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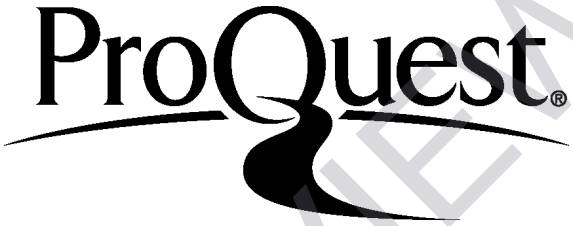

Abstract

Health is a key determinant of the quality of life. As such, the extremely high cost of health care in the US and the resulting barriers to access are concerning. This dissertation consists of three essays exploring the determinants of health care provision—both in terms of access and type of treatment—and their impact on patient health and health care costs.

In Chapter 1, I investigate how policies that pay physicians to reduce costs affect treatment decisions. I show that a Medicare pilot program in New Jersey that paid doctors bonuses for reducing costs was unsuccessful; doctors changed which patients were admitted and sorted healthier patients into participating hospitals, but did not reduce costs. I argue that understanding the gaming behavior displayed by physicians is important for policy design.

While Chapter 1 explores how doctors make decisions over treatment, the second chapter shifts focus to the determinants of access to treatment itself. In Chapter 2, co-authored with Molly Schnell, we link the supply of available providers to the provision of mental health care and mental health outcomes. While the costs of untreated mental illness are widely recognized, access to treatment is often limited. In this chapter, we show that allowing nurse practitioners to prescribe medication without physician oversight is associated with improvements in population mental health. Our results suggest that liberalizing scope of practice legislation for nurse practitioners can extend care to both underserved and disadvantaged populations.

In the third chapter, I turn back to physicians, and examine how payment can affect both treatment choice and patient health. In particular, I explore how changing pay affects the decision of whether or not to perform a C-section. I find that when Medicaid pays physicians relatively more for C-sections, physicians perform more C-sections, and there are fewer infant deaths. Taken together, these findings suggest that C-section rates may be too low for some groups, and that policies aimed at decreasing costs by lowering procedure use among low-income patients may have adverse health consequences.

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Chapter 1

How do Doctors Respond to Incentives? Unintended Consequences of Paying Doctors to Reduce Costs*

1.1 Introduction

Lowering the growth in health care costs has long been a key U.S. public policy goal. Yet while many ideas exist for how to reduce costs, there is no consensus on which path is most promising Gruber (2008, 2010). Because of this uncertainty, the Patient Protection and Affordable Care Act (ACA) has earmarked billions of dollars for pilot programs.[1] The ACA's strategy is to try "virtually every cost-control reform proposed by doctors, economists, and health policy experts and [include] the means for these reforms to be assessed quickly and scaled up if they're successful," thus ensuring "that effective change will occur" Orszag and Emanuel (2010). A large set of these pilot programs focus on changing the financial incentives of doctors, motivated by the fact that

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[1]The Center for Medicare and Medicaid Innovation was established by Section 3021 of the Affordable Care Act (ACA). The Innovation Center is tasked with testing innovative health care payment and service delivery models with the potential to improve the quality of care and reduce Medicare, Medicaid, and CHIP expenditures. The ACA appropriated $10 billion for the Innovation Center from FY 2011 to FY 2019 (http://www.hhs.gov/about/budget/fy2015/budget-in-brief/cms/innovation-programs/index.html).

doctors in the US are paid separately for each service provided ("fee-for-service"), potentially encouraging them to perform unnecessary procedures. These programs offer the opportunity to study how much and on which margins doctors respond to altered payment schemes, an important open question in the literature. However, the small-scale nature of pilot programs leaves them susceptible to gaming and selection bias, making it unclear whether the information they generate is actually informative for a nationwide reform.

In this paper, I study a pilot program that paid doctors for reducing costs. I ask both how doctors responded to these changing incentives, and whether the information learned is useful for informing a national reform. In particular, I analyze the effects of the New Jersey Gainsharing Demonstration, under which hospitals paid doctors bonuses for reducing the total costs of treatment for each Medicare admission. The bonuses were tied to the total costs incurred during a hospital stay, and were designed to experiment with bundled payments—an incentive scheme where doctors are paid one fee for treating a patient, rather than separately for each service provided.

