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ABSTRACT

Stemming from the belief that the key barrier to achieving high-quality and low-cost health care is the deficiency of information and medical knowledge among patients, an enormous number of health policies are focused on patient education. In this paper, we attempt to place an upper bound on the improvements to health care quality that may emanate from such information campaigns. To do so, we compare the care received by a group of patients that should have the best possible information on health care service efficacy—i.e., physicians as patients—with a comparable group of non-physician patients, taking various steps to account for unobservable differences between the two groups. Our results suggest that physicians do only slightly better in adhering to both low- and high-value care guidelines than non-physicians – but not by much and not always.

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A data appendix is available at http://www.nber.org/data-appendix/w26038

I. INTRODUCTION

There is widespread belief in health care that the deficiency in information and medical knowledge among consumers is *the* key barrier to achieving high-quality health outcomes and lower costs of care. An enormous number of health policies follow from this assumption, including efforts to educate patients about health, both at a population level through large-scale public health campaigns (e.g., campaigns to encourage exercise and healthier diets) and at an individual level through provider-led patient education (e.g., education of patients about the inappropriateness of antibiotics for the common cold, the importance of vaccination, etc.), decision-making support, and so on. In addition to information-based policies intended to improve health, other important demand-side approaches intended to improve the efficiency of health care (e.g., high-deductible health plans) focus on increasing direct consumer engagement in the purchase of health care, relying heavily on the notion that informing patients about the costs and benefits of health care services can steer patients towards higher-quality, more efficient care.

The widely prevailing view that information scarcity is a key obstacle to achieving high quality health outcomes raises the basic question: is it simply inadequate medical knowledge and information among patients that has limited the utility of various demand-side approaches to health improvement? If so, it remains possible that improvements could be made along both cost and quality lines should policymakers and providers encourage even greater levels of information disclosure to patients, a point not only stressed by patient-centered health care enthusiasts promoting shared decision-making models, but also intrinsic to the many public health efforts that aim to use patient education as a primary way to improve health. In this paper, we attempt to shed light on whether eliminating the scarcity of information in medical knowledge – an extreme form of information disclosure – could plausibly lead to the delivery and receipt of higher value patient care.

A natural way to explore the importance of scarcity of medical knowledge and information is to look at the care received by a group of patients that should have the best possible information on health care service efficacy: physicians. The decisions of physicians about which type of health care to receive would likely place an upper bound on how well non-physicians could do in selecting their health care treatments if fully informed about the costs and benefits of different types of health care interventions. With the exception of Johnson and Rehavi (2016), who focused on a single health care service – cesarean sections – there is no work which has been able to study the role of physicians as patients.

We are able to address this shortfall by using a source of data previously unexploited in economics research: data on physicians in the Military Health System (MHS). The MHS provides health insurance for all active duty military, their dependents, and retirees. Care is provided both directly on military bases and purchased from an off-base network of contracted providers. The MHS is one of the largest sources of health care spending in the U.S., with spending of over $50 billion per year. We have gathered data on the complete claims records for all MHS enrollees over a ten-year period. Importantly, this includes the claims data for MHS physicians when they are treated as patients themselves (drawing from records of over nearly 35,000 military physicians). The ability to observe physicians as patients provides us with a unique and powerful opportunity to answer the question: do especially well informed patients elect to receive higher value medical services?

For these purposes, we evaluate the quality of health care services received by physicians and non-physicians, focusing on a set of services for which objective, evidence-based standards exist. In particular, we assess whether physicians receive more services deemed "high value" by the relevant medical literature and fewer services deemed "low-value," in each case relative to the less-informed comparison group of similar non-physician patients. An example of low value care is a chest x-ray before eye surgery, a very low risk procedure for which pre-operative diagnostic testing is not recommended. An example of high value care would be statin therapy for patients with cardiovascular disease. If deficiency of medical knowledge and information is an important reason why demand-side interventions to improve patient health have met with limited success, we should expect that physicians as patients would exhibit markedly higher levels of adherence to high-value health care services and lower levels of low-value care compared to otherwise similar non-physician patients.

One concern with this analysis, of course, is that physicians may be of different health statuses and have different tastes for medical interventions than non-physicians. We address this concern in five ways. First, we choose conditions and health care treatments over which there is widespread agreement in the medical community about how care should be provided; e.g., it is widely understood that little pre-operative care is needed for benign surgeries like eye surgery, a medical recommendation that does not depend on underlying health risks of individuals. By limiting our focus to specific care recommendations that are agreed to apply to *all* patients, we diminish concerns that the observed levels of services received by a given patient may be driven by variation in unobservable health status and expected benefits specific to that patient. Second, by examining both low- and high-value care, we can rule out one-sided bias; e.g., if physicians are unobservably healthy, they will get less low-value care but also less high-value care. Third, we control for a rich set of health indicators, including prior year medical spending, that correlate with any underlying health differences across groups. Fourth, we compare physicians to other military officers, to control for underlying tastes. Finally, we compare dependents of physicians with dependents of military officers, two groups that are likely even more similar along unobservables, but who should still benefit from the informational advantages of their physician family member.

Our results suggest that physicians do only slightly better than non-physicians – but not by much and not always. Across most of our low-value settings, physicians receive less low-value care than do non-physicians, but the differences are modest, and generally amount to less than one-fifth of the gap between what is received by non-physicians and recommended guidelines. The results are slightly more mixed in the case of the high-value care analysis, with some evidence suggesting that physicians appear to receive high-value care at roughly the same rate received by non-physicians and some evidence suggesting that physicians do slightly better than non-physicians. These results provide a rough boundary on the extent to which additional information disclosure (beyond prevailing levels) can be expected to improve the delivery of health care in the U.S. Relatedly, these findings suggest that, despite the threat to the optimality of the health care system posed by information asymmetries between physicians and patients (Arrow 1963), most of the explanation behind the over- and under-utilization of low- and high-value services likely arises from factors other than informational deficiencies of patients.

Moreover, in the case of low-value care—where we do find modest physician effects—we attempt to shed light on the mechanisms underlying any information channel. We do not find consistent evidence to suggest that the observed average physician effects arise from the patient's choice of a low-intensity physician or from a reduced scope for physician induced demand. Given these findings, it is likely that some of the modest physician effects we estimate arise simply from informed patients making higher quality choices at the moment of the care decision itself.

Our paper proceeds as follows. Part II reviews the existing literature on the impacts of health care information initiatives and provides a conceptual overview behind our approach of observing physicians as patients as a means of exploring the bounds of the quality gains that may arise from greater information disclosure. Part III provides a background on the Military Health System and discusses our data and empirical methodology. Part IV presents the results of our analysis and Part V concludes.

II. Literature Review and Conceptual Overview

II.A. Previous Literature on Information-Sharing Policies

An essential component to most modern proposals for a consumer-driven, patient-centered approach to health care is the provision of sufficient information to patients to facilitate their informed medical decisions. The question is whether there is a way to transmit sufficient information, and whether that is enough to create informed medical decisions.

A number of studies show that patients typically enter their treatment regimens with relatively little information on their treatment options. Several studies survey patients with particular conditions or undergoing particular procedures and "quiz" them on their knowledge of the relevant options, generally documenting very low levels of understanding (Pope 2017). For instance, Weeks et al. (2012) found that only 19% of patients with colorectal cancer understood that chemotherapy was not likely to cure their cancer. Similarly, Kureshi et al. (2014) found that only 3% of patients scheduled for percutaneous coronary intervention understood that procedure.

A range of similar studies have endeavored to explore the capacity of patients to understand their scenarios in the first place. A representative study of this latter nature can be found in Herz et al. (1992), in which the researchers provided pre-treatment teaching sessions by a neurosurgeon to a group of 106 patients receiving either anterior cervical fusion or lumbar laminectomy. Immediately after the session, patients were given a basic written test and, on average, scored only 43.5 percent. Given the simplicity of the questions, the authors concluded that greater information disclosure to patients cannot necessarily ensure accurate comprehension.[1]

Another relevant empirical literature examines a set of policy initiatives that are aimed at facilitating patient / consumer choice of hospitals and physicians. Among these market-based policies are those that require hospitals (and, sometimes, physicians) to publicly report on various specified outcomes, whether at the state level (e.g., CABG report card programs in New York and Pennsylvania) or at the federal level (e.g., Medicare Hospital Compare program). Studies suggest, however, that the vast majority of patients do not even access this public information in the first place (Kaiser Family Foundation 2008; Associated Press—NORC Center for Public Affairs Research 2014). Moreover, even when patients are aware of the disclosed information, it is unclear whether it affects their decisions.[2] A number of studies have evaluated the effect of provider report cards on provider market shares, generally finding mixed results (with most such studies focusing on the context of cardiac surgery). Among those studies finding some impact of report cards on provider choice include Bundorf et al. (2009), Wang et al. (2011), and Cutler et al. (2004). Among those studies finding either no impact or only minor impacts include Kolstad (2013), Romano and Zhou (2004), Mukamel et al. (2010), Schneider and Epstein (1998). Even in those studies documenting report card effects, however, such responses need not necessarily emanate from individual patient choice itself but may instead reflect either employer or managed-care responses.

[1] Meisel and Roth (1983) survey additional early studies on the degree to which patients understand disclosures by their physicians.
[2] See Madison (2017) for a recent discussion of information forcing initiatives at the state and federal level.

