency for Healthcare Research and Quality Web site (http://www.hcup-us.ahrq.gov/ toolssoftware/comorbidity/comorbidity.jsp).

chronic conditions were also visited and were sent mailings. All identified patients with diabetes were considered in the program unless they opted out. Of note, less than 1% of patients opted out of the diabetes disease management program. Evidence from prior literature[25,26] has suggested that other interventions can synergize with the P4Ps to significantly improve the quality of care, and the use of P4P incentives must

be integrated with these interventions. Second, in a P4P using administrative claims data, a time lag of 2 to 3 years may exist before an effect on behavior is observed because physicians do not receive feedback until the beginning of year 2 for their performance in year 1. Although in our study there was no significant direct effect of exclusively seeing P4P-participating physicians during 1 year, patients who exclusively saw P4P-

■ **Table 5.** Receipt of Quality Care (A1C and LDL-C Testing) Among Patients With Diabetes Seen by New P4P-Participating Physicians Versus Non–P4P-Participating Physicians

	%		
Calendar Year	**New P4P-Participating Physicians**	**Non–P4P-Participating Physicians**	**_P_, χ² Test**
2000	44.3 (n = 5555)	43.7 (n = 1640)	.66
2001	48.2 (n = 6296)	39.8 (n = 1071)	<.001[a]
2002	35.2 (n = 4906)	48.0 (n = 2255)	<.001[a]
2003	55.4 (n = 4440)	54.6 (n = 2062)	.54
2004	55.5 (n = 3793)	53.4 (n = 1609)	.20
2005	58.9 (n = 3158)	57.8 (n = 1956)	.44
2006	65.5 (n = 3682)	63.4 (n = 860)	.24

A1C indicates glycosylated hemoglobin; LDL-C, low-density lipoprotein cholesterol; P4P, pay-for-performance program.
[a]The _P_ value showed a significant difference between new P4P-participating physicians and non–P4P-participating physicians in 2001 and 2002. However, the direction of significance is flipped. In 2001, new P4P-participating physicians provided a higher percentage of quality care (48.2%) than non–P4P-participating physicians (39.8%); in 2002, new P4P-participating physicians provided a lower percentage of quality care (35.2%) than non–P4P-participating physicians (48.0%). Therefore, we conclude that there was no significant difference in performance between new P4P-participating physicians and non–P4P-participating physicians.

participating physicians for 3 consecutive years (2004-2006) were significantly less likely to be hospitalized. Therefore, the 8 years during which the P4P was implemented in this study was sufficient to allow physicians and healthcare systems to implement systematic changes to improve the quality of care and to positively influence outcomes.

This study also showed that patients who visited more than 1 distinct primary care physician during 1 year were less likely to receive quality care and were more likely to be hospitalized. This finding supports the hypothesis that patients have better outcomes when they have a medical home (ie, continual care managed and coordinated by a single personal physician).[27]

This study has some limitations. First, this study assessed the effect of a P4P in a PPO setting, which may not be generalizable to other settings (eg, health maintenance organizations and federally qualified health centers). Second, because data were unavailable for the years before program implementation, we could not evaluate whether the trends observed after implementation existed before the program was implemented. It is possible that the differences observed between P4P-participating physicians and non–P4P-participating physicians were due to selection bias, as physicians who followed recommended guidelines or were more receptive to the P4P strategy might be more likely to enroll in the program. To investigate the potential selection bias of high performers' self-selecting to join the P4P, the previous year's performance rates for A1C and LDL-C testing between physicians who joined the program for the first time in a given year versus physicians who chose not to join the program were compared (**Table 5**); results revealed no significant differences. Third, we present herein the effects of the P4P and the receipt of quality care on only 1 potential outcome (ie, hospitalization rates). To address

this limitation, we performed a sensitivity analysis using amputation and inpatient mortality as additional outcomes and found that the results were consistent and supported the findings presented herein. Fourth, there were unmeasured factors that predict hospitalization rates (eg, blood pressure, A1C and LDL-C levels, smoking, and obesity) that were not controlled for in the multivariate analyses. Fifth, this is a claims-based analysis with certain potential biases, including missing data and coding variation among physicians. Despite these limitations, administrative claims data have been used to effectively examine patterns of healthcare utilization,[17,28] detect opportunities to improve the quality of care,[29] estimate incidence of disease,[30-32] and assess outcomes.[33,34]

