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Care Continuity in a Patient-Centered Medical Home Setting

Rebecca J. Perry, Nancy McCall, Suzanne G. Wensky, and Susan G. Haber

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RTI International
3040 East Cornwallis Road
PO Box 12194
Research Triangle Park, NC
27709-2194 USA

Tel: +1.919.541.6000
E-mail: rtipress@rti.org
Web site: www.rti.org

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About the Authors

Rebecca J. Perry, MSc, BA, is a Public Health Analyst in RTI International's Health Equity Analytics and Solutions Program.

Nancy McCall, ScD, SM, BS, RN, is a Senior Fellow at Mathematica Policy Research.

Suzanne G. Wensky, PhD, BA, is a Social Science Research Analyst with the Center for Medicare & Medicaid Innovation within the Centers for Medicare & Medicaid Services in Baltimore, Maryland.

Susan G. Haber, ScD, MCRP, MPH, BA, is a Program Director and Senior Economist in RTI International's Health Coverage for Low-Income Uninsured Populations Program.

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Abstract

The patient-centered medical home (PCMH) is a health system innovation aimed to improve cost, quality, and health outcomes. Research shows that Medicare beneficiaries at practices with PCMH recognition have lower Medicare costs than those at practices without such recognition. Our study explores whether greater care continuity—an ongoing relationship between the patient and clinicians at a practice that monitors the patient's health status and care—drives these lower costs in PCMH-recognized practices. We used Medicare Parts A and B claims data to calculate Medicare payments for services. We conducted weighted least squares regression analyses at the practice level to examine the association of Medicare payments with PCMH recognition and care continuity. We measured care continuity using an index that reflects the concentration of visits in the practice that serves as the beneficiary's usual source of care.

Medicare beneficiaries at PCMH-recognized practices had lower total annual Medicare payments (–$1,099; $p < 0.01$) than patients at nonrecognized practices. After controlling for care continuity, the association with PCMH recognition decreased substantially and beneficiaries in practices with high (compared to low) care continuity had significantly lower total payments (–$1,872, $p = 0.02$). Evidence from this study indicates that care continuity is a key driver of cost reductions associated with PCMH recognition.

Introduction

The patient-centered medical home (PCMH) model is increasingly seen as a way to improve the quality of health care for all patients, meet the growing demand for primary care services, and address escalating health care costs. A PCMH is, in broad terms, a clinical practice that provides care that is "accessible, continuous, comprehensive, family centered, coordinated, compassionate and culturally effective" (American Academy of Family Physicians [AAFP], American Academy of Pediatrics [AAP], American College of Physicians [ACP], & American Osteopathic Association [AOA], 2007). PCMHs offer many potential pathways to reduce health care costs and improve quality; however, the evidence of this impact remains limited and conflicting (Coleman et al., 2002; Hoff, Weller, & DePuccio, 2012; Jackson et al., 2013; Peikes, Chen, Schore, & Brown, 2009; Peikes, Zutshi, Genevro, Parchman, & Meyers, 2012). The Centers for Medicare & Medicaid Services (CMS) and other payers are testing PCMH models, among other innovative reforms, to determine their impact on health care costs, health care quality, and health outcomes.

In 2003, the National Committee on Quality Assurance Physician Practice Connections–Patient-Centered Medical Home (NCQA PPC-PCMH), a national standard-setting program, initiated a PCMH recognition program. This program sets forth 30 elements organized into nine standards that practices need to attest to meeting to be certified at one of three PCMH levels (National Committee for Quality Assurance [NCQA], 2008). Practices receive points based on the number of elements under each standard they meet, and the total number of points guides each practice's recognition level. To achieve specific NCQA PPC-PCMH levels, practices must attest to achieving specific elements that are designated as "must pass."

A recent study showed that Medicare fee-for-service (FFS) beneficiaries at practices with NCQA PPC-PCMH recognition have lower total Medicare costs and acute care hospital costs than their counterparts at practices that are not recognized (van Hasselt, McCall, Keyes, Wensky, & Smith, 2015). However, this study did not examine the primary drivers of those lower costs. Our study builds on this evidence to determine the role of care continuity in lowering costs for patients at PCMH practices.

Care continuity is a key component of the PCMH model. Care continuity occurs when patients have a practice or clinician within that practice who monitors their health status and coordinates their care as they move through the health care system (Saultz, 2003). Continuity of care is closely associated with having a usual source of care, but communication and coordination between the usual source of care and other providers is also a critical component. Care continuity coincides with a number of NCQA PPC-PCMH standards and elements. The most noteworthy are NCQA PPC-PCMH standard 3, Care Management, and 7, Referral Tracking. These standards assess the extent to which practices track follow-up visits and care received from referred specialists, and whether practices coordinate care transitions with health care facilities (NCQA, 2008).

The importance of care continuity rests in its ability to prevent redundant testing, harmful drug interactions, and even conflicting medical guidance—outcomes that not only affect patients' health status but can also cost payers more (Coleman et al., 2002; Mattke, 2008; Peikes et al., 2009; Saultz & Lochner, 2005). Care continuity is a particular concern for the Medicare FFS population; research indicates that 50 percent of Medicare beneficiaries receive treatment at four or more practices each year and from seven or more physicians (Pham, Schrag, O'Malley, Wu, & Bach, 2007). Each visit with a different clinician increases Medicare costs and the likelihood that patient care will be fragmented. For payers and Medicare beneficiaries and their families, this fragmentation is costly in terms of care quality, time and energy spent visiting clinicians, and in unnecessary or contraindicated medications, tests, and care (Becker, Drachman, & Kirscht, 1974; Coleman et al., 2002; Gill & Mainous, 1998; Peikes et al., 2009; Wasson et al., 1984).

For our study, we examined the influence of care continuity on Medicare payments among Medicare FFS beneficiaries. We assessed care continuity using

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the Bice and Boxerman continuity of care (COC) index (Bice & Boxerman, 1977). The index is a measure of the concentration of visits to clinicians in the practice that is the beneficiary's usual source of care or to whom the beneficiary was referred by a clinician in that practice.