II.B. Overview of Physicians-as-Patients Approach to Exploring Impacts of Information Disclosure

Even with strong physician disclosure of information, patients may face inherent limitations in their ability to process this information—e.g., due, in some cases, to the lack of intellectual capacity or educational background. or due to the fact that patients are often in diseased states during the time of disclosure, impeding their ability to absorb this information. In our analysis, we look to the decisions of a set of patients—e.g., physicians as patients themselves—that are less likely to suffer from these particular limitations. As such, our approach is designed to provide an upper bound on the gains that may arise from providing patients with greater sources of information at the clinical decision-making stage.

This bounding approach is similar to two relatively recent studies on the impacts of medical expertise, beginning with Bronnenberg et al.'s (2015) analysis of consumer behavior using scanner data. Bronnenerg et al. compare the use of store brand versus generic products—e.g., over-the-counter medications, pantry supplies, etc.—in the case of expert versus non-expert shoppers. Of closest relevance to our piece is their finding that pharmacists are substantially more likely to choose generic headache medicines (roughly 91% of the time) compared with the average consumer (choosing generic headache medicines roughly 74% of the time).

Johnson and Rehavi (2013) perform a similar informed-consumer analysis, though one that focuses more on an actual patient-physician encounter. They explore cesarean section delivery. Using vital statistics data from California matched with licensure information from physicians, they find that informed patients—i.e., physician mothers—are roughly 10 percent (relative to the mean) less likely to deliver children via cesarean section in comparison with non-physician mothers. Johnson and Rehavi's focus is on the implications of their findings for physician induced demand, arguing that their findings provide evidence that excess care is provided. Another interpretation of their results, however, is as a bound on the effects of a perfectly informed consumer. Estimates typically suggest that cesarean sections are widely over used, so that a 10% *relative* reduction is fairly modest if this is the full information benchmark.

There are limitations, however, in using their study as a measure of the bounded effects of information (which should not be taken as a criticism of their study, since this was not the intended purpose). First, they are unable to address the general concern that physicians may generally have tastes for less intensive care (which would overstate the information effects) or more intensive care (which means that they understate the effect of being a more informed consumer). Second, they only examine one clinical setting—i.e., cesarean section delivery—implicating generalizability concerns.

In our analysis to follow, we likewise explore whether patients with superior medical knowledge and information—physician patients—ultimately receive more appropriate medical care. But we do so across a much broader array of clinical settings that comprise both "high-value" and "low-value" medical care, drawing on the medical literature for guidance in selecting the appropriate high- and low-value care medical guidelines. As we discuss below, focusing on both ends of the quality spectrum in this manner allows us to separate the impacts of differential knowledge between physician patients and non-physician patients from the impacts arising from any underlying health differences (or health care preferences) between these two groups. In the next section, we provide a background on the Military Health System and summarize our data and methodological approaches; in this process, we describe in detail, the particular clinical contexts and health care choices that drive this investigation.

Of course, our approach has limitations as well. In particular, this is only a partial equilibrium analysis that examines the treatment of particularly well-informed patients, as opposed to a general equilibrium change in the entire informational environment. If treatment decisions are driven primarily by medical providers, and those providers have established patterns of treatment, then there may be no change in treatment between more and less informed patients. A broader and effective information intervention could change treatment patterns more broadly. However, we are unaware of any examples of successful interventions of this broader type.

III. Background on Military Health System, Data and Methodology

III.A. Background on Military Health System

The Military Health System (MHS) is the primary payer of health care services for all active duty military, their dependents and retirees through the TriCare program. TriCare is not involved in health care delivery in combat zones and operates separately from the Department of Veterans Affairs' Veterans Health Administration health service delivery system (Schoenfeld et al. 2016). The MHS actually consists of two systems. For some beneficiaries, the MHS directly delivers health care at Military Treatment Facilities (MTF) on military bases (i.e., the "Direct Care" system). For other beneficiaries, the MHS purchases care from private providers who are within a contracting administrator's network (i.e., the "Purchased Care" system), similar to most privately insured in the U.S. Whether MHS beneficiaries receive care on the base or off the base is largely a function of where they live. Those living close to the MTFs are expected to receive care from the MTF and those living farther away are expected to go to civilian providers off the base.[3]

While all military members, families and retirees face coverage under the MHS, the system does offer alternative insurance plans with different cost-sharing and other terms. All active-duty personnel are required to enroll in TRICARE Prime plans. While facing other alternatives, nearly 90% of the non-active duty in our records likewise choose to enroll in TRICARE Prime. TRICARE Prime beneficiaries who are active duty or dependents of active duty face no out-of-pocket costs whether they go on the base for care (Direct Care) or off the base for care (Purchased Care).[4]

III.B. Data

The data for our analysis come from the Military Health System Data Repository (MDR), which is the main database of health records maintained by the MHS. Broadly, it provides incident-level claims data across a range of clinical settings and contexts, with data on inpatient stays, outpatient stays, pharmaceutical records, and radiological and laboratory testing, in all cases for both the Direct Care and Purchased Care settings. Each record provides details regarding the encounter—primarily the diagnosis and procedure codes associated with the event and various other utilization metrics. Furthermore, the MDR database also contains separate files with coverage, demographic, geographic and other information on each MHS beneficiary, which we link to the claims records.

[3] In principle, enrollees who live within the "catchment area" of an MTF hospital or the "prism" area of an MTF clinic are supposed to go to the MTF for care. These area, respectively, were defined as 40 miles and 20 miles originally, although the military has shifted to time-based boundaries over time. But our data show clearly that this rule is not rigorously enforced during our sample period. As is clear from the data, those who live closer to an MTF are much more likely to go there, but with a more gradual fall off rather than a strong distance discontinuity.

[4] Matters are slightly different for prescription cost-sharing, however. Active duty patients have no co-payments regardless of their care location. Non-active-duty patients likewise pay no co-payments when filling their prescriptions at MTF pharmacy facilities, though they do pay small co-payments when filling prescriptions via mail order ($7 for generics) or at civilian retail pharmacies ($11 for generics).

Critically, these data provide Department-of-Defense-specific identifiers for each MHS beneficiary. The Direct Care records use those same identifiers to acknowledge the identity of the provider in charge of the care represented in those records. The fact that these same identifiers are used to identify both patients and providers presents us with a unique opportunity—that is, the ability to observe active-duty MHS physicians as patients themselves. Large-scale health care claims databases of this sort rarely provide information on the profession of the patient, let alone with enough specificity to identify those patients who are also physicians. As will be discussed further below, the key methodological thrust of our paper is to take advantage of this opportunity and to compare the care received by physicians as patients with the care received by otherwise similar non-physicians in an effort to elucidate the role that information plays in encouraging more high-value care and less low-value care.

One of the empirical challenges in this exercise is to ensure that the physician and non-physician comparison groups are otherwise equal, such that the differences that we observe between these groups can be attributed to the informational advantages of the physician-as-patients group. Non-comparability concerns arise in at least two key dimensions. First, physician patients and non-physician patients may need health care services to different degrees given differences in underlying health statuses. Second, even aside from need, physician patients and non-physician patients may prefer health care services to different degrees—e.g., perhaps physicians have especially little time to seek care for their own maladies. We take a number of approaches to address this concern throughout the analysis below.

At the outset, we emphasize several sample selection choices that are helpful in addressing comparability concerns between physician and non-physician patients. First, in most of the contexts we explore, we focus on environments in which the medical community has reached an evidence-based consensus that certain specified actions should be taken or should not be taken *for nearly all patients*. With this degree of clinical clarity, should a patient's care deviate from this medical guidance, that deviation is less likely to be driven by unobservable features of the health status of the patient in question. Second, we remove any differences in financial incentives by limiting the analysis to those beneficiaries with TRICARE Prime coverage.

Finally, in each clinical context that we explore, we attempt to construct comparison groups among MHS beneficiaries that are similar to active-duty physicians in terms of socio-economic status and of the demands of their time, both of which may bear on a patient's inclination to receive particular forms of medical care. For these purposes, we limit our attention to non-physician military officers. In alternative specifications, we alter the composition of both our treatment and control groups to focus on dependents—that is, we compare dependents of physicians with dependents of officers. This approach is premised on the idea that dependents of active duty physicians may benefit from the knowledge of their physician family members, to the extent the physician family members are involved in the clinical decision-making for the affected patients. One benefit that this approach has over comparing physicians to non-physician officers is that the dependents on both sides may be otherwise more similar to each other—especially in terms of the demands on their time—relative to the similarity between active duty physicians and officers. As discussed further below, it is true in the case of observable patient characteristics that the treatment-control differential is generally smaller in the case of the dependents sample relative to the sponsors sample.

To proceed further, we provide more specifics on the first of these key sample selection strategies—that is, identifying certain clinical contexts in which medical guidelines setting forth low- and high-value care are clearly established. In the Online Appendix, we provide much of the specifics regarding the construction of the relevant low- and high-value care samples. In the text to follow, we very briefly summarize the samples and outcome measures explore.

III.C Low vs. High Value Care

In order to assess the role of informed consumers in making medical decisions, we contrast the treatment of physicians to non-physician patients when receiving care that is, by medical consensus, either low or high value care. Services receiving the label of "high value" can be thought of as those with clinical benefits that more than justify the costs and harms of those services, while low value is the opposite.

Low-Value Care: Labor and Delivery

The first instance of low-value care that we consider is cesarean delivery. The low-value label applied by the health care community in this context is not premised on the idea that cesareans should never be performed, but rather that they should be performed at less the half of the rates that currently prevail (World Health Organization, 2015). To explore the potential impact of greater information disclosure to patients on cesarean rates, we compare cesarean use between physician and non-physician mothers using the sub-sample of deliveries in the MDR (on and off the base). We consider the incidence of any cesarean delivery, along with the incidence of a "primary" cesarean delivery, the latter of which removes from the relevant delivery sample breech deliveries, multiple deliveries (e.g., twins) and previous cesarean deliveries—i.e., types of deliveries of which physicians have less discretion in the cesarean decision.