I find three main results of this program. First, doctors change which patients are admitted, as opposed to treated and then sent home. In particular, doctors are more likely to admit patients whose treatment generates high expected bonuses, and less likely to admit patients who generate low expected bonuses. Second, doctors often work in more than one hospital, and thus can change where patients are admitted. Doctors sort healthier patients into participating hospitals (even conditional on the program's risk-adjustment criteria), as these patients are cheaper to treat and therefore generate bigger bonuses. Third, conditional on admission and patient health, doctors do not change their procedure choice or otherwise lower treatment costs. Thus, the bonuses caused doctors to change their admission decisions—where and whether a patient was admitted—rather than reduce costs.

My empirical strategy leverages the fact that many doctors treat patients in more than one hospital. I measure the effect of the bonuses by comparing changes in a doctor's behavior at a participating hospital to the same doctor in a non-participating hospital. I worked at the New Jersey Department of Health to construct a unique dataset which allows me use a within-doctor

specification. These data allow me to follow both both patients and doctors over time, and across all hospitals in New Jersey. The data include admission and discharge dates, all diagnoses and procedure codes, payer and patient demographic information, codes for doctors and patients, and list charges.

The bonuses given to doctors under the pilot program were designed to lower costs by reducing the incentive to provide treatments with low marginal benefits. In practice, patients were divided into types by diagnosis and severity of illness, and a maximum bonus was assigned to each group. Doctors were then paid a fraction of this maximum bonus after treating an eligible patient, depending on how close they got to pre-program cost benchmarks. Because of the limited scope of the pilot program, doctors could only receive a bonus if they treated an admitted Medicare patient at a participating hospital.

My first main result is that the cost-reduction bonuses change the patterns of admission across patient types. Admission is an important outcome, both in terms of costs and patient health; it is the difference between intense and prolonged monitoring by health care professionals, and being sent home after treatment.[2] I find that the cost reduction bonuses are associated with an increase the admission of patients in high-bonus types, relative to baseline. Conversely, patients in low-bonus types are less likely to be admitted. As capacity constraints and program rules limit the ability of doctors to increase overall admission rates, doctors instead reallocate admission across patients.

Second, doctors send healthier patients to participating hospitals in response to the program. After the bonus program was implemented, the mix of patients who were admitted at participating hospitals were ex ante healthier. Patients admitted to participating hospitals had fewer chronic conditions and lower scores on co-morbidity indices, conditional on their type. As healthier patients are cheaper to treat, doctors receive higher average bonuses for treating these patients. While defining the bonuses within diagnosis and severity level cells was meant to serve as a type of risk-adjustment, doctors were able to identify low-cost patients even within these groups, and sort patients across hospitals in order to increase their expected bonus payments.

[2]Generally, admitted patients are assigned a hospital bed and spend at least one night at the hospital.

Finally, conditional on admission and patient health, the bonuses did not reduce costs or change procedure use. I look at many measures of services performed: length of stay, the use of different types of diagnostic imaging procedures labeled as overused by doctors (CT scans, MRIs, and other diagnostic imaging procedures), and total costs. I find no evidence that doctors change costs or procedure use in response to the program, relative to their behavior at non-participating hospitals. The bonuses create two conflicting forces which may explain why the program did not decrease costs, conditional on patient health. First, there is the intended effect: less care is provided if a patient is admitted under the bonus program than if they were admitted in a hospital with no bonuses. On the other hand, the bonus program causes doctors to admit some patients who otherwise would not have been admitted, and admitted patients receive more care.

While sorting patients between hospitals does not necessarily change treatment costs, it can cause "naive" evaluations of the policy to be biased. In an evaluation of the first wave of the program, the Agency for Healthcare Research and Policy published an article reporting that the bonuses reduced costs per admission by eight percent (AHRQ, Agency for Healthcare Research and Quality (2014)). However, the evaluation only compared the costs of admitted patients at participating hospitals, before and after the program was implemented. My results suggest that a simple pre- versus post- comparison of admitted patients is misleading; it does not take into account changes in admission, nor does it not capture the fact that the composition of admitted patients at these hospitals changed in response to the program.

Related Literature My paper contributes to three main strands of literature. First, it is related to the literature on how doctors respond to financial incentives. There is a large body of work studying how reimbursement levels influence procedure choice, mostly focusing on the decision to perform one particular procedure (see Chapter 3, as well as Clemens and Gottlieb (2014); Coey (2013); Dranove and Wehner (1994); Gruber and Owings (1996); Gruber et al. (1999); Grant (2009); Hadley et al. (2001, 2009); Keeler and Fok (1996); Yip (1998)).[3] These papers generally find that doc-

[3]Most of these papers focus on C-sections, though other procedures such as coronary artery bypass grafting and breast conserving surgery have also been studied.

tors supply more services when payment increases, as well as when the payment of a competing procedure decreases. An implication of this research is that reforms which lower the profit for performing "unnecessary" procedures could be very effective at lowering costs.

