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Interdependence in decision-making by medical consultants: implications for improving the efficiency of inpatient physician services

Adam S. Wilk^a and Lena M. Chen^{b,c,d,e}

^aDepartment of Health Policy and Management, Rollins School of Public Health, Emory University. Address: 1518 Clifton Rd, Ste 634, Atlanta, GA 30322. Telephone: 404-727-1482. Fax: 404-727-9198

^bCenter for Health Outcomes and Policy, University of Michigan. Address: 2800 Plymouth Rd, Bldg 16, Rm 407E, Ann Arbor, MI 48109. Telephone: 734-232-0799. Fax: 734-998-7473

^cInstitute for Healthcare Policy and Innovation, University of Michigan

^dDivision of General Medicine, Department of Internal Medicine, University of Michigan Health System

^eVA Ann Arbor Healthcare System, Ann Arbor, MI

Abstract

Objectives—Hospital administrators are seeking to improve efficiency in medical consultation services, yet whether consultants make decisions to provide more or less care is unknown. We examined how medical consultants' account for prior consultants' care when determining whether to provide intensive consulting care or sign off in the treatment of complex surgical inpatients. We applied three distinct theoretical frameworks in the interpretation of our results.

Methods—We performed a retrospective cohort study of consultants' care intensity, measured alternately using a dummy variable for providing two or more days consulting (versus one) and using a continuous measure of total days consulting, with 100% Medicare claims data from 2007-2010. Our analytic samples included consults for beneficiaries undergoing coronary artery bypass grafting (n=61,785) or colectomy (n=33,460) in general acute care hospitals. We compared the care intensity of consultants who observed different patterns of consulting care before their initial consults using ordinary least squares regression models at the patient-physician dyad level, controlling for patient comorbidity and many other patient- and physician-level factors as well as hospital region and year fixed effects.

Results—Consultants were less likely to provide intensive consulting care with each additional prior consultant on the case (1.2-1.7 percent) or if a prior consultant rendered intensive consulting

Declaration of Interests

The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

care (20.6-21.5 percent) but more likely when prior consults were more concentrated across consultants (2.9-3.1 percent). Effects on consultants' total days consulting were similar.

Conclusion—On average, consultants appeared to calibrate their care intensity for individual patients to maximize their value to all patients. Interventions for improving consulting care efficiency should seek to facilitate (not constrain) consultants' decision-making processes.

Keywords

consultations; physician decision-making; efficiency; postoperative; patient care management

Introduction

Medical consultations or 'consults' in the inpatient hospital setting represent 33 percent of allowed charges for physicians' evaluation and management services[1], yet evidence about the effects and benefits of consults is mixed [2-9]. Efforts are underway that could improve the efficiency of inpatient physician services—that is, to reduce their use while maintaining or improving patient outcomes. Among these are payer efforts to promote discounted episode-based payments, some of which would bundle payments for inpatient physician services, inpatient facility fees, and post-discharge care [10-16]. Moreover, many hospitals are expanding the use of more directive models of patient care management, such as co-management, as well as technological innovations such as e-consults and telemedicine services, in the hopes of reducing costs while increasing patients' access to specialty care [17-25].

These different types of interventions aim to achieve improved efficiency and value through different mechanisms. However, to identify which types of interventions are most likely to succeed, we must answer the following question: under established fee-for-service incentive structures, do consultants manage their time and coordinate with fellow clinicians in ways that promote efficiency or inefficiency in the use of consults? This study presents empirical evidence concerning these activities, focusing on the interpersonal factors that influence consultants' patterns of care for some of Medicare's most costly patients: older, medically complex patients hospitalized for a major surgical procedure.

We use administrative claims data for two large samples of Medicare patients to analyze the intensity of consultants' care for individual patients—that is, decisions concerning whether to sign off or to provide additional consults after their initial consults. This analysis serves to establish that consultants' care intensity decisions affect one another, which suggests that their patient care roles and responsibilities may often overlap. Furthermore, although our analysis did not test directly the efficiency of consultants' care, this article identifies which of three theoretical frameworks captures consultants' decision-making processes most accurately. Our evidence shows that consultants' behavior is most consistent with the predictions of a framework in which consultants' decision-making processes are self-regulatory and aim to improve overall care efficiency. This suggests that interventions chosen to improve consulting care efficiency should enable these processes rather than constrain them.