Low Value Care: Pre-operative care for low-risk surgeries

While cesareans are low-value in the sense of being over-used, other forms of health care are "low value" in the sense that the relevant medical guidelines recommend that such services not be performed at all. We next consider a low-value measure of this nature: pre-operative diagnostic testing prior to low-risk surgeries. For these purposes, we consider the sample of low-risk surgeries specified by Schwartz et al. (2012)—e.g., cataract removal and hernia repair—and thereafter flag the incidence of the following unnecessary tests prior to—i.e., within 30 days of—the relevant low-risk surgery: chest radiography, complete blood count, coagulation panel or comprehensive metabolic panel. We estimate specifications that consider these tests individually, while also estimating specifications that pool them.

As a robustness exercise, we also consider an alternative to the Schwartz et al. list of low-risk surgeries. We use the inpatient and outpatient MDR records to identify a set of surgeries with low mortality rates (mortality of less than 1 per 1,000 surgeries within 30 days following the surgery/procedure). Once again, preoperative testing for these very low risk surgeries is deemed low value care.

High-Value Care: Diabetes

In our first high-value care analysis, we focus on a sample of patients with diabetes and follow them throughout the course of the relevant sample year to determine if they received "Comprehensive Diabetes Care" (CDC), as that term is specified by the Healthcare Effectiveness Data and Information Set (HEDIS). To better ensure comparability in health status across patients, we limit the sample to those who have had a diabetes diagnosis flagged in their medical records for at least two years prior to the relevant observation year. We identify compliance with CDC by receipt of all of the following: (1) hemoglobin A1c (HbA1c) testing, (2) retinal eye exam, and (3) medical attention for nephropathy. Following HEDIS, we also assess whether the focal diabetes patient receives statin therapy over the observation year (subject to certain additional sample restrictions).

High-Value Care: Cardiovascular Care

In our next high-value care analysis, we assess whether patients comply with the HEDIS protocols for cardiovascular care, focusing on the subsample of patients with a previous atherosclerotic cardiovascular disease diagnosis (CD sample). Within this sub-sample, we follow patients over a year-long observation period and identify high value care by observing (a) whether the affected patient received statin therapy (of high or moderate intensity) at least once over this period or, alternatively, (b) the number of days over the year in which patients filled a prescription for statin therapy, in addition to an indicator, following HEDIS guidelines, for whether they received statin therapy for at least 80% of the observation year.

High-Value Care: Medication Adherence

Inspired by drug adherence investigations from the medical literature, we next explore the degree to which patients adhere to a medication protocol during the first year in which the patient was prescribed the indicated therapy, focusing on two sub-samples: (1) patients with a new diagnosis for hypertension and (2) patients with a new diagnosis of hypercholesterolemia. In both cases, we follow the affected patient over the first year following the diagnosis of this new condition and determine the patient's Medication Possession Ratio, which equals the total number of medication supply days divided by the total number of days indicated for that year.

High-Value Care: Vaccination / Immunization

In a final high value care analysis, we explore the extent to which children of physicians receive by 2 years of age the following vaccinations (and does frequencies) recommended by HEDIS: (1) four vaccines for diphtheria, tetanus and acellular pertussis (DTaP), (2) three polio vaccines (IPV), (3) one measles, mumps and rubella (MMR), (4) three vaccines for haemophilus influenza type B (HiB), (5) one vaccine for hepatitis A, (6) three vaccines for hepatitis B, (7) one vaccine for chicken pox, (8) four vaccines for pneumococcal conjugate (PCV), and (9) two or three vaccines for rotavirus.[5]

III.C. Methodology

To assess whether greater patient information is likely to lead to less low-value care and more high-value care, we estimate the following specification for each of the samples identified in sub-section III.B above:

(1) $Y_{ite} = \alpha + \theta PHYSICIAN_{it} + \delta \mathbf{X_{ite}} + \mu_{jtl} + \varepsilon$

Where *i* denotes the individual patent, j denotes the patient's assigned military base and t denotes the relevant observation year. The care location—either on-base at an MTF or off-base at a civilian facility—is captured by *l* (discussed further below). The encounter or episode over which we are evaluating the care provided to the patient is captured by *e*. In the case of the cesarean analysis, *e* represents the individual delivery. For the pre-operative care analysis, *e* represents the 30-day period prior to an individual low-risk surgery. For the HEDIS diabetes and cardiovascular disease samples, *e* represents the full sample year over which we observe the care provided to the relevant patient (that is, each observation is a given person-year cell). For the first-year drug adherence analyses, *e* similarly represents the full sample year over which we observe the care provided to the affected patients. For the immunization analysis, *e* represents the first two years of the relevant child's life.

Y_{ite} represents the relevant outcome variable for the particular sample at issue—e.g., the incidence of cesarean delivery, the receipt of a chest radiography in the 30 days prior to a low-risk surgery, etc. $PHYSICIAN_{it}$ is an indicator for whether the patient in question is an active-duty

[5] One concern with this analysis respects possible under-reporting / recording of vaccinations in the MDR database. We address this concern in the Online Appendix along with our associated response.

physician in year *t*. This indicator equals 0 for our key control group—i.e, non-physician military officers. By focusing on officers, we aim to select a control group that is otherwise similar in terms of pay-scale within the military and in terms of the workday demands of the individual patient, both of which may bear on a patient's health status and on their tastes and inclinations for medical service. In separate specifications, as discussed above, we focus on an analysis of dependents only—e.g., dependents of active duty physicians ($PHYSICIAN_{it} = 1$) compared with dependents of non-physician military officers ($PHYSICIAN_{it} = 0$).

We also attempt to control for other differences between physicians and non-physicians by including a rich set of control variables, $\mathbf{X}_{\mathbf{ite}}$, which includes patient age-by-sex dummies, patient race dummies (white, black, and other), and pay-grade level dummies for the relevant patient's sponsor (junior officer and senior officer). $\mathbf{X}_{\mathbf{ite}}$ also includes four additional metrics reflective of the health status of the relevant patient (in an effort to ensure comparability between the physician patient and the non-physician counterpart). Three are measures of patient ex-ante resource utilization: (1) the number of inpatient bed-days over the preceding year, (2) the patient's aggregate "Relative Value Units" (RVU) for the previous calendar year,[6] and (3) the patient's aggregate "Relative Weighted Product" for the previous calendar year; the latter is an MHS-created measure which captures the overall intensity of patient treatment in inpatient settings for the preceding year (Frakes and Gruber 2018). The fourth is a direct measure of patient health, the Charlson comorbidity score.[7] Some of the specifications include additional controls (as identified specifically below). For instance, in the pre-operative testing analysis where we pool across

[6] Developed for use with Medicare's reimbursement system, RVUs are a measure specified on a common scale across health care services that are meant to be reflective of the resources used in providing the relevant service, where resources accounted for reflect (1) physician work efforts involved (time, technical skill, mental effort, etc. involved in providing the service), (2) practice expenses involved (accounting for the nonphysician clinical and nonclinical labor of the practice, in addition to other office expenses) and (3) medical liability expenses. For an overview of RVUs, see https://www.cms.gov/apps/physician-fee-schedule/overview.aspx.

[7] The Charslon score is a weighted index of 17 comorbidity conditions (Deyo et al. 1992).

different types of low-risk surgeries, we include fixed effects for the given surgeries comprising this sample.[8]

Further, in specification (1), we include a rich set of fixed effects for military base-by-year-by-care-location groups, μ_{jtl}. Care location controls—i.e., flagging on-base versus off-base care—are important to the extent that physician patients are more or less likely to receive care on the base versus off the base and to the extent that the nature of health care services differs at MTFs versus civilian facilities. With this rich set of effects, we effectively compare physician patients and non-physician patients in their receipt of high- and low-value medical services within a given base, within a given year, and within a given on-base-versus-off-base cite—e.g., within Evans Army Community Hospital in Fort Carson, Colorado in 2009. Since patient locational choices are potentially endogenous, we also estimate models excluding these care-location controls, and the results are virtually unchanged.[9]

For some of the clinical settings—e.g., in the case of labor and delivery—it is straightforward to assign the on-base indicator variable. For other settings—e.g., drug adherence over the observation year—it is less straightforward in that patients may receive medical services both on the base and off the base over the observation year. In these latter instances, we determine for each patient, the share of the RVUs associated with their medical care that is rendered on the base and set an indicator variable for the receipt of on-base care equal to "1" for above-median on-base RVU shares (and 0 for below-median on-base RVU shares).[10]

[8] For those specifications, where it is possible for there to be repeat observations over time for the same patient—i.e. for all specifications other than the first year- drug adherence and childhood immunization analysis—we cluster standard errors at the patient level.

[9] Given that the choice of on-base versus off-base care is largely driven by geography (Frakes and Gruber 2018), we treat those specifications that drop care-location variation as specification checks only.

[10] The results presented below are nearly identical when including base-by-year fixed effects and when simply controlling for this on-base RVU share. For the pharmaceutical-use specifications, care-location measures capture their choice of on-base versus off-base care in the sense of what medical providers they visit, not what type of pharmacy they visit—MTF pharmacy versus retail pharmacy. As discussed above, this pharmacy-location distinction is potentially relevant for the dependents sample given that dependents face higher co-payments for prescriptions filled outside of MTF pharmacies. This creates a potential concern for the dependents sample to the extent the physician group differentially uses MTF pharmacies. While the vast majority of prescriptions are nonetheless filled at MTFs, we include an additional control for the dependents sample (in the pharmaceutical specifications) for the location of the pharmacy (on base versus off).

