Hospital Postacute Care Referral Networks: Is Referral Concentration Associated with Medicare-Style Bundled Payments?

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Objective. To evaluate whether Medicare-style bundled payments are lower or higher for beneficiaries discharged from hospitals with postacute care (PAC) referrals concentrated among fewer PAC providers.

Data Source. Medicare Part A and Part B claim (2008–2012) for all beneficiaries residing in any of 17 market areas: the Provider of Service file, the Healthcare Cost Report Information System, and the Dartmouth Atlas.

Study Design. An observational study in which hospitals were distinguished according to PAC referral concentration, which is the tendency to utilize fewer rather than more PAC providers. We tested the hypothesis that higher referral concentration would be associated with total Medicare bundled payments.

Data Collection/Extraction Methods. The data represent a convenience sample of market areas that were defined by the locations of grantees from the ONC Beacon Community Program.

Principal Findings. The four most-used PAC providers accounted for an average of 60 percent of patients discharged from hospitals in the sample. Regression analysis suggested that higher referral concentration was associated with lower Medicare costs per bundle.

Conclusions. Hospitals that tend to use fewer PAC providers may lead to lower costs for payers such as Medicare. The study results reinforce the importance of limited networks for PAC services under bundling arrangements for hospital and PAC payments.

Key Words. Bundles of care, bundled payments, postacute care referral network

As part of the Affordable Care Act initiative to demonstrate alternative payment methods, the Medicare program has begun to test and implement payment models that bundle hospital, physician, and postacute care (PAC) payments. Bundled Payments for Care Improvement (BPCI) was Medicare's

initial demonstration, followed by the Comprehensive Care for Joint Replacement model, which rolled out to 75 markets across the country in April 2016. These may replace the currently disjointed payment systems for hospitals and each PAC setting, with the goal of reducing Medicare spending for the entire bundle of services (Center for Medicare & Medicaid Services [CMS 2013, 2015]).

The essence of bundled payments is to measure combined Medicare payments for hospitals and PAC providers and to make inferences about relative efficiency based on the cost to Medicare of the entire bundle. A single target price is established using historic data and then compared to actual Medicare spending totals or “bundled payment amount” during the risk period.

The type of bundle of interest for this study includes hospital, physician, and PAC services provided over a specified period of time. In the current BPCI demonstration,¹ Medicare contracts with one of the providers (known as the ‘bundler’), either a hospital or physician group, which assumes financial risk related to cost outcomes for all beneficiaries participating in the demonstration (i.e., discharged with a DRG that falls under the bundler’s contract with CMS). All providers continue to be paid on a fee-for-service basis. CMS then does a quarterly² reconciliation to compare observed expenditures to the bundler’s target price. The target price has evolved over time, but it is basically a historic average for each DRG within the bundle that has been trended forward. CMS imposes a 2 percent discount. Hospitals and physician groups keep net gains above the discount and pay CMS back for net losses.

Research on bundling payments has focused special attention on the relationships between hospitals and PAC providers and potential ways to reorganize care (Sood et al. 2011; Rahman et al. 2013; Lau et al. 2014). Two main reasons for this focus are as follows: First, PAC spending is high in many markets, and variation in PAC utilization has been associated with a significant proportion of the variation in bundled spending (MaCurdy et al. 2013; Newhouse et al. 2013; Mechanic 2014). Second, research suggests a significant association between hospitals and PAC organizational relationships and bundled payment amounts (Bogasky et al. 2009).

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A majority of PAC providers are free-standing (i.e., not owned by a hospital), and a majority of PAC discharges are made to these “free-standing” PAC providers (Bogasky et al. 2009). This makes sense given Oliver Williamson (1991) notion of a hybrid organizational form where the relationship between firms in a supply chain does not involve ownership of one firm by another and involves collaboration among independent organizations according to mutual advantage.³

Transactions between hospitals and PAC providers involve uncertainty that arises due to the stochastic demand for PAC placement and, in turn, frequently needing PAC sites for patient placements. Ideally, hospitals and physician groups that need frequent and timely placement of challenging as well as highly desirable PAC patients will work with PAC providers to develop systems of communication that support PAC placement and thus are likely to prefer some form of hybrid organization with selected PAC providers. The focus here is on a type of hybrid that is formed based on the work patterns and ongoing nature of the relationships between organizations, also described as relational contracts (Robinson and Casalino 1996; MacLeod 2007; Malcolmson 2012). In other words, mutually beneficial partnerships develop and are maintained out of necessity without a formal contractual arrangement.

A few studies have examined the referral relationships between hospitals and PAC providers to define and quantify the organizational links between hospitals and PAC providers. Sood et al. (2011) analyzed 2004 Medicare claims and hospital cost reports data to determine the number of PAC providers used by the hospitals for five major diagnostics groups. They found that approximately half of all hospitals refer more than 18 PAC providers, and about one-third of all hospitals refer patients to more than 30 PAC providers.