The COC index assumes there is care continuity when services are delivered by clinicians within the usual source of primary care or when there is good communication between providers at the usual care practices and other practices where a patient is seen. A higher concentration of visits to the medical home or by referral from a medical home clinician is assumed to strengthen the relationship between patients and their medical homes, enhance communication among the patient's clinicians, and promote coordinated treatment across clinicians with consistent medical management plans.

By taking into account referrals, as well as visits within the medical home practice, the COC index recognizes that it may be appropriate for patients to see a provider outside the practice that is their usual source of primary care—for example, if they need specialist services. Considering the concentration of visits only within the usual care practice would bias the index upward for large multispecialty practices relative to smaller, single specialty practices where it is more likely that a patient will need to be referred out for care. The measure assumes that having a referral increases communication and coordination with providers outside the usual source of care, thereby increasing care continuity.

We sought to answer two main questions: (1) whether the level of care continuity differed between practices that received PCMH recognition by NCQA and comparison practices that do not have such recognition; and (2) whether differences in the level of care continuity explained differences in Medicare payments between PCMHs and comparison practices, or whether an independent association existed between PCMH recognition and Medicare payments.

Methods

Sample

This study focused on Medicare FFS beneficiaries receiving care from 312 NCQA PCMH-recognized practices and from a comparison sample of 312 practices that did not have NCQA PCMH recognition during our study timeframe, July 1, 2009, through June 30, 2010.

NCQA PCMH-Recognized Practice Sample

We drew the PCMH[1] sample from 1,247 practice locations that had received recognition by NCQA's 2008 PPC-PCMH standards between 2008 and 2010 (NCQA, 2008). Of these practice locations, 1,095 practices treated Medicare FFS beneficiaries and were deemed initially eligible for participation in our study. Invitations to participate in the study were mailed to the 1,095 practice locations. Of the 1,095 practices invited to participate, 343 consented by sending a signed data release authorization form (electronically or via mail) to the study team.

Of the 343 consenting practices, 31 PCMHs were subsequently excluded because they had fewer than 30 beneficiaries assigned to them using assignment procedures described below, leaving 312 PCMHs in the final sample. Thus, the 312 PCMHs included practices that agreed to have NCQA release their recognition information, that treated Medicare FFS beneficiaries, and that had more than 30 Medicare FFS beneficiaries receiving care from the practice during the study period.

Comparison Group Sample

Our comparison group consisted of 312 practices without NCQA recognition that were matched to the PCMH sample using a multistep process that included propensity score matching. We first identified all physician practices, including federally qualified health centers (FQHCs), in the same zip codes as the consenting PCMHs. We used a Tax Identification Number (TIN) to identify physician practices and an organizational National Provider Identifier (NPI)

[1] Throughout this document, the term PCMHs is used interchangeably with the terms *NCQA-recognized PCMH* and *NCQA PPC-PCMH recognized practices*.

number to identify FQHCs. Beneficiaries were assigned to the pool of potential comparison practices using the same beneficiary assignment methodology applied to the PCMHs. As with the PCMH sample, comparison group practices were excluded from the sample if they had fewer than 30 assigned beneficiaries.

We developed a parametric, logistic regression propensity score model to identify the practices (including FQHCs) that were most similar to the consenting PCMHs by balancing the covariate distributions of the comparison group practices to the NCQA PCMH-recognized practices (Rosenbaum & Rubin, 1983). These covariates are described below.

1. Beneficiary characteristics: average prospective Hierarchical Condition Category (HCC) risk score (definition can be found in Beneficiary Characteristics and Health Status Variables section on page 6). Charlson comorbidity index score, total Medicare payment, and age; and percentage of beneficiaries who were female, disabled, enrolled in Medicaid, nonwhite, institutionalized in the previous year, and diagnosed with end-stage renal disease (ESRD).
2. Practice characteristics: practice size based on the number of NPIs at a location, number of beneficiaries seen by the practice, and specialty configuration.
3. Zip code–level area characteristics: median household income, number of non-federal primary care and specialist physicians per 100,000 population, number of FQHCs in the surrounding area, percentage of the population that is Hispanic and black, and percentage of Medicare beneficiaries making at least one primary care or one emergency department (ED) visit in the previous year.
4. Geographic characteristics: a metropolitan statistical area (MSA) and region of the country (North, South, East, or West; covariate data were taken from the baseline year, July 1, 2007, to June 30, 2008).

We estimated the propensity score for each practice in the comparison pool, removed any practices with predicted propensity scores that were above or below those observed among the NCQA-recognized PCMHs, and divided the remaining practices into propensity score subclasses. Finally, we randomly selected comparison practices to match the number of NCQA-recognized practices in each subclass. Differences in beneficiary characteristics (such as age, HCC risk score, and total Medicare payments) and practice characteristics (such as practice specialty and practice size), and geographic characteristics of the practice location (MSA and region of the country) exist between the NCQA-recognized PCMHs and the comparison group practices. To adjust for these differences, we included these propensity score variables as covariates and used the propensity score weights in our regression models. In theory, weighting by the propensity score makes practices in the comparison group more similar to or comparable with NCQA-recognized practices, in terms of their covariate distributions. We assessed covariate balance after weighting by calculating the standardized differences between the two groups (Austin, 2009; D'Agostino, 1998).

Beneficiary Assignment

We focused on beneficiaries covered by the Medicare program; this included individuals covered in the traditional FFS program eligible by virtue of age, and individuals covered through the ESRD or total and permanent disability programs.

Beneficiaries were assigned to NCQA-recognized PCMHs and comparison practices based on a plurality of visits algorithm, a methodology adopted from previous research on Medicare beneficiaries (Peitzman & Richardson, 2010; Pope & Kautter, 2007). This algorithm assigned beneficiaries to practices based on where they receive the plurality of their primary care evaluation and management (E&M)[2] services during the baseline year (also known as the assignment timeframe), July 1, 2007, through June 30, 2008.

