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PHYSICIAN BELIEFS AND PATIENT PREFERENCES: A NEW LOOK AT REGIONAL VARIATION IN HEALTH CARE SPENDING

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ABSTRACT

There is considerable controversy about the causes of regional variations in healthcare expenditures. We use vignettes from patient and physician surveys, linked to Medicare expenditures at the level of the Hospital Referral Region, to test whether patient demand-side factors, or physician supply-side factors, explains regional variations in Medicare spending. We find patient demand is relatively unimportant in explaining variations. Physician organizational factors (such as peer effects) matter, but the single most important factor is physician beliefs about treatment: 36 percent of end-of-life spending, and 17 percent of U.S. health care spending, are associated with physician beliefs unsupported by clinical evidence.

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Regional variations in rates of medical treatments are large in the United States and other countries (Skinner et al., 2012). For example, in the U.S. Medicare population over age 65, price-adjusted per-patient Medicare expenditures ranged from under $7,000 to nearly $14,000, with most of the variation unexplained by regional differences in patient illness or poverty.

What drives such variation in treatment and spending? One possibility is patient demand. Many studies of variations have been conducted in environments where all patients have a similar and fairly generous insurance policy,[1] so price and income differences are unlikely to be large. Still, heterogeneity in patient preferences for care may play a role. In very acute situations, some patients may prefer to try all possible measures, while others may prefer palliation and an out-of-hospital death. If patients with similar preferences group together geographically – for example, if people who value life-prolonging treatments live in areas with world-class interventional physicians – patient preference heterogeneity could lead to regional variation in equilibrium outcomes (Anthony et al., 2010; Mandelblatt et al., 2012;).

Another possible source of variation arises from the supply side. "Supplier-induced demand" describes a situation in which a health care provider shifts a patient's demand curve beyond what the patient would want. This would be true in a principle-agent framework (McGuire and Pauly, 1991), if prices are high enough (and income scarce). While physician utilization has been shown to be sensitive to prices (Jacobson et al., 2006, Clemens and Gottlieb, 2012), it would be difficult to explain observed Medicare variations using profit margins alone, since reimbursement rates are set administratively and do not vary greatly across areas.

Variation in desired supply may also result from non-monetary incentives. Physicians could respond to organizational pressure or peer pressure to perform more procedures, even if

[1] This is generally true in the U.S. Medicare program. The presence of supplemental insurance coverage differs across the country, but most studies do not find that these differences affect utilization by more than a small degree (McClellan and Skinner, 2006).

their current income is no higher as a consequence. Physicians might also have differing beliefs about appropriate treatments, particularly for conditions where there are few professional guidelines (Wennberg et al., 1982). These differences in beliefs may arise because of differences in where physicians received medical training (Epstein and Nicholson, 2009) or their personal experiences with different treatments (Levine-Taub et al., 2011). If this variation is correlated spatially – for example, if intensive physicians are more likely to hire physicians with similar views – the resulting regional differences in beliefs could explain regional variations in equilibrium spending.

It has proven difficult to estimate separately the impact of physician beliefs, patient preferences, and other factors as they affect equilibrium healthcare outcomes, largely because of challenges in identifying factors that affect only supply or demand (Dranove and Wehner, 1994). We address this problem using "strategic surveys," as in Ameriks et al. (2011), in which we use survey vignettes to elicit motivation and clinical beliefs of physicians (suppliers), and attitudes and preferences of patients (demanders) as well as intervention-specific preferences from both groups. These responses are then linked to utilization measures at the regional level, which allows us to estimate directly how supply and demand factors affect regional healthcare utilization.

Patient preferences are measured by a survey of Medicare enrollees age 65 and older asking about whether they would want a variety of aggressive care interventions. We focus on the tradeoff between invasive procedures with potential longevity benefits versus palliative care and comfort at the end of life. Physician beliefs are captured by two surveys, one of cardiologists and the second of primary care physicians. Both sets of physicians were presented with vignettes about four elderly individuals with chronic health conditions, and asked how they

would manage each one. Based on their responses, we characterize physicians along two non-exclusive dimensions: those who consistently and unambiguously recommended intensive care beyond guidelines ("cowboys"), and those who consistently recommended palliative care for the very severely ill ("comforters").

We first use these surveys to examine whether patient or physician preferences are more important in explaining regional variations in care. Our results show that physician preferences are significantly greater than patient preferences in explaining regional utilization patterns. In some models, we can explain over half of the variation in end-of-life spending across areas by knowing only how a small sample of physicians in an area would treat hypothetical patients. In contrast, patient preferences explain little of the cross-area variation.

We then try to understand why physicians have the treatment preferences they do, relating physicians' views about optimal treatment to questions about malpractice concerns, financial arrangements (fraction of Medicaid and capitated patients), and perceived organizational pressures (providing treatment for patients who expected but didn't need it, or doing a procedure because the referring physician expected it). We find that only a fraction of physicians claim to have made recent decisions as a result of purely financial considerations. We also find that "pressure to accommodate" either patients (by providing treatments that are not needed) or referring physicians (doing procedures to keep them happy and meet their expectations) have a modest but significant relationship with physician beliefs about appropriate care. While many physicians report making interventions as a result of malpractice concerns, these responses do not explain the residual variation in treatment recommendations.

Ultimately, the largest degree of regional variation appears to be due to differences in physician beliefs about the efficacy of particular therapies. Physicians in our data have starkly

different views about how to treat the same patients, and these views are not highly correlated with demographics, background, and practice characteristics, and are often not consistent with professional guidelines for appropriate care. As much as 36 percent of end-of-life Medicare expenditures, and 17 percent of overall Medicare expenditures, are explained by physician beliefs that cannot be justified either by patient preferences or by clinical effectiveness.

I. A Model of Variation in Utilization

We develop a simple model of patient demand and physician supply. The demand side of the model is a standard one; the patient's indirect utility function is a function of out-of-pocket prices (p), income (Y), and preferences for care (η); V = V(p, Y, η). Solving this for optimal intensity of care, x, yields x^D. As in McGuire (2011), we assume that x^D is the fully informed patient's demand for the quantity of procedures prior to any demand "inducement."

On the supply side, we assume that physicians seek to maximize the perceived health of their patient, s(x), by appropriate choice of inputs x, subject to patient demand (x^D), financial considerations, and organizational factors. Note that the function s(x) captures both patient survival and quality of life, for example as measured by quality-adjusted life years (QALYs).

Individual physicians are assumed to be price-takers (after their networks have negotiated prices with insurance companies), but face a wide range of reimbursement rates from private insurance providers, Medicare, and Medicaid. The model is therefore simpler than models in which hospital groups and physicians jointly determine quantity, quality, and price, (Pauly, 1980) or where physicians exercise market power over patients to provide them with "too much" health care (McGuire, 2011). Following Chandra and Skinner (2012), we write the physician's overall utility as:

$$(1) \qquad U = \Psi s(x) + \Omega(W + \pi x - R) - \phi(|x - x^D|) - \varphi(|x - x^O|)$$

where Ψ is perceived social value of improving health, Ω is the physician's utility function of own income, comprising her fixed payment W (a salary, for example) net of fixed costs R, and including the incremental "profits" from each additional test or procedure performed, π.[2] The sign of π depends on the type of procedure and the payment system a physician faces.

The third term represents the loss in provider utility arising from the deviation between the quantity of services the provider recommends (x) and what the informed patient demands (x^D). This function could reflect classic supplier-induced demand – from the physician's point of view, x^D is too low relative to the physician's optimal x – or it may reflect the extent to which physicians are acting as the agent of the (possibly misinformed) patient, for example when the patient wants a procedure that the physician does not feel is medically appropriate. The fourth term reflects a parallel influence on physician decision making from organizational factors that do not directly affect financial rewards, such as (physician) peer pressure.

The first-order condition for (1) is:

$$\Psi s'(x) = -\Omega'\pi + \phi' + \varphi' \equiv \lambda \quad (2)$$

Physicians provide care up to the point where the choice of x reflects a balance between the perceived marginal value of health, Ψs′(x), and factors summarized by λ: (a) the incremental change in net income π, weighted by the importance of financial resources Ω′, (b) the incremental disutility from moving patient demand away from where it was originally, ϕ', and (c) the incremental disutility from how much the physician's own choice of x deviates from her organization's perceived optimal level of intervention, φ'.

[2] We ignore capacity constraints, such as the supply of hospital or ICU beds.

In this model,[3] there are two ways to define "supplier-induced demand." The broadest definition is simply the presence of any equilibrium quantity of care beyond the level of the *ex ante* preferences of an informed patient, i.e. $x > x^D$. This is still relatively benign; the marginal value of this care may still be positive. More relevant is the sign of $s(x) - s(x^D)$; does the additional care enhance or diminish health outcomes? Supplier-induced demand could more narrowly be defined as $s(x) - s(x^D) \leq 0$; patients gain no improvement in health outcomes and may even experience a decline in health or a significant financial loss. Note that both of these definitions leave the question of physician *knowledge* of inducement undefined. That is, a physician with strong (but incorrect) beliefs may over-treat her patients, even in the absence of financial or organizational incentives to do so.

To develop an empirical model, we adopt a simple closed-form solution of the utility function for physician i:[4]

$$(1') \quad U_i = \Psi s_i(x_i) + \omega[W_i + \pi_i x_i - R_i] - \frac{\phi}{2}(x_i - {x_i}^D)^2 - \frac{\varphi}{2}(x_i - {x_i}^O)^2$$

Note that ω/Ψ reflects the relative tradeoff between the physician's income and the value of improving patient lives, and thus might be viewed as a measure of "professionalism." The first-order condition is therefore:

$$(2') \quad \Psi s_i'(x_i) = \lambda \equiv -\omega\pi_i + \phi(x_i - {x_i}^D) + \varphi(x - {x_i}^O)$$

Figure 1 shows $\Psi s'(x)$ and λ. Note that λ is linear in x with an intercept equal to $-(\omega\pi_i + \phi {x_i}^D + \varphi {x_i}^O)$. Note also the key assumption that patients are sorted in order from most appropriate to least appropriate for treatment, thus describing a downward sloping $\Psi s'(x)$ curve. The equilibrium is where $\Psi s'(x) = \lambda$, at point A. A shift in the intercept, which depends on

[3] A more general model would account for the patient's ability to leave the physician and seek care from a different physician, as in McGuire (2011).
[4] We are grateful to Pascal St.-Amour for suggesting this approach.

reimbursement rates for procedures π, taste for income ω, regional demand x^D, and organizational or peer effects x^O, would yield a different λ^*, and hence a different utilization rate. But all of these factors affect the intensity of treatments via a movement *along* the marginal benefit curve, $\Psi s'(x)$.

