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Value of Physician Performance in Diabetes System of Care Among the Elderly Medicare Patients: Implications for Pay-for-Performance

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Abstract

While pay-for-performance (P4P) is an appealing method of influencing physician behavior, the direct impact of P4P on quality performance and return on investment remains unknown. This study seeks to quantify in dollar terms the value of incremental improvements in Geisinger's Diabetes System of Care (DSC) – i.e., an all-or-none "bundle" of nine diabetes-related performance measures – among Medicare Advantage members attributable to individual primary care physicians (PCPs). The results indicate that a one-percentage point improvement in the percent of a PCP's patients with diabetes that met all the DSC elements in a given year – i.e., DSC bundle score – was associated with approximately $4 per-member-per-month (in 2006 dollars) reduction in total medical cost incurred in the same year. This was driven mainly by reductions in inpatient cost. Moreover, there is variation in how much each DSC element contributes to the cost reduction. Among the nine elements, urine protein testing and blood pressure measurements were most consistently associated with lower total medical costs. These findings suggest the DSC may be useful in establishing a feasible P4P scheme that incentivizes PCPs to improve diabetes care quality.

Introduction

The traditional fee-for-service reimbursement system for physician services provides a strong incentive to focus on quantity and volume of care rather than on quality of care and patient outcome.[1]Additionally, evidence suggests that there exists substantial variation in practice patterns that are unwarranted by patient care needs and risk profile.[2] This variation in practice patterns do not appear to be correlated with the actual patient outcomes.[3] Such unwarranted variation in practice patterns is more acutely observed in diabetes care, in which there already exist well-established and evidence-based practice guidelines.[4]

In efforts to address this fundamental problem with the fee-for-service reimbursement arrangements for physicians, pay-for-performance (P4P) has gained popularity.[5] Although conceptually appealing, P4P presents several challenges in its practical application. First, there is the challenge of designing the "right" P4P structure – i.e., what to measure and how to measure it. The second challenge is how to translate actual performance into concrete financial terms. Often the financial incentives provided under P4P for physicians are presented as arbitrarily determined fixed bonuses or increased payment rates that depend on equally arbitrary thresholds of performance.[6,7,8,9] The consequence is that the financial benefits of incremental improvement in performance may not be closely correlated with the individual physician's effort. As a result, P4P may provide either insufficient incentive for physicians to improve performance or financial reward that does not reflect the actual value of performance improvement.

This study empirically examines the Geisinger Health System's experience of implementing its Diabetes System of Care (DSC) – i.e., an all-or-none "bundle" of nine diabetes-related performance measures – attributed to individual primary care physicians (PCPs) in dollar terms and explores its implication in developing a feasible P4P scheme that can be implemented in a wider scale. More specifically, this study seeks to quantify the value of incremental improvements in the DSC performance metric by PCPs in dollar terms from the perspective of a payer using a health plan claims data. Previous studies have shown that the DSC is associated with improved patient outcomes[10] and reduced long-term cost of care.[11] In this study, we

examine whether individual PCPs' variation in the DSC performance measures is correlated with the total cost of care incurred by each of the patient in the same year. In addition, the value of each of the individual DSC bundle elements is also explored to examine whether some of the bundle elements provide more value than others.

Background

Exhibit 1: Diabetes System of Care "Bundle" Elements

Bundle Element	Quality Standard
HgbA1C measurement	Every 6 months
HgbA1C control Patient Specific Goal	<7 %
LDL measurement	Annually
LDL control Patient Specific Goal	<100 mg/dl
Blood Pressure measurement	<130 SBP*, <80 DBP
Urine protein testing	Annually
Influenza immunization	Annually
Pneumococcal immunization	Once before 65, once after 65
Smoking status assessment^	Non-Smoker

* The BP threshold was changed to <140/<80 starting in 2012. To keep the measurement definition consistent across all years (necessary for the purposes of this study), the <130/<80 definition was maintained for all years.

