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Coordination Within Teams and The Cost of Health Care

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Abstract: We examine how primary care physicians (PCPs) assemble teams of specialists to care for their patients. In our model, PCPs can invest in a relationship with specialists that requires upfront costs but has benefits for care coordination. PCPs who work with fewer specialists (have higher *referral concentration*) invest more in relationship-specific capital. Using the Massachusetts APCD, we show that this team-based coordination of care measure is virtually uncorrelated with existing patient-based coordination of care measures. We identify the effect of referral concentration on spending by comparing the spending of individuals who see the same specialist, but come from PCPs with different referral concentration. We use the same technique with standardized prices to distinguish whether the effects are a result of specialist prices or utilization effects. We find that a one standard deviation increase in coordination of care by a PCP (a change of 0.05 in HHI) reduces average costs by 2.2%.

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A rich body of literature in health services research and health economics links poor care coordination to higher costs.[1] The theory motivating this research is that having a well-coordinated team of providers enables better monitoring for overuse and duplication, easier information handoffs and a clearer division of responsibilities for patient care. The net result is less waste, less duplication, fewer errors and lower costs. Care coordination may be suboptimally low in fee-for-service payment systems that compensate providers for performing procedures but not for coordinating among doctors to avoid procedures. Promoting coordination among teams of providers is the rationale for policy initiatives ranging from Accountable Care Organizations to Patient Centered Medical Homes to public subsidies for provider investments in health information technologies.

Recent research has found that measures of coordination are negatively associated with healthcare costs.[2] If this association were causal, it would be powerful evidence in favor of policies and management practices promoting coordinated care. The limitations of prior studies, however, makes it difficult to have confidence that this is indeed a causal effect. The first of these limitations is that these studies rely on a measure of care coordination that focuses on the experience of *individual* patients. If a patient's encounters are distributed across a large number of providers, so the thinking goes, provider coordination of care for that patient is likely to be more difficult. But this approach conflates an *individual patient's* care with the problem of coordinating care delivered across a *team* of

[1] See for example Hussey et. al. (2014); Romano et. al (2015); and Milstein and Gilbertson (2009). In economics care coordination is often referred to by the obverse term, "care fragmentation". For a discussion and review of the literature on fragmentation see Cebul et. al. (2008); Frandsen and Rebitzer (2014); and Rebitzer and Votruba (2011). The problem of building organizations and institutions that coordinate the activities of specialized providers has implications that extend beyond health care costs. See, for example, Meltzer's (2001; 2010) work on hospitalists. For a general analysis of specialization and coordination see Becker and Murphy (1992).

[2] See for example Hussey et. al. (2014); and Frandsen et. al. (2015)

providers. To see the significance of this distinction, imagine a PCP who refers each of her chronically ill patients to 2 specialists: a cardiologist and an endocrinologist. The PCP can choose to make each of her patient's referrals to the same cardiologist and the same endocrinologist, or could use a different cardiologist and endocrinologist for each patient. In both these cases, the distribution of an individual's care across providers are the same. But in the former case the *team's* level of care is much more concentrated than in the latter and so team coordination is easier to achieve in the former than the latter. If it is coordination at the *team* level that matters for costs, much of the recent literature is built upon measures constructed at the wrong level.

Reliance on individual as opposed to team measures of the coordination of care introduces important econometric complications. Individual measures of care coordination are, to a first approximation, functions of the number of providers an individual sees (Craig E. Pollack, Peter S. Hussey, Robert S. Rudin, Steven D. Fox, Julie Lai and Eric C. Schneider. 2013). Thus patients who visit more doctors because of the severity or complexity of their conditions are likely to score lower on individual measures of care coordination. But these same patient characteristics are also likely to increase the cost of the care patients receive. Thus a cross-sectional regression of individual costs on individual care coordination measures will *overstate* the causal effect of coordination unless the regressions include a complete set of controls for each patient's clinical conditions. Unfortunately, most large-scale studies of care coordination rely on the billing records of commercial health insurers or Medicare. These records offer a detailed and rich but also quite incomplete view of a patient's clinical condition and so leave lots of scope for omitted variables.