Table 1 shows the sample balance. Since we have many different samples corresponding to our different high/low value analyses and many different covariates along which to assess balance, we evaluate, for each sample, the balance of predicted outcomes. That is, we form predictions for the key outcome variables—e.g., predicted cesarean delivery—based on the relevant set of covariates and thereafter test for balance in these predicted treatment measures between the physician and non-physician groups. This omnibus approach provides us with a means of exploring the degree of covariate imbalance in a collective sense. In the Online Appendix, we show a comparison of individual covariates one by one.

Generally, with the sponsors comparison, we find modest imbalance across individual covariates, but with no particular pattern – and therefore there are only small differences in the predicted outcomes summary measure. For example, we find that physician sponsors are predicted, based on their covariates, to deliver via cesarean section at a roughly 1 percentage-point lower rate relative to non-physician officers. In each sample, the degree to which these predictions differ between physicians and non-physicians is small in magnitude, generally between 0 and 2 percentage points but upwards of 4 percentage points in the case of predicted comprehensive diabetes care. Moreover, across most of these samples, the covariate imbalance appears to shrink when comparing dependents of physicians with dependents of non-physician officers, consistent with our expectations that the treatment and control groups in the dependents sample are likely to be more similar. In the childhood immunization analyses, naturally, we show imbalance only for the dependents sample. The evidence suggests at most only a minor degree of imbalance between the physician and non-physician group in the immunization sample.

As one final methodological note on patient comparability, we highlight the importance of the fact that, in some contexts, we are testing for high value care, whereas in other contexts, we are testing for low-value care. If there is any bias in our approach created by unobservable differences in health status or tastes for receiving medical interventions between our treatment and control groups, one would expect that bias to work in one consistent direction—e.g., physician patients should consistently receive less care low- *and* high-value care than their non-physician counterparts. If any such bias would indeed be one-sided in nature (if it exists at all) and if the findings happen to demonstrate small physician effects in *both* the high- and low-value care settings, then one might confidently infer that the information level of patients plays a small role in determining the use of high- and low-value services. [11]

IV. RESULTS

IV.A. Low-Value Care Analysis

In Table A2 of the Online Appendix, we show uncontrolled differences between physicians and non-physicians in the means of our various outcome measures. In this section we turn to regression estimation to assess how these physician / non-physician comparisons hold up to controlling for various measures that may also differ between these groups.

Cesarean Delivery

We begin in Table 2 by presenting the results from our first low-value care analysis, where we explore whether physicians as patients receive fewer cesarean deliveries relative to military officers. In Panel A, we focus on the sponsors comparison (physicians versus non-physician officers), whereas in Panel B, we focus on the dependents comparison (dependents of physicians

[11] That is, if information does substantially alter compliance with guidelines and if physicians are of weaker health—which may hypothetically explain small physician effects in low value-care—then one would tend to expect large positive physician effects in the case of the high-value care analysis (since both information and unobservable health status would elevate physician's receipt of treatment). In this case, if we observe modest physician effects in the high-value care setting, this would tend to suggest a small, if any, degree of bias and a small information effect.

versus dependents of non-physician officers). Given the gender differences between the sponsor and dependent samples, we have a notably larger sample size in the dependents analysis presented in Panel B. We present results separately for specifications that evaluate the incidence of any cesarean delivery among all deliveries and that evaluate the incidence of "primary" cesareans among a more restricted set of deliveries (subject to the above stated exclusions).

Each row in Table 2 represents a different regression using the indicated dependent variable (in the specified sample). Point estimates and standard errors for the estimated physician effect coefficient are provided in Columns 4 and 5. To help place the magnitudes of the physician effects in perspective, we indicate in Column 3 the baseline mean rate for the relevant cesarean rate. For conciseness purposes, we follow this format throughout when presenting results across our various clinical contexts given the large number of resulting specifications estimated.

For physician mothers themselves, we find that there is an insignificant effect on the odds of having any cesarean – but for the more discretionary set of "primary" cesareans, there is a significant 2.9 percentage-point reduction, which is about 15 percent of the mean. For dependents of physicians, a much larger sample, we find significant reductions in the incidence of any cesarean—at an amount equal to roughly 6 percent of the mean cesarean rate—but not in the case of the incidence of a primary cesarean delivery.[12]

Though the findings vary across samples and across cesarean measures, the magnitude of the estimated physician effect—in those specifications with significant effects—corresponds somewhat closely with the roughly 10-percent effect (relative to the mean) found in Johnson and Rehavi (2016). Johnson and Rehavi's analysis uses vital statistics data from California, limiting

[12] We also considered specifications where we separately estimate the specific effects of obstetricians / gynecologists (OBGYNS) and non-OBGYNs, as opposed to treating all physicians alike. The point estimate for a physician effect is indeed larger when treating physicians more specifically—i.e., focusing on OBGYNs in this cesarean analysis—however, there are only 116 deliveries by dependents of active duty OBGYNs in our analysis and we simply do not have enough power to detect a difference in physician effects depending on the degree of specificity in the physician indicator.

their ability to consider the full set of clinical contexts explored in our analysis. The correspondence in our findings, however, perhaps provides some support for the generalizability of our findings—including our non-cesarean-related findings—to individuals beyond the beneficiaries of the military health system.

Even in those specifications with significant effects, this cesarean finding is arguably still a modest effect. The World Health Organization (WHO 2015) suggests that the overall cesarean rate should be 10-15 percent, a relative reduction of more than 50 percent in light of the nearly 30 percent prevailing rate of cesarean deliveries. By these standards, our results demonstrate a fairly modest difference between physicians and non-physicians—i.e., a reduction of 6-15 percent of the mean among physicians compared to the 50-percent-plus reduction called for by the WHO. These results therefore suggest that, at most, we may only observe a minor improvement in outcomes—defined here as greater adherence to the established ideal—when providing patients with substantially greater sources of information (especially when bearing in mind that physician patients are a particularly well informed group). Stated differently, our results suggest that factors other than inadequate patient information are likely to explain the majority of the disparity between the ideal cesarean rate and the observed cesarean rate that has animated the WHO.

Low-Risk Surgeries

While cesarean section rates are a useful case for comparison to previous work, it has the weakness that there is still a significant optimal use rate. To strengthen our conclusions, we turn to services which have a clearly recommended optimal use rate of zero. Schwartz et al. (2014) present a set of diagnostic tests delivered prior to a set of specified low risk surgeries which, by strong medical consensus, have no reason to be used. Tests such as chest radiography or a complete blood panel are never recommended before procedures such as cataract surgery, yet they occur with either modest or alarming frequency. Of course, the definition of "low risk" used by Schwartz et al. is a subjectively chosen one, so we further confirm these findings by using our data to empirically identify very low risk surgeries.

Table 3 shows the results for the use of low-value diagnostic tests prior to low-risk surgeries, with Panel A focusing on the sponsors comparison (physician patients versus non-physician officers) and with Panel B focusing on the dependents comparison. As above, each row in this table reflects a different specification, where the columns provide information on the point estimates and standard errors of the estimated physician effects, along with the total number of observations and number of physician observations.

In the sponsors sample, we find a smaller rate of pre-operative chest radiography for physicians—at a roughly 2 percentage-point lower level in the case of the Schwartz et al. sample (relative to a mean rate of 10 percent) and at a roughly 0.3 percentage-point lower level in the case of the derived low-risk sample (relative to a mean rate of 4.8 percent). However, in the case of each of the other pre-operative measures in the sponsors sample—and in the case of the aggregate any-preoperative testing measure—we estimate near-zero point estimates for the physician effects (each statistically indistinguishable from zero). For instance, in the sponsors derived-low-risk sample, we estimate a 95-percent confidence interval for the estimated physician effect of the any-preoperative-testing specification that spans -0.4 to 0.5 percentage-points, or roughly -2.4 to 2.6 percent relative to the mean rate of any pre-operative testing (we find a similar range in the case of the Schwartz et al. sample). Accordingly, based on the results of the sponsors sample, we can rule out a large physician impact and thus a large influence of superior patient information in the choice to receive low-value testing prior to low-risk surgeries.

In the case of the dependents sample, we generally find evidence of modestly lower use of pre-operative testing for the physician group. For instance, with respect to the Schwartz et al. (2014) list of surgeries, we find a 1.7 percentage-point lower use of chest radiography prior to low risk surgeries and a roughly 1.0 percentage-point lower rate of coagulation panels. With respect to any preoperative testing, however, our findings are small and indistinguishable from zero, largely due to the lack of a difference in complete blood count testing between physicians and non-physicians. When drawing on the low-risk surgery sample derived from the MDR records, we find more consistent evidence of a negative physician effect across the different types of preoperative tests. In the case of any preoperative test within this sample, we find that physician patients receive such tests at a roughly 1.2 percentage-point lower rate, amounting to a 5.4 percent effect relative to the mean testing rate of 21.9 percent. Importantly, however, even in this case, physician patients receive unnecessary preoperative testing close to 20 percent of the time prior to low-risk surgeries. Accordingly, even when taking results from this pre-operative testing analysis that suggest the strongest physician effect, our findings imply that the upper bounds of information disclosure are not likely to close the considerable gap between prevailing rates of care and ideal rates.