Materials and Methods

Theoretical Frameworks

We compared three theoretical frameworks that may help to explain consultants' decision-making processes and that have very different implications for the efficiency of consultants' care. These included the two frameworks we have seen described in the limited literature on consults and one drawn from economic theory.

One framework that may predict how consultants govern their own care intensity in response to other consultants' care intensity decisions was put forth by Stavert and Lott [26]. They expressed concern that the responsibility for managing complex patients' care is often diffused across multiple consultants. In the absence of a central organizing authority, consultants may fail collectively to intervene when necessary to re-direct the patient's care pathway due to expectations that other consultants will intervene instead. As the number of involved consultants increases, each consultant perceives an increasing likelihood that at least one other consultant will act. But because all consultants believe this to be the case, none ultimately intervenes. As Stavert and Lott noted, this pattern is consistent with the theory of the Bystander Effect, first described in 1968 following the case of Kitty Genovese [27]. If this theory holds true, hospitals might institute co-management programs requiring that at least one physician (in addition to the surgeon) is ultimately responsible for coordinating and managing every complex patient's care.

In the second framework we explored, consultants behave in accordance with an 'all hands on deck' mindset. Consultants, when observing greater numbers of other consultants involved in the case, may infer a great patient need: the attending physician considers the case so complex that he or she requires the assistance of many colleagues to ensure the patient's well-being [28]. Consequently, the consultants would be less likely to 'sign off' and discontinue seeing the patient until the case is demonstrably stabilized. More cynically, this response could also be driven by opportunism among consultants seeking a pretext to bill for additional consultations (for example, see Stark and Waxman [29]). If this framework holds, consults would be provided too often and inefficiently; such overprovision could be constrained through audits or incentive programs that benchmark the provision of medicine consults along with related patient outcomes.

In economic theory, the Law of Diminishing Marginal Productivity suggests that, for a given patient case, the value to the patient of a consult (or consultant) falls with each additional consult (or consultant). If consultants recognize a diminishing value in their own consults, they may be more inclined to sign off in favor of providing more valuable care to other patients. This theory also offers an interesting nuance—which distinguishes it from the Bystander Effect—that the value of additional consults by the same consultant may diminish more rapidly than the value of additional consultants on the case; new consultants may present new insights or perspectives valuable to the patient more often than other consultants already engaged. If this theory holds, then on average consultants may be making their care intensity decisions economically, calibrating their levels of involvement in individual patient cases to maximize the total benefit they provide to all patients. Interventions intended to improve consulting care efficiency should take care not to constrain such decision-making

processes but rather to facilitate them, as by supporting effective communication and robust information-sharing among consultants.

The baseline predictions of the Bystander Effect and Diminishing Marginal Productivity theories are the same (though for different reasons): as the numbers of consults already rendered to the patient or of consultants already involved in a patient's case increase, the next consultant is less likely to render additional consults. The All Hands on Deck framework yields the opposite prediction.

We distinguish the Bystander Effect and Diminishing Marginal Productivity theories in their predictions for how new consultants' care intensity decisions are affected by prior distributions of consults that are more or less concentrated. Specifically, for given numbers of prior consults and consultants, the new consultant's care intensity decision may depend on whether most of the consults were provided by a few consultants (i.e., more concentrated) versus provided in virtually equal numbers by each consultant (i.e., less concentrated). It is a corollary of the Bystander Effect that, when a new consultant observes that other consultants have already taken on an expanded care management role, the new consultant will see little reason to do likewise. Thus, as the observed distribution of consults across consultants becomes more concentrated, reflecting greater investment by other consultants in the patient's case, the Bystander Effect predicts that the next consultant will provide less intensive consulting care.

By contrast, the Diminishing Marginal Productivity framework's predictions in this context are ambiguous. On the one hand, the framework suggests that new consultants joining cases with concentrated consult distributions would infer that the patient's needs for active management were already met and provide fewer consults themselves. On the other hand, the framework also holds that the value of consults diminishes more rapidly within consultants than across consultants. That is, when consult distributions are more concentrated, a new consultant's consults may be particularly valuable to the patient. New consultants may recognize the potential value of their new perspectives and provide more consults in such cases than when joining cases with less concentrated consult distributions.

Table 1 summarizes the predictions of the All Hands on Deck, Diminishing Marginal Productivity, and Bystander Effect models and how they align and conflict.