In conclusion, a P4P in a PPO setting may significantly increase the receipt of quality care and decrease hospitalization rates among patients with diabetes. However, without concurrent quality improvement interventions such as diabetes disease management programs, a P4P may increase quality-of-care processes but fail to improve outcomes. Further research should focus on defining the effect of P4Ps on intermediate outcomes such as A1C and LDL-C levels and on quantifying the additional benefits of quality improvement activities such as diabetes disease management programs on the P4P.

entity that would pose a conflict of interest with the subject matter of this article.

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REFERENCES

1. Institute of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington, DC: National Academies Press; 2001.

2. Baker G, Carter B. *Introduction to Case Studies in Health Plan Pay-for-Performance.* Washington, DC: Atlantic Information Services; 2004.

3. Rosenthal MB, Landon BE, Normand SL, Frank RG, Epstein AM. Pay for performance in commercial HMOs. *N Engl J Med.* 2006;355(18):1895-1902.

4. Terry K. Pay for performance: how fast is it spreading? http://medicaleconomics.modernmedicine.com/memag/article/articleDetail.jsp?id=190108. Accessed August 11, 2008.

5. Centers for Medicare & Medicaid Services. Medicare "pay for performance (P4P)" initiatives. http://www.cms.hhs.gov/apps/media/press/release.asp?counter=1343. Accessed August 11, 2008.

6. Rosenthal MB, Frank RG, Li Z, Epstein AM. Early experience with pay-for-performance: from concept to practice. *JAMA.* 2005;294(14):1788-1793.

7. Fairbrother G, Hanson KL, Friedman S, Butts GC. The impact of physician bonuses, enhanced fees, and feedback on childhood immunization coverage rates. *Am J Public Health.* 1999;89(2):171-175.

8. Fairbrother G, Siegel MJ, Friedman S, Kory PD, Butts GC. Impact of financial incentives on documented immunization rates in the inner city: results of a randomized controlled trial. *Ambul Pediatr.* 2001;1(4):206-212.

9. Roski J, Jeddeloh R, An L, et al. The impact of financial incentives and a patient registry on preventive care quality: increasing provider adherence to evidence-based smoking cessation practice guidelines. *Prev Med.* 2003;36(3):291-299.

10. Petersen LA, Woodard LD, Urech T, Daw C, Sookanan S. Does pay-for-performance improve the quality of health care? *Ann Intern Med.* 2006;145(4):265-272.

11. Felt-Lisk S. Monitoring quality in Medicaid managed care: accomplishments and challenges at the year 2000. *J Urban Health.* 2000;77(4):536-559.

12. Hillman AL, Ripley K, Goldfarb N, Nuamah I, Weiner J, Lusk E. Physician financial incentives and feedback: failure to increase cancer screening in Medicaid managed care. *Am J Public Health.* 1998;88(11):1699-1701.

13. Glickman SW, Ou FS, DeLong ER, et al. Pay for performance, quality of care, and outcomes in acute myocardial infarction. *JAMA.* 2007;297(21):2373-2380.

14. Grady KE, Lemkau JP, Lee NR, Caddell C. Enhancing mammography referral in primary care. *Prev Med.* 1997;26(6):791-800.

15. Nahra TA, Reiter KL, Hirth RA, Shermer JE, Wheeler JR. Cost-effectiveness of hospital pay-for-performance incentives. *Med Care Res Rev.* 2006;63(1 suppl):49S-72S.