Using Medicare claims data from 2004 to 2006, Rahman et al. (2013) found that hospitals that do not own a skilled nursing facility (SNF) send on average 26 percent of their discharges to a single facility. Lau et al. (2014) reported that on an average 81 percent of patients placed in SNFs went to the five SNF providers most frequently used by the discharging hospital. For use of home health agencies (HHAs), the same authors reported a mean value of 88 percent to the five most frequently used HHA providers. In summary, these studies suggest that hospitals may use a large number of PAC providers in aggregate but tend to concentrate placements in relatively few PAC providers.

Not as much attention has been paid to the implications of referral patterns for cost and quality outcomes. Lau et al. (2014) found a

significant negative association between strength of hospitals' referral relationships, defined as a proportion of PAC referrals to the five most frequently used PAC providers, and spending per capita for inpatient and PAC services in hospital referral region. However, the study was limited to examining referrals only to SNFs and HHAs and did not examine referrals to long-term care hospitals (LTCHs) or inpatient rehabilitation facilities (IRFs).

Rahman et al. (2013) showed using an instrumental variable approach that the strength of relationship between a hospital and SNFs, defined by the proportion of discharges from a hospital to the most-used SNF, is associated with reduced hospital readmissions. The authors find that a 10 percentage-point increase in the proportion of hospital discharges to the most referred SNF was associated with a modest 1.2 percentage-point decline in the 30-day rehospitalization rate.

Building on the literature, this study focuses on bundled payments and hospitals' referrals to all four types of PAC (HHA, SNF, LTCH, and IRF) and seeks to answer the following questions:

1. How concentrated are hospitals' PAC referral networks as indicated by the discharge patterns of the patients?
2. Is concentration in PAC referrals associated with Medicare spending amounts for selected bundles?

FRAMEWORK

With respect to bundled payments, the impact of concentrated referrals is hard to predict. Given the supposition that concentrated networks can be formed to overcome the uncertainty that exists in the organizations' environment, it is expected that hospitals that enter informal organizational relationship with PAC providers are better able to organize patients' postdischarge care. If hospitals who organize with selected PAC providers focus on reducing readmission, as reported in an earlier study (Rahman et al. 2013), the bundled payments would be lower for their patients compared to others. On the other hand, if hospitals with organized relationships with PAC providers use those providers more, their overall bundled payments would be higher (Bogasky et al. 2009).

METHODS

This observational study draws on Medicare claims data to assess the relationship between hospital-PAC concentration and bundled payment amounts.

Data

The sample of Medicare claims data for this study comes from a database that was created to provide technical assistance to the Beacon Community Program, which was launched in 2010 by the Office of the National Coordinator for Health Information Technology. The database includes 2008–2012 Medicare claims information for beneficiaries who lived in any of the 17 geographic regions where Beacon grantees were located. The Dartmouth Atlas database from 2012 is used to obtain information on hospital service areas (HSAs). We used the ZIP code information for each hospital identified in the data and the ZIP code information for the Beacon catchment areas to identify hospitals located within respective market areas. Dartmouth crosswalk files are used in this study to match ZIP codes to HSAs and HSAs to hospitals.

The Medicare Provider of Services database from 2012 is used for information on hospital characteristics including the following: size, teaching and ownership status, location, and ZIP code; and PAC characteristics, including ZIP code and bed size. The Healthcare Cost Report Information System is used to identify the acute hospital's ownership of PAC providers. The data include information on the provider identifiers of hospital-based SNFs, HHAs, and IRFs.

The Medicare claims data include all inpatient, carrier/physician, outpatient, home health, and skilled nursing claims for the beneficiaries residing in the sample market areas. A Medicare beneficiary summary file is used to derive information on the patient characteristics, such as age, sex, and reason for entitlement.

Sample

The study is designed to stimulate the experience of Medicare beneficiaries who would qualify for a bundled payment given BPCI definitions, which are linked to specified diagnosis-related groups (DRGs) as the “anchor” for participation. Patient cohorts are defined for each hospital in the sample market areas. Beneficiary inclusion criteria include enrollment in Medicare parts A

and B and discharge from a sample hospital for any DRG corresponding to a selected bundle. Exclusion criteria were Medicare entitlement due to end-stage renal disease, enrollment in Medicare Part C, or death during the anchor hospital stay. Patients also were excluded if they had a zero or negative bundled payment amount.

The analysis focuses on five bundles with high PAC utilization and variation in bundle payments: (1) congestive heart failure (CHF), (2) hip and femur procedures except major joint (HIPF), (3) major joint replacement of lower extremity (MJLE), (4) stroke, and (5) urinary tract infection (UTI). BPCI includes an additional 43 bundles that are not considered in detail here, except for the calculation of PAC referral concentration.