Alternatively, it may be that $s_i'(x)$ differs across physicians – productivity differs, rather than constraints. For example, if $s_i'(x) = \alpha_i s'(x)$, where $s'(x)$ is average physician productivity and α varies across regions, this would be represented as a shift in the marginal benefit curve. Point C in Figure 1 corresponds to greater intensity of care than point A and arises naturally when the physician is or believes she is more productive. For example, heart attack patients experience better outcomes from cardiac interventions in regions with higher rates of revascularization, consistent with a Roy model of occupational sorting (Chandra and Staiger, 2007). Because patients in regions with high intervention rates benefit differentially from these interventions, this scenario does not correspond to the narrow definition of "supplier-induced demand."

The productivity shifter α may also vary because of "professional uncertainty" – a situation where the physician's perceived α differs from the true α (Wennberg et al., 1982). For example, physicians may be overly optimistic with respect to their ability to perform procedures, leading to expected benefits that exceed actual realized benefits. Baumann et al. (1991) have documented the phenomenon of "macro uncertainty, micro certainty" in which physicians and nurses are sure that their treatment benefited a specific patient (micro certainty) even when there is no general consensus on which procedure is more clinically effective (macro uncertainty).

Much of the evidence from psychology[5] argues for overconfidence in one's own ability, leading to a natural bias towards doing more.

To see this in Figure 1, suppose the actual benefit is s′(x) but the perceived benefit is g′(x). The equilibrium is point C; the incremental treatment harms the patient, even though the physician believes the opposite. In equilibrium, this supplier behavior would appear consistent with classic supplier-induced demand, but the cause is quite different.

Empirical Specification. To examine these theories empirically, we consider variation in practice at the regional level (for reasons explained below). Taking a first-order Taylor-series approximation of equation (2′) for region i yields a linear equation that groups equilibrium outcomes into two components, demand factors Z^D and supply factors Z^S:

(4) $$x_i = \bar{x} + Z_i^D + Z_i^S + \varepsilon_i.$$

The demand-side component is:

(5) $$Z_i^D = \frac{\phi}{\mathrm{M}}(x_i^D - \bar{x}^D)$$

where $M = -\Psi s''(\bar{x}) + \phi + \varphi$. This first element of equation (5) reflects the higher average demand for health care, multiplied by the extent to which physicians accommodate that demand, ϕ. The supply side component is:

(6) $$Z_i^S = \frac{1}{M}\{\omega\Delta\pi_i + \pi\Delta\omega_i + \phi(x_i{}^O - \bar{x}^O) + \Psi s'(\bar{x})\Delta\alpha_i\}$$

The first term in equation (6) reflects how differences in profits in region i relative to the national average (Δπ) affect utilization. The second term reflects the extent to which physicians weight income more heavily. The third term captures organizational goals in region i relative to national

[5] If the patient gets better, the physician gets the credit, but if the patient gets worse, the physician is able to say that she did everything possible (Ransohoff et al., 2002).

averages ($x_i^O - \bar{x}^O$). The final term captures the impact of different physician beliefs about productivity of the treatment ($\Delta\alpha_i$); this term shifts the marginal productivity curve.[6]

Equation (4) can be expanded to capture varying parameter values as well – for example, in some regions physicians may be more responsive to patient demand (a larger ϕ_i). These interactive effects, considered below, reflect the interaction of supply and demand and would magnify the responses here.

II. Data and Estimation Strategy

In general, it is difficult to distinguish among demand and supply explanations for treatment variation; even detailed clinical data reveal only a subset of what the physician knows. Further, patient preferences and physician beliefs about the desirability or appropriateness of different procedures are unknown in *ex post* clinical data. In studying motives for household saving, Ameriks et al. (2011) implemented "strategic surveys" to identify demand and supply. We follow this approach here, using surveys asking potential patients about preferences for hypothetical end-of-life choices (that is, x^D before their interaction with the physician), and asking physicians how they would treat a set of hypothetical patients with varying disease severity, as well as questions about their financial and organizational constraints.

In an ideal world, patient surveys would be matched with surveys from their treating physicians. Because our data do not match physicians with their own patients, we instead matched supply and demand at the area level by HRR, or Hospital Referral Region.[7] In equation (4), we therefore define x to be a regional average spending measure. Our primary measure is the natural logarithm of risk-adjusted and price-adjusted Medicare expenditures in the last two years

[6] Note that these effects are scaled by 1/M, which depends on –s″. If returns to treatment do not decline rapidly, strongly-held physician opinions can lead to highly variable treatment rates (Chandra and Skinner, 2012).

[7] These HRRs are defined in the *Dartmouth Atlas of Health Care*, which divides the United States into 306 HRRs. Spending measures are based on area of residence, not where treatment is actually received.

of life. We also consider several other measures such as one-year risk- and price-adjusted expenditures for Medicare enrollees for hip fracture, and overall price-adjusted Medicare expenditures.

Our first estimation, based on Equation 4, asks whether area-level supply or demand factors can better explain actual regional expenditures. Our second estimates then seeks to understand why physicians hold the beliefs they do (Equation 6). For the latter, we relate individual physician vignette responses to financial and organizational factors. We interpret vignette responses that cannot be explained by demographic, organizational or financial incentives as reflecting primary physician beliefs (e.g., a shift in perceived marginal treatment curve from $\Psi s'(x)$ to $\Psi g'(x)$). We describe each survey in turn.

Patient Survey. The survey sampling frame was all Medicare beneficiaries in the 20% denominator file who were age 65 or older on July 1, 2003 (Barnato et al., 2009). A random sample of 4,000 individuals was drawn; the response rate was 65%. We limited the final sample to respondents who provided all variables of interest, leaving a total of 1,413 Medicare beneficiary surveys. The final sample of respondents reside in 64 of the larger HRRs, all of which have sufficient physician observations to be included in the empirical model.

We used responses to 5 survey questions, with the exact wording shown in Panel I of Appendix A. Since the questions patients respond to are hypothetical and typically describe scenarios that have not yet happened, we think of them as x^D, or preferences not affected by physician advice.

Two of the questions relate to unnecessary care, asking people if they would like a test or cardiac referral even if their primary care physician did not think they needed one (Table 1).[8] Overall, 73 percent of patients wanted such a test and 56 percent wanted a cardiac referral. There is wide variation across regions in averages responses to these question. Figure 2 shows the distribution of the share of patients responding that they wanted an unnecessary specialist referral for the 64 larger HRRs; the standard deviation of the area average is 10 percent. While some of this variation is likely due to small sample sizes within HRRs, we tested for the null of no regional variation by bootstrapping the distribution of area spending assuming people were randomly assigned to areas; p–values are reported in the last column of Table 1.

The three other questions, grouped into two binary indicators, measured preferences for end-of-life care. One reflected patients' desire for aggressive care at the end of life: whether they respond that they would want to be put on a respirator if it would extend their life for either a week (one question) or a month (another question). The second question asked, if the patient reached a point at which they were feeling bad all of the time, would they want drugs to make them feel better, even if those drugs might shorten their life. In each case, there is statistically significant variation across areas (Table 1).

Patients' preferences are generally positively correlated across items. For example, the correlation coefficient between wanting an unneeded cardiac referral and wanting an unnecessary test is 0.43 ($p < .01$). But other comparisons point to very modest associations, for example a -0.02 correlation coefficient between wanting palliative care and wanting to be on a respirator at the end of life.

[8] This question captures pure patient demand independent of what the physician wants. Note, however, that patients could still answer they would not seek an additional referral if they were unwilling to disagree with their physician.

Since survey responses may vary systematically by demographic covariates such as race and ethnicity; we create demographically-adjusted HRR-level measures of preferences by adjusting for observed patient characteristics (race, age and sex).

Physician Surveys. A total of 999 cardiologists were randomly selected to receive the survey. Of these, 614 cardiologists responded, for a response rate of 61%. Seventeen physicians did not self-identify as cardiologists, and 88 physicians were missing crucial information such as practice type or practiced in HRRs with too few respondents to include in the analysis, leaving us a final sample of 509 cardiologists. These cardiologists practice in 64 HRRs, all of which have 3 or more cardiologists represented in the survey.

The primary care physician (PCP) responses come from a parallel survey of PCPs (family practice, internal medicine, or internal medicine/family practice). A total of 1,333 primary care physicians were randomly selected to receive the survey. The response rate was 73%. A total of 840 PCPs had complete responses to the survey and practiced in HRRs with enough local respondents to include in the analysis.

Physicians were asked about a number of clinical vignettes, discussed in the next section, as well as a variety of characteristics of their practices. Two measures of financial circumstances are reported in Table 1 for all physicians: the share of patients for whom they are reimbursed on a capitated basis (on average, 16 percent), and the share of a physician's patients on Medicaid (10 percent), with both factors generally associated with lower marginal reimbursement.

A second set of questions asks about characteristics of the physician and her practice. Twenty-nine percent are in small practices, 60 percent are in single or multi-specialty group practices, and 11 percent are in HMOs or hospital-based practices. We also observe a number of

characteristics about the physician, including age, gender, whether the physician is board certified, and the number of weekly patient days practiced.

Third, the survey asks about physician's actual responsiveness to external incentives over the past year, including how frequently, if ever, in the past 12 months they have intervened for non-clinical reasons. We create a set of binary variables that indicates whether a physician responded to each set of incentives at least "sometimes" (i.e. "sometimes" or "frequently") over the past year. Ten percent of cardiologists reported that they had sometimes or frequently performed a cardiac catheterization because of the expectations of the referring physician; 41 percent of all physicians did so because of colleague's expectations (Table 1).