Interpretation

We find that even the best informed patients do not make any less use of low-value health services. Of course, our results do not necessarily suggest that patient information is universally of minor relevance in the selection of low-value medical services, such that if we unraveled all of the existing sources of information dissemination to patients, we would observe no meaningful consequences in the observed rates of use of low-value care. Rather, our results more conservatively imply that if we were to provide additional information to patients on top of the current information-revelation mechanisms in place, we may only observe minor additional improvements in the case of low-value care utilization.

As discussed in Part III, we acknowledge the possibility that these modest findings may be attributable to omitted-variables bias. That is, there could indeed be a large information effect that drives down the use of low-value services. However, masking this information effect could be unobservable factors that drive physicians to receive more care and that thus partially wash out this hypothetically strong information effect. For instance, perhaps physicians are in unobservably weaker states of health relative to non-physician military officers, a possibility which may necessitate more care and testing. Alternatively, perhaps physician patients simply prefer more intensive practice styles, health status aside.

Mediating against the health-status concern, of course, is our choice of medical guidelines—i.e., preoperative testing prior to the indicated surgeries is identified to be low-value for nearly *all* patients receiving such surgeries. Further mediating is our findings not only for physicians themselves but also for their dependents. Nonetheless, to help further rule out this omitted variables concern, we now invert our focus and explore the role of information in the utilization of high-value medical services.

IV.B. High-Value Care Analysis

There are a variety of medical interventions which are unambiguously recommended for patients, such as low cost maintenance interventions for those with diabetes or cardiac disease. In this section, we assess differential use rates by physicians and non-physicians in these high value contexts. In Table A2 of the Online Appendix, we show uncontrolled differences between physicians and non-physicians for high-value care. In Table 4, we use our regression approach to control for observable differences between physicians and non-physicians.

Diabetes care

We start this analysis by exploring adherence by diabetes patients to HEDIS guidelines for Comprehensive Diabetes Care (CDC) within the relevant year, where each observation is a patient-by-year cell. We also show physician effects for compliance with each of the components of comprehensive diabetes care. Separately, we also test for physician effects in the receipt of recommended statin therapy for diabetes patients.

As above, each row in Table 4 represents a different regression with the indicated dependent variable. In the case of both the dependents analysis and the sponsors analysis, we do not find evidence that physicians are more likely to follow the CDC guidelines than non-physicians or more likely to receive statin therapy. For instance, in the case of compliance with CDC care for sponsors, the 95-percent confidence interval for the physician effect spans from -3.8 to 5.0 percentage points or from roughly -6.5 to 8.6 percent relative to the mean CDC rate. As such, even if we focus on the end of this interval, these results would still suggest that physician patients fail to receive CDC over 30 percent of the time. The statin therapy results imply a similar conclusion. Accordingly, these results suggest only modest potential impacts, at best, resulting from greater information disclosure to diabetes patients.

Cardiovascular Care

Table 4 also explores the role of information in the receipt of recommended care for cardiovascular disease. In one specification, the dependent variable captures the receipt of the indicated therapy at all over the annual observation period. In another specification, we specify a dependent variable indicative of adherence to the relevant medication over the observation period, either based on the days supplied over the observation year or the incidence of meeting at least 80% adherence over the year.

Both in the case of the sponsors sample and the dependents sample, we estimate a physician effect that is indistinguishable from zero. For instance, in the sponsors sample, the 95-percent confidence interval for the physician effect on the incidence of at least 80-percent adherence to statin therapy throughout the year (i.e, the adherence threshold recommended by HEDIS) spans from a -6.2 to 2.8 percentage-point change, or from roughly -13.3 to 6.0 percent relative to the mean. We find similar effects for the dependents analysis. Thus, even if the true effect were at the upper range of the confidence interval—where physicians attain 80-percent adherence at only a 2.8 percentage-point higher rate than non-physicians—only 49.5 percent of physicians would themselves receive recommended care.

Other Medication Adherence Analysis

In Table 5, we estimate the physician effect on adherence to medication within the first year following a new diagnosis for hypertension and hypercholesterolemia. We find modest, mixed effects of a physician effect in this adherence context. For the sponsors sample, we estimate a 1.9 percentage-point physician effect on the Medication Possession Ratio (MPR) for hypertensive therapy (which equals the number of days supplied over the observation year divided by the number of days in the observation year; the absolute effect corresponds to a 2.6 percent increase relative to a baseline rate of adherence of 72.3 percent). The point estimate for this effect in the dependents sample is similar, though the standard errors rise slightly such that the dependents effect is not distinguishable from zero.

For the case of adherence to medication after a new diagnosis of hypercholesterolemia, we now find a stronger physician effect in the case of the dependents sample than the sponsors sample. In the dependents sample, we estimate a 2.2 percentage-point (or 3 percent relative to a baseline rate of 63.8%) physician effect on the MPR for hypercholesterolemia therapy (though only marginally significant). This estimate is closer to and indistinguishable from zero in the sponsors sample.

The conclusion from this adherence analysis is much the same as in the settings above. While the evidence is as such that it is possible that physicians receive more appropriate care than non-physicians, the results suggest that physicians nonetheless continue to fall far short in receiving recommended levels of care. For instance, physicians fall to adhere to hypertension medication roughly 26 percent of the time and to hypercholesterolemia medication over 30 percent of the time.

Vaccination / Immunization Analysis

In Table 6, we present estimated physician effects in the case of the childhood immunization analysis, for the physician dependent sample. Across many of the individual measures—e.g., chicken pox, pneumococcal conjugate (PCV), rotavirus, and haemophilus influenza type B (HiB)—we estimate statistically significant physician effects suggestive of small improvements in compliance with recommended HEDIS guidelines for dependents of physicians relative to dependents of physician officers. We find marginally significant effects in the case of inactivated poliovirus (IPV) and measles/mumps/rubella (MMR) immunizations. With the remainder of measures—diptheria/tetanus/pertussis (DTaP), hepatitis A, and hepatitis B—we estimate insignificant physician effects that are relatively tightly bound around zero.[13]

To summarize, across the various high-value-care metrics that we explore, we only find that physicians receive more high-value care than non-physicians in select cases—e.g., medication adherence for new diagnoses of hypertension and hypercholesterolemia and with respect to various

[13] In the Online Appendix, we present results where we include all bases, even those that report very low rates of immunizations. The conclusion is similar—if anything, the physician group receives slightly more immunizations, but in many case, there is no discernable difference between the physician and non-physician group.

of the childhood immunizations. Even in these instances, however, the magnitudes of the physician effect are modest. In the remainder of the high-value care specifications that we estimate, we find little to no difference in the care received by physician patients and non-physician patients.

IV.C. Proportion of Over-or Under-utilization of Care Explained by Information Effect

In the above analysis, we have interpreted the physician / non-physician difference as an upper bound of the marginal change in the relevant outcome measure that may arise from greater information disclosure to patients. Critical to our assessment thus far, however, has not simply been a comparison between physicians and non-physicians. Of relevance is also a simple comparison between the rate by which physicians adhere to the respective guideline and the ideal adherence rate implicated by the relevant guideline, a comparison that is incidentally less subject to concerns over omitted variables biases. As discussed above, even in those situations where we do estimate a difference between the physician and non-physician group, the gap between the physician's treatment rate and the ideal rate is still considerable. These findings suggest that much of the explanation behind the over- and under-utilization of low- and high-value services likely arises from factors other than informational deficiencies of patients.

In Figures 1 and 2, we attempt to graphically demonstrate both of these forms of comparisons—that is, comparisons of physicians and non-physicians and comparisons against the ideal. In Figure 1, we focus on the sponsors samples, while in Figure 2, we focus on the dependents samples. In each figure, we depict a series of bar graphs for a select group of our key outcome measures, the heights of each bar reflecting the full degree of over- or under-utilization of the respective measure—relative to the ideal rate—by an uninformed patient. For the purposes of brevity and so as to not crowd this figure, we show this for just one representative measure across each of our classes of samples. For instance, in the case of cesarean delivery, the bar height reflects the difference between the non-physician cesarean rate and 15% (a conservative take on the WHO ideal rate). The ideal rates used for pre-operative testing and for each of the high-value-care measures are 0% and 100%, respectively. Within each bar graph, we also show the fraction of this over- or under-utilization that our analysis suggests can be explained by the inferior information of this non-physician patient group, using our estimated physician effects for these purposes (focusing on the point estimates from the above tables and ignoring standard errors for these purposes). The consistent implication arising from each of the bar graphs across these two figures is that the share of inappropriate treatment that can be explained by information relative to other factors is small in some cases and negligible in others.

IV.D. Mechanism Analysis

To the extent that better information does cause patients to adhere to medical guidelines at higher rates, one might wonder whether this is due to (1) informed patients making better care choices at the time of care selection itself, (2) informed patients choosing better treating physicians or (3) informed patients negating the ability of financially-motivated physicians from inducing demand. In a final empirical exercise, we attempt to shed light on these mechanism questions. We largely focus this analysis on the cesarean decision and on the choice of chest radiography testing prior to low-risk surgeries, as these are settings in which we find some evidence suggestive of a physician effect on care choice. Moreover, these low-value-care settings are suitable for this analysis in that an induced demand mechanism is more relevant for low-value as opposed to high-value care.

