YOU HAD ME AT HELLO: THE EFFECTS OF DISRUPTIONS TO THE PATIENT-PHYSICIAN RELATIONSHIP

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Dedicated to Candace, Caleb, Jenna and Colin who always keep me grounded. I'd truly be lost without you.

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As a father, I knew the truth behind the proverb that "it takes a village" in child-rearing. I did not know when I embarked on this journey, however, that it would be equally true in writing a dissertation.

Words can't express how grateful I am for the support of my family. Thank you to my wife, Candace, for the incredible support you've offered me, allowing me to keep my head in the clouds while you ensure the household keeps running smoothly. For 16 years, through three combat deployments and now a PhD, you've never wavered in your support. I could never have done it without you.

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ABSTRACT

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Despite substantial focus on continuity of care, recent policy has led to significant patient churn. There is little research, however, on the effects of these discontinuities on physician behavior and patient outcomes, and whether physicians behave differently when anticipating a discontinuity. In this paper, I develop a theory of provider behavior. In theory, a provider must choose whether to spend her time treating an ailment or seeking information to diagnose. The optimal trade-off between seeking information and treating varies with the complexity of the patient, but also varies if there is a stock of information from previous encounters. I test this theory using 10 years of panel data from the Military Health System. In this setting, primary care physicians are pulled from their practices and deployed overseas. Using a stacked difference in differences strategy, I separately identify changes in use of care in an anticipatory period after a provider has been informed of the deployment, and in a post period after the provider has left. I find significant changes in both periods, with specialist visits increasing 15- 30 percent (4-8 percentage points) and emergency department visits increasing 15-18 percent (1.7-2 percentage points).

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CHAPTER 1 : Introduction

> The care of the patient must be completely personal. The significance of the intimate personal relationship between physician and patient cannot be too strongly emphasized, for in an extraordinarily large number of cases both diagnosis and treatment are entirely dependent on it, and the failure of the young physician to establish this relationship accounts for much of his ineffectiveness in the care of patients. -Francis Peabody, 1927

As US health care costs continue their precipitous rise towards 20% of GDP, considerable focus has been placed on care coordination. For instance Berwick and Hackbarth (2012) estimate that poor care coordination has resulted in $25 billion to $45 billion in waste in 2011 alone. These coordination costs exist largely because care has become more fragmented (Rebitzer and Votruba 2011) leading patients to have multiple interactions across a variety of caregivers and locations.

To put this in context, consider an anecdote chronicled by a general internist (Press 2014). A patient booked an appointment with his primary care physician due to pain and fever. After tests revealed a tumor, the patient saw 11 clinicians in addition to his primary care physician over the course of 80 days. The primary care physician in this tale communicated repeatedly with each of these specialists, with the patient and with the patient's spouse. While the patient's care was fragmented across 12 providers, he received well coordinated care due to continuity with his primary care provider, who was able to maintain a full awareness of the patient's situation. Not all patients have this type of continuity, though, with as many as 4-11% of patients switching physicians each year (Sorbero et al. 2003), often involuntarily (Mold, Fryer, and Roberts 2004; Safran et al. 2001).

In this paper, I present a theory of continuity. I theorize that a patient and his physicians learn about each from their repeated interactions. In simple patients, there is little value to this information. But in complex patients, this stock of information allows the provider to move from the diagnostic phase to the treatment phase of an ailment more quickly. This results in more time spent treating the patient and ultimately better outcomes. This expectation of better outcomes then allows a provider to shift his margin for referring a patient to specialty care - ultimately helping the patient and saving the system from additional costs.

In this paper I consider a situation where a provider leaves a medical practice in order to test this theory and estimate the effects of discontinuity in the patient - primary care provider relationship. Using unique data from the Military Health System I construct a 10-year panel of patients. In the military, physicians are routinely pulled from their practices and deployed oversees creating a plausibly exogenous source of physician turnover. I augment this data with a series of interviews with military medical practitioners.

While I only find a small decrease in therapeutic procedures per an encounter, I find about a 3% increase in primary care visits. More interesting I find that there a steep 21 % increase (8.3 percentage points) in the probability of using specialty care after a patient's physician deploys.

I also test whether these disruptions create an access to care crunch. Using patients assigned to other providers within the practice, I separately estimate these information and access to care effects. Overall I find a significant 22% drop in primary care utilization and a 2.6% increase in emergency department visits.