We began by obtaining a list of clinician NPI numbers associated with each NCQA-recognized PCMH and

[2] For this study, we defined E&M visits based on the commonly used E&M CPT codes for this population: 99201 through 99205; 99211 through 99215; 99241 through 99245; 99304 through 99350; 99381 through 99387; 99391 through 99397; 99401 through 99412; 99420 through 99429; G0402; G0438; G0439 and revenue center codes 051 and 052 for FQHC's global visit codes.

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comparison practice location. To find the clinician NPIs associated with each practice, we pulled all physician and outpatient claims that were billed using one of the organizational NPIs. After a list was compiled, we removed non-primary care clinicians from the list. We defined primary care clinicians as physicians working in general practice, family practice, internal medicine, multispecialty practice, and geriatric medicine; nurse practitioners; certified clinical nurse specialists; and physician assistants. Next, we identified beneficiaries receiving any of the specified E&M services from these clinician NPIs. For each beneficiary identified, we also determined the number of E&M services they received from other NPIs. Finally, we assigned beneficiaries to a practice if the plurality of services was provided by NPIs at that practice location. In situations where a beneficiary received equal numbers of services from NPIs at two different practice locations, we assigned the beneficiary to the NPI with the most recent date of service.

We selected beneficiaries who had three or more E&M visits to any of the sampled practices during our study timeframe, July 1, 2009, through June 30, 2010. Requiring three or more visits was based on the notion that the pattern of care continuity could not be fully assessed using fewer than three visits (Liss et al., 2011). Seventy-five percent of 254,450 Medicare FFS beneficiaries who were attributed to practices in the study sample were included in our study. The final study sample consisted of 190,982 Medicare FFS beneficiaries, with 102,188 assigned to the 312 PCMHs and 88,794 assigned to the 312 comparison practices. RTI's Institutional Review Board reviewed and approved this study.

Analytical Variables and Data Sources

We assembled insurance claims data for Medicare Parts A and B for two time periods: July 1, 2007, through June 30, 2008, for the baseline year and beneficiary assignment; and July 1, 2009, through June 30, 2010, for the study timeframe. These sources spanned all Medicare-covered services except Part D prescription drugs. Medicare's Enrollment Data Base provided Medicare eligibility and demographic characteristics. In our analyses, the dependent variables, Medicare payments, are constructed with claims data from July 1, 2009, through June 30, 2010. Medicare claims data from the baseline timeframe, July 1, 2007, through June 30, 2008, are used to create two covariates, HCC risk score and total Medicare payments, that were included in the regression analyses.

Local area characteristics (i.e., zip code–based measures) were taken from the 2009 U.S. Census and the 2005 American Medical Association Physician Workforce file.

Care Continuity

The main independent (explanatory) variable was care continuity, which we measured using the Bice and Boxerman COC index (Bice & Boxerman, 1977). This COC index is a measure of the concentration of visits among clinicians in the practice that is the beneficiary's usual source of care or to whom the beneficiary was referred by a clinician in that practice.

In the case of this study, we identified a beneficiary's usual source of care using the plurality of visits algorithm outlined above. The COC index is similar to a Herfindahl-Hirschman index, but it has been modified to take into account referrals to clinicians outside a patient's usual practice, not only the concentration of visits to the practice that is the usual source of care (Eriksson & Mattsson, 1983). Patients with complex needs, like many Medicare patients, may need to see providers outside their primary care practice, particularly if it is a single specialty practice. As mentioned, including referrals avoids biasing the COC index downward for single specialty practices relative to large multispecialty practices. Treating referred visits comparably with visits within the usual care practice assumes that the referring relationship is associated with better communication and coordination between providers. Unlike a simple percentage of visits that are within or by referral from the patient's usual practice, the COC index accounts for both the number of different providers seen without a referral and the total number of visits.

The COC index equation is as follows:

$$\mathrm{COC} = \sum_{j=1}^{s} (n_j^2 - N) \,/\, [N(N-1)]$$

where N is total number of E&M visits a Medicare beneficiary had in 1 year, the study timeframe

(July 1, 2009, through June 30, 2010); n_j is the number of visits to clinician j during the year; and S is the number of clinicians who treated the Medicare beneficiary during the year. We used the same set of E&M service codes to calculate the COC index and for beneficiary assignment. Clinicians in the beneficiary's assigned practice or those seen through a referral from this practice are counted as a single clinician; all unreferred clinicians are counted individually.

To calculate the number of clinicians, we first identified the NPI number for all clinicians that billed Medicare from each practice. We focused on clinicians that billed one of the E&M codes. We labeled clinicians at the practices where we assigned beneficiaries as usual clinicians. Next, we identified all visits made to clinicians that had a referral from a clinician at the usual practice. Under the Medicare program claims coding rules, clinicians are required to include the NPI of the clinician from whom the beneficiary was referred. If the referring NPI was one of the NPIs that billed to the beneficiary's usual practice, we labeled it as a referred visit. Referred visits were grouped together with those made to the beneficiary's usual practice. All remaining visits were labeled as "unreferred."

Scores for the COC index range from 0 to 1. For example, a beneficiary with 20 visits between two clinicians—11 visits to her PCMH and 9 to an unreferred clinician—will have a COC score of 0.48. We then calculated the mean COC index value at the practice level. For our initial analyses, we included the COC index as a continuous variable. However, in line with other studies, we used a categorical version of the COC index for the remaining descriptive and regression analyses. We changed the COC index from a continuous variable to a categorical one to make it easier to interpret. In particular, we were concerned that the index would generate nonlinear relationships and therefore make it difficult to fully understand the results.

We identified three groups of practices—low, medium, and high care continuity—based on the mean COC index value for Medicare beneficiaries whom we assigned to the practice (Christakis, Mell, Koepsell, Zimmerman, & Connell, 2001). We categorized practices as follows: those with COC scores below the 33rd percentile (less than 0.46) had low care continuity scores; those with scores that fell within the 33rd and 66th percentiles (0.46 to 0.55) had medium care continuity scores; and those with scores above the 66th percentile (greater than 0.55) had high care continuity scores. We created categorical variables for these groups that were used in regression models.