Physician Selection Mechanism

In Table 7, we present results from an exercise in which we first assign each delivery in our obstetrics sample (or each surgery in our preoperative testing sample) a mean cesarean rate (or mean preoperative chest radiography rate) for the physician associated with the encounter and in which we exclude the focal patient from the mean physician care-rate calculation. We then regress this mean physician care-rate on an indicator for whether or not the associated patient is a physician, while also controlling for all of the variables included in the primary specifications above. We do the same for the dependents sample.[14] The purpose of this analysis is to assess whether physicians as patients choose physicians with lower rates of low-value care, a relationship that might be expected if physicians use their medical knowledge to obtain treatment by other physicians whose practice patterns are most consistent with evidence based standards of care.

Even though the results from Table 2 demonstrate that physician mothers deliver at slightly lower cesarean rates relative to non-physician mothers (more so in the case of dependents), the results from Table 7 do not suggest that this arises from physician mothers choosing lower cesarean-rate physicians. To the contrary, the results suggest that physician mothers choose higher cesarean rate physicians, controlling for several factors that might make cesarean delivery more likely and appropriate (e.g., older maternal age). This pattern of results may be consistent with a story in which physician mothers unsure of whether they will need a cesarean delivery ex ante prefer to be treated by a physician with higher cesarean volume and thus potentially greater cesarean expertise. Nonetheless, physician mothers may still deliver at lower rates of cesarean section given their involvement in the cesarean decision at the time of labor and delivery itself, as distinct from their involvement in the decision over which physician to see.

[14] Moreover, we weight the regression by the treating-physician-delivery count used as the denominator in the dependent variable and cluster the standard errors at the treating physician level.

With respect to pre-operative chest radiography, our findings are somewhat mixed. When employing the Schwartz et al. sample of low-risk surgeries, we do find evidence suggesting that some portion of the chest-radiography physician effects from Table 3 may arise from provider choice. The findings from the sample of low-risk surgeries derived from the MDR records, however, suggest otherwise. In the dependents sample from this alternative low-risk surgery set, we find no relationship between physician patients and the preoperative chest radiography rate of the selected provider. In the sponsors sample, we actually find a small positive relationship.

Induced Demand Mechanism

Health economists have long theorized that physicians may take advantage of their informational advantages over their patients to induce patient demand for clinically unnecessary services in order to achieve certain gains—e.g., higher reimbursement (McGuire 2000). Under this theory, physicians will naturally be better able to induce demand for uninformed relative to informed patients. With this in mind, some of the physician effects that we document in the low-value care analysis may arise from a weaker ability to induce demand on physician patients.

To test this, we estimate the same specification above but add an interaction between the physician indicator and an indicator for whether the care occurs on the base versus off (along with the relevant constitutive terms).[15] Military physicians are compensated on a salaried basis, while providers off the base—at least to a greater degree relative to military physicians—continue to be reimbursed on a largely fee-for-service basis. Accordingly, off-base encounters likely entail a greater scope for induced-demand behaviors. If we find stronger physician effects off the base relative to on the base, this may be suggestive of a role for induced demand in explaining some of the modest physician effects in low-value-care documented above. That is, if informed patients

[15] When doing so, the indicator for on-base care is dropped due to the inclusion of base-by-year-by-care-location fixed effects. The results presented are nearly unchanged when only including base-by-year fixed effects.

were able to combat induced demand in low-value-care, one would expect a weaker such physician effect in the case of on-base care, in which case one would expect a positive coefficient for the interaction term.

As demonstrated by Table 8, we fail to find a pattern of coefficients of this nature in the case of the labor and delivery sample and the low-risk surgery sample, generally finding insignificant interaction coefficients. If anything, the sponsors cesarean sample may suggest a stronger negative physician effect on the base. Overall, we do not find compelling evidence suggestive of an information effect in low-value care that is especially strong in settings where physicians are theoretically incentivized to induce demand.

Mechanism Summary

Taken together, in the case of cesarean delivery and preoperative chest radiography where we do find modest physician effects, this additional analysis does not support a robust physician-selection or induced-demand explanation for the observed effects. While it is difficult to conclude with certainty, this analysis lends support to a story in which informed patients simply make better clinical choices at the time of care delivery.

V. DISCUSSION AND CONCLUSION

We attempted to explore the upper bounds of the gains that may ensue from consumer-driven health care approaches that draw upon greater information-disclosure to patients by exploring the care choices of physicians when acting as patients themselves relative to the clinical choices of non-physician patients. In an attempt to isolate the information-component to the differences between these two groups of patients, we took various approaches to ensure comparability between physician and non-physician groups. Our results consistently suggest that, at most, superior patient knowledge is associated with only modest improvements in the quality of care selected during medical encounters. Perhaps one interpretation of these findings is that patients remain generally deferential to the care recommendations of their treating physicians, even in the case of near fully-informed patients. This interpretation would be consistent with other recent findings in the health economics literature, including recent research by Chernew et al. (2018) showing that referring physicians are dramatically stronger determinants of where patients receive MRIs relative to patient cost-sharing factors. Should concerns over the quality of care received by patients remain—as is suggested by the large gaps demonstrated between prevailing rates of adherence to high- and low-value care guidelines and recommended rates of adherence—our results are informative on the limitations that may come with information-focused, demand-side solutions.

Despite our efforts to ensure comparability across our treatment and control groups, concerns may remain over the generalizability of our findings. In particular, among other external validity issues, some may be concerned that we tested for the impacts of information in an environment characterized by very low levels of cost-sharing. The influence of information, however, may interact with financial considerations of this nature. Consider, for instance, pre-operative testing and assume, as is the case with the Military Health System beneficiaries, that co-payments for these diagnostic procedures are negligible. Even though such tests may render insufficient benefits to justify their full social costs and even if patients are aware of this, informed patients may nonetheless undertake the tests anyway given the negligible financial implications. In contrast, informed patients may decide to forego these tests when cost-sharing is more substantial.

This consideration does not necessarily threaten the external validity of our low-value care findings—at least not overly so—in light of the fact that the costs to undergoing low-value care extend beyond just direct financial outlays. For instance, in the case of pre-operative testing by the patients in our sample, we demonstrate in the Online Appendix that much or most of these instances of pre-operative testing necessitate an entirely separate visit to a medical provider on a separate day, an outcome that likely imposes costs and inconveniences of another nature on the affected patient. Accordingly, if we still estimate modest physician effects in the face of low-value care decisions that carry potentially significant non-cost-sharing consequences, such modest findings may indeed generalize to populations facing higher levels of cost-sharing.

Further reinforcing this point, the costs associated with receiving low-value care may extend beyond cost-sharing dollars in light of the possibility of physical harms and discomfort associated with the care itself. This is very likely true with the case of cesarean delivery, especially considering the recovery period involved. These physical consequences are, of course, likely to be far less significant in the preoperative testing setting, especially in the case of blood draws.[16]

Finally, it is important to note that this particular generalizability concern does not extend to the high-value care analysis. If anything, the fact that cost-sharing is lower in the MHS should only elevate the role of information in encouraging greater guideline adherence. In this light, our finding of little to no improvements in high-value-care adherence in fully-informed patients is likely to generalize to settings with higher levels of cost-sharing.

[16] Though, in the case of chest radiography, there are known minor carcinogenic risks associated with exposure to chest x-rays. This consideration may explain why our estimated physician effects are of greater magnitudes (relative to the respective baseline mean) in the case of chest radiography relative to blood testing, an implication which may further support an information interpretation of our pattern of findings.

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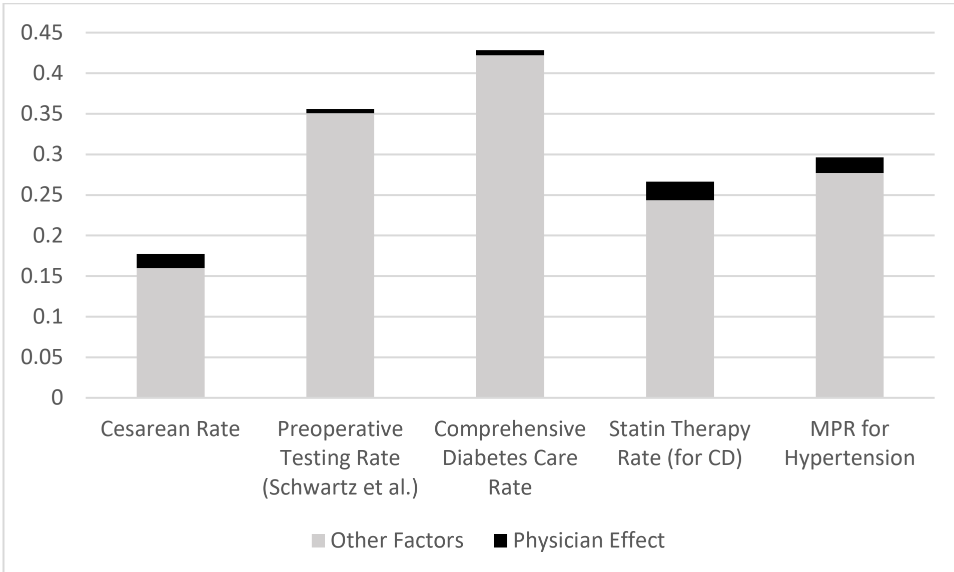
FIGURE 1