Medicare Utilization Data. We match the survey responses with expenditure data by HRR. Our primary measure is Medicare expenditures in the last two years of life for enrollees over age 65 with a number of fatal illnesses.[9] All HRR-level measures are adjusted for age, sex, race, differences in Medicare reimbursement rates and the type of disease (including an indicator for multiple diseases). This measure implicitly adjusts for differences across regions in health status; an individual with renal failure who subsequently dies is likely to be in similar (poor) health regardless of whether she lives in West Virginia or Oregon.[10] End-of-life measures are commonly used to instrument for health care intensity, (e.g., Fisher et al., 2003), are highly correlated with other medical expenditure measures such as one-year expenditures following a heart attack (Skinner et al., 2010), and do not appear sensitive to the inclusion of additional individual-level risk-adjusters (Kelley, et al., 2012). In sensitivity analysis, we consider price-

[9] These include congestive heart failure, cancer/leukemia, chronic pulmonary disease, coronary artery disease, peripheral vascular disease, severe chronic liver disease, diabetes with end organ damage, chronic renal failure, and dementia.

[10] If more intensive spending saves lives, then in regions with more intensive spending, fewer die, leading to potential biases in the end-of-life measure (Bach et al., 2004). However, the bias can be either positive or negative, and, given conventional estimates of cost-effectiveness in end-of-life spending, the magnitude of the bias would be small.

adjusted Medicare expenditures for all fee-for-service enrollees age 65 and above, and a "forward looking" measure of one-year expenditures following hospital admission for a different severe condition, hip fracture. The HRR-level price-adjusted expenditures for the hip fracture cohort are adjusted for age, sex, race, comorbid conditions at admission, and the hierarchical condition categories (HCC) risk-adjustment index for the 6 months prior to admission. We focus on the 64 HRRs in the combined sample with a minimum of 3 cardiologists (average =5.4) and 2 primary care physicians (average = 7.9) surveyed. Among patients, we observe an average of 22 respondents per HRR.

III. Clinical Vignettes from the Physician Surveys

Since the clinical vignettes are crucial for our analysis, we describe them in some detail. We note first the obvious: responses to the vignette may not be what physicians would actually do in practice. Empirical evidence, however, strongly indicates that clinical vignettes closely predict how physicians intervene (Peabody et al., 2004; Mandelblatt et al., 2012; Dresselhaus et al., 2004).

We assume that the physician's responses to the vignettes are "all in" measures (Z^S, as in equation 6), reflecting physician beliefs as well as the variety of financial, organizational, and capacity-related constraints physicians face. Alternatively, one could interpret the physician's responses to the vignettes as a pure reflection of beliefs (for example, how one might answer for qualifying boards), and not as representative of the day-to-day realities of their practice. We tested this alternative explanation by including the organizational and financial variables in our estimation equations in addition to the vignette estimates. This did not appreciably increase the explanatory power of these equations.

One might alternatively argue that physicians in regions where most of their low-income patients are in poor health may "fill in" missing characteristics of the vignettes, and be more likely to recommend intensive care. Thus imperfectly risk-adjusted Medicare expenditures would be spuriously correlated with more intensive vignette recommendations. However, such physicians may be *less* likely to recommend intensive medical or surgical treatments, since outcomes are dependent on coordinated follow-up care that may not be available to patients living in low-income neighborhoods.

The detailed clinical vignette questions are in Appendix A (Panel II); summary statistics are presented in Table 1. We begin with the vignette for Patient A, which asks how frequently the physician would schedule routine follow-up visits for patients with stable angina whose symptoms and cardiac risk factors are now well controlled on current medical therapy (cardiologists) or patients with hypertension (primary care physicians). The response is unbounded, and expressed in months, which in practice ranged from 1 month to 24 months. Figure 3 presents a HRR-level histogram of averages from the cardiology survey for all regions with at least 3 cardiologists.

How do these responses correspond to guidelines for managing chronic stable angina? While diagnosis and management of coronary artery disease (the cause of angina) is the most common clinical issue faced by cardiologists on a day-to-day basis, there are no hard data to support any recommendation. The 2005 American College of Cardiology/American Heart Association [ACC/AHA] guidelines (Hunt et al., 2005) – what most cardiologists would have considered the "Bible" in the field at the time the survey was fielded – were very imprecise: they recommended follow-up every 4-12 months. However, even with these broad recommendations,

we find that over one fifth (23%) of cardiologists in the sample recommend follow-up visits more frequently than every 4 months.

The equivalent follow-up measure for primary care physicians is for a patient with well-controlled hypertension. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (U.S. Department of Health and Human Services, 2004), which would have been the most current guideline recommendation at the time, suggests follow up every 3-6 months based on expert opinion.

We define a "high follow up" physician as one who recommends follow-up visits more frequently than clinical guidelines would suggest and a "low follow up" physician as one who recommends follow-up visits less frequently than clinical guidelines would suggest. By this definition, fewer than 1 percent of cardiologists and 9 percent of PCPs in our data are classified as "low follow-up" physicians while 23 percent of cardiologists and 9 percent of PCPs are classified as "high follow-up" physicians.

Office visits are not a large component of physicians' income (or overall Medicare expenditures). Thus any correlation between the frequency of follow-up visits and overall expenditures would most likely be because frequent office visits are also associated with more highly remunerated tests and interventions (such as echocardiography, stress imaging studies, and so forth) that further set in motion the "diagnostic-therapeutic cascade," resulting in subsequent diagnostic tests, treatments, and follow-up visits (Lucas, et al., 2008). Thus the next two vignettes focus on patients with heart failure, a much more expensive setting. Heart failure is also natural to ask about because it is common, the disease is chronic, prognosis is poor, and treatment is expensive.

Vignettes for Patients B and C ask questions about the treatment of Class IV heart failure, the most severe classification and one in which patients have symptoms at rest. In both scenarios the patient is on maximal (presumably optimal) medications, and neither is a candidate for revascularization: Patient B already had a coronary stent placed without symptom change, and Patient C is explicitly noted to not be a candidate for this procedure. The key differences between the two scenarios are patients' ages (75 in the first, 85 in the second), the presence of asymptomatic non-sustained ventricular tachycardia in the younger man, and severe symptoms that resolve partially with increased oxygen in the older man.

Cardiologists in the survey were asked about various interventions as well as palliative care for each of these patients. For patient B, they were given five choices: three intensive treatments (repeat angiography; implantable cardiac defibrillator [ICD], and pacemaker insertion), one involving medication (anti arrhythmic therapy), and palliative care. Patient C also has three intensive options (admit to the ICU/CCU, placement of a coronary artery catheter, and pacemaker insertion), two less aggressive options (admit to the hospital (but not the ICU/CCU) for diuresis, and send home on increased oxygen and diuresis) and palliative care. In each case, cardiologists ranked their likelihood of recommending each intervention individually on a range from "never" to "always / almost always." Physicians could indicate strong or weak support for more than one option, for example, for both palliative care and an intervention.

We start with the obvious: regardless of the religious, political or moral persuasion of the cardiologist, these two men deserve a frank conversation about their prognosis and an ascertainment of their preferences for end-of-life care. One-year mortality for those with Class IV heart failure is nearly 50 percent. If compliant with the guidelines, therefore, every one of the

cardiologists should have answered "always/almost always", or at least "most of the time," to initiating or continuing discussions about palliative care.[11]

Studies have shown that patients, physicians and family members are often not on the "same page" when it comes to advanced directive planning (Connors, et al., 1995), and this shows up in the data. For Patient B, only 30 percent of cardiologists responded that they would take this course of action "most of the time" or "always/almost always." For Patient C, 43 percent of cardiologists and 50 percent of primary care physicians were likely to recommend this course of action most of the time or always/almost always. In both cases, physicians' recommendations fall short of clinical guidelines. We define our second index of physicians to reflect this. We classify the doctor as a "comforter" if the physician would discuss palliative care with the patient "always / almost always" for both Patients B and C (cardiologists) or just for patient C (primary care physicians). In our final sample, 29 percent of cardiologists and 44 percent of primary care physicians met the requirement for being a comforter.

We now turn to more controversial aspects of patient management. The language in the vignettes was carefully constructed relative to the contemp-oraneous guidelines. Several key aspects of Patient B rule out both the ICD and pacemaker insertion[12] and indeed the ACC-AHA guidelines explicitly recommend against the use of an ICD for Class IV patients potentially near death (Hunt et al., 2005; p. e206). On the other hand, both treatments are highly reimbursed.

Since patient C is already on maximal medications and is not a candidate for revascularization, the management goal should be to make him as comfortable as possible. This

[11] According to the AHA-ACC directives, "Patient and family education about options for formulating and implementing advance directives and the role of palliative and hospice care services with reevaluation for changing clinical status is recommended for patients with HF [heart failure] at the end of life." (Hunt et al., 2005, p. e206)

[12] This includes his advanced stage; his severe (Class IV) medication refractory heart failure; and the asymptomatic non-sustained nature of the ventricular tachycardia.

goal should be accomplished in the least invasive manner possible (e.g., at home), and if that is not possible in an uncomplicated setting, for example during admission to the hospital for simple diuresis. According to the ACC/AHA guidelines, no additional interventions are appropriate.[13] In fact, even a "simple" but invasive test, the pulmonary artery catheter, has been found to be of no marginal value over good clinical decision making in managing patients with CHF, and could even cause harm (ESCAPE, 2005).

Despite these guideline recommendations, physicians in our data show a surprising degree of enthusiasm for additional interventions. For patient B, nearly one-third of the cardiologists surveyed would recommend a repeat angiography some of the time, most of the time, almost always, and always. Similarly, 65 percent of cardiologists recommend an ICD most of the time, always or almost always, while 47 percent recommend a pacemaker. For patient C, 18 percent recommend an ICU/CCU admission, 2 percent recommend a pulmonary artery catheter and 15 percent recommend a pacemaker at least most of the time.