Sample

We analyzed the decision-making of consultants in the context of perioperative consults—identified using Current Procedural Terminology (CPT) codes 99261-99263, 99271-99275, 99221-99223, 99291-99292, 99251-99255, and 99231-99233—for Medicare beneficiaries undergoing coronary artery bypass graft (CABG)—International Classification of Diseases, Ninth Revision (ICD-9) procedure codes 36.10-36.19—or colectomy—ICD-9 procedure codes 45.73-45.76. We selected these distinct cohorts because CABG and colectomy procedures are common, and patients undergoing them are often complex and so may require consulting care. We derived our samples from 100% MedPAR (hospital inpatient services) files and all Medicare Part B claims (Carrier files) between admission and discharge dates from 2007 through 2010, a period preceding the introduction of the Bundled

Payments for Care Improvement initiative and other payment reforms potentially affecting inpatient physician services. We used Medicare Beneficiary Summary files and the 2008 American Hospital Association survey to identify additional beneficiary and hospital characteristics, respectively.

We restricted our analytic samples to CABG patients not also undergoing valve replacement or percutaneous coronary intervention procedures—ICD-9 procedure codes 35.10-35.29 and 36.01-36.02 and 36.05-36.07 respectively—and colectomy patients whose inpatient hospital claims include diagnoses of colon cancer—ICD-9 diagnosis codes 153.0-153.9 and 154.0. We also excluded patients if they were younger than age 65 or older than age 100, lacked Part B coverage, received zero consults during their hospital stay, had been hospitalized for the same procedure earlier in the same year, were admitted to federal, Veterans Administration, or non-acute care hospitals or hospitals that could not be matched to AHA data or were outside the fifty states and the District of Columbia, or were otherwise missing data. Because of concerns about potential changes in consult coding practices between years (e.g., certain consultation CPT codes were no longer accepted on Medicare claims as of January 2010), admissions spanning more than one calendar year (e.g., including December 31, 2007 and January 1, 2008) were excluded. The remaining sample (approximately 99.4%) had a slightly shorter average length of stay than the full sample due to this exclusion, though this should not have meaningfully affected our findings.

We identified consulting physicians using unique physician ID numbers (Carrier Line Performing Profiling Identification Number) appearing on Medicare Carrier File claim lines. We excluded the surgeons and anesthesiologists involved in the patients' principal procedures. (Our effect estimates were not materially affected by this exclusion.) While we were not able to distinguish attending physicians from other consulting physicians using available data, we conducted sensitivity analyses that identified effects separately among generalist consultants (general practice, family practice, internal medicine, and geriatrics) versus among proceduralist (cardiology, gastroenterology, pulmonology, hematology oncology, and medical oncology) and non-proceduralist (nephrology, infectious disease, physical medicine and rehabilitation, endocrinology, dermatology, allergy and immunology, neurology, rheumatology, pain management, and hematology) specialist consultants, obtaining similar results.

Statistical Analysis

We first estimated a patient-physician dyad-level model, as shown in Equation (1), of the consultant c 's care intensity (Int_{pcht}) on behalf of a patient p in hospital h in year t . We measured Int_{pcht} two ways: whether the consultant provides two or more days consulting and the consultant's total days consulting. We regressed these outcomes on two measures of other consultants' care before the date of c 's first consult: N_{pc} , the number of physicians rendering consults, and $PREVInt_{pc}$, an indicator of whether another consulting physician may have provided consults over two or more days. In this equation, β_I and β'_I represented our parameters of interest: positive estimates would be consistent with the All Hands on Deck framework, and negative estimates would be consistent with the Bystander Effect and Diminishing Marginal Product Frameworks, as illustrated in Table 1. Any statistically

significant, non-zero estimate would represent evidence of inter-dependencies among consultants' care intensity decisions and non-specialty specific overlap in their responsibilities.

$$Int_{pcht} = \alpha + \beta_1 N_{pc} + \beta'_1 PREVInt_{pc} + \beta_2 X_p + \beta_3 X_c + \beta_4 X_{pc} + \beta_5 X_h + R_h + y_t + \omega_{pcht} \quad (1)$$