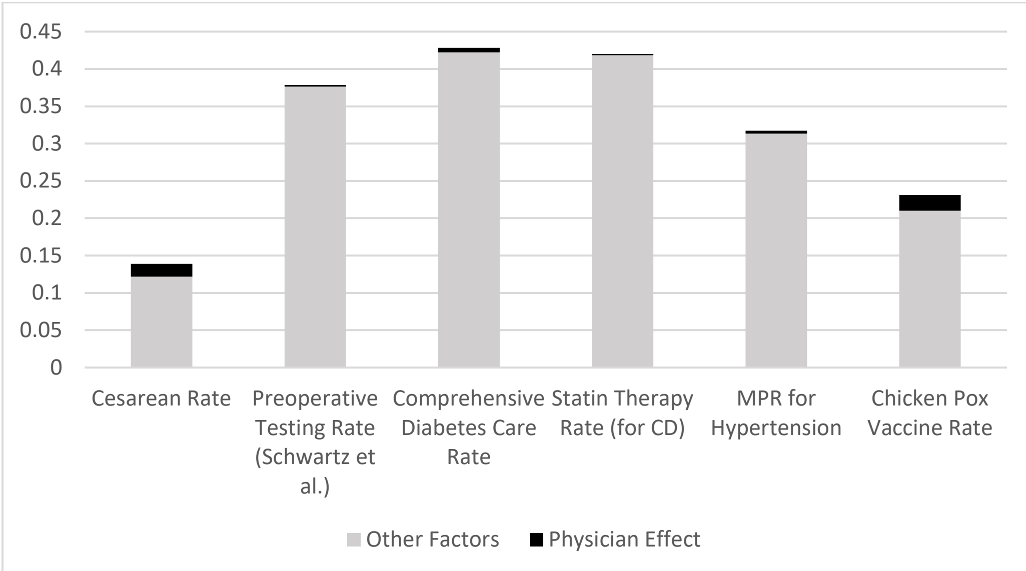
Degree of Over- or Under-utilization of Various Measures explained by Physician Effect—i.e., Information Effect—and by Other Factors (Sponsors Samples)



Notes: data from the Military Health System Data Repository. The height of each bar represents the degree of over-utilization (for the case of cesarean delivery and preoperative testing prior to low-risk surgeries) and under-utilization (for the case of diabetes and cardiovascular care adherence and medication adherence for hypertension) represented in the respective samples, assessed with reference to non-physician patients. The black portion of this bar represents the degree of this over- or under-utilization that can be explained by the weaker information state of the non-physician patients. The height of the black portion is derived from the estimated physician effects from Tables 2-5.

FIGURE 2

Degree of Over- or Under-utilization of Various Measures explained by Physician Effect—i.e., Information Effect—and by Other Factors (Dependents Samples)



Notes: data from the Military Health System Data Repository. The height of each bar represents the degree of over-utilization (for the case of cesarean delivery and preoperative testing prior to low-risk surgeries) and under-utilization (for the case of diabetes and cardiovascular care adherence and medication adherence for hypertension) represented in the respective samples, assessed with reference to non-physician patients. The black portion of this bar represents the degree of this over- or under-utilization that can be explained by the weaker information state of the non-physician patients. The height of the black portion is derived from the estimated physician effects from Tables 2-6.

TABLE 1

Covariate Balance between Treatment and Control Groups

	(1) PHYSICIANS (AS PATIENTS)	(2) OFFICERS	(3) DIFFERENCE	(4) DEPENDENTS OF PHYSICIANS	(5) DEPENDENTS OF OFFICERS	(6) DIFFERENCE
Predicted Incidence of Cesarean Delivery	0.300 (0.148)	0.312 (0.165)	-0.0148** (0.0034)	0.266 (0.093)	0.272 (0.099)	-0.006*** (0.001)
Predicted Incidence of Preoperative Testing	0.1835 (0.1045)	0.1785 (0.1107)	0.0051*** (0.0010)	0.2214 (0.1306)	0.2187 (0.1288)	0.0027 (0.0018)
Predicted Incidence of Comprehensive Diabetes Care	0.616 (0.214)	0.577 (0.190)	0.039*** (0.010)	0.517 (0.204)	0.538 (0.189)	-0.020*** (0.008)
Predicted Incidence of Statin Use	0.758 (0.142)	0.757 (0.126)	0.002 (0.008)	0.608 (0.214)	0.581 (0.194)	0.028 (0.018)
Predicted Medication Possession Ratio for Hypertension	0.713 (0.091)	0.723 (0.095)	-0.011*** (0.003)	0.685 (0.120)	0.687 (0.129)	-0.002 (0.0050)
Predicted Medication Possession Ratio for hypercholesterolemia,	0.621 (0.089)	0.642 (0.104)	-0.022*** (0.0025)	0.632 (0.112)	0.638 (0.115)	-0.006 (0.0042)
Predicted Incidence of DTaP Immunization Compliance	-	-	-	0.658 (0.119)	0.648 (0.126)	0.011*** (0.003)
Predicted Incidence of IPV Immunization Compliance	-	-	-	0.627 (0.113)	0.631 (0.121)	-0.004 (0.003)
Predicted Incidence of HiB Immunization Compliance	-	-	-	0.687 (0.153)	0.695 (0.156)	-0.008** (0.004)
Predicted Incidence of Hepatitis A Immunization Compliance	-	-	-	0.862 (0.100)	0.865 (0.103)	-0.003 (0.002)
Predicted Incidence of Hepatitis B Immunization Compliance	-	-	-	0.739 (0.112)	0.740 (0.122)	0.001 (0.003)
Predicted Incidence of Chicken Pox Immunization Compliance	-	-	-	0.783 (0.096)	0.795 (0.100)	-0.012*** (0.002)
Predicted Incidence of PCV Immunization Compliance	-	-	-	0.787 (0.112)	0.801 (0.115)	-0.014*** (0.003)
Predicted Incidence of Rotavirus Immunization Compliance	-	-	-	0.317 (0.209)	0.317 (0.209)	0.000 (0.004)

Notes: standard deviations are reported in Columns 1, 2, 4 and 5. Standard errors are reported in the differencing columns (Columns 3 and 6) and are clustered at the individual beneficiary level. Predicted values of the indicated outcome variables are from regressions of the indicated measure (within the relevant sample) on the key covariates employed in the analysis: patient age-by-sex dummies, patient race dummies, patient pay-grade dummies, previous year RVU, previous year RWP, previous year inpatient days, Charlson combordity index, and base-by-year-by-care-location fixed effects. Data are from the Military Health System Data Repository, 2003-2013. *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

TABLE 2

Estimated Physician Effects in Cesarean Utilization

	(1)	(2)	(3)	(4)	(5)
	N: TOTAL	N: PHYSICIANS	BASELINE RATE	PHYSICIAN COEFFICIENT	STANDARD ERROR
Panel A. Sponsors Analysis: Comparison of Physician Patients with Non-Physician Military Officers					
Cesarean Incidence (among all deliveries)	18,092	2,395	0.3100	-0.0172	0.0127
Primary Cesarean Incidence (among restricted delivery sample)	13,859	1,784	0.1844	-0.0288***	0.0108
Panel B. Dependents Analysis: Comparison of Dependents of Physician Patients with Dependents of Non-Physician Military Officers					
Cesarean Incidence (within all deliveries)	96,436	5,421	0.2716	-0.0173**	0.0075
Primary Cesarean Incidence (among restricted delivery sample)	73,106	4,078	0.1251	-0.0080	0.0055

Notes: standard errors are reported in parentheses and clustered at the individual beneficiary level. Each row represents results from a different specification using the specified dependent variable and the specified sample. Primary cesarean specifications exclude multiple births, breech presentations and previous cesarean deliveries from the sample. All specifications control for patient age dummies, patient race dummies, patient pay-grade dummies, previous year RVU, previous year RWP, previous year inpatient days, Charlson combordity index, and base-by-year-by-care-location fixed effects. Data are from the Military Health System Data Repository, 2003-2013. *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

TABLE 3

Estimated Physician Effects on Preoperative Testing Prior to Low-Risk Surgeries

		(1)	(2)	(3)	(4)	(5)
		N: TOTAL	N: PHYSICIANS	BASELINE RATE	PHYSICIAN COEFFICIENT	STANDARD ERROR
Panel A. Sponsors Analysis: Comparison of Physician Patients with Non-Physician Military Officers						
Schwartz et al Sample	Chest Radiography	88,560	4,813	0.0959	-0.0215***	0.0039
	Complete Blood Count	88,560	4,813	0.3068	-0.0007	0.0073
	Comprehensive Metabolic Panel	88,560	4,813	0.0940	0.0010	0.0038
	Coagulation Panel	88,560	4,813	0.1041	-0.0076	0.0065
	Any Preoperative Care	88,560	4,813	0.3506	-0.0054	0.0075
Derived Low-Risk Sample	Chest Radiography	1,313,701	48,963	0.0452	-0.0025**	0.0012
	Complete Blood Count	1,313,701	48,963	0.1386	0.0017	0.0020
	Comprehensive Metabolic Panel	1,313,701	48,963	0.0608	0.0023	0.0012
	Coagulation Panel	1,313,701	48,963	0.0241	-0.0008	0.0009
	Any Preoperative Care	1,313,701	48,963	0.1786	0.0002	0.0022
Panel B. Dependents Analysis: Comparison of Dependents of Physician Patients with Dependents of Non-Physician Military Officers						
Schwartz et al Sample	Chest Radiography	99,994	4,614	0.0591	-0.0165***	0.0029
	Complete Blood Count	99,994	4,614	0.3470	0.0004	0.0077
	Comprehensive Metabolic Panel	99,994	4,614	0.0857	-0.0052	0.0038
	Coagulation Panel	99,994	4,614	0.0668	-0.0104***	0.0055
	Any Preoperative Care	99,994	4,614	0.3762	-0.0024	0.0078
Derived Low-Risk Sample	Chest Radiography	609,011	18,980	0.0416	-0.0062***	0.0018
	Complete Blood Count	609,011	18,980	0.1764	-0.0070**	0.0036
	Comprehensive Metabolic Panel	609,011	18,980	0.0878	-0.0060**	0.0025
	Coagulation Panel	609,011	18,980	0.0351	-0.0032*	0.0020
	Any Preoperative Care	609,011	18,980	0.2188	-0.0124***	0.0040