Following the CMS requirement of a minimum case volume of 25 for calculating hospital-level measures, hospitals with fewer than 25 qualifying patients for any given bundle were excluded from analysis related to that bundle. The resulting numbers of hospitals and bundles for each condition are shown in Table 1.

Bundles of Care

We followed the elapsed time-based definition for bundles of care, as included in BPCI's June 2014 specifications for Model 2.⁴ Each bundle of care starts with an inpatient stay that has 1 of the DRGs associated with any of the 48 BPCI conditions bundles and includes all subsequent PAC services for a 90-day postdischarge period. The bundles were used for two main purposes. First, bundled payment for each bundle was calculated using the time boundaries defined by the episodes. The bundled payments were used to formulate the values of dependent variables in the regression analysis. Second, PAC referral patterns for each bundle were measured during the 14-day postdischarge period following hospital discharge. The use of PAC services in this immediate postdischarge period was also used to calculate the values of the variable defining hospitals' referral concentration with PAC providers.

Dependent Variables

To measure bundled payment amounts, we specified two dependent variables: (1) total bundled payments for the whole bundle and (2) PAC bundled payments for the PAC services that are provided during the 90-day postdischarge period. The bundled payment amount includes both Medicare direct payments and coinsurance amounts required of beneficiaries. To determine the

Table 1: Sample Description

Variable	CHF	HIPF	MJLE	Stroke	UTI
Mean (SD)					
Patient-bundle variables					
Nfor total bundled payments model	43,158	16,586	65,937	26,391	30,514
Nfor PAC bundled payments model	23,599	13,975	51,058	16,837	17,391
Female (%)	56.9 (49.5)	74.8 (43.4)	67 (47)	56.6 (49.6)	74.6 (43.5)
Age	78.1 (11.4)	80.9 (10.7)	74.1 (9)	77.2 (10.6)	78.5 (12.6)
Dual eligible	26.8 (44.3)	19.9 (39.9)	12.3 (32.9)	20.7 (40.5)	30.5 (46)
HCC score	2.7 (1.4)	1.7 (1.2)	1.16 (.86)	1.6 (1.1)	2.2 (1.5)
Hospital LOS	5.3 (3.1)	6.2 (2.9)	4.5 (1.8)	5.4 (3.7)	4.9 (2.7)
Total bundle payment	\$ 19,654 (\$16,404)	\$40,535 (\$17,407)	\$25,351 (\$13,060)	\$27,636 (\$21,359)	\$18,988 (\$15,563)
PAC bundle payment	\$5,870 (\$10,555)	\$24,119 (\$15,711)	\$9,394 (\$10,991)	\$15,648 (\$18,549)	\$8,970 (\$13,066)
Hospital-level variables					
Nfor total bundled payments model	215	164	210	174	200
Nfor PAC bundled payments model	190	152	202	154	167
CONC4 (PAC referral concentration (%))	56.1 (26.0)	67.4 (18.3)	69.9 (16.3)	72.8 (13.7)	55.9 (18.0)
Number of bundles	201 (173)	101 (77)	314 (302)	152 (141)	153 (126)
Number of beds	274 (268)	301 (273)	281 (269)	320 (280)	273 (271)
Not-for-profit (%)	53 (50)	55.5 (50)	54.3 (50)	57.5 (49.6)	54 (50)
Government (%)	23.3 (42.3)	24.4 (43.1)	20.5 (40.4)	24.1 (42.9)	22.5 (41.9)
For-profit (%)	14 (34.7)	9.7 (29.8)	15.2 (36)	9.2 (30)	13.5 (34.3)
Teaching (%)	35.8 (48.1)	34.8 (47.8)	35.7 (48)	38.5 (48.8)	34.5 (47.7)
Urban (%)	73.5 (44.2)	75 (43.4)	76.7 (42.4)	77 (42.2)	73.5 (44.2)
PAC ownership (%)	64.4 (50)	67.7 (46.9)	62.6 (48.5)	68.2 (46.7)	63.3 (48.3)

Notes: Standard deviations shown in parentheses.
CHF, congestive heart failure; HCC, hierarchical condition categories; HIPF, hip and femur procedures except major joint; LOS, length of stay; MJLE, major joint replacement of lower extremity; PAC, postacute care; SD, standard deviations; UTI, urinary tract infection.

total bundled payments, all inpatient, carrier, HHA, and SNF amounts were aggregated for each bundle according to dates given on the claims. To determine the PAC bundled payments, all SNF, IRF, LTCH, HHA, carrier, and acute readmission amounts were aggregated for the 90-day postdischarge period. We followed the BPCI specifications for the exclusion of hospital readmissions and Part B services during the postdischarge period that were not associated with the clinical condition (e.g., organ transplant services). In cases where claims for IRF, LTCH, acute readmission, SNF, or HHA extend beyond the 90-day postdischarge period, bundled payment amounts were prorated according to the CMS rules. Proration rules also apply to the Part B bills that overlap the anchor and the PAC period, with dollars assigned proportionally by days in setting.