Exhibit 1 summarizes the nine elements of Geisinger's DSC. Patients are considered eligible for DSC if they are18 years of age and older, have one or more of completed physician office visits (primary care or endocrinology) within the past year, and have a diagnosis of diabetes on their problem list, as recorded in their electronic health records. Patients are excluded if they are in nursing homes or hospice or are under palliative and/or symptomatic treatments, because such patients may be under separate diabetes management programs or protocols. In addition, those patients who do not have a Geisinger PCP; reside outside Geisinger's service area in Pennsylvania; have resolved or deleted diabetes diagnosis from their problem lists; have health maintenance modifiers to permanently discontinue diabetes screens; or are either test patients or patients in clinical trials are also excluded.

Although DSC eligibility is not restricted to certain age groups (any adult 18 years of age or older is eligible for DSC) or payer types, this study specifically focuses on the subset of the DSC-eligible diabetes patients who were elderly (defined as 65 years of age or older) and also were enrolled in of Geisinger Health Plan's (GHP) Medicare Advantage plans during the study period. The rationale for this cohort selection is two-fold: First, for this subset of the DSC-

eligible patients, their complete GHP claims data are available to directly examine the impact of the DSC performance on cost of care. GHP is a full-service regional health plan with approximately a half-million members; roughly 30% of GHP's members receive primary care from Geisinger Clinic. Second, under the Medicare Access and CHIP Reauthorization Act (MACRA), Medicare's provider reimbursement system now seeks to reflect quality of care and value rather than volume; as such, findings from this study are specifically relevant to the MACRA provisions. Furthermore, the current average age of Geisinger's diabetes patient population is well over 70 years old; therefore, focusing on the elderly members from a single reginal health plan reduces heterogeneity in patient characteristics and payment rates that can potentially bias the results, without losing generalizability to the patient population that Geisinger serves.

This study was conducted as a pat of Geisinger Health System's quality improvement effort and therefore was not subject to Geisinger's institutional review board oversight.

Data

In addition to the DSC eligibility criteria outlined above, additional inclusion and exclusion criteria were applied to identified the analytic sample. For the purposes of this study, the analytic sample includes patients who met the eligibility criteria for DSC as described above between January1, 2006 through September 30, 2014 and enrolled in GHP Medicare Advantage plans during the same period. Also, the following exclusion criteria have been applied for the analytic purposes: 1) enrolled in GHP Medicare Advantage plans for less than six months in each calendar year (to ensure accumulation of sufficient claims history and plan enrollment status); 2) switched PCPs at any point during the study period; and 3) switched plan types, health maintenance organization (HMO) or preferred provider organization (PPO), within a same calendar year. The last two exclusion criteria removes potential confounding due to contamination between high and low performing PCPs as well as between different managed care benefit structures (e.g. different cost sharing requirements depending on in-network vs. out-of-network provider selection).

The key explanatory variables are the DSC performance metric of the PCP who was responsible for each patient in the sample in the given year, measured as percentages of the PCP's patients who met each of the nine bundle elements shown in Exhibit 1 as well as the percentage of those who met all nine elements simultaneously each calendar year. In particular, the percent of each PCP's patients who met all nine DSC elements in a given year is referred to as DSC "bundle score". Note that a DSC bundle score is specific to each PCP in each year and is calculated across all DSC-eligible patients under the care of the PCP for the year, regardless of their age, payer type, or the inclusion/exclusion criteria outlined above. Thus, the denominators used to calculate the DSC bundle scores are larger than the number of patients actually included in the analysis. This is done in order to capture the PCP performance across all the patients for whom the PCP was responsible, not just across the subset of the patients selected for this particular analysis.

The dependent variables are cost of care defined by the "allowed amounts" – GHP plan payment to providers plus patient out-of-pocket costs – obtained from the GHP claims data, aggregated to a per-member-per-month (PMPM) level for those patients who have been identified from Geisinger's electronic health records to be under the care of the PCPs in each calendar year of the study period. The total medical cost is defined as all costs associated with care covered under GHP's medical benefits. Prescription drug costs are excluded because

approximately 30% of the patients in the sample did not have prescription drug coverage through GHP. The total medical cost is then further broken down into three main components: professional cost, acute inpatient cost, and outpatient cost.