Our next measure of Z^S is based on a summary of these intensity recommendations. We start with the three most intensive interventions for both patients. Cardiologists' responses on aggressiveness are highly correlated across these two patients. Of the 28 percent (N=143) of cardiologists in the sample who would "frequently" or "always/almost always" recommend at least one of the above-listed high-intensity procedures for patient C, 93 percent (N=133) would also frequently or always/almost always recommend at least one high-intensity intervention for patient B. We use this overlap (the highest treatment recommendation overlap in our data) to define a "cowboy" cardiologist – a cardiologist who recommends at least one of the three possible intensive treatments to both patients B and C most of the time or always/almost always.

[13] Clinical improvement with a simple intervention (increasing his oxygen) also argues against more intensive interventions.

Because Vignette B was not presented to the primary care physicians, we use only their response to Vignette C to categorize them using the same criteria. In total, 27 percent of the cardiologists in our sample are classified as cowboys, as are 19 percent of the primary care physicians.

All told, we test four measures of Z^S: high or low frequency of follow-up visits, a dummy variable for being a cowboy, and a dummy variable for being a comforter. How are these measures related? Table 2 shows that among both PCPs and cardiologists, chi-squared tests strongly reject the null of no association between follow-up frequencies recommended for vignette patients and status as a "cowboy" or "comforter." Physicians with a low follow-up frequency are more likely to be comforters and less likely to be cowboys than physicians with a high follow-up frequency. Similarly, cowboy physicians are far less likely to be comforter physicians (even though doctors could be classified as both). Most differences are statistically significant.

IV. Model Estimates

We now proceed with our estimates of the models presented above. We first consider Equation (4), the relationship between area-level spending and local patient and physician preferences. We then turn to Equation (6), modeling the factors leading physicians to be more and less aggressive.

Do Survey Responses Predict Regional Medicare Expenditures?

We start with the basic relationship between area spending, patient preferences and physician preferences for the 64 HRRs with at least 3 cardiologists and 2 primary care physician responses. Figure 4 shows scatter plots between area-level end of life spending and our measures of supply and demand for care. The measures we include are the fraction of all physicians in the area who are cowboys (panel a), the fraction of physicians who are comforters

(panel b), the fraction of physicians who recommend follow-up more frequently than recommended guidelines (panel c), and the share of patients who desire more aggressive care at the end of life (panel d). Each circle is an HRR, and the size of the circle is proportional to the respective survey sample size in the HRR.

In the case of the three supply-side variables, the results are consistent with the theory: despite the small sample sizes of physicians per HRR, end of life spending is positively related to the cowboy ratio, negatively related to the comforter ratio, and positively related to high frequency of follow-up visits. The demand variable, in contrast, is not related to spending; the data points form a cloud more than a line.

Table 3 explores this result more formally with regression estimates of log end-of-life expenditures, weighted by the number of physician observations per HRR and including controls for the fraction of PCPs among our survey responders. As the first column shows, the local proportion of cowboys and comforters predicts 36 percent of the observed regional variation in risk-adjusted end-of-life spending. Further, the estimated magnitudes are large: increasing the percentage of cowboys by 10 percentage points increases end-of-life expenditures by 7.5 percent, while increasing the fraction of comforters by 10 percent reduces expenditures by 4.1 percent. This relationship between spending and the local fractions of cowboys and comforters holds for both cardiologists and primary care physicians analyzed separately, as shown in the Appendix.

Column 2 of Table 3 shows that the indicator for high frequency follow-up recommendations is also a meaningful predictor of HRR-level end-of-life spending; conditional on the fraction of cowboys and comforters, an increase of 10 percentage points in the percentage of physicians who prefer to see patients more frequently than guidelines recommend is predicted to increase end-of-life spending by 9.5 percent; and while the low follow-up coefficient is large

in magnitude (-0.417), it is not statistically significant. The combination of just these supplier beliefs alone explains over 60 percent of the observed end-of-life spending variation in the 64 HRRs observed.[14]

The next two columns add measures of patient preferences to the regressions: the share of patients wishing to have unneeded tests, the share wanting to see an unneeded cardiologist, the share preferring aggressive end-of-life care, and the share preferring comfortable end-of-life care. None of these variables are statistically significant at the 5% level. Even excluding the physician belief variables entirely, as in column 6, the R^2 from the patient preference variables is just 0.075. Separate regressions for cardiologists and primary care physicians are presented in Appendices C and D and indicate similar results.[15]

It is possible that there is an interaction effect between patient preferences and physician beliefs, for example if aggressive physicians interact with aggressive patients to generate even more utilization (or conversely for comforter physicians and patients). These hypotheses are considered in Table 4. Column 1 of the table repeats Column 5 of Table 3 for reference. The subsequent columns add interaction terms. As shown in Column 2, however, there is little consistent evidence for the interactive aggressiveness hypothesis; the interaction between cowboy physicians and patients with aggressive preferences is negative (not positive as theory would suggest), and while the coefficient between comforter physicians and patients is negative (column 3), it is not significant.

Column 4 of Table 4 repeats the analyses in column 1, but uses total average per beneficiary expenditures (adjusted for prices, age, sex, and race/ethnicity) as the dependent

[14] As Black et al. (2000) note, the OLS estimate is a lower bound and under weak assumptions, the expected value of the OLS parameter estimate is of smaller magnitude than the true parameter. (The R^2 is also a lower bound owing to measurement error.)

[15] Our results do not appear to be driven by geography. The coefficient estimates are similar when the east and west coasts of the US are estimated separately.

variable. This expenditure measure likely reflects a greater share of primary care relative to specialty care. In the combined sample, the fraction of cowboys in an HRR is a consistently strong predictor of spending across models. Moreover, although R^2 values are smaller in these models, supply-side factors continue to explain more of the variation in spending than demand-side factors. Finally, we consider fully risk-adjusted one-year expenditures for a "forward looking" cohort of hip fracture patients in Column 5 of Table 5. The estimated coefficients exhibit results similar to those in Column 1, but, like the model explaining overall Medicare expenditures, the coefficients are smaller in magnitude and the R^2 is smaller as well (0.37 versus 0.64).

Our data imply large effects of physician type on spending, as a simple back-of-the-envelope calculation suggests. We calculated how much Medicare expenditures would change if there were no cowboys, all physicians were comforters, and all physicians met guidelines for follow-up care. If this were to occur, end-of-life expenditures would decline by 36 percent, and total expenditures would decline by 17 percent. These comparisons point to the importance of physician beliefs in explaining regional (or national) utilization.

What factors predict physician responses to the vignettes?

To this point, we have shown that physician beliefs matter for spending, and that physician beliefs vary across areas more than would be expected given random variation. The obvious question is then: what explains this variation in physician beliefs? In this section, we estimate the model in Equation (6) to test for the relative importance of financial and organizational factors in explaining physician recommendations.

Table 5 presents coefficients from a linear probability model with HRR-level random effects for three regressions at the physician level. Our dependent variables are binary indictors

for whether the physician is a cowboy (Column 1), a comforter (Column 2), or believes in high follow-up (Column 3). In each model, we include basic physician demographics: age, gender, board certification status, whether the physician is a cardiologist, and days per week spent seeing patients, as well as cardiologists per 100,000 Medicare beneficiaries.

The demographic factors reveal that older physicians are more likely to recommend high rates of follow-up and are more likely to be cowboys, but age is not a significant predictor of comforter status. Male physicians are less likely to be comforters, while board certification – a marker for physician quality – is negatively associated with cowboy status and high follow-up frequency. This result is consistent with Doyle et al. (2010), who found that lower quality physicians spent 10-25% more for otherwise identical patients.

A greater number of cardiologists per 100,000 Medicare beneficiaries is associated with a higher likelihood of a physician being a cowboy or high follow-up doctor and with a lower likelihood of the physician being a comforter. One might be tempted to interpret this as classic "supplier-induced demand" effect, with more cardiologists per capita leading to less income per cardiologist, and hence a greater incentive to treat a given patient more intensively. Yet the equilibrium supply of cardiologists is likely to depend on a wide variety of factors, suggesting caution in the interpretation.

The substitution effect implies that lower incremental reimbursements associated with Medicaid and capitated patients would lead to fewer interventions and more palliative care. Table 5 shows that physicians with a larger fraction of Medicaid and (to a lesser extent) capitated patients are more likely to be cowboys and high-follow-up physicians, rejecting the substitution hypothesis. One may appeal again to a strong income effect to explain these patterns.

Some organizational factors are strongly associated with physician beliefs about appropriate practice. Physicians in solo or 2-person practices are far more likely to be aggressive than physicians in single or multi-specialty group practices or physicians who are part of an HMO or a hospital-based practice. Yet physicians in group or staff model HMOs or hospital-based practices are no more likely to be comforters. Physicians who respond to patient expectations are predicted to be comforters, and those responding to referring physician expectations are more likely to be high follow-up physicians, but neither effect is significant. Whether cardiologists accommodate referring physicians – a financial factor (since cardiologists will benefit financially from future referrals) as well as an organizational one – is a large and significant predictor of being a cowboy.[16] Finally, malpractice concerns are not predictive of cowboy or comforter status, perhaps because procedures performed on high-risk patients (such as Patients B and C) can increase the risk of a malpractice suit.

The explanatory power of these regressions is quite modest – between 6 and 15 percent – suggesting that a considerable degree of the remaining variation is the consequence of physician beliefs regarding the productivity of treatments, rather than behavior caused by financial, organizational, or other factors.

As a final exercise, we include these financial, organizational, and responsiveness variables, aggregated up to the HRR, in a regression that seeks to explain the variation in log end-of-life spending – an expanded counterpart to Table 4. These results are presented in Appendix E. Aside from the per-capita supply of cardiologists – a potentially suspect measure of capacity – none of the additional variables are significant, nor do they add appreciably to the explanatory power of the regression. Physician beliefs independent of financial or organizational

[16] Note that this question is asked only of cardiologists.

factors appear to explain why physicians are cowboys or comforters (or both) and how that affects overall spending.