16. Curtin K, Beckman H, Pankow G, Milillo Y, Green RA. Return on investment in pay for performance: a diabetes case study. *J Healthc Manag.* 2006;51(6):365-376.

17. Gilmore AS, Zhao Y, Kang N, et al. Patient outcomes and evidence-based medicine in a preferred provider organization setting: a six-year evaluation of a physician pay-for-performance program. *Health Serv Res.* 2007;42(6, pt 1):2140-2159.

18. Coleman K, Reiter KL, Fulwiler D. The impact of pay-for-performance on diabetes care in a large network of community health centers. *J Health Care Poor Underserved.* 2007;18(4):966-983.

19. Chung RS, Chernicoff HO, Nakao KA, Nickel RC, Legorreta AP. A quality-driven physician compensation model: four-year follow-up study. *J Healthc Qual.* 2003;25(6):31-37.

20. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. *Med Care.* 1998;36(1):8-27.

21. Healthcare Cost and Utilization Project (HCUP). Comorbidity Software, version 3.3. http://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp. Accessed July 28, 2008.

22. Colhoun MH, Betteridge DJ, Durrington PN, et al; CARDS Investigators. Primary prevention of cardiovascular disease with atorvastatin in type 2 diabetes in the Collaborative Atorvastatin Diabetes Study (CARDS): multicentre randomised placebo-controlled trial. *Lancet.* 2004;364(9435):685-696.

23. American Diabetes Association. Standards of medical care in diabetes: 2008. *Diabetes Care.* 2008;31(suppl 1):S12-S54.

24. Casalino LP, Elster A, Eisenberg A, Lewis E, Montgomery J, Ramos D. Will pay-for-performance and quality reporting affect health care disparities? *Health Aff (Millwood).* 2007;26(3):w405-w414.

25. Mandel KE, Kotagal UR. Pay for performance alone cannot drive quality. *Arch Pediatr Adolesc Med.* 2007;161(7):650-655.

26. Cutler TW, Palmieri J, Khalsa M, Stebbins M. Evaluation of the relationship between a chronic disease care management program and California pay-for-performance diabetes care cholesterol measures in one medical group. *J Manag Care Pharm.* 2007;13(7):578-588.

27. Starfield B, Shi L. The medical home, access to care, and insurance: a review of evidence. *Pediatrics.* 2004;113(5 suppl):1493-1498.

28. Wennberg JE, Freeman JL, Shelton RM, Bubolz TA. Hospital use and mortality among Medicare beneficiaries in Boston and New Haven. *N Engl J Med.* 1989;321(17):1168-1173.

29. Lohr KN. Use of insurance claims data in measuring quality of care. *Int J Technol Assess Health Care.* 1990;6(2):263-271.

30. McBean AM, Warren JL, Babish JD. Measuring the incidence of cancer in elderly Americans using Medicare claims data. *Cancer.* 1994;73(9):2417-2425.

31. McBean AM, Babish JD, Warren JL. Determination of lung cancer incidence in the elderly using Medicare claims data. *Am J Epidemiol.* 1993;137(2):226-234.

32. Nattinger AB, Laud PW, Bajorunaite R, Sparapani RA, Freeman JL. An algorithm for the use of Medicare claims data to identify women with incident breast cancer. *Health Serv Res.* 2004;39(6, pt 1):1733-1749.

33. O'Connor RD, Rosenzweig JR, Stanford RH, et al. Asthma-related exacerbations, therapy switching, and therapy discontinuation: a comparison of 3 commonly used controller regimens. *Ann Allergy Asthma Immunol.* 2005;95(6):535-540.

34. Min JK, Kang N, Shaw LJ, et al. Costs and clinical outcomes after coronary multidetector CT angiography in patients without known coronary artery disease: comparison to myocardial perfusion SPECT. *Radiology.* 2008;249(1):62-70. ∎