We included numerous patient-level, physician-level, and patient-physician dyad-level controls (X_p , X_c , and X_{pc} , respectively) to account for observable differences in patient severity and comorbidity, differences in average patterns of consults rendered by consultants like c , and observed patterns of care for patient p . These controls included the number of consultants rendering consults by discharge, age, sex, and race indicators, 29 Elixhauser comorbidity indicators [30], the surgery's elective status, length of stay, the days of the week of the patient's admission and surgery—the timing and patterns of consults may be affected by weekends—and the presence of any post-surgical consultations by the patient's surgeon or anesthesiologist, to whom other consultants might defer in managing the patient. The comorbidity and length of stay variables might be endogenous with our consulting care intensity measures if consultants providing more intensive management were more likely to identify and document patient comorbidities or to prolong the patient's stay [31]. If so, including them in our models made our results more conservative.

The physician-level controls included indicators for consultant c 's specialty and whether his or her initial consult fell within three or five days of the patient's death or discharge—expectations for the patient's death or discharge could affect the consultant's care plan. Our patient-physician dyad-level controls, reflecting the case's status before the date of c 's first consult, included dummies indicating whether a specialist consultant had rendered a consult for each of 19 specialties. Lastly, our hospital-level controls X_h included teaching status, investor-owned status, size (bed counts), nurse-to-patient ratio, and Medicaid fraction. We also included hospital region R_h and year fixed effects y_t to control for broad cultural differences across physician populations and differences in billing practices or medical technology diffusion. We clustered standard errors at the hospital level to account for heteroskedasticity across hospitals.

In our second model, shown in Equation (2), we regressed the same outcomes on a measure HHI_{pc} identifying how concentrated the distribution of consulting days across other consultants was before the date of c 's first consult. This concentration measure was constructed in the same way as the well-known Herfindahl-Hirschman Index (HHI) often used to measure market power: the sum of the squares of all previous consultants' shares of consulting days, with shares expressed as fractions multiplied by 100. To ensure that HHI_{pc} was well-defined, this analysis was limited to the experiences of consultants whose first consult took place at least one day after the patient's first consult overall. We also modified our controls X_{pc} adding total prior consultants and consulting days variables; otherwise this model was structured similarly to that in Equation (1). A negatively signed δ_1 estimate would indicate both the Bystander Effect and Diminishing Marginal Productivity frameworks may have affected consultants' decision making, while a positively signed

estimate would indicate the Diminishing Marginal Productivity framework prevailed (Table 1).

$$Int_{pcht} = \gamma + \delta_1 HHI_{pc} + \delta_2 X_p + \delta_3 X_c + \delta_4 X_{pc} + \delta_5 X_h + R_h + y_t + \varepsilon_{pcht} \quad (2)$$

This study protocol was approved by <redacted for blinded peer review> under expedited review.

Results

After applying all inclusion and exclusion criteria, our patient-physician dyad-level analytic samples consisted of 253,209 observations for 61,785 CABG patients and 115,853 observations for 33,460 colectomy patients. In Table 2 we present select descriptive statistics characterizing these samples. (Corresponding patient-level descriptive statistics are presented Table SM1, available in Supplemental Material online.) Both samples' patients were elderly, relatively sick, and complex. CABG patients were more likely to be male, younger, diabetic, hypertensive, and treated in an academic hospital, and their consulting physicians were more likely to be specialists.

Our analytic results on the effects of prior consulting care characteristics are presented in Table 3. For each additional prior consultant, the next consultant's probability of providing two or more days consulting fell 0.8-1.1 percentage points (1.2-1.7 percent of sample means), and her total days consulting fell 0.24-0.25 days (7.1-7.4 percent). In addition, if a prior consultant rendered two or more days consulting, the next consultant's probability of providing two or more days consulting fell 13.2-14.2 percentage points (20.6-21.5 percent), and her total days consulting fell 0.49-0.95 days (15.5-26.6 percent).

Our results analyzing the effects of prior consults' concentration are presented in Table 4. Prior to estimating this model, we divided our consult share HHI measure by 2,500; thus a one-unit change in this rescaled measure corresponded to an increase in the concentration (HHI) of consult-day shares across consultants of 2,500. This was a large change in consult-day concentrations, equivalent to the difference between an even distribution of consult-days across four consultants (less concentrated) and another even distribution of consult-days across only two consultants (more concentrated). We found that when the new consultant observes consults have been more concentrated prior to her first consult, her probability of providing two or more days consulting increased by 1.9-2.0 percentage points (2.9-3.1 percent), and her total days consulting increased 0.19-0.21 days (5.8-6.1 percent). The tight confidence intervals about these estimates ruled out the negative-signed effects predicted by the Bystander Effect framework.