V. Conclusion and Implications

While there is a good deal of regional variation in medical spending and care utilization in the U.S. and elsewhere, there is little agreement about the causes of such variations. Do they arise from variation in patient demand, from variation in physician behavior, or both? In this paper, we found that patient demand as measured by responses to a nationwide survey has modest predictive association with regional end-of-life expenditures. By contrast, individual physician beliefs regarding treatment options can explain a substantial degree of regional variation in utilization among the U.S. Medicare population. While other results have suggested such a finding (Sirovich et al. (2008), Lucas et al. (2008), Bederman et. al. (2011), and Wennberg et al. (1997)), our paper is the first to directly relate Medicare spending to physician beliefs. The regressions imply that, were physicians to follow professional guidelines, end-of-life Medicare expenditures would be 36 percent less, and overall expenditures 17 percent lower.

We then turned to the factors that lead physicians to have different preferences. We found that the traditional factors in supplier-induced demand models, such as the fraction of patients paid through capitation (or on Medicaid), or the responsiveness to financial factors, play a relatively small role in explaining equilibrium variations in utilization patterns. Organizational factors such as accommodating colleagues help to explain some, but not most, individual intervention decisions. Instead, differences in physician beliefs about the effectiveness of treatments are the primary source of variation in Medicare expenditures.[17]

[17] This result is consistent with Epstein and Nicholson (2009), who find large variations in Cesarean section surgical rates among obstetricians within the same practice, even after adjusting for where the physicians trained.

Our results differ from the existing literature in that they are based on vignettes and thus represent a lower bound to practice variations. Generally, prior studies inferred practice variations as the residual from an area model, leading to estimates being biased either upward (because of unobserved regional factors) or biased downward (because of flawed risk-adjustment, as in Song et al., 2010).

One concern about the interpretation of the vignette responses as "overuse" is that they may reflect the true productivity of physicians. While we cannot rule this out, we note that physicians with greater objective qualifications such as board certification are no more likely to be cowboys. Nor do the updated 2009 heart failure guidelines recommend more aggressive care (Hunt et al., 2009), as a model of inappropriately cautious and slowly evolving recommendations would suggest.

Another hypothesis is that while "cowboys" may over-treat patients along some dimensions, they may also avoid the underuse of effective care along other dimensions (e.g., Landrum et al., 2008). Our survey did not ask about whether the physician provides effective care or not. But other evidence does not support this hypothesis: an HRR-level composite AMI quality measure from 2007 Hospital Compare data, (Dartmouth Atlas, 2013) is negatively associated with the HRR-level fraction of physicians who are cowboys.

We know little about how physician beliefs arise. Simple heterogeneity in physician beliefs cannot explain regional variation in expenditures, since regional patterns of beliefs exhibit greater variation than would be expected due to chance alone. Rather, spatial correlation in beliefs is required in order to explain the regional patterns we see. We do find that physicians' propensity to intervene for non-clinical reasons is related to the expectations of physicians with whom they regularly interact, a result consistent with network models. Similarly, Molitor (2011)

finds that cardiologists who move to more or less aggressive regions change their practice style to better conform to local norms. But we are still left with questions as to how and why some regions become more aggressive than others.

Our results do not imply that economic incentives are unimportant. Clearly, changes in payment margins have a large impact on behavior, as has been shown in a variety of settings. But the prevalence of geographic variations in European countries, where economic incentives are often blunted, is consistent with the view that physician beliefs play a large role in explaining such variations. A better understanding of both how physician beliefs form, and (if necessary) how they can be shaped, is a key challenge for future research.

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Figure 1: Variations in Equilibrium: Differences in λ and Differences in Actual or Perceived Productivity

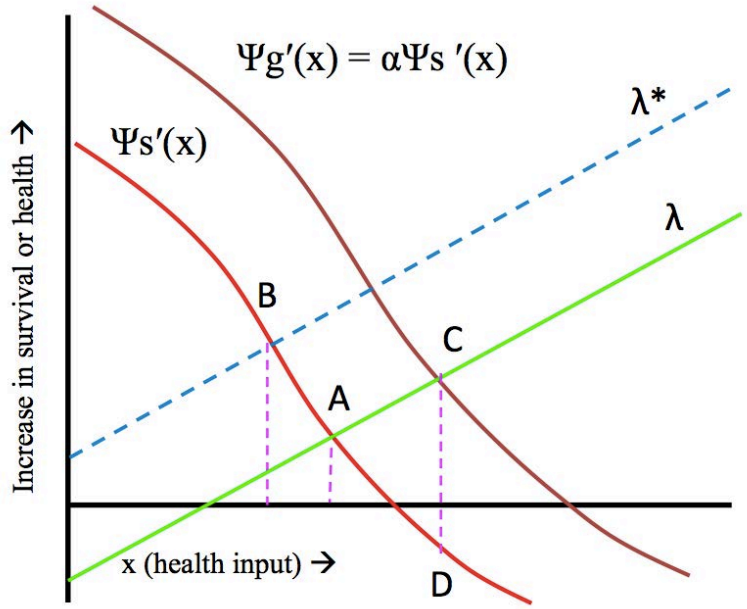


Figure 2: Fraction of Patients Who Would See Unneeded Cardiologist (HRR-Level Distribution)

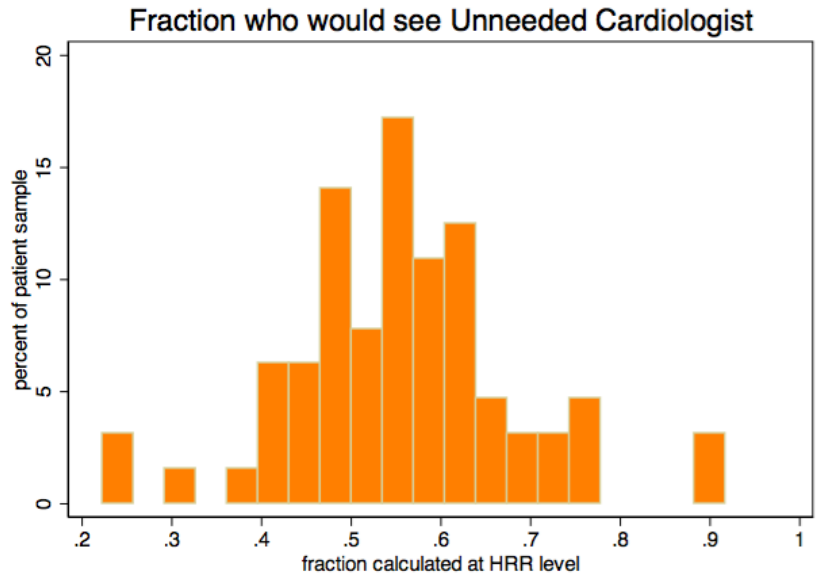


Figure 3: Distribution of Length of Time before Next Visit for Patient with Well-Controlled Angina (Cardiologist HRR-Level Distribution)

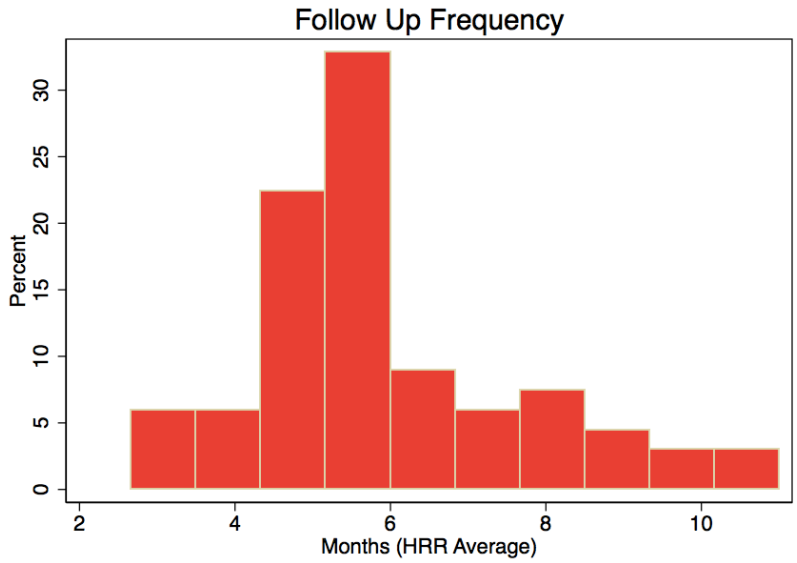


Figure 4: Log of Inpatient 2-year End-of-Life Regional Spending vs. Various Independent Variables