The problem of omitted patient level variables is magnified by the fact that PCPs do not randomly assign specialists to patients. Rather, they send a patient to an additional provider because something in the patient's condition warrants that visit. If referrals are a response to clinical information available to the PCP but not the econometrician, then it follows that the number of providers an individual sees - or equivalently the patient's individual coordination of care measure- should be included as a control variable in any cross-sectional cost regression. Thus if measures of team-based care coordination are closely correlated with individual measures of coordination of care, identifying the causal effects of coordination of care may not be possible at all.

The final limitation of prior studies of care coordination concerns the nature of the samples used to identify referrals. Studies of the non-Medicare population tend to rely either on the billing records of a single commercial insurer or a subset of employers. Studies of the Medicare population generally rely upon a 20% Medicare sample. These samples likely do a good job capturing the concentration of care for the providers that individual patients included in the sample actually see. These samples are, however, likely to miss many of the provider-to-provider referrals required to measure team based coordination. Mitigating this measurement error requires much more comprehensive samples than have previously been available for analysis.

In this paper, we estimate the association between care coordination and costs in ways designed to address the limitations of prior studies. Our analysis begins with a simple model of physician team formation in which PCPs refer patients to specialists. This model treats team level care coordination outcomes as the endogenous result of both patient characteristics and organizational/institutional factors that vary at the team level. By

clearly specifying these factors, we can clarify the assumptions under which it is possible to identify the causal effect of team coordination on costs in a cross-sectional study.

We develop a team level coordination of care measure, which we term *referral concentration*. We calculate the PCP's Herfindahl–Hirschman Index (HHI) for referrals for each specialty—i.e. does the PCP refer to a single cardiologist (high HHI, high "market" concentration) or to many different cardiologists (low HHI, low market concentration). This empirical measure that proxies for coordination of care, since more concentrated referrals allows for better communication and relationship-specific capital. It is essentially the PCP analogue of the patient-based coordination of care measures (see Figure 1): instead of asking how many different physicians are providing care to a given patient, we ask how many different specialists a PCP is working with to provide care to her patient panel.

Our data is All Payer Claims Data (APCD) for the state of Massachusetts (see Ericson and Starc 2015 for a description). This new data, which is a 100% sample of commercially insured patients in the state, encompasses a larger fraction of provider to provider referrals than has been available in other data sets from commercial insurers and so reduces measurement error in team level coordination of care measures. This data also allows us to distinguish between utilization and spending: for each patient, we calculate spending at the observed prices (as negotiated between insurer and provider) as well as at standardized prices. As a result, we can decompose the lower spending resulting from team coordination of care into a utilization effect (fewer procedures) and a price effect (cheaper providers).

We find that referral concentration has a large association with costs but is nearly uncorrelated with individual coordination of care measures used in prior studies. Moreover, referral concentration is a stable characteristic at the PCP level: PCPs who refer to a large number of specialists of one type (e.g., cardiologists) similarly spread referrals around across a large number of providers in other specialties (e.g. endocrinologists).

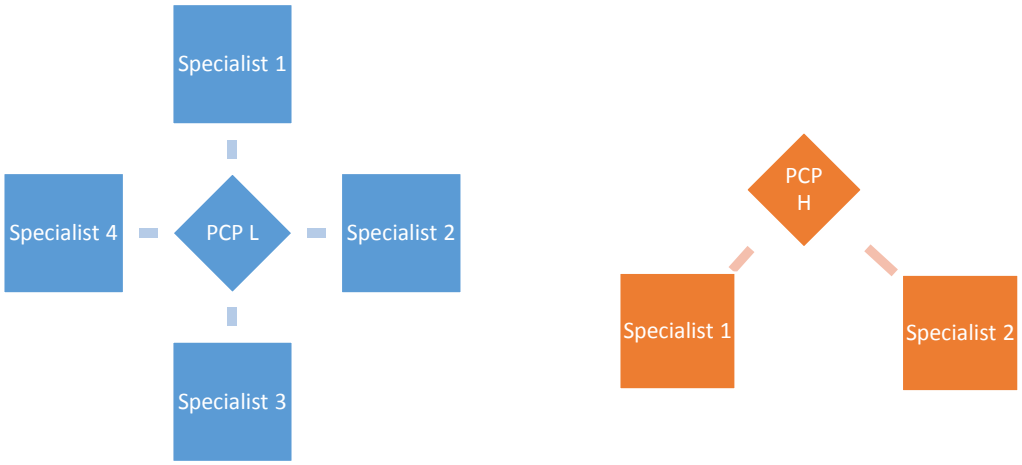
Our first set of empirical estimates (Table 2) team level coordination of care measures for every PCP against patient costs for all enrollees with a chronic condition. The regressions also include a detailed vector of patient characteristics (including risk adjustment score and controls for specific conditions), the number of physicians seen by the patient, and physician characteristics. It shows a significant relationship between referral concentration and spending. We find that a one standard deviation increase in coordination of care by a PCP (a change of 0.05 in HHI) reduces average costs by 2.2%. These results are both statistically and economically significant.