Because we are comparing performance on total bundled payments and PAC bundled payments across hospitals, it is important to eliminate variation in payments that are due to Medicare's input-price adjustments, a process that is called price standardization (CMS 2013). For the total bundled payments, we followed the BPCI specifications for price standardization which removes differences in wage rates.⁵

Indirect medical education (IME) and disproportional share (DSH) payments are also subtracted from the total bundled payment. The wage-standardized total bundled payment amount is then truncated (Winsorized) at the 5th and 95th percentile based on bundled payments in a national sample of hospitals to prevent undue impact of extremely low and extremely high bundled payments on the results (CMS 2013). The PAC bundled payment is truncated at the 5th and 95th percentile.

Concentration of Hospital's PAC Referrals (CONC4)

The main explanatory variable is defined as the proportion of a hospital's PAC discharges within 14 days of hospital discharge to the four most frequently used PAC providers. Versions of this measure have been widely used in economics studies to measure concentration (Scherer & Ross, 1990). In the case of PAC referral networks, a variant has been used to measure the concentration of hospitals' PAC referrals to the five most frequently used SNFs and HHAs (Lau et al. 2014). To be consistent with the concentration measure used in the economics studies, we measure referral concentration to the four most frequently used PAC providers. The CONC4 measure is calculated by pooling the Medicare PAC discharges for all 48 clinical bundles included in the BPCI program. Following the CMS requirement of a minimum case

volume of 25 required for calculating hospital-level measures, the concentration measure was calculated for only those hospitals that had a minimum of 25 patients with PAC use per bundle.

For the concentration index, the different types of PAC sites (SNFs, HHAs, IRFs, and LTCHs) are counted without distinction. This is possible because the measure is a proportion of all PAC admissions and does not consider length of stay or other characteristics that vary widely by setting. For example, a hospital with 20 SNF, 20 HHA, and 5 LTCH admissions within 14 days of discharge has a denominator of 45 PAC admissions. If the top four providers account for 18 admissions, then the concentration ratio is 18/45, or 0.40. This approach allows us to construct the measure despite the existence of different configuration PAC providers in different HSAs, such as more HHAs or IRFs in one HSA as compared to another. However, these attributes are captured in measures of supply and PAC capacity.

Our measure is comprehensive by taking IRFs and LTCHs in the mix of frequently used PAC providers. Although on average IRFs and LTCHs may not be frequently used PAC settings, we are able to capture them in CONC4 in the markets where they play a prominent role. Among the sample hospitals included in this study, about 50 percent of the hospitals had an IRF in top four PAC providers and about 10 percent of the hospitals had a LTCH in top four PAC providers. We also calculate concentration of hospitals' referral to SNFs and to HHAs separately. This allows a more focused look at the impact of concentration given a provider's decision to use a specific type of service.

The PAC supply was measured as the number of IRF, SNF, and LTCH beds per 1000 Medicare beneficiaries within an HSA (Bogasky et al. 2009). There is no comparable accepted measure for HHA capacity. We also include a measure for average capacity of the IRF, SNF, and LTCH providers within an HSA.

Other Independent Variables

As we are comparing performance on bundled payments across hospitals, it is important to account for the differences that are due to the mix and severity of the population treated in a hospital. For this, we go beyond the specifications for the BPCI demonstration and include a patient-level variable for risk score to adjust for health status of the hospitals' patient population when comparing the bundled payments across hospitals. The risk score is based on CMS hierarchical condition category (HCC) risk adjustment model in which the risk score is calculated using information on a patient's age, sex, Medicaid status,

and diagnosis information from 12 months prior to the start of the bundle. Along with the patient's HCC risk score, we included patient's age, gender, Medicaid status in the previous year, and hospital length of stay⁶ as patient-level covariates.

We used two types of hospital-level explanatory variables in the multivariate models: hospital characteristics and the availability of PAC services around the hospital. The hospital's tax status is coded as three categories: for-profit (FP), government, and not-for-profit (NFP). Hospital size is measured as the number of beds. We used a dummy variable for teaching status, with 1 for hospitals that have teaching programs and 0 for nonteaching hospitals. Location is coded as 1 for urban areas and 0 for rural areas. We used a dummy variable to identify hospitals that owned PAC facilities (HHA, SNF, or IRF) facilities, with 1 if a hospital owns any type of PAC and 0 for non-PAC owners.

ANALYSIS

We first present the summary statistics for the key patient and hospital characteristics and compared the characteristics across different clinical cohorts using a combination of chi-square and t-tests. Next we present the descriptive statistics for the main explanatory variable, CONC4, and examined how it varies across sample hospitals.