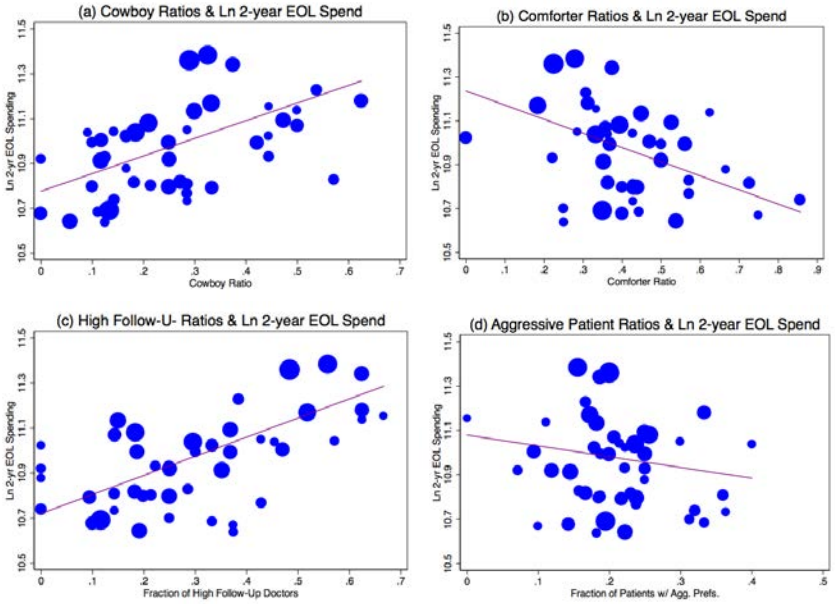


Table 1: Primary Variables and Sample Distribution

Variable	Mean	Individual SD	Area Average SD	p-value
Spending and Utilization				
2-Year End-of-Life Spending	$56,219	-	$10,715	-
6-Month End-of-Life Spending	$14,272	-	$2,660	-
Total Per Patient Spending	$7,837	-	$1,032	-
Hip Fracture Patient Spending	$52,574	-	$4,996	-
Patient Variables				
Have Unneeded Tests	73%	44%	10%	<0.01
See Unneeded Cardiologist	56%	50%	10%	<0.01
Aggressive Patient Preferences Ratio	8%	27%	5%	<0.01
Comfort Patient Preferences Ratio	48%	50%	12%	<0.01
Primary Care Physician Variables				
Cowboy Ratio	19%	39%	19%	<0.01
Comforter Ratio	44%	50%	20%	<0.01
Follow-Up Low	9%	28%	11%	<0.01
Follow-Up High	4%	19%	7%	<0.01
Cardiologist variables				
Cowboy Ratio	27%	45%	19%	<0.01
Comforter Ratio	29%	45%	20%	<0.01
Follow-Up Low	0%	4%	3%	0.09
Follow-Up High	23%	44%	21%	<0.01
Organizational and Financial Variables				
Fraction Capitated Patients	16%	25%	-	-
Fraction Medicaid Patients	10%	13%	-	-
Weekly Patient Days	3.1	1.5	-	-
Physician Age	57.5	9.8	-	-
Board Certified	89%	31%	-	-
Cardiologists per 100k	6.7	1.90	-	-
Responds to Referrer Expectations	10%	30%	-	-
Responds to Colleague Expectations	41%	49%	-	-
Responds to Patient Expectations	59%	49%	-	-
Responds to Malpractice Concerns	43%	49%	-	-
Responds to Practice Financial Incentives	32%	46%	-	-

Note: The table shows means for the sample living or practicing in one of the 64 HRRs with at least 3 cardiologists and 2 primary care physicians. The area average standard deviation is weighted by the number of observations in the HRR. The p-value in the last column is for the null hypothesis of no excess variance across areas. The p-value is taken from a bootstrap of patient or physician responses across areas. For each of 1,000 simulations, we draw patients or providers randomly (with replacement) and calculate the simulated area average and the standard deviation of that area average. The empirical distribution of the standard deviation of the area average is used to form the p-value for the actual area average.

Table 2: Distribution of Physicians by Vignette Responses

Panel A: PCPs						
	Cowboy			**Comforter**		
Follow-Up Frequency	Yes	No		Yes	No	
Low	16	61	8.4%	39	38	8.4%
Medium	98	452	60%	300	250	60%
High	87	200	31%	115	172	31%
	22%	78%		50%	50%	
$p(\chi^2)$:	**<0.01**			$p(\chi^2)$:	**0.02**	
	Comforter					
Cowboy	Yes	No				
Yes	87	114	22%			
No	367	346	78%			
	50%	50%				
$p(\chi^2)$:	0.145					
Panel B: Cardiologists						
	Cowboy			**Comforter**		
Follow-Up Frequency	Yes	No		Yes	No	
Low	17	76	18%	27	66	18%
Medium	85	238	63%	94	229	63%
High	31	69	19%	22	78	19%
	26%	74%		27%	72%	
$p(\chi^2)$:	**<0.01**			$p(\chi^2)$:	**<0.01**	
	Comforter					
Cowboy	Yes	No				
Yes	39	94	26%			
No	104	279	74%			
	28%	72%				
$p(\chi^2)$:	**<0.01**					

This table shows the bivariate relationships between the guideline-defined indicatorsfor recommended Follow-Up Frequency, as well as"Cowboy" and "Comforter" status among both PCPs and Cardiologists in our data. Chi-squared tests evaluate the null that there is no association between pairs of indicators in the table.

Table 3: Regression Estimates of Ln Medicare Expenditures in the Last Two Years

Combined Sample of PCPs and Cardiologists						
	(1)	(2)	(3)	(4)	(5)	(6)
Cowboy Ratio, All Doctors	0.7535***	0.6056***	0.6096***	0.5928***	0.5972***	
	(0.1626)	(0.1385)	(0.1173)	(0.1446)	(0.1221)	
Comforter Ratio, All Doctors	-0.4068**	-0.3206***	-0.2878**	-0.3089***	-0.2745**	
	(0.1681)	(0.1109)	(0.1103)	(0.1065)	(0.1044)	
Follow-Up Low, All Doctors		-0.4174	-0.3626	-0.4884	-0.4422	
		(0.2755)	(0.2849)	(0.3299)	(0.3215)	
Follow-Up High, All Doctors		0.9712***	0.9721***	0.9680***	0.9670***	
		(0.2053)	(0.1963)	(0.2026)	(0.1910)	
Have Unneeded Tests			0.1177		0.1424	-0.0543
			(0.2062)		(0.2251)	(0.3400)
See Unneeded Cardiologist			0.2728*		0.3035*	0.5397*
			(0.1549)		(0.1679)	(0.2855)
Aggressive Preferences Patient Ratio				-0.2355	-0.2762	-0.5395
				(0.4607)	(0.4409)	(0.7526)
Comfortable Preferences Patient Ratio				-0.1154	-0.2033	-0.1917
				(0.1584)	(0.2015)	(0.2499)
N	64	64	64	64	64	64
R^2	0.3627	0.6092	0.6299	0.6127	0.6377	0.0750

* p<0.10, ** p<0.05, *** p<0.01

2-year End-of-Life Spending is in natural log form and is price, age, sex and race adjusted. Results shown are for the 64 Hospital Referral Regions (HRRs) in which we have at least 3 patients and 3 cardiologists surveyed. All regressions include a constant and control for the fraction of primary care physicians in the sample. Respondent data is adjusted for race, sex and age. Survey sampling weights take into account differences in the number of physician observations per HRR.

Table 4: Regression Estimates of Ln Medicare Expenditures Considering Interaction Terms and Additional Measures of HRR-Level Spending

Combined Sample of PCPs and Cardiologists (dependent variables listed in column headings; all are in natural logs)					
	(1) 2-yr EOL Spend (As in Table 4)	(2) 2-yr EOL Spend	(3) 2-yr EOL Spend	(4) Total Spend (Av. per Beneficiary)	(5) Total Spend (Hip Fract. Cohort)
Cowboy Ratio, All Doctors	0.5972***	0.5938***	0.5835***	0.3306***	0.2793***
	(0.1221)	(0.1119)	(0.1260)	(0.1028)	(0.0806)
Comforter Ratio, All Doctors	-0.2745**	-0.2600**	-0.3175**	-0.0889	-0.0682
	(0.1044)	(0.1002)	(0.1224)	(0.1064)	(0.0749)
Follow-Up Low, All Doctors	-0.4422	-0.4074	-0.4824	-0.5208	-0.1663
	(0.3215)	(0.2749)	(0.3180)	(0.3751)	(0.2322)
Follow-Up High, All Doctors	0.9670***	1.0267***	0.9436***	0.2480	0.2933**
	(0.1910)	(0.1837)	(0.1870)	(0.1777)	(0.1291)
Have Unneeded Tests	0.1424	0.1015	0.1766	-0.0792	-0.0417
	(0.2251)	(0.2274)	(0.2242)	(0.2005)	(0.1814)
See Unneeded Cardiologist	0.3035*	0.2159	0.2746*	0.3353	0.1996
	(0.1679)	(0.1666)	(0.1617)	(0.2434)	(0.1478)
Aggressive Preferences Patient Ratio	-0.2762	0.1880	0.6315	-0.3026	-0.1027
	(0.4409)	(0.5051)	(0.9285)	(0.4703)	(0.3086)
Comfortable Preferences Patient Ratio	-0.2033	-0.6297***	0.1663	-0.2500	-0.0660
	(0.2015)	(0.1975)	(0.3022)	(0.1830)	(0.1524)
Cowboy Ratio*Aggressive Preferences Patient Ratio		-2.1268			
		(2.1367)			
Cowboy Ratio*Comfortable Preferences Patient Ratio		1.5977**			
		(0.7557)			
Comforter Ratio*Aggressive Preferences Patient Ratio			-2.2461		
			(1.8854)		
Comforter Ratio*Comfortable Preferences Patient Ratio			-0.9179		
			(0.6437)		
N	64	64	64	64	64
R^2	0.6377	0.6603	0.6459	0.3482	0.3705

* p<0.10, ** p<0.05, *** p<0.01; 2-year End-of-Life Spending and total spending are are price, age, sex and race adjusted. Hip fracture cohort spending is adjusted for age, sex, race, comorbid conditions at admission, and the hierarchical condition categories risk-adjustment index for the six months prior to admission. Results shown are for the 64 Hospital Referral Regions (HRRs) in which we have at least 3 patients and 3 cardiologists surveyed. All regressions include a constant and control for the fraction of primary care physicians in the sample. Respondent data is adjusted for race, sex and age. Survey sampling weights take into account differences in the number of physician observations per HRR.