We conducted several supplemental analyses to ensure both models' results were robust to reasonable changes of specifications and to test a related hypothesis. Select results of these analyses are presented in the Supplemental Material online, Tables SM2 and SM3.

We tested whether our results would persist—or strengthen—when we re-estimated our models in two comparable, yet more complex patient groups. First, we examined effects for

patients with both three comorbid conditions *and* at least one critical care consult—we required that the critical care consult fell within the first three days of the hospital stay (and that the total length of stay exceeded five days), so that we would be assured that for these cases we would be able to observe patterns of consults that were conditional on this clear, early signal of the patient’s heightened complexity. And, second, we examined effects for those patients with exactly six comorbid conditions identified. Within these samples, our conclusions remained unchanged, though the statistical significance of our estimates was reduced in some cases (likely due to significantly reduced sample sizes). Given that the defining traits of these populations were selected arbitrarily, we also estimated our models for comparable populations (e.g., with a critical care visit within five days of admission or with five comorbid conditions) and again produced similar findings.

The decision-making processes of consultants could be significantly affected by the different financial and organizational incentives they face in investor-owned versus non-for-profit hospitals or in academic versus non-academic hospitals. To test for such heterogeneous effects, we re-estimated our models using samples restricted to patients who attended investor-owned hospitals or teaching hospitals. Overall, our estimates for both subsamples were similar to those for the base sample, though the magnitudes of our observed positive effects were somewhat smaller for the academic hospital sample.

In hospitals with a more established record of ‘co-management,’ in which a physician provides consults on at least 70% of patient days [32], a consultant’s providing multiple days consulting could be a strong indicator to other physicians that the patient’s needs for strong care management support are being met. Thus the establishment of such regimented programs could attenuate our observed effects. We prepared supplemental models to test this hypothesis. Specifically, we added to our main models a co-management rate measure, which captured the proportion of the hospital’s patients that experienced co-management in the previous calendar year. We also included interaction terms multiplying the co-management rate with our measures of prior consultants’ care intensity—these terms could capture whether consultants’ decision-making processes are affected when they practice at hospitals with greater use of co-management. Our estimates of the effects of more concentrated distributions of prior consults were, in fact, more strongly positive in high co-management hospitals than in low co-management hospitals. These results again supported the Diminishing Marginal Productivity framework rather than the Bystander Effect as most reflective of consultants’ decision-making on average.

Discussion

Understanding the scope of inpatient medical consultants’ care and how they behave under established incentive structures is an important step toward anticipating how they may respond to new initiatives to improve efficiency in inpatient medical care, such as e-consults, inpatient telemedicine, bundled payments for hospital and inpatient physician services, and the Merit-Based Incentive Payment System [33-37]. In this study, we analyzed how consultants determined the intensity of their consulting care and the role other consultants’ care intensity decisions played in this process.

This study's contributions to the research literature on consults include the examination of three disparate, established theoretical frameworks for understanding how consultants decide whether to provide intensive consulting care upon joining a case and how this decision is affected, in part, by prior consultants' care intensity decisions. These frameworks are important to weigh against one another as they have very different implications for how policymakers and administrators should intervene to improve efficiency in consulting care. Our empirical approach for distinguishing among these frameworks employs new measures of consulting care intensity, conditional on providing an initial consult, that shift away from the literature's traditional focus on the physician requesting a consult (i.e., the attending physician) toward a focus on the physician rendering the consult. The consultant's perspective is important to consider given the significant autonomy he or she has in determining whether to sign off or provide additional consults once engaged in a patient case. Additionally, our measure of the distribution of consulting days across consultants elucidates these consultants' roles in patient care and help to gauge the potential additive value of a new consultant's input.