Current cost-reduction proposals, however, generally involve changing the entire payment system, which could change doctor behavior on margins other than just procedure choice. To this end, a much smaller branch of the literature has studied how doctors respond to different types of payment systems—for example, fee-for-service versus capitated payments Ho and Pakes (2014); Dickstein (2014).[4] Unfortunately, studying the effect of payment structure on doctor decision-making is hampered both by data availability, and the fact that doctors practicing under different payment schemes may differ on unobservable characteristics. Therefore, how much and on what margins doctors will respond to payment reform policies remains an open question.

Second, the finding that doctors are able to send healthier patients to participating hospitals is similar to the ability of Managed Care plans to select healthier patients into their plans Duggan (2004); Duggan and Hayford (2013); Leibowitz et al. (1992); Brown et al. (2011). There is much less work, however, on the ability of doctors to identify patients with low expected costs. Doctors selecting patients according to their underlying health has been studied in the context of "report card" policies—public disclosures of the patient health outcomes of individual doctors. The evidence on report cards, however, is mixed; Dranove et al. (2003) find that the introduction of report cards cause cardiac surgeons to select healthier patients, while Kolstad (2013) finds little evidence of selection. Especially with the recent popularity of cost reduction strategies that target doctor pay, it is important to know whether doctors are able to selectively identify low-cost patients to treat.

Third, problems and limitations of pilot programs have been widely studied in economics, particularly in development, education, and environmental economics Duflo (2004); Cullen et al. (2013); Allcott (2015). However, these lessons have generally not been applied to U.S. health

[4] A closely related literature looks at the reaction of *hospitals* to the introduction of prospective payment Cutler (1990, 1995); Ellis and McGuire (1996); Dafny (2005). These papers find that hospitals respond by changing treatment intensity and coding practices in response to DRG specific price changes.

care reform. The Centers for Medicare and Medicaid Services (CMS) has spent millions of dollars on pilot programs (or "demonstrations") since the 1960s, without considering whether partial equilibrium effects generated by such programs would hold in general equilibrium. Furthermore, the results of these pilot programs help direct the annual spending of Medicare, a 600 billion dollar program. In this paper, I point out that even when there is evidence that such programs are effective, it may be due to gaming rather than true improvements in efficiency.

Roadmap The rest of the paper is organized as follows. Section 1.2 describes the bonus program, and the specific incentives it created for doctors. To formalize the economics behind my empirical results, in Section 1.3 I develop a model of doctor decision-making. I show that the bonuses in the Gainsharing Demonstration clearly incentivize doctors to change who is admitted, and to sort patients between hospitals. The effects of the bonuses on resource use is ambiguous, and so remains a purely empirical question. In the remainder of the paper, I measure the impact of the bonuses empirically. Section 1.4 describes my data and identification strategy, and results are presented in Section 1.5. Section 1.6 concludes.

1.2 Institutional Background

Before describing the details of the pilot program, I first lay out the institutional arrangements of doctors treating patients within a hospital setting. I describe how doctors and hospitals are paid, focusing on Medicare payment rules. Finally, I discuss the New Jersey Gainsharing Demonstration, the details of the bonus calculation formula, and its implementation.

1.2.1 How Doctors Treat Patients within Hospitals

When treating a patient in a hospital, doctors must decide both whether a patient should be admitted, and where to send the patient. Doctors can either decide to admit a patient and treat them, or they can treat the patient in the hospital and then discharge them. The technical definition of

admission is simply that a doctor has written an order of admission. In practice, admitted patients generally stay at least over night and occupy a bed. Within all patient types in my data, there are both patients treated with and without being admitted. When considering whether to admit a patient, a doctor must weigh the benefits against the costs; admitted patients are intensely monitored, and receive more care. On the other hand, admission is costly for the patient, both in terms of time and money. In addition, admitted patients spend more time in the hospital, and thus face a higher risk of contracting a hospital acquired infections, which are often resistant to treatment.

When considering where to treat a patient, doctors are limited to choosing between hospitals where they have pre-arranged relationships. The exact employment relationship between doctors and the hospitals they work within is complicated, and varies from place to place. For the most part, however, doctors treating patients in hospitals are independent contractors, rather than hospital employees. These doctors have arrangements with hospitals which allow them to see patients there—so-called admitting or surgical privileges.[5] Doctors often have such privileges at more than one hospital (in my data, the average doctor is seen to treat patients at two different hospitals). That doctors tend to work at more than one hospital is key to my identification strategy, as I will compare the behavior of the same doctor that works both in a hospital that offers the bonuses and one that does not.