Our second set of estimates (Table 3) add fixed effect controls to the regression for each individual specialist. Thus, in Table 3, we identify the effect of care coordination by comparing two patients who saw the same cardiologist, one of whom came from a PCP with low referral concentration versus one who came from a PCP with high referral concentration. These regressions show a slightly smaller, but still strong effect of referral concentration on spending.

Body of Paper Forthcoming.

Panel A: PCP with Low Team-based Coordination of Care Measure (*Referral Concentration*)

Panel B: PCP with High Team-based Coordination of Care Measure (*Referral Concentration*)



Panel C: Patient with Low Patient-based Coordination Measure

Panel D: Patient with High Patient-based Coordination Measure

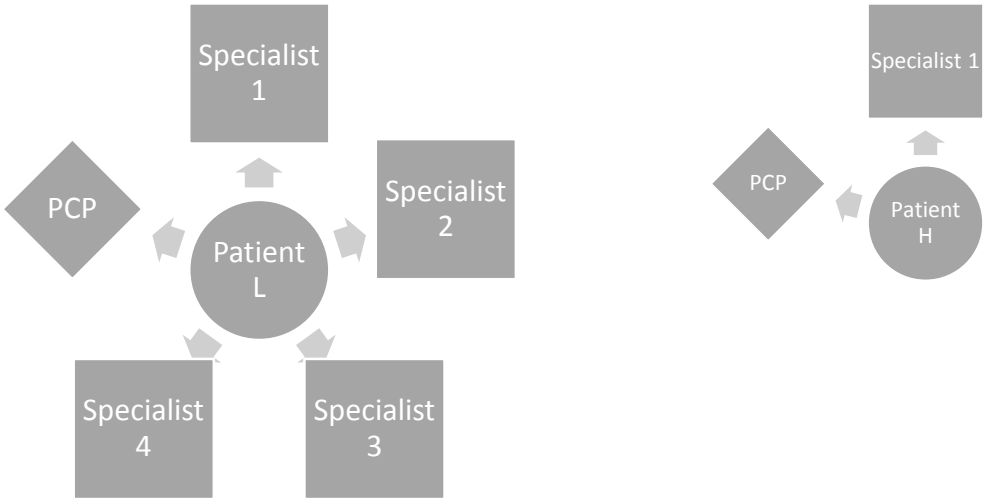


Figure 1. Referral Concentration versus Patient-Based Measures of Care Coordination. Links in Panels A and B are comprised of patients of the PCP who also see the connected specialist. Arrows in Panels C and D are patients visiting the listed physicians.