To keep the dependent variables consistent with how the DSC bundle scores were constructed for the PCPs (measured yearly for each calendar year of the study), mean yearly PMPM allowed amounts were calculated by summing the allowed amounts incurred by each patient for each calendar year then dividing the sum by the number of months during which the patient was a GHP Medicare Advantage members in the same calendar year. The mean yearly PMPM allowed amounts therefore account for the variation in lengths of GHP enrollment across the patients in the sample.

Method

Multivariate linear regression models were estimated to assess the association between the key explanatory variables and the dependent variables. Other covariates in the linear regression models were the following: age, gender, number of comorbid conditions (up to nine – chronic kidney disease, end-stage renal disease, asthma, hypertension, coronary artery disease, chronic obstructive pulmonary disease, cancer, congestive heart failure, and depression), hierarchical condition categories (HCC) risk score (used by Centers for Medicare and Medicaid Services for case-mix adjustments,[12] and binary indicator variables for whether the patient was under case management, had prescription drug coverage through GHP, was in a patient-centered medical home (PCMH), and had PPO or HMO. In addition, patient volume per PCP per year (i.e., number of DSC-eligible patients for whom each PCP was responsible in each year of the study period) was also included as an additional covariate because the results may be confounded by the variation in the number of DSC-eligible patients for whom each PCP is responsible.

Two sets of linear regression models were estimated: one set that included the percentage of each of the nine DSC bundle elements as separate explanatory variables, and another set that includes only the percentage of patients who met all nine elements during the same calendar year as the explanatory variable – i.e., the DSC bundle score. And a separate regression model was estimated for each of the four dependent variables – total medical cost, professional cost, acute inpatient cost, and outpatient cost. Bootstrapped standard errors with 100 replications were obtained to produce 95% confidence intervals around the estimates.

Results

Exhibit 2: Descriptive Statistics

See Exhibit 2 on the following page, followed by relevant analysis and discussion.

Variables	Mean / Proportion	SD
Provider Characteristics (1,581 provider-year combinations; 358 unique providers)		
Mean Number of Patients per Provider per Year	135	91
DSC Bundle Elements:		
Mean % Patients per Year: Pneumonia Vaccine	81.3	11.4
Mean % Patients per Year: Flu Vaccine	69.7	12.7
Mean % Patients per Year: A1c Measurement	89.7	9.0
Mean % Patients per Year: A1c Control	45.2	13.6
Mean % Patients per Year: LDL Measurement	95.2	7.9
Mean % Patients per Year: LDL Control	57.6	13.9
Mean % Patients per Year: Urine Protein Testing	82.1	13.5
Mean % Patients per Year: Non-smoker	83.8	9.7
Mean % Patients per Year: BP Measurement	52.2	16.5
Mean % Patients per Year: All DSC Elements (Bundle Score)	10.5	8.2
Patient Characteristics (32,923 patient-year combinations; 7,291 unique patients)		
Mean Yearly Cost of Care ($PMPM):		
Total Medical	840	1699
Professional	248	359
IP Acute	239	868
OP	283	882
% Under Case Management	43.9	
% in PCMH	80.7	
# Comorbid Conditions (range: 0-9):		
% with 0 or 1	30.7	
% with 2	28.6	
% with 3	20.2	
% with 4	11.8	
% 5 or more	8.7	
HCC Risk Score	1.47	1.04
Age	75.93	6.47
% with GHP Prescription Drug Coverage	74.2	
% Female	50.6	
% PPO (vs. % HMO)	4.3	
Year:		
% in 2006	9.5	
% in 2007	9.9	
% in2008	10.3	
% in 2009	10.5	
% in 2010	11.6	
% in 2011	11.8	
% in 2012	11.9	
% in 2013	12.1	
% in 2014	12.5	

The sample includes 358 unique PCPs, and each of these PCPs was responsible for, on average, approximately 135 GHP Medicare Advantage members eligible for DSC in a given year (Exhibit 2). This represents only a subset of all the DSC-eligible patients for whom the PCPs were responsible for that year. Across the nine DSC elements, there is variation in the percent of patients meeting each DSC element: for instance, the average percent of patients for whom a PCP was responsible that had achieved the non-smoker status was about 84%; however, the average percent of patients for whom a PCP was responsible that had achieved A1c control (<7%) was only about 45%. Consequently, Exhibit 2 also indicates that the mean DSC bundle score across the PCPs was much lower at around 10%.