Health Service Use and Payment Variables

We constructed all health service use and payment variables at the practice level. First, we calculated annual health service use and payments at the beneficiary level. For beneficiaries with less than a full year of eligibility in Medicare Parts A and B, we calculated their annual health service use and payment amounts using an eligibility fraction that represents the portion of the year the beneficiary qualified for Medicare Parts A and B. For example, a beneficiary who died 6 months into the year and had $3,000 in total Medicare payments during those 6 months would have $6,000 in annual total Medicare payments. We then aggregated beneficiary-level measures to the practice level by calculating the mean for beneficiaries assigned to the practice. Practice means are weighted by beneficiary eligibility fractions (Diehr, Yanez, Ash, Hornbrook, & Lin, 1999; Ellis & Ash, 1995).

We calculated rates of all-cause and ambulatory-care-sensitive condition (ACSC) acute care hospitalizations, ED visits, and observation stays from Part A claims. We categorized episodes as ACSCs when the claim contained one of 32 previously defined ACSC diagnosis codes as the principal reason for the hospital admission, ED visit, or observation stay.[3] To calculate mean number of annual visits by physician specialty, we used Part B claims and classified E&M visits into three categories—primary care, medical, and surgical—based on the specialty code listed on the claim.[4]

[3] Thirty-two ACSCs appropriate for the elderly Medicare population were used in this study (McCall et al., 2004) and are available from the authors on request.

[4] Provider specialty codes used to define these three categories are as follows: Primary Care—01, 08, 11, 38, 50, 84, 89, and 97; Medical Specialists—03, 04, 06, 07, 10, 13, 16, 18, 22, 25, 26, 29, 30, 34, 39, 41, 44, 46, 48, 66, 70, 76, 81, 82, 83, 86, 90, 92, 93, and 98; and Surgical Specialists—02, 05, 14, 19, 20, 24, 28, 33, 40, 77, 78, 85, and 91.

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We constructed four practice-level annual Medicare payment variables reflecting the mean for patients attributed to the practice:

- mean total Medicare payments per beneficiary identified using Parts A and B claims;
- mean total physician payments per beneficiary identified using Part B claims;
- mean total acute care hospital payments per beneficiary identified using Part A claims; and
- mean total outpatient department payments per beneficiary identified using Part A claims.

We also constructed three sets of practice-level variables to capture annual Medicare payments for potentially avoidable services, again defined as the mean for patients attributed to the practice:

- ACSC acute care inpatient hospital payments identified using Part A claims and associated Part B payments for physician services, with and without post-acute care (PAC) services that may occur up to 30 days after discharge;
- medical acute care hospital payments identified using Parts A and B claims, with and without payments for PAC services; and
- ACSC ED visit payments, including outpatient hospital and physician payments identified using Parts A and B claims, and observation bed stays.

Practice Characteristics Variables

We created a PCMH recognition variable in which we labeled practices that had NCQA PPC-PCMH recognition with a 1 and those without recognition with a 0, the comparison group practices.

We also used claims data to construct three practice-level variables: size of practice defined by number of primary care clinicians billing Medicare; number of assigned beneficiaries; and clinician specialty mix of each practice (primary care only, multispecialty, and clinic/FQHC).

Also, as mentioned above, we created zip code-based and regional variables linked to each practice. These variables were included in multivariate analyses (described below) to adjust for local socioeconomic, physician supply, and health care market characteristics.

Beneficiary Characteristics and Health Status Variables

Beneficiary characteristic measures—demographic measures and Medicare eligibility measures—and health status measures were first constructed at the beneficiary level. Beneficiary-level measures were then aggregated to the practice level by calculating the mean for beneficiaries that we assigned to the practice.

These aggregated data include the following measures of the characteristics of the practices' Medicare FFS beneficiaries: mean age categorized within one of four age categories (younger than 65 years old, 65 to 75 years old, 76 to 85 years old, and older than 85 years); and percentage female, white, originally entitled to Medicare because of a disability, enrolled in Medicaid, having ESRD, and institutionalized. A beneficiary was identified as institutionalized (residing in a nursing home) if a physician billed for a nursing home visit during 2 of 3 consecutive months during the baseline period.

Patient health status was measured using the HCC risk score, which was calculated using baseline claims data to predict their costliness during the study year. The HCC score is derived from models predicting annual Medicare payments based on claim-based diagnoses in a prior year of claims where higher scores are predictive of higher spending and poorer health status. The average Medicare FFS beneficiary will have a score of approximately 1, whereas sicker and more costly beneficiaries than the average will have scores above 1, and those who are healthier and less costly than the average will have scores below 1. Thus, an HCC score of 1.2 predicts that a patient will be 20 percent more costly than the average Medicare FFS beneficiary (Pope et al., 2004).

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Statistical Analysis

We conducted all analyses at the practice level. We created a two-part weight to adjust for any differences between NCQA-recognized and comparison practices. The first part involved calculating the mean eligibility fraction among all beneficiaries assigned to the practice, where for an individual beneficiary the eligibility fraction was the number of Medicare eligible days divided by 365. The use of this eligibility fraction in the regression weight prevented beneficiaries who were ineligible for Medicare for part of each year from strongly influencing the practice averages or rates. The second part of the regression weight was determined by the practice's estimated propensity score. The propensity score weights include the same covariates reflecting beneficiary, geographic, and practice characteristics included in the propensity score model used for comparison group selection. We used the Proc SurveyReg and Proc SurveyMean procedures in SAS (version 9.2; Cary, North Carolina) to conduct weighted statistical testing at the practice level.

We used weighted Student's t-test for two sets of descriptive analyses. First, we examined differences in average COC scores between PCMH practices and comparison practices, in total and stratified by practice characteristics (size of practice, number of assigned beneficiaries, and clinician specialty mix). Second, we examined baseline differences in practice-level beneficiary demographic and health characteristics, average acute care health service use rates, and Medicare payments between NCQA-recognized and comparison practices.