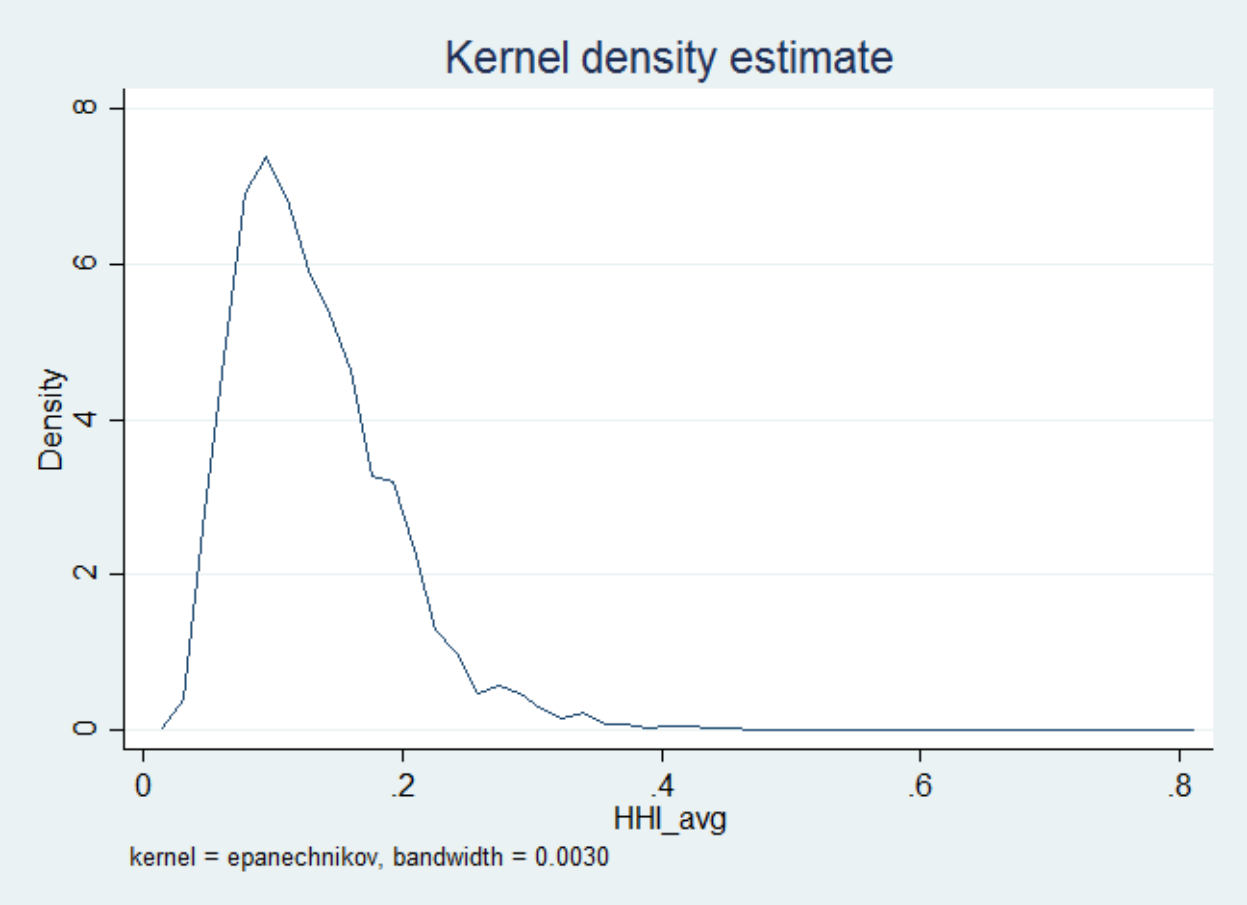


Figure 2. Distribution of Patients' Physician Level Referral Concentration. One observation per patient.