The average age of the patients in the sample was about 76 years old and most of them (95.7%) had HMO plans. The mean total medical cost was $840 PMPM, and this was distributed somewhat evenly across the professional, acute inpatient, and outpatient categories. Note that the sum of the mean values across the three cost categories is less than the mean total medical value because non-acute inpatient cost (e.g., skilled nursing facility costs, etc.) were not included in any of the three categories as they constitute a relatively small portion (<10%) of the total medical cost. Approximately 70% of the patients in the sample had two or more comorbid conditions. This is reflected by the average HCC score of 1.47, which represents a higher than average risk profile for this Medicare Advantage population (Exhibit 2).

Exhibit 3: Incremental Value of Diabetes Bundle Improvements by Provider – Total Medical Cost

	# Unique Patient=7,291; # Unique PCPs = 358	
	N = 32,923 patient-year combinations	
	$PMPM Change	Bootstrapped 95% CI
% Patients per Year: All DSC Elements (Bundle Score)	-3.69*	(-6.38 , -1.01)
% Patients per Year: Pneumonia Vaccine	-0.6	(-3.75 , 2.54)
% Patients per Year: Flu Vaccine	0.72	(-2.31 , 3.75)
% Patients per Year: A1c Measurement	-3.18	(-7.96 , 1.61)
% Patients per Year: A1c Control	-1.04	(-4.16 , 2.09)
% Patients per Year: LDL Measurement	-4.73	(-9.99 , 0.52)
% Patients per Year: LDL Control	1.59	(-1.24 , 4.42)
% Patients per Year: Urine Protein Testing	-2.91*	(-5.71 , -0.12)
% Patients per Year: Non-smoker	3.63	(-0.16 , 7.42)
% Patients per Year: BP Measurement	-2.89*	(-5.00 , -0.78)

*** p<0.05**

Exhibit 3 shows the incremental change in the PMPM total medical cost associated with one-percentage point increase in a PCP's DSC performance in 2006 dollars. For a given PCP, a one-percentage point increase in the percent of patients who met all nine of the DSC elements was associated with a $3.69 PMPM (p=0.014) reduction in total medical cost. In addition, among the nine DSC elements, one-percentage point improvement in urine protein testing or blood pressure measurement is associated with approximately $3 PMPM (p=0.025) reductions in total medical cost. Refer to the Appendix for the full regression outputs.

Exhibit 4: Incremental Value of Diabetes Bundle Improvements by Provider – Main Cost Components

	# Unique Patient=7,291; # Unique PCPs = 358		
	N = 32,923 patient-year combinations		
	$PMPM Change		
	Professional	Inpatient Acute	Outpatient
% Patients per Year: All DSC Elements (Bundle Score)	0.03	-1.72*	-1.46
% Patients per Year: Pneumonia Vaccine	0.29	-0.59	-0.86
% Patients per Year: Flu Vaccine	-0.1	0.87	0.25
% Patients per Year: A1c Measurement	-0.62	-1.69	-0.74
% Patients per Year: A1c Control	-0.07	-0.59	-0.54
% Patients per Year: LDL Measurement	0.71	-2.23	-2.28
% Patients per Year: LDL Control	-0.58*	0.9	1.53
% Patients per Year: Urine Protein Testing	-0.26	-1.34	-0.82
% Patients per Year: Non-smoker	0.61	0.7	2.3*
% Patients per Year: BP Measurement	0.32	-1.36*	-1.83*