We also conducted weighted least squares regression analyses at the practice level to examine the relationship between average Medicare payments and NCQA recognition and level of care continuity. For this cross-sectional analysis, we used the following regression model:

$$\begin{aligned} \text{PAYMENT}_{tj} = f\,[&\text{SPECIALTY}_{tj};\ \text{URBAN}_{tj};\\ &\text{REGION}_{tj};\ \text{CHAR}_{tj};\ \text{HEALTH}_{bj};\\ &\text{PAYMENTS}_{bj};\ \text{RECOGNITION}_{tj},\\ &\text{COC}_{tj}] \end{aligned}$$

This model examines the relationship between Medicare payments (PAYMENT), NCQA recognition status (RECOGNITION), and degree of care continuity (COC) within the practice. The model is estimated at the practice level (j). To control for any potential imbalances in observed characteristics between the comparison group practices and the PCMH-recognized practices, we incorporated covariates for practice characteristics such as practice specialty (SPECIALTY), and MSA status (URBAN), and geographic region (REGION) of the practice location; and for beneficiary characteristics (CHAR), prior-year HCC risk score (HEALTH) and prior-year total Medicare payments (PAYMENTS). We used data from the baseline timeframe (b)—July 1, 2007, through June 30, 2008—which was 2 years before our study timeframe (t)—July 1, 2009, through June 30, 2010. Two covariates, HEALTH and PAYMENTS, are calculated over the baseline timeframe to control for practice-level variations existing before possible NCQA recognition. The remaining variables are calculated over the study timeframe (t). The model included variables indicating whether a practice had high or medium care continuity, with low care continuity as the omitted category. The model is estimated separately for each of the previously described average Medicare payment variables.

We estimated two sets of regression models. The first set of models controlled only for PCMH recognition. The second set of models included the same dependent variables and covariates as the first, along with variables for high and medium care continuity in addition to a variable for PCMH recognition. These analyses also included an adjustment for heteroskedasticity (systematic differences in the variance of the dependent Medicare payment variables) resulting from differences in practice size.

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Results

Table 1 reports mean COC scores for the NCQA-recognized and comparison practices by practice characteristics. Overall, NCQA-recognized practices had a mean COC score of 0.57, whereas the comparison practices had a mean COC score of 0.47 ($p < 0.01$). Across all studied practice characteristics, NCQA-recognized practices had statistically significantly[5] higher mean care continuity scores than comparison practices.

Table 2 displays beneficiary characteristics, rates of health service use, and Medicare payments for NCQA-recognized and comparison practices during the baseline period. As mentioned above, for the age, we categorized practices into four groups based on mean beneficiary age (younger than 65 years old, 65 to 75 years old, 76 to 85 years old, and older than 85 years). We did not find statistically significant differences between NCQA-recognized practices and comparison practices in beneficiary characteristics, including age; gender; and Medicaid, ESRD, disabled, or institutionalized status. Beneficiaries at NCQA-recognized practices were predicted to be 10 percent less costly in the year prior to the start of the study period (as reflected through a lower average HCC score) than those at comparison practices (significant at $p < 0.01$).

Beneficiaries assigned to NCQA-recognized practices had significantly lower average rates of all-cause

[5] For this work, we assessed statistical significance at $p < 0.05$.

Table 1. Average continuity of care score for NCQA-recognized and comparison practices, in total and by practice characteristics

Variables	NCQA-Recognized Practices Mean Continuity of Care Score (n)	Comparison Practices Mean Continuity of Care Score (n)	P-value[a]
All practices	0.57 (312)	0.47 (312)	<0.01
Practice size[b]			
Solo	0.55 (65)	0.50 (67)	0.02
2-person	0.57 (52)	0.46 (88)	0.04
Small	0.57 (102)	0.46 (98)	<0.01
Medium	0.60 (54)	0.48 (33)	<0.01
Large	0.58 (39)	0.43 (26)	<0.01
Number of assigned beneficiaries[c]			
<150	0.56 (110)	0.44 (160)	<0.01
150–300	0.59 (93)	0.47 (71)	<0.01
300–500	0.58 (49)	0.52 (36)	0.02
>500	0.57 (60)	0.50 (45)	<0.01
Practice specialty[d]			
Primary care only	0.57 (234)	0.49 (225)	<0.01
Federally Qualified Health Center	0.63 (33)	0.52 (20)	<0.01
Multispecialty	0.53 (43)	0.35 (67)	<0.01

NCQA = National Committee on Quality Assurance.

[a] P-values are generated using Student's t-test that compares mean care continuity scores for NCQA Physician Practice Connections–Patient-Centered Medical Home (PPC-PCMH) recognized practices with comparison practices.

[b] The practice size variable was defined as: Solo = 1 National Provider Identifier (NPI) number practicing at a practice location; 2-person = 2 NPIs practicing at a practice location; small = 2 to 5 NPIs practicing at a practice location; medium = 6 to 10 NPIs practicing at a practice location; and large = more than 10 NPIs practicing at a practice location.

[c] We used a plurality of Evaluation & Management (E&M) visit methodology to assign beneficiaries to practices (details included in the Beneficiary Assignment section of the Methods).

[d] Two Patient-Centered Medical Home (PCMH) practices are not reported in this portion of the table because they were the only single specialty practices in the sample.

Source: Medicare Part A and B claims and Medicare's Enrollment Database, 2009–2010.