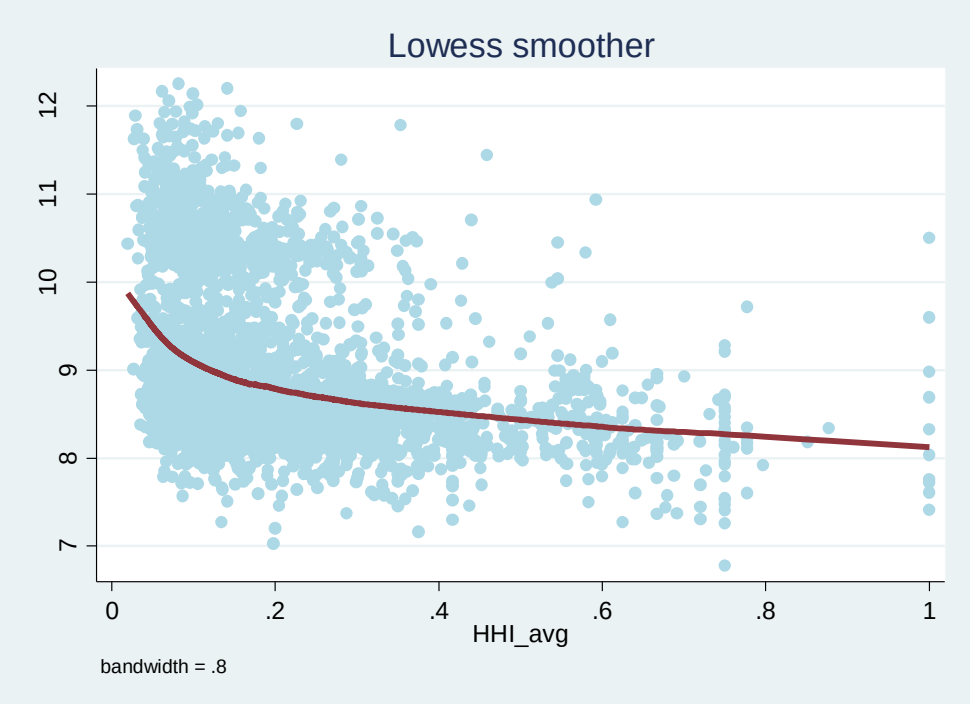


Figure 3. Association between Referral Concentration (HHI) and Spending.

	HHI: orthopedics	HHI: endocrinology	HHI: OBGYN	HHI: dermatology	HHI: emergency	HHI: average
HHI: orthopedics	1.00					
HHI: endocrinology	0.18	1.00				
HHI: OBGYN	0.37	0.22	1.00			
HHI: dermatology	0.36	0.24	0.39	1.00		
HHI: emergency	0.27	0.22	0.24	0.27	1.00	
HHI: average	0.60	0.73	0.65	0.69	0.45	1.00

Table 1. Correlation Matrix of Specialty Specific Referral Concentration Measures

	(1)	(2)	(3)	(4)	(5)	(6)
		log(spending)			log(standardized spending)	
PCP's Referral Concentration (HHI Avg)	-1.946***	-0.630***	-0.433***	-1.438***	-0.317***	-0.331***
	(0.117)	(0.0811)	(0.0814)	(0.101)	(0.0657)	(0.0641)
Number of Unique Physicians Seen by Patient		0.249***	Spline		0.254***	Spline
		(0.00180)			(0.00181)	
Patient Risk Score		0.0657***	Spline		0.0613***	Spline
		(0.00180)			(0.00175)	
Patient Age		0.00749***	Spline		0.00598***	Spline
		(0.000149)			(0.000148)	
Patient Zip Fixed Effects	No	Yes	Yes	No	Yes	Yes
Physician Zip Fixed Effects	No	No	Yes	No	No	Yes
HCC Category Fixed Effects	No	No	Yes	No	No	Yes
Additional Controls	No	Yes	Yes	No	Yes	Yes
N Patients	642,550	642,538	642,538	639,855	639,844	639,844
R2	0.006	0.488	0.591	0.003	0.479	0.580

Additional Controls: PCP average patient risk score (as spline), insurer fixed effects, PCP specialty, PCP Number of patient referred to each specialty (as spline).

Standard errors clustered at the PCP level.

Table 2. Regressions of Spending on Referral Concentration.

	log(spending)	log(standardized spending)
PCP Referral Concentration (HHI)	-0.331***	-0.285***
	(0.0808)	(0.0697)
Number of Unique Physicians (Spline)	Yes	Yes
Patient Risk Score (Spline)	Yes	Yes
Primary Cardiologist Fixed Effects	Yes	Yes
Primary Orthopedist Fixed Effects	Yes	Yes
Primary Endocrinologist Fixed Effects	Yes	Yes
Primary OBGYN Fixed Effects	Yes	Yes
Primary Dermotologist	Yes	Yes
Other Controls	Yes	Yes
N Patients	359,768	358,897
R2	0.610	0.600

Table 3. Effect of Referral Concentration on Spending, Holding Constant Specialists Seen

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