We use multivariate regression models to determine the association between concentration of PAC referral networks and outcome variables. To account for the nature of the data, which includes bundles nested within hospitals, we used random-effects models (using SAS9.3 SURVEYREG procedure with a cluster statement). This allows us to analyze bundle-level outcomes while addressing patient clustering within hospitals. Such a relationship is described by equation (1).

$$\text{Outcome}_{ih} = \beta_0 + \beta \text{CONC4}_h + \text{XH}_h \gamma_1 + \text{XI}_{ih} \gamma_2 + \eta_3 Y_i + \alpha_h + \mu_{ih} \quad (1)$$

Here, Outcome_{ih} is the bundled payment for bundle *i* discharged from hospital *h*. β_0 is the intercept, representing the overall mean bundle or postacute cost. CONC4_{*h*} is the main explanatory variable, the proportion of hospital *h*'s bundles discharged to four most frequently used PAC sites. XH_{*h*} is a vector of hospital-varying covariates and XI_{*ih*} is a vector of patient-varying covariates. *Y_i* is a fixed effect representing the year of the bundle. α_h is a

random error component for hospital, and μ_{ih} is the beneficiary error component, an independent residual distributed normally in the patient population (Hedeker, Gibbons, and Flay 1994).

Multivariate relationships were analyzed separately for each of the selected bundle cohorts. Results with two sided p -values of less than .05 were considered statistically significant. To quantify the strength of associations between referral concentration and bundled payments, we calculated the percent change in bundled payments relative to the mean bundled payment amount associated with a 10-point increase in the referral concentration (Hodgkin, Merrick, & Hiatt, 2012).

Sensitivity Analysis

Another important concern with the model specified above is that a part of the variation in bundled payment amount may be due to unobserved regional effects. To deal with this issue, we estimated another version of the model using fixed effects for the 17 market areas included in this study. In a second sensitivity test, we remove the variable for hospital length of stay from the regression equations. Finally, we estimated the model with total bundled payments as the outcome variable using hospitals' referral concentration with SNFs and hospitals' referral concentration with HHAs separately (see Appendix).

RESULTS

Sample Description

For the regression models with total bundled payments as the dependent variable, major joint replacement of lower extremity (MJLE) has the largest sample with 65,937 bundles at 210 hospitals. Hip and femur procedures except major joint (HIPF), on the other hand, have 16,586 bundles at 164 hospitals. The other bundles (congestive heart failure [CHF], urinary tract infection [UTI], and stroke) fall between these two.

For the regression models with PAC bundled payments as the dependent variable, the MJLE sample has 51,058 bundles at 202 hospitals. HIPF, on the other hand, has 13,975 bundles at 152 hospitals. The other bundles (CHF, UTI, and stroke) fall between these two. Among the five bundles, HIPF had the highest mean total bundled and PAC bundled payment. The mean total bundled payment ranged from \$18,988 for the UTI bundle to \$40,535

for HIPF. The mean PAC bundled payment ranged from \$10,469 for the CHF bundle to \$26,859 for HIPF. The mean PAC referral concentration ranged from 56 percent for UTI to 73 percent for stroke.

Figure 1 shows the average hospitals' referral concentration at four frequently used PAC providers was 60 percent and ranged from 20 percent to 100 percent. Hospital's referral concentration to four most commonly referred SNFs was 67 percent, on average, and to four most commonly referred HHAs was 80 percent, on average (Table 2).

Across the sample, hospital size was monotonically associated with referral concentration (Table 2). Hospitals with less than 100 beds had higher concentration as compared to hospitals with greater than 250 beds. Hospitals with higher average HCC risk score had less concentrated network as compared to their counterparts with lower average HCC risk score. Hospitals with an HHA or an SNF in top four providers had higher concentration as compared to hospitals with an IRF or an LTCH in top four providers.

Multivariate Results

Total bundle payments for hospitalized beneficiaries in three of the five bundles were significantly associated with the hospital's referral concentration (Table 3). Higher concentration in a hospital's PAC referrals was associated with lower total bundled payments among HIPF ($p < .001$), MJLE ($p < .001$),

Figure 1: Distribution of Hospitals' PAC Referral Concentration

Table 2: Concentration of Hospitals' Postacute Care Referral Concentration by Hospital Characteristics