Table 2. Comparison of beneficiary characteristics and health service use rates and Medicare payments between NCQA-recognized and comparison practices

Rates of Use of Health Care Services and Medicare Payments	NCQA-Recognized Practices	Comparison Practices	P-value[a]
Number of practices	**312**	**312**	
Beneficiary characteristics			
Age groups			
<65 years	21.6%	21.3%	0.95
65–75 years	43.1%	42.5%	0.49
76–85 years	26.4%	27.6%	0.18
>85 years	8.9%	8.6%	0.47
Female	60.5%	60.4%	0.96
White	84.9%	83.8%	0.52
Disabled	24.9%	24.8%	0.98
Medicaid	21.0%	20.6%	0.86
ESRD	0.5%	0.5%	0.51
Institutionalized	0.5%	0.4%	0.67
Prospective HCC score	1.2	1.3	<0.01
Rate of acute care hospitalizations per 100 beneficiaries			
All causes	26.2	34.5	0.02
ACSC	9.9	12.8	0.12
Rate of ED/observation visits per 100 beneficiaries			
All causes	49.1	70.3	<0.01
ACSC	15.8	22.0	<0.01
Mean number of annual visits by physician specialty			
Primary care	5.9	6.0	0.49
Medical specialist	4.3	5.1	<0.01
Surgical specialist	7.7	9.7	<0.01
Mean annual Medicare payments by type of service			
Total Medicare payments	$8,332	$10,905	<0.01
Physician payments	$2,825	$3,596	<0.01
Acute care hospital payments	$2,453	$3,680	<0.01
Outpatient department payments	$1,358	$1,650	<0.01
Mean annual potentially avoidable payments			
ACSC acute care inpatient payments	$1,174	$1,539	0.09
ACSC acute care inpatient payments with 30 days of post-acute care	$1,775	$2,332	0.23
Medical acute care inpatient payments	$1,271	$1,653	0.14
Medical acute care inpatient payments with 30 days of post-acute care	$1,973	$2,541	0.31
ACSC ED/observation bed payments	$181	$255	<0.01

ACSC = ambulatory care sensitive conditions; ED = emergency department; ESRD = end-stage renal disease; HCC = Hierarchical Condition Category; NCQA = National Committee for Quality Assurance.

[a] P-values are generated using Student's t-test that compares the mean values for NCQA Physician Practice Connections–Patient-Centered Medical Home (PPC-PCMH) recognized practices with comparison practices.

Source: Medicare Part A and B claims and Medicare's Enrollment Database, 2009–2010.

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acute care hospitalizations, all-cause and ACSC ED visits, and medical and surgical specialty visits than beneficiaries in comparison practices. We also observed that average total Medicare payments and payments for physician services, acute care hospitalizations, ACSC ED visits, and hospital outpatient services were significantly lower for patients in NCQA-recognized practices than for patients in comparison practices.

Tables 3 and 4 display coefficients from regression models that examine the relationship between NCQA-PCMH recognition and level of care continuity with nine categories of Medicare payments. Table 3 displays regression coefficients for the NCQA recognition variable in the model without controlling for care continuity. Average annual per beneficiary Medicare payments for beneficiaries in NCQA-recognized practices (compared with payments for beneficiaries in comparison practices) were $1,099 lower for total Medicare payments, $408 lower for physician payments, $568 lower for all-cause acute care hospital payments, $200 lower for hospital outpatient department payments, and $64 lower for ACSC ED payments (all significant at $p < 0.01$). We do not observe a significant association between Medicare payments for ACSC acute care inpatient payments with and without 30 days of PAC or medical acute inpatient payments with and without 30 days of PAC for beneficiaries in NCQA-recognized practices compared with beneficiaries in comparison practices.

In Table 4, we display the same regression model as in Table 3, but this model includes care continuity variables in addition to NCQA recognition variables.

After controlling for care continuity, NCQA recognition was still significantly associated with lower average physician payments ($p = 0.02$), hospital outpatient department payments ($p < 0.01$), and ACSC ED payments ($p < 0.01$). However, controlling for differences in levels of continuity of care between NCQA-recognized practices and the comparison practices reduced the estimated association between PCMH recognition and total Medicare payments from –$1,099 to –$680 and is no longer statistically significant ($p = 0.06$).

When we compared average payments for practices with a high level of continuity versus practices with a low level of continuity, controlling for NCQA recognition, we observe, on average, $1,872 lower

Table 3. Regression estimates for the association between NCQA-PCMH recognition and Medicare payments excluding care continuity

	Model with NCQA-PCMH Recognition Only[a]		
Dependent Variable	Coefficient Estimates on the PCMH Variable	Standard Error	P-value[b]
Total Medicare payments	–$1,099	308.08	<0.01
Total physician payments	–$408	123.80	<0.01
Acute care hospital payments	–$568	163.19	<0.01
Outpatient department payments	–$200	49.35	<0.01
ACSC acute care inpatient payments	–$66	87.55	0.45
ACSC acute care inpatient payments with 30 days of post-acute care	–$53	162.65	0.75
Medical acute care inpatient payments	–$57	98.80	0.56
Medical acute care inpatient payments with 30 days of post-acute care	–$16	181.87	0.93
ACSC emergency department/observation bed payments	–$64	10.45	<0.01

NCQA = National Committee for Quality Assurance; PCMH = Patient-Centered Medical Home; ACSC = ambulatory care sensitive conditions.

[a] The model also included the following independent variables: Practice characteristics such as size of practice and number of assigned beneficiaries; clinician specialty mix of each practice; practice urbanicity; practice geographic region; beneficiary characteristics; the previous period's (2007–2008) mean beneficiary Medicare payments, and mean beneficiary health status.

[b] P-values are generated using weighted least squares regression modeling.

Sources: Medicare Part A and B claims and Medicare's Enrollment Database, 2009–2010 and 2007–2008. Only Hierarchical Condition Category (HCC) risk score and baseline total Medicare payment covariates were constructed using 2007–2008 Medicare claims data.