*** p<0.05**

Exhibit 4 shows the incremental change in the PMPM costs broken down by the three cost categories: professional, acute inpatient, and outpatient. A one-percentage point increase in the DSC bundle score was associated with an approximately $1.72 PMPM (p=0.018) reduction in acute inpatient cost. A one-percentage point improvement in blood pressure measurement score was also associated with $1.36 PMPM (p=0.008) reduction in acute inpatient cost as well as $1.83 PMPM (p=0.027) reduction in outpatient cost. In addition, an improvement in LDL control performance also was associated with $0.58 PMPM (p=0.045) reduction in professional costs. However, an improvement in the percent of patients who achieved non-smoker status was associated with an increased outpatient cost of care by $2.30 PMPM (p=0.027). Refer to the Appendix for the full regression outputs.

Discussion

The results of this study confirm the hypothesis that improved PCP performance on provision of diabetes care is associated with total cost of care savings, which is consistent with the findings reported previously by an earlier study.[11] Additionally, this study further sheds light on how the DSC might achieve the cost savings. While some individual elements of DSC appear to be more strongly associated with cost savings than others, the effect of the all-or-none bundle is greater and more consistent than the individual measures combined. This is consistent with current guidelines for diabetes care.[13] The results also suggest that an improvement in the non-smoker status achievements was associated with a higher cost of care. This phenomenon has been observed previously elsewhere,[14] and it is likely to be temporary and unique to smoking cessation efforts. Despite such a phenomenon, the association between improved DSC bundle scores and total medical cost savings appears to be robust.

This study illustrates the possibility that the all-or-none DSC bundle may be used to establish a feasible P4P scheme that appropriately incentivizes PCPs to improve diabetes care quality. The DSC bundle can be readily adopted by healthcare delivery systems with a robust health information technology infrastructure that enables a systematic and routine identification

of the DSC eligible population and their PCPs who are responsible for their care, as determined from the electronic health records. Furthermore, as demonstrated in this study, incremental improvements in DSC performance can be specifically translated into actual cost savings from the payer's perspective. DSC therefore represents a progress towards a value-based health care delivery system that rewards quality rather than quantity.

Incidentally, the results of this study also suggest how challenging it is likely to be for PCPs to achieve all nine DSC elements consistently for all diabetes patients, as evidenced by the fact that, on average, only about 10% of the DSC-eligible patients for each PCP actually met all nine DSC elements as shown in Exhibit 2. This suggests that merely implementing performance measures and introducing P4P to existing primary care practices will not lead to meaningful improvements in patient outcomes or sustainable cost reductions, unless the DSC implementation is accompanied by a fundamental redesign of how primary care is delivered and infrastructural support for PCPs. That is, the success of DSC implementation likely depends on a new system of primary care delivery that does not solely rely on diligence of individual PCPs to deliver appropriate care every time.

Limitations of this study include the fact that it relies on observational data obtained from a specific subset of the diabetes patient population. Therefore, the results may be subject to unobserved biases, and the generalizability of the findings beyond the study population is unknown. Also, the linear regression model imposes the assumption that the relationship between the DSC bundle score and cost of care is linear – that is, the effect of one unit improvement in DSC bundle score is the same regardless of the baseline DSC bundle score. There may be a ceiling effect, for instance, in which the effect of one-unit incremental DSC bundle score improvement is much lower if the baseline DSC bundle score is already high to begin with. However, considering that the mean DSC bundle score was 10% in the study sample, such ceiling effects are unlikely to be a concern.

Moreover, this study does not explicitly consider whether there is a causal link between the incremental improvements in DSC performance and the cost savings. That is, it is unknown whether a higher DSC bundle score is reflective of greater PCP efforts and provision of higher quality care (i.e. a causal effect), as opposed to a systematic selection of self-engaged patients (i.e., a selection effect). Future studies may therefore include a closer analysis of the potential causal link between DSC performance and utilization of care, as well as an examination of the long-term impact of incremental improvements in DSC performance on patients' clinical outcomes such as incidence of adverse events such as stroke, myocardial infarction, amputation, and mortality.