	<i>Hospitals (N)</i>	<i>CONC4 (PAC referral concentration) (%) Mean (%) (SD)</i>	<i>CONC4_SNF (SNF referral concentration) (%) Mean (%) (SD)</i>	<i>CONC4_HHA (HHA referral concentration) (%) Mean (%) (SD)</i>
All	249	60.0 (18.0)	67.4 (23.2)	79.8 (17.2)
Hospital size				
Hospital size <100 beds	74	69.9 (18.1)	83.2 (18.5)	85.9 (14.9)
Hospital size 100–250 beds	136	58.6 (16.2)	66.6 (20.0)	79.8 (17.1)
Hospital size >250 beds	39	44.7 (10.7)	40.3 (13.5)	68.4 (16.4)
Tax status				
Not-for-profit	127	58.0 (16.6)	64.1 (22.4)	81.0 (14.6)
Government	54	65.0 (20.1)	76.3 (22.5)	82.0 (18.4)
For-profit	41	59.7 (19.4)	69.4 (25.2)	74.8 (19.4)
Teaching status				
Teaching	86	49.0 (15.2)	51.9 (20.3)	70.1 (19.1)
Nonteaching	163	65.5 (16.7)	75.6 (20.3)	85.0 (13.6)
Location				
Urban	186	54.3 (15.7)	60.1 (21.7)	75.7 (17.2)
Rural	63	76.0 (14.2)	89.0 (10.7)	92.0 (10.3)
PAC ownership			0	
PAC owner	149	61.8 (17.2)	70.3 (22.9)	81.7 (17.1)
Non-PAC owner	96	56.8 (18.8)	63.7 (22.5)	76.9 (17.2)
Patient Population Risk Score				
Below median (<1.814)	129	61.8 (17.1)	66.4 (22.4)	81.8 (15.3)
Above median (>1.814)	120	57.6 (18.7)	68.5 (24.1)	77.7 (18.9)
Composition of Top 4 PAC providers				
One type	16	55.48 (19.8)	–	–
Two types	130	64.6 (18.8)	–	–
Three types	94	55.4 (14.6)	–	–
Four types	9	42.8 (12.1)	–	–
Hospitals with HHA in Top 4	241	60.2 (18.0)	–	–
Hospitals with SNF in Top 4	208	61.3 (17.9)	–	–
Hospitals with IRF in Top 4	121	54.1 (14.1)	–	–
Hospitals with LTCH in Top 4	24	44.7 (16.0)	–	–

Notes: Standard deviations shown in parentheses.
HHA, home health agency; PAC, postacute care; SNF, skilled nursing facility.

and UTI ($p < .01$) cohorts. An increase of 10 percentage point in the referral concentration measure was associated with approximately \$944 (2.3 percent) lower total bundled payments for HIPF bundle, \$532 (2.1 percent) lower

Table 3: Association Between Hospitals' Postacute Care Referral Concentration and Total Bundled Payments

<i>Variable</i>	<i>CHF</i>	<i>HIPF</i>	<i>MJLE</i>	<i>Stroke</i>	<i>UTI</i>
CONC4 (PAC referral concentration)	−9.25	−94.40***	−53.18***	−46.87	−50.22**
Patient characteristics					
Female	378.75**	247.02	1,671.94***	1,000.19***	166.83
Any Medicaid in previous year	891.80***	826.01	2,520.82***	1,428.93***	712.04**
Age 65–74	595.93	2,775.94***	528.70*	1,298.71**	2,064.10***
Age 75–84	632.54*	7,356.07***	2,990.84***	4,025.11***	3,788.52***
Age 85+	801.21**	10,473.25***	9,838.56***	4,941.48***	4,925.37***
HCC risk score	1,712.30***	1,619.36***	2,968.47***	1,510.92***	1,625.65***
Hospital length of stay	1,356.49***	1,603.58**	2,380.32***	2,179.33***	1,265.85***
Characteristics of discharging acute hospital					
Number of beds	−0.71	−3.68*	−0.06	−1.51	−1.80*
Urban location	275.84	−282.30	−1,021.69**	−2,435.63**	169.26
Not-for-profit	422.35	1,021.26	1,397.08***	2,342.99*	662.83
Government run	458.74	1,160.10	1,559.39***	2,309.81*	1,829.40**
Teaching hospital	−413.76	−960.87	−65.87	465.37	165.91
PAC owner	688.46	869.41	666.94*	−233.86	958.00*
Supply					
SNF beds/1,000 beneficiaries in an HSA	0.85	−5.34	−4.89	−4.62	1.93
LTCH beds/1,000 beneficiaries in an HSA	16.67	−87.91	−76.15*	33.25	−10.58
IRF beds/1,000 beneficiaries in an HSA	10.04	412.71	88.90	289.34**	202.41*
Average PAC size in an HSA	−4.30	8.28*	0.49	−19.51*	2.03
Intercept	6,607.87	24,075.40***	8,993.02***	12,915.53***	6,036.49***
Percent impact (relative to mean) of 10- point change in CONC4		−2.3%	−2.1%		−2.7%

Notes: *** $p < .001$; ** $p < .01$; * $p < .05$.

CHF, congestive heart failure; CONC4, postacute care referral concentration; HCC, hierarchical condition categories; HIPF, hip and femur procedures except major joint; HSA, hospital service area; IRF, inpatient rehabilitation facility; LTCH, long-term care hospital; MJLE, major joint replacement of lower extremity; PAC, postacute care; SNF, skilled nursing facility; UTI, urinary tract infection.