Understanding the effects of discontinuity in care has important implications for both policy and practice. Relatively little policy focus has been placed on this interpersonal relationship (Guthrie et al. 2008) however. In fact policies have been largely associated with discontinuity in the physician-patient relationship. For instance, the rise of managed care has been associated with annual contracts that may lead to forced discontinuities (Flocke, Stange, and Zyzanski 1997). While the Centers for Medicare and Medicaid Services (CMS) has focused on care coordination as a potential cost-saving tool (McClellan et al. 2010), there has been significant patient churn in accountable care organizations (Hsu et al. 2017) and Medicaid policy often require patients to frequently change policies (Cutler, Wikler, and Basch 2012). Additionally the individual market under the Affordable Care Act (ACA) potentially leads to annual changes in primary care physicians. Narrow and changing networks often prevent an enrollee from developing a personal relationship with her physician (Buettgens, Nichols, and Dorn 2012). The US system of employer based health insurance also contributes to the frequency of discontinuities. There is an approximately 21% average annual private insurance cancellation rate, about one third of which is due to changes in employer group offerings (Cebul et al. 2008).

Research has shown that patients place relatively low value on this interpersonal relationship. Dahl and Forbes (2016) found that only about one third of individuals are willing to pay higher premiums to maintain their relationship with a primary care physician. Meltzer (2001) found that while about 10 % of individuals were willing to pay more than $750 to be cared for by their primary care physician rather than a hospitalist, most individuals were willing to pay only about $62. This may be because patients tend to assume care will be continuous. Haggerty (2013) found that patients experience continuity as security and confidence and that patients assume providers are communicating until a gap emerges.

My research contributes to three streams of literature. First, there is a significant literature on continuity and fragmentation of care (Cebul et al. 2008; Agha, Frandsen, and Rebitzer 2017). Next, there is a small literature on the effects of forced discontinuities such as through insurance changes or physician turnover (Kikano et al. 2000; Waldman et al. 2004). Finally, there is a large stream of literature on the transference of information (Polanyi 1958; Jensen and Meckling 1992). Relevant to my context, there is also considerable research on recent innovations including electronic health records, the patient centered medical home model, and service line management which may improve care coordination in the face of discontinuities of care. I omit other innovations that are not relevant to my setting such as accountable care organizations and bundled payment models.

My work builds on previous research in several important ways. First, much of the previous work has suffered from the endogeneity of the patient's decision to either discontinue a relationship or to maintain a regular physician at all. Due to military rules, patients in my sample are required to maintain enrollment in a managed care plan with an assigned primary care provider. Second, previous research has generally had to contend with loss of other forms of continuity as well as the loss of the patient-physician relationship. For instance a patient may change from having no physician to having a physician or move to a physician that is not on a shared medical record. Because my patients are static, universally covered with no out of pocket costs, and on a shared electronic medical record I am able to isolate the effects of the loss of the relationship. Third, I have a high level of patient continuity unlike commercial claims where there is high turnover. I have a ten year panel covering 718,000 patients that incorporates at least several years of medical information on each patient. While most administrative data relies on billing claims, this data is pulled directly from the Military's electronic medical record that includes additional variables such as the patient's chief complaint. I use this data to form an index of patient complexity that is not subject to physician coding preferences. Additionally, I have access to individual military personnel records. This allows me to observe considerably more information about both the patients and the medical practices than most previous work. Fourth, most previous studies have focused on elderly and/or chronically ill individuals. My population, conversely, tends to be younger and healthier - potentially identifying a lower threshold for the effects of discontinuity in care. Finally, I am able to observe the adoption of a recent innovation in care coordination during my period: the patient centered medical home. I find that this care model vastly reduces the affects of the discontinuity in care.

1.1. Outline

The dissertation continues as follows. In the next chapter I review the literature and include a brief review of the three recent innovations in care coordination that are relevant to my setting. In chapter 3 I present a conceptual framework and economic theory. In chapter four a provide an in depth look at the Military Health System with a particular focus on primary care and the previously discussed innovations. In chapter five I present my empirical strategy and results. In chapter six I discuss the results and conclude with a particular emphasis on the managerial and policy implications of my research.