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Appendix

Full Linear Regression Model Output – % Met All Bundle Elements

	Total Medical	Professional	IP Acute	OP
	Coefficient	**Coefficient**	**Coefficient**	**Coefficient**
% Met All Bundle Elements	-3.69**	0.03	-1.72**	-1.46
Number of Patients	-0.12	-0.02	0	-0.1
# Comorbidity: 2	175.02**	47.15**	55.23**	72.02**
# Comorbidity: 3	348.74**	84.75**	132.6**	123.43**
# Comorbidity: 4	671.36**	135.81**	226.9**	277.75**
# Comorbidity: 5+	1293.78**	242.36**	479.45**	488.04**
Under Case Management	719.84**	146.07**	365.06**	151.11**
HCC Risk Score	99.27**	34.45**	8.52	42.09**
Has Rx Coverage	-78.15**	-7.39	-31.84**	-46.39
Age	-11.66**	-2.33**	-3.49**	-7.82**
Female	-31.85	-4.03	-22.95**	-21.06
PPO	17.94	8.15	12.11	-1.13
PCMH	-151.34**	-23.63**	-83.47**	-27.1
2007	67.89**	10.56	28.32*	18.06
2008	187.23**	33.74**	89.21**	47.13*
2009	228.59**	36.42**	99.66**	67.1**
2010	162.18**	28.64**	51.03**	65.78*
2011	34.14	4.68	-0.17	27.41
2012	-14.05	4.27	-18.65	-8.28
2013	74.94	28.34**	-1.58	27.85
2014	182.2**	45.9**	46.47*	73.83
Constant	1112.8**	250.82**	310.61**	696.22**

* p<0.1; **p<0.05

Full Linear Regression Model Output – % Met Individual DSC Bundle Elements

	Total Medical	Professional	IP Acute	OP
	Coefficient	**Coefficient**	**Coefficient**	**Coefficient**
% Pneumonia Vaccine	-0.6	0.29	-0.59	-0.86
% Flu Vaccine	0.72	-0.1	0.87	0.25
% A1c Measurement	-3.18	-0.62	-1.69	-0.74
% A1c Control	-1.04	-0.07	-0.59	-0.54
% LDL Measurement	-4.73*	0.71	-2.23	-2.28
% LDL Control	1.59	-0.58**	0.9	1.53
% Urine Protein Testing	-2.91**	-0.26	-1.34*	-0.82
% Non-smoker	3.63*	0.61	0.7	2.3**
% BP Measurement	-2.89**	0.32	-1.36**	-1.83**
Number of Patients	0.05	-0.01	0.08	-0.02
# Comorbidity: 2	177.11**	47.32**	56.28**	72.68**
# Comorbidity: 3	353.21**	84.9**	134.74**	125.28**
# Comorbidity: 4	675.03**	136.07**	228.67**	279.32**
# Comorbidity: 5+	1296.53**	243.06**	480.69**	488.86**
Under Case Management	721.98**	145.97**	366.02**	151.93**
HCC Risk Score	98.97**	34.27**	8.51	42.15**
Has Rx Coverage	-69.92**	-7.44	-28.15**	-42.24
Age	-11.84**	-2.32**	-3.56**	-7.91**
Female	-32.5	-4.92	-22.46**	-21.24
PPO	22.39	8.43	14.52	0.58
PCMH	-143.11**	-22.29**	-78.54**	-27.71
2007	69.74*	5.38	32.84*	26.25
2008	187.26**	30.61**	92.81**	51.27
2009	266.71**	35.28**	120.91**	84.24**
2010	156.36**	19*	51.37*	79.59*
2011	60.69	-4.67	15.95	53.04
2012	10.26	-4.04	-3.22	13.28
2013	84.71	24.26**	4.7	36.98
2014	215.08**	35.82**	63.93**	107.95*
Constant	1803.51**	217.36**	715.66**	894**

* p<0.1; **p<0.0