Table 5: Predictors of Cowboy, Comforter & High Follow-Up Types

	(1) Cowboy	(2) Comforter	(3) High Follow-Up
General Controls			
Age	0.0047***	0.0005	0.0056***
	(0.0013)	(0.0015)	(0.0012)
Male	0.0532*	-0.0625*	-0.0165
	(0.0315)	(0.0370)	(0.0314)
Weekly Patient Days	-0.0112	0.0145	0.0008
	(0.0076)	(0.0090)	(0.0076)
Board Certified	-0.0727*	0.0184	-0.1400***
	(0.0379)	(0.0445)	(0.0378)
Cardiologists per 100k	0.0203***	-0.0223***	0.0410***
	(0.0076)	(0.0079)	(0.0061)
Cardiologist Dummy	-0.0187	-0.1752***	-0.0695*
	(0.0363)	(0.0426)	(0.0361)
Financial Factors			
Fraction Capitated Patients	0.0980**	-0.0428	0.1073**
	(0.0462)	(0.0540)	(0.0457)
Fraction Medicaid Patients	0.2894***	0.0325	0.3978***
Organizational Factors			
(Baseline = Solo or 2-person Practice)	-	-	-
Single/Multi Speciality Group Practice	-0.0584**	-0.0169	-0.2019***
	(0.0265)	(0.0310)	(0.0262)
Group/Staff HMO or Hospital-Based Practice	-0.1539***	0.0357	-0.2221***
	(0.0429)	(0.0502)	(0.0426)
Responsiveness Factors			
Responds to Patient Expectations	-0.0272	0.0307	-0.0145
	(0.0313)	(0.0368)	(0.0313)
Responds to Colleague Expectations	0.0147	-0.0007	0.0360
	(0.0247)	(0.0291)	(0.0247)
Responds to Referrer Expectations	0.1084***	0.0248	-0.0516
	(0.0419)	(0.0493)	(0.0420)
Responds to Malpractice Concerns	-0.0051	0.0222	-0.0105
	(0.0247)	(0.0290)	(0.0247)
N	1349	1349	1349
R^2 (within)	0.0502	0.0509	0.1075
R^2 (between)	0.0379	0.1049	0.2110
R^2 (overall)	0.0613	0.0596	0.1609

* p<0.10, ** p<0.05, *** p<0.01

All logit regressions include a constant, and HRR-level random effects as well as general physician-level controls. Additional explanatory variables include financial, organizational and responsiveness factors. The question about responding to referring doctor expectations appeared in the Cardiologist survey only, and so reflects the preferences of cardiologists only. The cardiology dummy variable therefore reflects both the pure effect of being a practicing cardiologist, and a secondary adjustment arising from the referral question being set to zero for all primary care physicians.

Appendix A: Clinical Vignettes and Response Options for Patients, Cardiologists and Primary Care Physicians

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Panel I: Patient Questions

SCENARIO 1- Questions relating to less-severe cardiac care preferences: *Suppose you noticed a mild but definite chest pain when walking up stairs....Suppose you went to your regular doctor for that chest pain and your doctor did not think you needed any special tests but you could have some tests if you wanted.*
a) If the tests did not have any health risks, do you think you would probably have the tests or probably not have them?

a - have tests
b - not have tests

b) Suppose your doctor told you he or she did not think you needed to see a heart specialist, but you could see one if you wanted. Do you think you would probably ask to see a specialist, or probably not see a specialist?

a - see specialist
b - not see specialist

SCENARIO 2 - Questions relating to end of life care preferences: *The next set of questions are about care a patient may receive during the last months of life. Remember, you can skip any question you don't want to answer. Suppose that you had a very serious illness. Imagine that no one knew exactly how long you would live, but your doctors said you almost certainly would live less than 1 year.*
a) If you reached the point at which you were feeling bad all the time, would you want drugs that would make you feel better, even if they might shorten your life?

a - yes: drugs
b - no

b1) If you needed a respirator to stay alive, and it would extend your life for a week, would you want to be put on a respirator?
b2) If it would extend your life for a month, would you want to be put on a respirator?

a - yes: respirator
b - no

Answers other than "yes" or "no" (e.g., "not concerned" or "I dont know") are treated as missing data. Item non-response was less than 1% among eligible respondents.

Panel II: Physician Questions

In the next set of questions, you will be presented with brief clinical descriptions for three different patients. For each, you will be asked a series of questions regarding how you would be likely to treat that patient were he or she in your care.

PATIENT A - CARDIOLOGIST - *For this question, think about a patient with stable angina whose symptoms and cardiac risk factors are now well controlled on current medical therapy. In general, how frequently do you schedule routine follow-up visits for a patient like this?*

*Answer recorded in number of months

PATIENT A - PCPs: *In general, how frequently do you schedule routine follow-up visits for a patient with well-controlled hypertension?*

*Answer recorded in number of months

PATIENT B: *A 75 year old man with severe (Class IV) congestive heart failure from ischemic heart disease, is on maximal medications and has effective disease management counseling. His symptoms did not improve after recent angioplasty and stent placement and CABG is not an option. He is uncomfortable at rest. He is noted to have frequent, asymptomatic nonsustained VT on cardiac monitoring. He has adequate health insurance to cover tests and medications. At this point, for a patient presenting like this, how often would you arrange for each of the following?*

CARDIOLOGIST SURVEY

a - Repeat angiography
b - Initiate antiarryghmic therapy
c - Recommend an Implantable Cardiac Defibrilator (ICD)
d - Recommend biventricular pacemaker for cardiac resynchronization
e - Initiate or continue discussions about palliative care

POSSIBLE RESPONSES

1 Always/Almost always
2 Most of the time
3 Some of the time
4 Rarely
5 Never
9 NA

Panel II: Physician Questions (Continued)

PATIENT C: *An 85 year old male patient has severe (Class IV) congestive heart failure from ischemic heart disease, is on maximal medications, and is not a candidate for coronary revascularization. He is on 2 liters per minute of supplemental oxygen at home. He presents to your office with worsening shortness of breath and difficulty sleeping due to orthopnea. Office chest xray confirms severe congestive heart failure. Oxygen saturation was 85% and increased to 94% on 4 liters and the patient is more comfortable. He has adequate health insurance to cover tests and medications. At this point, for a patient presenting like this, how often would you arrange for each of the following?*

PCP and CARDIOLOGIST SURVEY
a - Allow the patient to return home on increased oxygen and increased diuretics
b - Admit to the hospital for aggressive diuresis (not to the ICU/CCU)
c - Admit to the ICU/CCU for intensive therapy and monitoring
d - Place a pulmonary artery catheter for hemodynamic optimization
e - Recommend biventricular pacemaker for cardiac resynchronization
f - Initiate or continue discussions about palliative care

POSSIBLE RESPONSES (both surveys)
1 Always/Almost always
2 Most of the time
3 Some of the time
4 Rarely
5 Never
9 NA

Appendix B: Full Variable Definitions

Panel I: Patient Variables:	
Have Unneeded Tests	fraction of patients who would like to have tests even if "doctor did not think [they were] needed"
See Unneeded Cardiologist	fraction of patients who would like to see a specialist even if doctor "did not think [patient] needed to"
Aggressive Patient Preferences Ratio	fraction of patients who would like to be on a respirator to extend their life by 1 week or 1 month
Comfort Patient Preferences Ratio	fraction of patients who would like to take drugs to be comfortable, "even if they might shorten [their] life"
Panel II: Cardiologist Variables:	
Cowboy Ratio*, Cardiologists	fraction of cowboys among the local (HRR-level) cardiologist population surveyed
Comforter Ratio*, Cardiologists	fraction of comforters among the local (HRR-level) cardiologist population surveyed
Follow-Up Low, Cardiologists	cardiologist's recommended follow-up frequency for "a patient with stable angina whose symptoms and cardiac risk factors are now well controlled on current medical therapy" is less frequent than medical guidelines
Follow-Up, high, Cardiologists	cardiologist's recommended follow-up frequency for "a patient with stable angina whose symptoms and cardiac risk factors are now well controlled on current medical therapy" is more frequent than medical guidelines
For the next set of questions, Cardiologists were asked *"Now wed like you to think about your own cardiac catheterization recommendations. Sometimes a cardiologist will recommend cardiac catheterization for other than purely clinical reasons. During the past 12 months, how often, if ever, have each of the following led you to recommend cardiac catheterization for a patient?"*	
Responds to Patient Expectations	"frequently" or "sometimes" response to "the patient expected to undergo the procedure"
Responds to Colleague Expectations	"frequently" or "sometimes" response to "your colleagues would do so in the same situation"
Responds to Referrer Expectations	"frequently" or "sometimes" response to "wanted to satisfy the expectations of the referring physicians"
Responds to Malpractice Concerns	"frequently" or "sometimes" response to "you wanted to protect against a possible malpractice suit'
Panel III: PCP Variables:	
Cowboy Ratio*, PCPs	fraction of cowboys among the local (HRR-level) PCP population surveyed
Comforter Ratio*, PCPs	fraction of comforters among the local (HRR-level) PCP population surveyed
Follow-Up Low, PCPs	PCPs recommended follow-up frequency for "a patient with well-controlled hypertension" is less frequent than medical guidelines
Follow-Up High, PCPs	PCPs recommended follow-up frequency for "a patient with well-controlled hypertension" is more frequent than medical guidelines
For the next set of questions, PCPs were asked *"Now, wed like you to think about your own specialist referrals. Sometimes a physician will make a specialty referral for other than purely clinical reasons. During the past 12 months, how often, if ever, have each of the following led you to refer a patient to a specialist?*	
Responds to Patient Expectations	"frequently" or "sometimes" response to "the patient requested a referral"
Responds to Colleague Expectations	"frequently" or "sometimes" response to "your colleagues would refer in the same situation"
Responds to Malpractice Concerns	"frequently" or "sometimes" response to "you wanted to protect against a possible malpractice suit"

Panel IV: Other Variables (all physicians):

Practice Type 1	physician is part of a solo or 2-person practice
Practice Type 2	physician is part of a singe or multi speciality group practice
Practice Type 3	physician is part of a group or staff model HMO or a Hospital based practice
Fraction Capitated Patients	fraction of patients for which physician is reimbursed on a captiated basis
Fraction Medicaid Patients	fraction of patients a physician sees who are on Medicaid
Weekly Patients Days	number of days per week a physician spends seeing patients
Age	physician's age in years
Board Certified	physician is currently board certified in her speciality
Cardiologists per 100k	cardiologists per 100,000 Medicare beneficiaries in HRR of practice as reported in the 2005 Dartmouth Atlas

Notes: detailed explanations of the algorithm used to define "Cowboys" (physicians aggressive beyond clinical guidelines) and "Comforters" (physicians who show a strong likelihood of recommending palliative and comfort-oriented care) are described in the paper. The indicator for "Aggressive Patient Preferences" combines two questions: affirmative responses to both part b1 and b2 of Patient Scenario 2 (see Appendix A above for original survey text)

Appendix C: Regression Estimates of Ln Medicare Expenditures in the Last Two Years (Cardiologists Only)