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Table 4. Regression estimates for the association between levels of continuity of care (COC), NCQA-PCMH recognition, and Medicare payments

	Model with NCQA-PCMH Recognition and Continuity of Care Level[a]					
	NCQA-PCMH Recognition			High versus Low Continuity of Care[b]		
Dependent Variable	Coefficient Estimates on the PCMH Variable	Standard Error	P-value[c]	Coefficient Estimates on the High COC Variable	Standard Error	P-value[c]
Total Medicare payments	–$680	367.52	0.06	–$1,872	803.68	0.02
Total physician payments	–$303	128.14	0.02	–$503	148.99	<0.01
Acute care hospital payments	–$324	211.57	0.13	–$1,053	507.56	0.04
Outpatient department payments	–$221	51.25	<0.01	$105	84.48	0.21
ACSC acute care inpatient payments	$43	103.75	0.68	–$480	210.78	0.02
ACSC acute care inpatient payments with 30 days of post-acute care	$135	195.12	0.49	–$820	408.26	0.05
Medical acute care inpatient payments	$62	119.13	0.60	–$517	255.04	0.04
Medical acute care inpatient payments with 30 days of post-acute care	$187	217.90	0.39	–$879	465.06	0.06
ACSC ED/observation bed payments	–$66	9.93	<0.01	$7	17.78	0.68

ACSC = ambulatory care sensitive conditions; ED = emergency department; NCQA = National Committee for Quality Assurance; PCMH = Patient-Centered Medical Home.

[a] The model also included the following independent variables: practice characteristics such as size of practice and number of assigned beneficiaries; clinician specialty mix of each practice; practice urbanicity; practice geographic region; beneficiary characteristics; the previous period's (2007–2008) mean beneficiary Medicare payments, and mean beneficiary health status.

[b] High COC practices (N) = 263; Medium COC practices (N) = 185; Low COC practices (N) = 176. The association of medium care continuity was examined but is not reported in this table because the coefficients were not significant at $p < 0.05$ in any of the models (see Table A.1 in the Appendix).

[c] P-values are generated using weighted least squares regression modeling.

Sources: Medicare Part A and B claims and Medicare's Enrollment Database, 2009–2010 and 2007–2008. Only Hierarchical Condition Category (HCC) risk score and baseline Medicare total payment covariates were derived from 2007–2008 Medicare claims data.

total annual Medicare payments for practices with a high level of care continuity ($p = 0.02$). Patients in practices with high COC index scores also had, on average, lower physician payments (–$503, $p < 0.01$), lower all-cause acute care hospital payments (–$1,053, $p = 0.04$), lower ACSC acute care inpatient payments without PAC services included (–$480, $p = 0.02$) and with PAC (–$820, $p = 0.05$), and lower medical acute care inpatient payments without PAC (–$517, $p = 0.04$) than patients in practices with low scores. We observed no statistically significant differences between medium care continuity and low care continuity practices after controlling for NCQA recognition (results are available in the Appendix).

Discussion

Previous research showed that NCQA PPC-PCMH recognition is associated with lower Medicare payments for FFS beneficiaries (van Hasselt et al., 2015). Our study extends these analyses by examining whether care continuity, an element of NCQA PPC-PCMH recognition, contributes to these favorable results.

Our analyses confirmed the relationship between NCQA PPC-PCMH recognition and Medicare payments found by Van Hasselt and colleagues. NCQA PPC-PCMH recognition was associated with significantly lower average total Medicare payments

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(–$1,099) and payments for several categories of services. The negative association with payments remained after controlling for level of care continuity (–$680), but the reduction was almost 40 percent lower than in the model without this control and no longer statistically significant at $p < 0.05$. This indicates that the cost savings associated with NCQA PPC-PCMH recognition are partly due to higher levels of care continuity in these practices. Yet, the fact that the association between PCMH recognition and total Medicare payments after controlling for level of care continuity is close to being statistically significant ($p = 0.06$) indicates that other aspects of PCMH recognition, in addition to care continuity, may contribute to cost savings.

Controlling for PCMH recognition, patients in practices with high care continuity scores had significantly lower average total Medicare payments (–$1,872) and significantly lower levels of payments for several sets of services important to the Medicare FFS population than did beneficiaries in practices with low levels of care continuity. The negative association between high care continuity and payment outcomes was substantially larger than the association found for PCMH recognition alone. This finding suggests that care continuity has critical cost implications regardless of whether a practice has achieved formal NCQA PPC-PCMH recognition. Although we observe a strong association between high care continuity and lower Medicare payments, further research is needed to understand how practices are achieving these better outcomes.

This study had five main limitations. First, the COC index has a value of 1 (i.e., "full continuity") when all visits are to the same clinician regardless of the number of visits. Thus, individuals with smaller numbers of visits have a higher chance of having a score of 1 than those with more visits. Despite this, research shows that COC index scores are highly correlated with other COC measures for both low and high numbers of visits (Smedby, Eklund, Eriksson, & Smedby, 1986). Additionally, because our study aggregated beneficiary-level COC scores up to the practice level, the impact of beneficiaries with small numbers of visits on a practice's COC score is reduced.

Second, the COC index is based on physician visits for E&M services, which is a component of two outcomes in our analyses—total Medicare payments and total physician payments. Regression estimates may be biased as a result of endogeneity that arises from the fact that the COC index and payments are driven in part by a common variable—E&M visits. However, E&M services constitute only a small portion of both payment outcomes, which mitigates concerns about endogeneity. We estimate that E&M services constitute approximately 6 percent[6] of total Medicare payments. Furthermore, because we only included primary care E&M services, the E&M visits included constitute a fraction of the overall E&M services that can be provided. Thus, the potential for endogeneity is further diminished. Our findings for the association of the COC index with total Medicare payments and total physician payments are generally consistent with findings for other outcomes for which endogeneity is not a concern. Nonetheless, in this study we focused on associations rather than causal effects because of the potential for endogeneity.

Third, this study may have been affected by sampling bias arising from how we selected the 312 comparison practices. Research indicates that using propensity score matching to select a comparison group sample can introduce sampling bias because, often, it effectively matches the treatment and comparison groups only on observable characteristics and not unobservable characteristics (King et al., 2011). Other methods, such as coarsened exact matching, have been shown to deliver comparison group matches that coincide with the treatment group across a larger number of variables than propensity score matching (Iacus, King, & Porro, 2011). We divided our practices into subclasses before matching and included two component weights, the propensity score weight and the eligibility fraction weight, and we included covariates to make the matching more robust—yet, we cannot rule out the possibility of some residual estimation bias resulting from an imbalance in unobserved confounding factors that affect payments.