Our results indicated that consultants' care intensity decisions are interdependent, which suggests that consultants may have overlapping, non-specialty-specific responsibilities. Moreover, our estimates were inconsistent with the predictions of the Bystander Effect as proposed by Stavert and Lott [26] and with the predictions of the All Hands on Deck framework. Instead, while our analysis did not test directly whether consultants' care was efficient, our results supported interpreting consultants' decision-making as consistent with a Diminishing Marginal Productivity framework, which would indicate that on average consultants calibrate the intensity of their consulting care for individual patients in a manner that could increase overall care efficiency. (While the predictions of the Bystander Effect and All Hands on Deck may be observable for some patient cases—our findings do not rule this out—the Diminishing Marginal Productivity framework appears to dominate.) Each of these findings was robust to several alternative specifications.

If physicians are indeed calibrating the intensity of their care in ways that economize their efforts, these decision-making processes could potentially be leveraged to achieve additional gains in efficiency and care quality. In particular, our finding that consultants calibrated their care intensity based on the decisions of preceding consultants suggests that consultants value timely information about the patient's established physician team—including the attending physician, surgeon, and consultants—and the care they have delivered. Thus our work suggests effective information-sharing and coordination is valuable within the inpatient setting, as has been established previously in the context of transitions from inpatient to outpatient settings in other research.[38] Additional research can also support these decisions by quantifying how rapidly the value of a consultant's consults (e.g., in terms of associated improvement in patient outcomes) diminishes. Conversely, other initiatives aiming to improve consultants' care efficiency (e.g., co-management requirements) may unintentionally reduce the efficiency of consultants' self-regulating care processes if they constrain consultants' decision-making.

This analysis has a few important limitations. First, our inferences about consultants' decision-making depend on claims-based measures of consulting care intensity, which do

not capture all relevant clinical information about patient cases, including important downstream outcomes. Similarly, our administrative data-driven analyses may have been vulnerable to bias due to unmeasured differences in health status and severity across patients. That said, we expected patients with more severe conditions should have more consulting physicians and more intensive consult provision by most individual consultants; consequently our analyses should have been more likely to favor an interpretation consistent with the All Hands on Deck Framework, which we rejected. Major post-operative complications (e.g., pulmonary embolism, delirium) may be similarly associated with increased consult use [39-41]. However, controlling for the presence of complications could have introduced additional endogeneity due to problems of attribution, as we could not distinguish between complications stemming from consultants' own care and complications arising for other reasons. Moreover, it is not clear how unmeasured health status or complications would be correlated with the concentration of consults across consultants, our independent variable of interest, and so we could not sign the potential bias in these results.

In addition, we reiterate that our analyses produced estimates of *average* effects. Thus our analyses may have masked underlying variation in the balance of the Bystander Effect and Diminishing Marginal Productivity framework, for example. In this case, it is possible that the Diminishing Marginal Productivity framework is dominant, while the Bystander Effect persists under some select conditions. Nevertheless, our first set of analytic results indicated, if the All Hands on Deck Framework holds under any conditions, these conditions would be rare. Finally, although our results were consistent across two distinct samples of patients undergoing different surgical procedures—CABG and colectomy—our findings may not be generalizable to other, non-elderly patients or patients admitted for non-surgical care.

Conclusion

In the interests of improving consulting care efficiency, administrators and policymakers may choose from among many alternative interventions, including regimented co-management programs, financial incentives tied to benchmarking, and public reporting. This study sheds light on the interactions and decision-making processes of medical consultants treating complex surgical patients under established incentive structures. We found that consultants' processes for determining how intensively they should care for individual patients already support the health care system's goal of improving inpatient care efficiency. Thus external efforts to achieve this same goal should seek to facilitate consultants' decision-making processes rather than to constrain them.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Theoretical Predictions for New Consultant's Behavior, by Theoretical Framework

Management of Case Prior to Consultant's Initial Consult	All Hands on Deck	Diminishing Marginal Productivity	The Bystander Effect
Additional consultants/consults	More consults; greater probability of providing more ICC	Fewer consults; reduced probability of providing more ICC	Fewer consults; reduced probability of providing more ICC
More concentrated distribution of consults across consultants	No prediction	Ambiguous predictions	Fewer consults; reduced probability of providing more ICC

Note: ICC = intensive consulting care

Table 2

Descriptive Statistics for Coronary Artery Bypass Grafting (CABG) and Colectomy Samples, 2007-2010