CHAPTER 2 : Literature Review

Continuity of Care

While continuity of care has no single accepted definition (Freeman et al. 2001), it can be thought of as the extent to which care is coordinated and uninterrupted over time (Shortell 1976; Haggerty et al. 2003). While a continuing relationship between an individual patient and his primary care provider may be simplest means of achieving continuity (Starfield et al. 1976), this requires patients to make two key trade-offs. First, patients may desire increased access to care - either gaining an appointment more quickly or at a more opportune time than their primary care provider can entertain (Freeman et al. 2001; Rubin et al. 2006). Second, the patient and provider may decide together that a patient will benefit more from seeing a specialist than seeing each other again (Meltzer 2001). In each case, a trade-off is made between relational continuity and the increased coordination costs that come with fragmenting care among more physicians.

As care becomes more fragmented, however, the health care system has responded with ways of managing these coordination costs. The literature identifies at least three dimensions of continuity beyond relational: informational, managerial, and longitudinal (Saultz 2003; Haggerty et al. 2003). Informational continuity, the extent to which a provider has access to information about the patient including past medical experiences (Saultz 2003), includes patient medical records or other provider to provider communication. Managerial continuity builds on informational continuity referring to the extent to which a patient's medical management is consistent and responsive (Haggerty et al. 2003). For example, multiple providers following a single treatment plan can potentially increase the level of managerial continuity. Finally, a level beyond managerial, longitudinal continuity refers to a patient receiving care from a team of providers that coordinate the patient's care among each other, including preventive services (Saultz 2003). The patient centered medical home, further discussed later in this chapter, is a means of enhancing longitudinal continuity.

The medical literature contains significant body of empirical research into continuity. Van Walraven et al (2010) conducted a broad review of the continuity literature finding a significant association between increased continuity and decreased system utilization in eight of nine high-quality studies. Empirical research on relational continuity specifically, though, is somewhat limited. The few studies that exist have primarily focused on indirect outcomes such as patient satisfaction rather than health outcomes finding that a continuous relationship increased the odds that a patient would be satisfied with a consultation (Hjortdahl and Laerum 1992). Other work considered the relationship between relational continuity and preventive medicine (Ettner 1999) or trust in ones physician (Mainous et al. 2001). Van Servellen et al (2006) reviewed the continuity literature, focused solely on clinical trials. They found that while 14 studies included relational continuity, all of these also involved at least one other continuity dimension, generally managerial.

Little work has connected relational continuity with health outcomes. Cabana and Jee (2004) conducted a systematic review on relational continuity and found only 18 studies that fit their criteria. Of these 18, only seven linked to patient outcomes including hospitalizations and emergency department utilization. Perhaps the most conclusive paper in their review is a randomized controlled trial from the Veteran's Administration in which male patients that were at least 55 years-old were randomized into a continuous care or discontinuous care group. Among other findings, the study found that patients in the continuous care group had fewer hospital days and intensive care days (Wasson et al. 1984). It's important to note that the overwhelming majority of studies on relational continuity were conducted before health information technology and other recent coordination mechanisms such as patient centered medical home became ubiquitous.

A major obstacle to relational continuity research is how to measure it. Jee and Cabana (2006) reviewed the literature and found 32 different continuity of care indices. They group the indices into four conceptual categories: duration of relationship, density, dispersion and sequence of visits.

There is also some evidence that physicians behave differently when treating a patient with whom they have a relationship. For instance Johnson, Rehavi and Chan (2016) considered obstetricians delivering other providers' patients and found a statistically significant difference in C-section rates than when delivering their own patients.

Fragmentation of Care

Like continuity, fragmentation is a concept without a standard accepted definition. On a broad level, fragmentation refers to health care providers that make decisions with only a portion of the relevant information (Elhauge 2010). This can occur when a patient sees multiple specialists or primary care physicians.

Researchers have attempted to quantify the effects of fragmentation and discontinuous care. Petersen and colleagues (1994) considered a change in house staff coverage in New York and found that adverse events were strongly associated with coverage from a physician on a different team. Similarly Meltzer (2001) while analyzing the rise of hospitalists, found that patients admitted to the hospital during the week lost most of the benefits of having a hospitalist if they were still admitted when the hospitalists had a weekend off. Johnston and Hockenberry (2008) considered changes in both patient outcomes and the cost of care due to increased specialization. They found that fragmented care resultant from specialization lead to better outcomes but also increased cost. Agha, Frandsen and Rebitzer (2017) found that 60% of fragmentation was independent of patient preferences and that primary care fragmentation lead to an increase in hospitalizations.