Notes: standard errors are reported in parentheses and clustered at the individual beneficiary level. Each row represents results from a different specification using the specified dependent variable and the specified sample. All specifications control for patient age-by-sex dummies, patient race dummies, patient pay-grade dummies, previous year RVU, previous year RWP, previous year inpatient days, Charlson combordity index, and base-by-year-by-care-location fixed effects, along with fixed effects indicating the relevant surgery within the respective sample of low-risk surgeries. Data are from the Military Health System Data Repository, 2003-2013. *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

TABLE 4

Estimated Physician Effect on High-Value Diabetic and Cardiovascular Care

	(1)	(2)	(3)	(4)	(5)
	N: TOTAL	N: PHYSICIANS	BASELINE RATE	PHYSICIAN COEFFICIENT	STANDARD ERROR
Panel A. Sponsors Analysis: Comparison of Physician Patients with Non-Physician Military Officers					
HEDIS Diabetes Measures					
hbA1c Testing	69,343	1,095	0.7631	0.0002	0.0180
Eye Exam	69,343	1,095	0.7855	-0.0155	0.0190
Attention to Nephropathy	69,343	1,095	0.8550	0.0125	0.0152
Comprehensive Diabetes Care	69,343	1,095	0.5778	0.0061	0.0218
Statin Therapy	38,623	623	0.7084	0.0469	0.0346
HEDIS Cardio Measures					
Any Statin Therapy	62,838	1,217	0.7565	0.0228	0.0220
Days Supplied of Statin Therapy	62,838	1,217	225.4458	2.1289	7.5821
Incidence of at least 80% Adherence	62,838	1,217	0.4666	-0.0170	0.0225
Panel B. Dependents Analysis: Comparison of Dependents of Physician Patients with Dependents of Non-Physician Military Officers					
HEDIS Diabetes Measures					
hbA1c Testing	73,122	1,592	0.7310	-0.0022	0.0185
Eye Exam	73,122	1,592	0.7862	0.0148	0.0173
Attention to Nephropathy	73,122	1,592	0.8048	-0.0106	0.0163
Comprehensive Diabetes Care	73,122	1,592	0.5380	0.0064	0.0197
Statin Therapy	32,677	658	0.6121	0.0224	0.0363
HEDIS Cardio Measures					
Any Statin Therapy	26,099	503	0.5814	0.0017	0.0408
Days Supplied of Statin Therapy	26,099	503	163.2406	-1.9929	12.9882
Incidence of at least 80% Adherence	26,099	503	0.3193	-0.0141	0.0324

Notes: standard errors are reported in parentheses and clustered at the individual beneficiary level. Each row represents results from a different specification using the specified dependent variable and the specified sample. All specifications control for patient age-by-sex dummies, patient race dummies, patient pay-grade dummies, previous year RVU, previous year RWP, previous year inpatient days, Charlson combordity index, and base-by-year-by-care-location fixed effects. Data are from the Military Health System Data Repository, 2003-2013. *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

TABLE 5

Estimated Physician Effect on Medication Adherence during First Year of Diagnosis for Hypertension and Hypercholesterolemia

	(1)	(2)	(3)	(4)	(5)
	N: TOTAL	N: PHYSICIANS	BASELINE RATE	PHYSICIAN COEFFICIENT	STANDARD ERROR
Panel A. Sponsors Analysis: Comparison of Physician Patients with Non-Physician Military Officers					
Medication Possession Ratio: Hypertension	39,435	1,018	0.7229	0.0191**	0.0093
Medication Possession Ratio: Hypercholesterolemia	52,017	1,322	0.6423	0.0030	0.0084
Panel B. Dependents Analysis: Comparison of Dependents of Physician Patients with Dependents of Non-Physician Military Officers					
Medication Possession Ratio: Hypertension	23,856	595	0.6868	0.0040	0.0137
Medication Possession Ratio: Hypercholesterolemia	30,014	719	0.6381	0.0218*	0.0120

Notes: standard errors are reported in parentheses and clustered at the individual beneficiary level. Each row represents results from a different specification using the specified dependent variable and the specified sample. All specifications control for patient age-by-sex dummies, patient race dummies, patient pay-grade dummies, previous year RVU, previous year RWP, previous year inpatient days, Charlson combordity index, and base-by-year-by-care-location fixed effects. Data are from the Military Health System Data Repository, 2003-2013. *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

TABLE 6

Estimated Physician Effect on Childhood Immunization Rates

	(1)	(2)	(3)	(4)	(5)
	N: TOTAL	N: PHYSICIANS	BASELINE RATE	PHYSICIAN COEFFICIENT	STANDARD ERROR
DTaP	34556	2030	0.67	-0.0109	0.0109
IPV	34556	2030	0.64	0.0201*	0.0110
MMR	34556	2030	0.80	0.0165*	0.0088
HiB	34556	2030	0.70	0.0211**	0.0100
Hepatitis A	34556	2030	0.85	0.0104	0.0075
Hepatitis B	34556	2030	0.59	0.01156	0.0096
Chicken Pox	34556	2030	0.79	0.0209**	0.0091
PCV	34556	2030	0.80	0.0194**	0.0088
Rotavirus	34556	2030	0.29	0.0269***	0.0097

Notes: standard errors are reported in parentheses and clustered at the individual beneficiary level. Each row represents results from a different specification using the specified dependent variable and the specified sample. All specifications control for patient age-by-sex dummies, patient race dummies, patient pay-grade dummies, previous year RVU, previous year RWP, previous year inpatient days, Charlson combordity index, and base-by-year-by-care-location fixed effects. Data are from the Military Health System Data Repository, 2003-2013. *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

TABLE 7

Relationship between Physician Patient Status and Mean Low-Value Care Rate of Treating Physician (for Direct-Care Encounters)

	(1)	(2)	(3)	(4)	(5)
	N: TOTAL	N: PHYSICIANS	BASELINE RATE	PHYSICIAN COEFFICIENT	STANDARD ERROR
Panel A. Sponsors Analysis: Comparison of Physician Patients with Non-Physician Military Officers					
Mean Cesarean Rate of Treating Physician	11,148	1,835	0.2801	0.0127***	0.0034
Mean Rate of Treating Surgeon of Preoperative Chest Radiography (Schwartz et al.)	52,024	3,934	0.0879	-0.0056***	0.0020
Mean Rate of Treating Surgeon of any Preoperative Care (Derived Low-Risk Sample)	910,938	42,339	0.0451	0.0037**	0.0017
Panel B. Dependents Analysis: Comparison of Dependents of Physician Patients with Dependents of Non-Physician Military Officers					
Mean Cesarean Rate of Treating Physician	43,749	4013	0.2703	0.0123***	0.0029
Mean Rate of Treating Surgeon of Preoperative Chest Radiography (Schwartz et al.)	55,698	3,660	0.0412	-0.0034**	0.0014
Mean Rate of Treating Surgeon of any Preoperative Care (Derived Low-Risk Sample)	213,961	11,385	0.0450	-0.0013	0.0008

Notes: standard errors are reported in parentheses and clustered at the individual beneficiary level. Each row represents results from a different specification using the specified dependent variable and the specified sample. All specifications control for patient age-by-sex dummies, patient race dummies, patient pay-grade dummies, previous year RVU, previous year RWP, previous year inpatient days, Charlson combordity index, and base-by-year-by-care-location fixed effects. Data are from the Military Health System Data Repository, 2003-2013. *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.

TABLE 8

Estimated Physician Effect on Low-Value Care, Interacted with On-Base Treatment Indicator

	(1)	(2)	(3)	(4)	(5)	(6)
	CESAREAN: SPONSORS	CESAREAN: DEPENDENTS	PREOPERATIVE CHEST RADIOGRAPHY: SPONSORS (SCHWARTZ ET AL. SAMPLE)	PREOPERATIVE CHEST RADIOGRAPHY : DEPENDENTS (SCHWARTZ ET AL. SAMPLE)	PREOPERATIVE CHEST RADIOGRAPHY: SPONSORS (DERIVED LOW-RISK SAMPLE)	PREOPERATIVE CHEST RADIOGRAPHY : DEPENDENTS (DERIVED LOW-RISK SAMPLE)
Physician	0.021	-0.007	-0.018	-0.019**	-0.000	-0.004
	(0.025)	(0.013)	(0.012)	(0.009)	(0.005)	(0.003)
Physician X On-Base	-0.050*	-0.015	-0.005	0.004	-0.003	-0.004
	(0.028)	(0.015)	(0.013)	(0.009)	(0.005)	(0.004)

Notes: standard errors are reported in parentheses and clustered at the individual beneficiary level. Each column represents results from a different specification using the specified dependent variable and the specified sample. All specifications control for patient age-by-sex dummies, patient race dummies, patient pay-grade dummies, previous year RVU, previous year RWP, previous year inpatient days, Charlson combordity index, and base-by-year-by-care-location fixed effects. The on-base indicator is dropped from the regression due to the inclusion of the latter set of fixed effects. Columns 3-6 also include fixed effects for the relevant surgery in the low-risk surgery sample. Data are from the Military Health System Data Repository, 2003-2013. *** Significant at the 1 percent level; ** Significant at the 5 percent level; * Significant at the 10 percent level.