Variable	CABG		Colectomy	
	Mean or %	SD	Mean or %	SD
<i>Consulting Care Intensity</i>				
2+ days consulting	64.3%		66.0%	
Days consulting	3.17	3.32	3.57	3.87
<i>Key Explanatory Variables</i>				
Prior consulting physicians	2.97	3.72	2.90	3.49
Prior MD had 2+ days consulting	55.7%		57.6%	
<i>Select Control Variables</i>				
Male	63.5%		44.3%	
Age	73.71	6.10	79.57	7.71
Black	7.5%		9.6%	
Other race (non-white)	5.1%		3.6%	
Length of stay	13.82	9.45	15.35	9.26
Post-op consult by surgeon	3.3%		4.9%	
Post-op consult by anes.	11.6%		17.6%	
Uncomplicated diabetes	42.3%		16.5%	
Congestive heart failure	3.3%		20.9%	
Hypertension 72.4%			48.6%	
Depression 2.6%			2.6%	
Elective procedure	40.5%		37.6%	
Academic hospital	26.9%		15.2%	
For-profit hospital	14.2%		12.2%	
Nurse-occupancy ratio	6.80	2.27	6.47	2.20
Medicaid share	15.83	8.48	15.79	9.13
Init. consult < 3 days from discharge	19.8%		17.3%	
Init. consult < 5 days from discharge	27.8%		25.6%	
Generalist physician	19.1%		36.5%	
Non-proceduralist specialist	16.8%		8.9%	
Proceduralist specialist	50.3%		43.7%	
n	253,209		115,853	

Notes: Statistics captured at the time of index consultant's first consult on patient case. Generalist physicians include general practice, family practice, internal medicine, and geriatrics; non-proceduralist specialties include nephrology, infectious disease, physical medicine and rehabilitation, endocrinology, dermatology, allergy and immunology, neurology, rheumatology, pain management, and hematology; proceduralist specialties include cardiology, gastroenterology, pulmonology, hematology oncology, and medical oncology.

Models of Consulting Care Intensity as a Function of Characteristics of Prior Consulting Care, Select Parameter Estimates

Table 3

Variable	Outcome: Consult Provision Over 2+ Days				Outcome: Total Days Consulting			
	CABG		Colectomy		CABG		Colectomy	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Prior consulting physicians	-0.0080	0.0008**	-0.0113	0.0010**	-0.2351	0.0109**	-0.2546	0.0123**
Prior MD had 2+ days consulting	-0.1324	0.0059**	-0.1419	0.0053**	-0.4901	0.0236**	-0.9485	0.0336**
Total consulting physicians	-0.0049	0.0006**	-0.0037	0.0006**	0.0453	0.0073**	0.0301	0.0073**
Length of stay	0.0048	0.0004**	0.0045	0.0003**	0.1243	0.0056**	0.1418	0.0060**
Elective procedure	0.0529	0.0035**	0.0178	0.0036**	0.1228	0.0221**	-0.2708	0.0295**
Init. consult < 3 days from disc.	-0.2111	0.0043**	-0.2016	0.0058**	-0.4468	0.0166**	-0.4127	0.0221**
Init. consult < 5 days from disc.	-0.0092	0.0044*	-0.0343	0.0052**	-0.2515	0.0222**	-0.4192	0.0296**
Prior post-op consult by surgeon	-0.0001	0.0058	0.0042	0.0070	-0.1003	0.0517	0.1683	0.0662*
Prior post-op consult by anes.	0.0023	0.0042	-0.0036	0.0042	0.1450	0.0427**	-0.1508	0.0409**
Male	-0.0002	0.0021	0.0006	0.0028	-0.0263	0.0162	0.0462	0.0232*
Age	0.0044	0.0037	0.0019	0.0034	-0.0180	0.0277	0.0599	0.0267
Black	0.0068	0.0054	0.0073	0.0054	0.0913	0.0457*	0.1993	0.0535**
Other race (non-white)	0.0170	0.0061**	0.0252	0.0079**	0.3080	0.0601**	0.4247	0.1005**
Academic hospital	-0.0352	0.0099**	-0.0349	0.0085**	-0.2789	0.0789**	-0.3942	0.0828**
Investor-owned hospital	0.0366	0.0101**	0.0357	0.0061**	0.3787	0.0792**	0.3954	0.0643**
Nurse-occupancy ratio	-0.0045	0.0013**	-0.0065	0.0011**	-0.0636	0.0136**	-0.0807	0.0114**
Medicaid share	-0.0008	0.0004	-0.0007	0.0002**	-0.0083	0.0034*	-0.0055	0.0025*
<i>n</i>	253,209		115,853		253,197		115,853	