[6] Authors' calculation. The Office of Inspector General (OIG) reported that Medicare payments for Part B E&M services was $33.5 billion in 2010 (DHHS OIS, 1). According to the 2010 National Health Expenditure Accounts, total Medicare payments in 2010 were $524.6 billion (CMS, 2010).

Another source of bias was due to differences in how we selected the 312 PCMHs and the 312 comparison practices. Practices with NCQA PPC-PCMH recognition had to agree to participate in our study, and only 28 percent of eligible practices agreed. By contrast, we selected comparison practices using claims data and a propensity score matching methodology, and they did not have to agree to participate. Also, although we know that the comparison group practices did not have NCQA PPC-PCMH recognition status during the study timeframe, we do not know whether the comparison practices could have qualified but simply did not seek NCQA PPC-PCMH recognition.

Fourth, we limited the study to Medicare payments and health service use during a 1-year time period. Future research could extend these findings by examining outcomes over a longer time period and including health outcomes to examine whether care continuity is associated with lower Medicare payments and improved outcomes.

Finally, care continuity can be measured across multiple levels of a beneficiary's care experience —longitudinal and informational. Longitudinal continuity refers to the ongoing relationship between a patient and a particular medical practice; for example, a patient with high longitudinal continuity has a long-term relationship with one or possibly a few clinicians who have cared for that patient over many years and multiple illness episodes (Saultz, 2003). Informational continuity relates to the comprehensiveness of the patient health care information that clinicians have—for example, whether the clinician has information on a patient's previous health care encounters. The COC index that was used in this study measures care continuity from a longitudinal perspective, albeit over a relatively short 1-year horizon. The COC index does not address the informational aspects of care continuity directly, although there is an implicit assumption that having a higher concentration of visits with or through referral from the usual care provider reduces the barriers to information exchange. Other measures of care continuity are needed to capture the informational dimension of care continuity. For example, measures could be based on a clinician survey or could rely on electronic health record and health information exchange-based measures to assess the transfer of information from clinician to clinician (Abrams & Crow, 2011). Continued research is needed to understand whether beneficiaries with high care continuity scores as measured in this work have equally high informational care continuity.

In January 2015, CMS launched a new care coordination Medicare payment code. This code will reimburse clinicians up to $40.39 per qualifying patient. In light of this new payment code, it is increasingly important for CMS to understand what aspects of care coordination and continuity are most critical for reducing Medicare costs and improving health quality.

Also, over the past decade, CMS has introduced numerous initiatives and programs, such as the Multi-Payer Advanced Primary Care Practice Demonstration and the Comprehensive Primary Care Initiative, focused on improving care coordination and lowering Medicare payments (Jaen et al., 2010; McDonald et al., 2007; Peikes et al., 2012; Takach, Townley, Yalowich, & Kinsler, 2015). Our analyses show that higher levels of care continuity partly explain the association between PCMH recognition from NCQA and lower Medicare payments, which was demonstrated in previous research (van Hasselt et al., 2015) and confirmed in our study. More important, this study indicates that higher levels of care continuity, as measured using Bice and Boxerman's COC index, are associated with lower Medicare payments regardless of NCQA PPC-PCMH recognition status. Therefore, we find that encouraging Medicare beneficiaries to seek care from a usual source of care such as a medical home or from a provider referred by a usual source of care practice—regardless of whether the practice has NCQA PPC-PCMH recognition—could be a key factor in reducing health care costs.

Further research would be helpful to identify the exact mechanisms and clinician behaviors by which care continuity lowers Medicare payments. For example, are clinicians at practices with high care continuity more likely to use electronic health records to share patient files and notes than their counterparts

at practices with low care continuity? Or do staff at practices with high care continuity follow up with their patients over the phone after a referred visit? In light of the strong association between continuity of care and lower costs demonstrated in this study, future studies should also explore the contribution of care continuity to achieving the other aspects of the triple aim—improved quality and enhanced patient health outcomes.

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Appendix

Table A-1. Regression estimates for the association between levels of continuity of care (COC), NCQA PCMH recognition, and Medicare payments

Dependent Variables	High vs. Low Continuity of Care[a]			Medium vs. Low Continuity of Care[a]		
	Coefficient Estimates on the High COC Variable	Standard Error	P-value[b]	Coefficient Estimates on the Medium COC Variable	Standard Error	P-value[b]
Total Medicare payments	−$1,872	803.68	0.02	−$1,210	886.45	0.17
Total physician payments	−$503	148.99	<0.01	−$6	197.22	0.98
Acute care hospital payments	−$1,053	507.56	0.04	−$1,014	547.95	0.06
Outpatient department payments	$105	84.48	0.21	−$53	81.05	0.51
ACSC acute care inpatient payments	−$480	210.78	0.02	−$383	221.04	0.08
ACSC acute care inpatient payments with 30 days of post-acute care	−$820	408.26	0.05	−$689	432.19	0.11
Medical acute care inpatient payments	−$517	255.04	0.04	−$467	272.53	0.09
Medical acute care inpatient payments with 30 days of post-acute care	−$879	465.06	0.06	−$825	494.77	0.10
ACSC ED/observation bed payments	$7	17.78	0.68	$24	18.35	0.19

ACSC = ambulatory care sensitive conditions; ED = emergency department; NCQA = National Committee for Quality Assurance; PCMH = Patient-Centered Medical Home.

Note: The model also included the following independent variables: practice characteristics such as size of practice and number of assigned beneficiaries; clinician specialty mix of each practice; practice urbanicity; practice geographic region; beneficiary characteristics; and the previous period's (2007–2008) mean beneficiary Medicare payments, and mean beneficiary health status.

[a] High COC practices (N) = 263; Medium COC practices (N) = 185; Low COC practices (N) = 176.

[b] P-values are generated using weighted least squares regression modeling.

Sources: Medicare Part A and B claims and Medicare's Enrollment Database, 2009–2010 and 2007–2008. Only HCC risk score and baseline Medicare total payment covariates were derived from 2007–2008 Medicare claims data.

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