Table 4: Association Between Hospitals' Postacute Care Referral Concentration and PAC Bundled Payments

<i>Variable</i>	<i>CHF</i>	<i>HIPF</i>	<i>MJLE</i>	<i>Stroke</i>	<i>UTI</i>
Conc4 (PAC referral concentration)	-19.55*	-67.27***	-29.14**	-32.04	-48.8**
Patient characteristics					
Female	428.48*	101.63	1,533.49***	291.67	-398.76
Any Medicaid in previous year	587.34*	1,391.45***	1,949.73***	1,410.06***	704.85**
Age 65-74	847.72*	1,387.82*	508.70***	1,075.57*	2,511.10***
Age 75-84	1,395.8***	4,730.15***	2,700.30***	3,103.21***	3,376.33***
Age 85+	1,972.78***	7,694.02***	7,433.27***	3,653.17***	3,832.95***
HCC risk score	630.32**	771.61***	1,703.53***	-227.72*	249.17***
Hospital length of stay	476.3***	445.76***	988.32***	885.56***	532.04***
Characteristics of discharging acute hospital					
Number of beds	-0.03	-2.02*	0.51	0.28	-1.02
Urban location	758.86	1,285.98	-504.81	-640.36	335.3
Not-for-profit	527.71	1,121.84	901.69***	1,668.39*	622.39
Government run	137.51	1,174.88	848.64**	1,447.76*	1,206.07*
Teaching hospital	-555.6*	-1,072.21	-676.08**	-1,097.58	-635.51
PAC owner	365.14	335.82	440.23	-162.02	392.48
Supply					
SNF beds/1,000 beneficiaries in an HSA	-0.8	-4.53	-2.07	-2.70	2.59
LTCH beds/1,000 beneficiaries in an HSA	-55.23	-55.40	-13.08	-2.22	-93.44*
IRF beds/1,000 beneficiaries in an HSA	-1.23	202.53	-116.13	80.63	187.22*
Average PAC size in an HSA	-0.71	7.89	-5.58	-5.7	1.23
Intercept	9,639.24***	19,307.54***	1,968.32*	16,563.81***	12,467.81***
Percent impact (relative to mean) of 10-point change in CONC4	-1.2%	-2.5%	-2.8%		-2.9%

Notes: *** $p < .001$; ** $p < .01$; * $p < .05$.

CHF, congestive heart failure; CONC4, postacute care referral concentration; HCC, hierarchical condition categories; HIPF, hip and femur procedures except major joint; HSA, hospital service area; IRF, inpatient rehabilitation facility; LTCH, long-term care hospital; MJLE, major joint replacement of lower extremity; PAC, postacute care; SNF, skilled nursing facility; UTL, urinary tract infection.

bundled payments for MJLE, and \$502 (2.7 percent) lower bundled payments for UTI bundle.

Table 4 indicates higher concentration in a hospital's PAC referrals was associated with lower PAC bundled payments among CHF ($p < .01$), HIPF ($p < .01$), MJLE ($p < .01$), and UTI ($p < .01$). An increase of 10 percentage points in referral concentration was associated with approximately \$196 (1.2 percent) lower PAC bundled payments for CHF, \$673 (2.5 percent) lower PAC bundled payments for HIPF, \$291 (2.8 percent) lower PAC bundled payments for MJLE, and \$488 (2.9 percent) lower PAC bundled payments for UTI.

Sensitivity Analysis Results

Adding regional fixed effects to the multivariate models of total bundled amounts led to results suggesting that the higher concentration in a hospital's PAC referrals was associated with lower bundled payment among HIPF ($p < .001$) and MJLE ($p < .05$) cohorts, but not other cohorts. Adding regional fixed effects to regression models of PAC bundled payment, higher concentration in a hospital's PAC referrals was associated with lower PAC bundle payment among CHF ($p < .05$), HIPF ($p < .001$), MJLE ($p < .01$), and UTI ($p < .001$) cohorts. The results for association between referral concentration and bundled payments do not change after we remove the variable for hospital length of stay from the repression equation.

In the multivariate model with concentration of hospital's SNF referral, concentration was associated with lower bundled among the HIPF ($p < .01$) cohort (see Table S1). In the multivariate model with concentration of hospital's HHA referral, concentration was associated with lower bundled among the HIPF ($p < .001$), MJLE ($p < .05$), and UTI ($p < .05$) cohorts (See Table S2).

LIMITATIONS

Our study has a number of limitations. First, referral concentration is an emerging and complex concept. We started thinking about referral concentration as four most frequently used PAC providers and counted the four PAC sites (SNFs, HHAs, IRFs, and LTCHs) without distinction, as well as setting specific concentration. However, this is an area for further development both conceptually and empirically.