1.2.2 How Doctors and Hospitals are Paid

Status Quo

For the most part, doctors in the US are paid under the fee-for-service system, and traditional Medicare is no exception. Many argue that this fee-for-service system incentivizes additional care on the margin, and is thought to cause doctors to provide treatments with low or zero marginal benefits. Conversely, hospitals in the US are not paid according to each individual service performed. Instead, hospitals are paid either a fixed amount per visit according to a broad diagnosis category,

[5] Even emergency room doctors are usually not employed by the hospital, but are provided by separate business.

or a per diem for each day spent in the hospital Reinhardt (2006).[6] Medicare, which makes up approximately a third of the average hospital's net revenue, pays hospitals a fixed sum based on the patient's diagnosis (called diagnosis related groups, or "DRGs")—no matter how expensive the patient is to treat. Thus for Medicare patients, hospitals are incentivized to use fewer services.

The financial incentives of doctors and hospitals over how much care to provide are fundamentally at odds, pushing doctors to do more and hospitals to do less. While hospitals can theoretically constrain doctors' resource use through the threat of revoking their privileges, in reality this is difficult. Doctors are afforded a lengthy due process to protect them from competitive forces that could override quality or patient safety. Furthermore, hospitals benefit from having doctors with privileges on staff, as these same privileges are what bring people into the hospital in the first place. Hospitals would like to use pay incentives to align the incentives of doctors with their own, but it is difficult in the current legal environment. Federal law constrains the ability of hospitals and doctors to participate in cost reduction programs, with the rationale that hospitals will pressure doctors into giving too little care, which would be bad for patient welfare.[7] Medicare demonstration projects, however, are typically granted waivers to these statutes.

Under the Cost-Reduction Bonus Program

The New Jersey Gainsharing Demonstration was created by the New Jersey Hospital Association to reduce costs by aligning the incentives of doctors with those of hospitals. Under the program, doctors are still paid separately for each service provided, but are now also paid bonuses for lowering costs per visit. These bonuses are paid by the hospital to the doctor, and are supposed to reduce costs by lowering the use of unnecessary procedures. Doctors treating admitted patients at

[6]Medicaid pays hospitals either a flat amount per visit based on diagnosis, or with per diem payments (a lump sum for each day spent in the hospital). Private insurers pay hospitals based on either DRGs, per diems, or discounts negotiated off list charges. Payments from Medicare and private insurers each make up approximately third of hospital revenue Reinhardt (2006).

[7]The civil money penalty (CMP) set forth in section 1128A(b)(1) of the Social Security Act prohibits any hospital or critical access hospital from knowingly making a payment directly or indirectly to a doctor as an inducement to reduce or limit services to Medicare or Medicaid beneficiaries under the doctor's care. In addition, gainsharing arrangements may also implicate the anti-kickback statute (section 1128B(b) of the Social Security Act) and the doctor self-referral prohibitions of the Act (section 1876 of the Social Security Act) Office of Inspector General (1999).

participating hospitals are eligible to receive one bonus per visit, where the maximum bonus they can receive depends on the patient's diagnosis and severity of illness.

When a hospital joins the Demonstration, doctors working in the hospital have the option to sign up for the program. While I do not have on which or how many doctors signed up, anecdotal evidence suggests take-up was high. There is no reason for a doctor to abstain, as there is no change in the process or form of payment, no additional paperwork, and no risk; doctors are only rewarded for improvement, and not punished for stagnation or increasing costs. While many providers are involved in patient care, only the responsible doctor is eligible to receive a cost reduction bonus under the Gainsharing Demonstration. For medical cases, this is the attending doctor, and for surgical cases, it is the surgeon.

The bonus a doctor receives through the Gainsharing Demonstration for treating an eligible (admitted and covered by Medicare) patient is calculated in three steps. First, patients are divided into types based on their diagnosis and how sick they are (for example, one type would be "hip joint replacement, severity of illness level two"), using 3M's All Patient Refined Diagnosis Related Group (APR-DRG) system.[8] Second, a maximum bonus is assigned to each patient type. All doctors face the same maximum bonus for treating patients of the same type. Third, this maximum bonus is scaled according to whether and how much the doctor reduces costs for that patient type relative to pre-program costs. A hypothetical bonus calculation example is presented in Figure 1.1. In this example, three doctors treat three patients with the same type, but receive different bonuses based on the costs of the treatment they provide.