Notes:

** : Statistically significant at $p < 0.01$.* : Statistically significant at $p < 0.05$. CABG = coronary artery bypass grafting. Other control variables (results not presented) include age², 29 Elixhauser comorbid condition indicators, indicators for the days of the week on which the patient was admitted and on which the index surgery took place (Monday refs.), 19 indicators of the index consultant's specialty, indicators of whether a consultant had

previously rendered a consult for each of 19 specialties, other profit status (neither discernibly investor-owned nor non-for-profit), indicators for hospital bed counts 200-349, 350-499, and 500+ (< 200 ref.), and region and year fixed effects. Standard errors are clustered at the hospital level.

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Table 4

Models of Consulting Care Intensity as a Function of Prior Consult Concentration, Controlling for Total Previous Consults and Total Consulting Physicians, Select Parameter Estimates

Variable	Outcome: Providing Consults Over 2+ Days				Outcome: Total Days Consulting			
	CABG	Colectomy	CABG	Colectomy	CABG	Colectomy	CABG	Colectomy
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Prior consult concentration[†]	0.0185	0.0018	0.0202	0.0021	0.1923	0.0132	0.2083	0.0147
Total previous consults	-0.0018	0.0001	-0.0020	0.0002	-0.0426	0.0018	-0.0453	0.0023
Total consulting physicians	-0.0006	0.0006	0.0002	0.0006	0.0280	0.0069	0.0272	0.0065
Length of stay	0.0040	0.0004	0.0037	0.0003	0.1109	0.0057	0.1068	0.0057
Elective procedure	0.0197	0.0035	-0.0002	0.0042	0.0666	0.0215	-0.1569	0.0284
Init. consult < 3 days from disc.	-0.2158	0.0044	-0.2095	0.0061	-0.4821	0.0159	-0.5140	0.0204
Init. consult < 5 days from disc.	-0.0213	0.0043	-0.0412	0.0056	-0.3333	0.0234	-0.4912	0.0306
Prior post-op consult by surgeon	0.0125	0.0064	0.0042	0.0081	-0.0257	0.0603	0.0837	0.0662
Prior post-op consult by anes.	0.0020	0.0044	0.0018	0.0049	0.1455	0.0456	-0.0437	0.0412
Male	-0.0042	0.0024	-0.0039	0.0035	-0.0097	0.0189	0.0433	0.0248
Age	0.0021	0.0043	0.0003	0.0040	-0.0349	0.0314	0.0648	0.0284
Black	-0.0008	0.0062	0.0128	0.0063	0.0049	0.0450	0.1883	0.0544
Other race (non-white)	0.0115	0.0067	0.0277	0.0097	0.1770	0.0566	0.2972	0.0826
Academic hospital	-0.0338	0.0098	-0.0420	0.0089	-0.2602	0.0717	-0.3434	0.0739
Investor-owned hospital	0.0301	0.0104	0.0351	0.0068	0.2946	0.0674	0.2987	0.0572
Nurse-occupancy ratio	-0.0038	0.0016	-0.0054	0.0010	-0.0488	0.0106	-0.0506	0.0099
Medicaid share	-0.0004	0.0004	-0.0005	0.0003	-0.0062	0.0030	-0.0033	0.0023
<i>n</i>	176,313		80,507		176,313		80,507	

Notes:

^{**} : Statistically significant at $p < 0.01$.

^{*} : Statistically significant at $p < 0.05$.

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⁷ ; Prior consult concentration measure constructed as a Herfindahl-Hirschmann index of prior consultants' consult-shares (rescaled dividing by 2,500 so that a one-unit increase reflects a demonstrable increase in the concentration of prior consults across prior consultants). CABG = coronary artery bypass grafting. Other control variables (results not presented) include age², 29 Elixhauser comorbid condition indicators, indicators for the days of the week on which the patient was admitted and on which the index surgery took place (Monday refs.), 19 indicators of the index consultant's specialty, indicators of whether a consultant had previously rendered a consult for each of 19 specialties, other profit status (neither discernibly investor-owned nor non-for-profit), indicators for hospital bed counts 200-349, 350-499, and 500+ (< 200 ref.), and region and year fixed effects. Standard errors are clustered at the hospital level.