	Cardiologists					
	(1)	(2)	(3)	(4)	(5)	(6)
Cowboy Ratio, Cardiologists	0.1825*	0.1831**	0.2460***	0.1726**	0.2391***	
	(0.1027)	(0.0864)	(0.0883)	(0.0857)	(0.0868)	
Comforter Ratio, Cardiologists	-0.1261	-0.0400	-0.0016	-0.0449	-0.0111	
	(0.1100)	(0.0848)	(0.0903)	(0.0852)	(0.0862)	
Followup Low, Cardiologists		-0.6662***	-0.5460***	-0.7836***	-0.6951***	
		(0.1062)	(0.1373)	(0.1648)	(0.1691)	
Followup High, Cardiologists		0.5323***	0.5265***	0.5333***	0.5292***	
		(0.1077)	(0.1027)	(0.1062)	(0.1017)	
Have Unneeded Tests			0.2587		0.2705	0.2343
			(0.1925)		(0.2066)	(0.2302)
See Unneeded Cardiologist			0.2674		0.2894	0.2411
			(0.1834)		(0.1791)	(0.2083)
Aggressive Preferences Patient Ratio				-0.2385	-0.2539	-0.2870
				(0.3013)	(0.3044)	(0.4397)
Comfortable Preferences Patient Ratio				-0.0628	-0.1267	0.0120
				(0.1488)	(0.1482)	(0.1559)
N	64	64	64	64	64	64
R^2	0.0535	0.4073	0.4446	0.4119	0.4530	0.0406

* p<0.10, ** p<0.05, *** p<0.01

2-year End-of-Life Spending is in natural log form and is price, age, sex and race adjusted. Results shown are for the 64 Hospital Referral Regions (HRRs) in which we have at least 3 patients and 3 cardiologists surveyed. All regressions include a constant and control for the fraction of primary care physicians in the sample. Respondent data is adjusted for race, sex and age. Survey sampling weights take into account differences in the number of physician observations per HRR.

Appendix D: Regression Estimates of Ln Medicare Expenditures in the Last Two Years (PCPs Only)

	PCPs					
	(1)	(2)	(3)	(4)	(5)	(6)
Cowboy Ratio, PCPs	0.6689***	0.5476***	0.4773***	0.5383***	0.4728***	
	(0.1687)	(0.1416)	(0.1333)	(0.1251)	(0.1223)	
Comforter Ratio, PCPs	-0.2489*	-0.2436**	-0.2104*	-0.1987**	-0.1724*	
	(0.1380)	(0.1137)	(0.1157)	(0.0944)	(0.0972)	
Followup Low, PCPs		-0.4729*	-0.4639*	-0.5905**	-0.5682*	
		(0.2754)	(0.2706)	(0.2938)	(0.2930)	
Followup High, PCPs		0.9091*	0.9918*	0.8640*	0.9333*	
		(0.5359)	(0.5386)	(0.5135)	(0.5064)	
Have Unneeded Tests			-0.2231		-0.1341	-0.2371
			(0.3258)		(0.3037)	(0.3941)
See Unneeded Cardiologist			0.4045*		0.4135**	0.7422**
			(0.2154)		(0.2046)	(0.3350)
Aggressive Preferences Patient Ratio				-0.8012	-0.7712	-0.6638
				(0.6915)	(0.6460)	(0.9768)
Comfortable Preferences Patient Ratio				-0.2719	-0.3058	-0.3864
				(0.2521)	(0.2739)	(0.3348)
N	64	64	64	64	64	64
R^2	0.3430	0.4613	0.4888	0.4852	0.5126	0.1290

* p<0.10, ** p<0.05, *** p<0.01

2-year End-of-Life Spending is in natural log form and is price, age, sex and race adjusted. Results shown are for the 64 Hospital Referral Regions (HRRs) in which we have at least 3 patients and 3 cardiologists surveyed. All regressions include a constant and control for the fraction of primary care physicians in the sample. Respondent data is adjusted for race, sex and age. Survey sampling weights take into account differences in the number of physician observations per HRR.

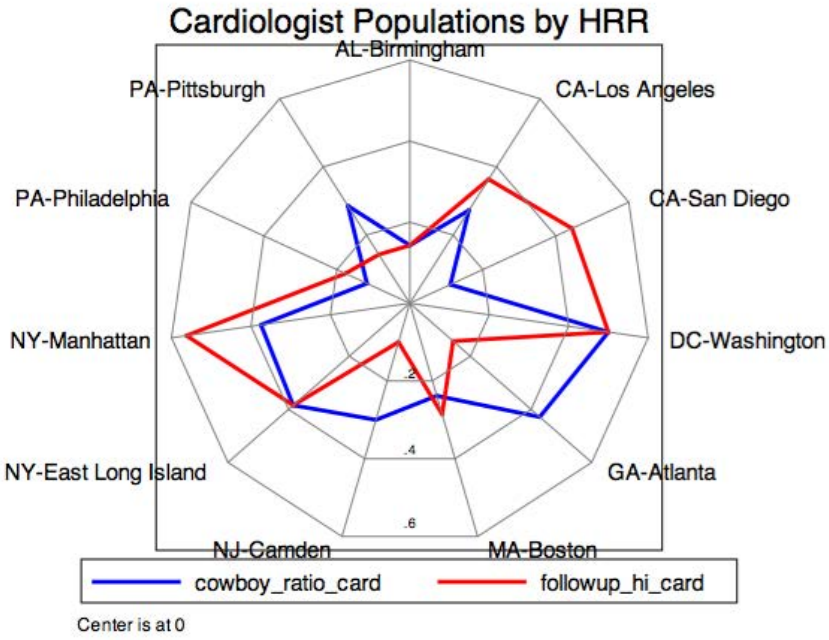
Appendix E: Expanded Regression Estimates of Ln Medicare Expenditures in the Last Two Years

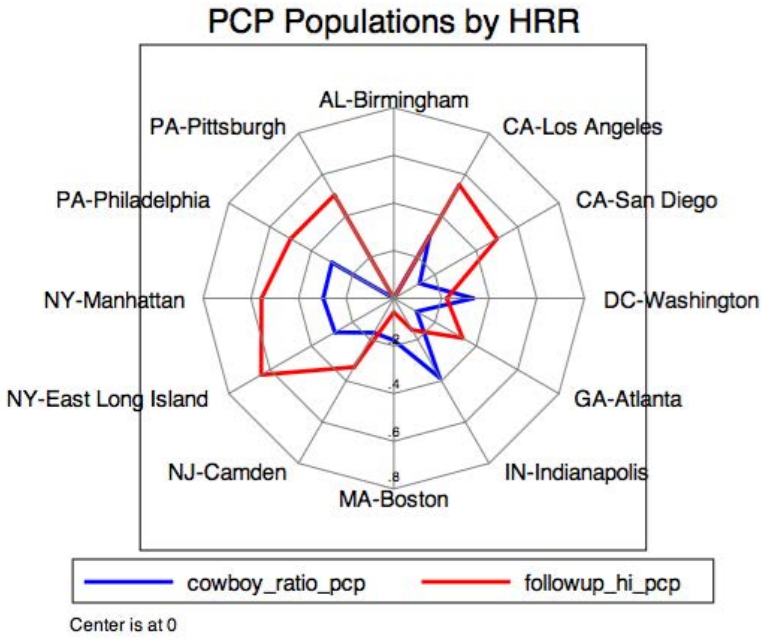
Combined Sample: Cardiologists and PCPs					
	(1)	(2)	(3)	(4)	(5)
Cardiologists per 100k				0.0390**	0.0499***
				(0.0165)	(0.0156)
Cowboy Ratio, All Doctors	0.6080***	0.5212***	0.5930***	0.5115***	0.3942***
	(0.1345)	(0.1232)	(0.1385)	(0.1252)	(0.1340)
Comforter Ratio, All Doctors	-0.3098***	-0.2876**	-0.3018***	-0.2289*	-0.1998*
	(0.1093)	(0.1144)	(0.1134)	(0.1277)	(0.1022)
Follow-Up Low, All Doctors	-0.3481	-0.1154	-0.3931	-0.1235	0.0410
	(0.2246)	(0.2165)	(0.2642)	(0.2010)	(0.2364)
Follow-Up High, All Doctors	0.9409***	0.7724***	1.0192***	0.7609***	0.5836*
	(0.1945)	(0.2239)	(0.2312)	(0.2169)	(0.2951)
(mean) Fraction Capitated		0.1622			0.2325*
		(0.1313)			(0.1245)
(mean) Fraction Medicaid		-0.5005*			-0.3495
		(0.2976)			(0.2288)
Base = (mean) Solo or 2-person Practice		-			-
(mean) Single/Multi Speciality Group Practice		-0.2432			-0.2381
		(0.1739)			(0.1580)
(mean) Group/Staff HMO or Hospital-Based Practice		-0.1735			-0.4342*
		(0.2104)			(0.2221)
(mean) Responds to Patient Expectations			0.0785		-0.0723
			(0.1415)		(0.1074)
(mean) Responds to Colleague Expectations			-0.1456		-0.0044
			(0.1208)		(0.0967)
(mean) Responds to Referrer Expectations			-0.0772		-0.1260
			(0.1690)		(0.1311)
(mean) Responds to Malpractice Concerns			0.1298		0.2344*
			(0.1830)		(0.1295)
N	64	64	64	64	64
R^2	0.6008	0.6442	0.6112	0.6641	0.7310

* p<0.10, ** p<0.05, *** p<0.01

2-year End-of-Life Spending is in natural log form and is price, age, sex and race adjusted. Results shown are for the 64 Hospital Referral Regions (HRRs) in which we have at least 3 patients and 3 cardiologists surveyed. All regressions include a constant and control for the fraction of primary care physicians in the sample. Respondent data is adjusted for race, sex and age. Survey sampling weights take into account differences in the number of physician observations per HRR.

Appendix F: Radar Plots of Select High Follow-up Frequency and Cowboy Prevalence by HRR:





This figure provides additional visual evidence of the relationship between cowboy status and recommended follow-up frequency for the HRRs with the greatest number of respondents; a point that is further out on the scale corresponds to a larger fraction of physicians.