The maximum bonuses are calculated using cost data from before the program started (the base year was 2007 for the original demonstration and 2011 for the expansion). The maximum bonus for treating a patient type is defined as one tenth of the average deviation from the 25th percentile of the cost distribution for that patient type in the base year. To this end, a third party calculated four maximum bonus amounts for each diagnosis (APR-DRG), depending on the severity of the

[8] As patient types are partially determined by the types and numbers of co-morbidities recorded by the doctor, there is a potential for "up-coding"—doctors changing a patient's diagnosis to increase expected profit. I will discuss this more later in the paper, however, I believe the scope for up-coding is minimal in the Gainsharing Demonstration.

patient's illness (SOI). The four severity of illness categories capture the fact that the same diagnosis (e.g. "peptic ulcer and gastritis") may be more or less serious depending on a patient's age and co-morbidities. I recreate these maximum bonuses using list charges from hospital billing records deflated by Medicare's hospital level cost-to-charge ratio (more details on bonus calculation can be found in the appendix). An example of maximum bonuses for two particular APR-DRGs is given in Table 1.1, and the distribution of maximum bonuses is shown in Figure 1.2.

The maximum bonus, rather than the realized bonus, is the important number when considering the impact of the gainsharing program on doctor behavior. The maximum bonus represents the most a doctor can hope to earn, *ex ante*, for any given patient. A reduction in costs of the same dollar amount for different patient types translates into different realized bonuses, depending on the maximum bonuses. Thus, the size of the maximum bonus reflects how valuable a patient is for participating doctors.

The formulas used to calculate maximum bonuses are based on the idea that high cost variance within a diagnosis is bad, as it suggests that there are high cost patients who could be getting the same treatment as low cost patients. The bonuses are designed to make patients in diagnoses with high cost variance especially profitable. However, the association between cost variance and waste is just a theory. Alternatively, the high cost variance could be due to medical reasons, rather than doctor behavior. If true, diagnoses with high cost variance may be exactly the diagnoses where it is relatively simple to find patients with much lower than average expected costs, making sorting particularly attractive.

1.2.3 Implementation of Gainsharing Demonstration

The Gainsharing Demonstration took place in two waves, which both applied only to admitted Medicare patients.[9] The initial phase took place in twelve New Jersey hospitals from July 1st,

[9] During its first incarnation, it was called the New Jersey Gainsharing Demonstration. Later, it was rechristened and expanded as a part of the Bundled Payment for Care Improvement Initiative (BPCI) under the CMS Innovation Center, which was charged by the PPACA to supports the development and testing of innovative health care payment and service delivery models. (For ease of exposition, I will call both waves the Gainsharing Demonstration throughout the paper, as the payment incentives were nearly identical.)

2009 to July 1st, 2012. Eight of the original twelve hospitals opted to extend the program through March 31st, 2013. On April 1st, the program was renamed the BPCI Model 1 program, and was expanded to 23 hospitals (including six of the original twelve). My data go from 2006 through the end of 2013, so while I use the variation from the start of the BPCI Model 1 program, the bulk of my variation comes from the first wave of the program, and the 2012 extension.

The hospitals that formed the demonstration and its expansion appear to be similar to other New Jersey hospitals, on average.[10] Figure 1.3 shows that the participating hospitals are scattered around the state, and are thoroughly interspersed with non-participating hospitals (a complete list of participating hospitals can be found in the appendix). As can been seen in Table 1.2, the main difference between participating and non-participating hospitals—especially in the first wave—is that hospitals participating in the program have more Medicare patients on average. That hospitals with more Medicare patients are more like to participate is to be expected, as hospitals with the most Medicare patients also have the most to gain from a program designed to reduce the costs of treating this population. In addition, hospitals that participated in the first wave were more likely to receive a grade of A on a hospital quality report card. By the second wave, however, these differences disappear. The selection of hospitals into the bonus program is clearly non-random—larger hospitals with more Medicare patients are more likely to participate, and these hospitals may be on different trajectories than non-participating hospitals. However, the identifying variation used in this paper is within doctor, which sidesteps many of the difficulties posed by differential trends at the hospital level.

1.3 Conceptual Framework

To formalize how the bonuses should affect doctor decision-making, I present a stylized model of the incentives and choices faced by doctors working in a hospital setting. The basic setup of the

[10] A cap of twelve participating hospitals for the original demonstration was mandated by Medicare, despite considerable interest from additional hospitals. In response, the New Jersey Hospital Association chose the first twelve participants to represent New Jersey hospitals as a whole. As can be seen in Table 1.2, this appears to have been successful.