Second, the analyses are cross-sectional and therefore can show associations between hypothesized explanatory variable and bundled payment but do not necessarily support causal inference. In some ways, association between concentration and bundled payment can be considered a dynamic process, which makes the causal inferences more challenging. For example, there may be an unobserved characteristic like strong case management that leads to higher concentration and lower bundled payments. If so, a hospital that does not have strong case management but tries to increase referral concentration in order to lower bundle cost may not achieve significant cost savings. Other unobservable differences to consider include leadership goals and community orientation. In general, these will lead to an overestimation of the effect of concentration.

Third, the results may not generalize to other reasons for hospitalization beyond the five conditions studied, although we did try to select a mix of acute, chronic, and treatment bundles to represent the range of inpatient services. Fourth, we approximate but cannot fully replicate the CMS payment rules for BPCI, including application of precedence rules and quarterly pricing “true ups.” We also do not have information on the relative quality of each bundle. This is a modification we may see in the future as CMS adapts bundle program to comply with the Medicare Access and CHIP Reauthorization Act alternative payment model requirements. Without quality, we cannot differentiate the relative efficiency of study hospitals. Finally, unobserved health status may affect results, for instance, if hospitals with healthier patient cohorts tend to concentrate referrals to PAC.

DISCUSSION

Results suggest that hospitals with higher concentration of referrals to PAC providers may have cost advantages over hospitals with more widely dispersed utilization of PAC providers. This could be a key driver of performance under risk arrangements such as Medicare’s bundled payment programs for hospital and PAC services.

Further, for three of the five groups, Medicare costs for the full care bundle were lower for beneficiaries discharged from hospitals with concentrated PAC referrals. This suggests that routines and relationships established in a hybrid supply chain can save resources, through faster discharge from PAC or reduced rehospitalizations, even when the participants do not have strong incentives to contain costs.

Our findings have important implications for the ongoing initiatives for bundling payments for hospitals and PAC providers. Because key provisions on bundled payment systems are intended to produce Medicare saving by inclusion of risk-based payments provisions for providers, it is particularly important for the providers to identify the segments of care that may be impacted by policy change. Our findings suggest that even in the absence of bundled payments, a significant amount of concentration in PAC referrals already exists. Our findings suggest that the concentration of PAC referrals is associated with lower bundle payment. The exact mechanism is not clear, but it may include easier communication between providers when the number of sites is limited or more consistent postdischarge care pathways.

The study focused on the factors associated with delivery system performance from the vantage point of hospitals because they play an important role as a starting segment of the hospital-PAC bundles and as a decision-making hub that impacts both the hospital and posthospitalization care trajectories. Physician groups can participate in BPCI, and they may have varying capacity to affect a hospital's discharge practices. It is also important to point out that BPCI preserves a beneficiary's right to choose where he/she receives care. Thus, even if postacute concentration is desirable, it may not always be easy to achieve.

Referral concentration was significantly negatively associated with PAC bundled payment for four of the five groups. These finding suggest that patients discharged from hospitals with concentrated referral networks are using fewer PAC services during the postdischarge period, including hospital readmissions.

If formation of selected networks helps to lower costs, we may expect increasing concentration under the bundled payments and gainsharing arrangements. Differences in utilization pattern persist even after controlling for a range of factors, including dummy variables for region.

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NOTES

1. More specifically, this is Model 2 in BPCI.
2. Participants can opt for annual reconciliation with CMS, but still see performance on a quarterly basis.
3. Hybrids are likely to form under circumstances where collaborative arrangements are preferred because the asset specificity of the transaction is characterized as uncertain and frequent, but unified ownership is either impossible or not preferable. Asset specificity is a phenomenon that explains the interdependency between the organizations developed due to reciprocal exchange of assets which include the following: site, physical, human, dedicated, brand name capital, and temporal (Williamson 2002).
4. Under Model 2, demonstration participants are identified by an anchor hospital stay, and financial performance for each hospital is determined by retrospective comparisons of actual to expected Medicare spending levels for the inpatient stay plus a specified postacute period. Other models in the demonstration vary these specifications (CMS 2013).
5. To eliminate geographic-based payment differences, we divided the actual bundle payment amount by the appropriate wage factors, defined as $0.7h + 0.3$, where h is the hospital wage index.
6. Within Medicare, hospital payments are determined by DRG, not length of stay. As a result, bundled payment should not be directly correlated with length of stay. However, hospital length of stay may be correlated with Part B payments during the inpatient stay. However, Part B payments are only a small fraction of the total inpatient payment amounts. As a result, we may anticipate minimal correlation between length of stay and bundled payments.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Table S1: Association Between Hospitals' Skilled Nursing Facility Referral Concentration and Total Bundled Payments.

Table S2: Association Between Hospitals' Home Health Agency Referral Concentration and Total Bundled Payments.