Exogenous Sources of Discontinuity in Care

Another body of literature has considered forced discontinuity of care. Several papers have looked at effects on patients whose insurance changed forcing discontinuity in care. Kikano and coauthors (2000) surveyed over 1,800 insured patients and found those who had a forced discontinuity ranked their quality of primary care lower. Other work found that patients who had a forced discontinuity experienced anger, frustration, and general dissatisfaction (Kahana et al. 1997).

Other work has considered discontinuities brought on by physician turnover. While I was not able to find recent estimates, older estimates range from 3.6% to 25% of physicians turning over each year (Misra-Hebert, Kay, and Stoller 2004). While the vast majority of work estimating turnover costs has focused on recruiting and training (Buchbinder et al. 1999), productivity losses have been estimated to be between 42 % and 66% of turnover costs(Waldman et al. 2004). This is particularly relevant in a universally insured population where lost productivity may impede access to care. Additionally, health plans with higher turnover rates have been associated with lower rates of preventive services, and lower overall patient satisfaction (Plomondon et al. 2007)

Information Transfers

One of the challenges with care coordination is that information varies in its transferability. Michael Polanyi (1958) noted that not all information can be written down. For example a pianist may know the appropriate pressure to place on the keys but may not be able to describe it. A patient may know that he is in pain but a description of the pain may elude words. This concept separates explicit information which can be written down or codified, from tacit knowledge.

Von Hippel (1994) builds on this concept, coining the term 'sticky' to relate the incremental expenditure needed to acquire, transfer or use information. He specifically notes that this is not solely based on the attributes of the information, but also involves the attributes of the information-seeker and information-provider. He further notes that organizations can reduce the stickiness of knowledge through investing in converting tacit knowledge to explicit, or adjusting their organizational structure. In the health care context, a patient-physician dyad may reduce the stickiness of information as they gain familiarity with each other, perhaps through enhanced communication, increased trust, or some other mechanism. The importance of information transfer becomes more critical as tasks become more interdependent and information becomes disparate (Tushman and Nadler 1978; Malone and Crowston 1994) as occurs when care becomes more fragmented.

Substantial work has pointed to limited information transfer between physicians. For instance Kripalani et al (2007) conducted a systemic review of the literature concerning hospital-based and primary care physician communication and found common deficits in information transfer. Other work found that nearly a quarter of primary care physicians were not even aware that their patient had been admitted to the hospital and less than half of primary care physicians received a discharge summary within two weeks (Bell et al. 2009).

The literature also identifies doctor-patient communication as a critical aspect of care. While the doctor needs to understand the patient, patients also tend to have better outcomes when they receive better information from their physician (Stewart 1995). As Roter (2000) describes it - the information the patient gleans from the physician may help the patient cope with the anxiety and uncertainty of his condition. For a complete review of the literature on patient-physician communication, see Ha and Longknecker (2010).

Jensen and Meckling (1992) define a spectrum of specific to general knowledge based on the difficulty in transmitting information. Specific knowledge can be thought of as information that is idiosyncratic to specific circumstances. For instance, where in an operating room the forceps are kept is specific because while it is certainly able to be transferred, it is particular to that hospital. There has been some work on the role of specific knowledge in health care. Huckman and Pisano (2006) considered cardiac surgeons that worked in multiple hospitals. They found that there was a volume-outcomes affect for a particular hospital but that effect did not transfer to other hospitals in which that surgeon worked. Similarly, other work has found a customer-specific learning curve. Clark, Huckman, and Staats considered outsourced radiology services. They found that repeated interactions with a particular customer lead to an increased ability to meet that customer's needs .

Care Coordination Innovations

Since the 1970's policy and practice innovations have attempted to mitigate the information transfer problem and reduce coordination costs (Kilo and Wasson 2010). Electronic Medical Records , Service Line Management, and Patient Centered Medical Homes are each attempts at promoting coordination. Each of these are also implemented by the military as I will expand on in chapter 4.

Electronic Medical Records

An Electronic health record (EHR) is a system that maintains patients information electronically. This includes everything from patient complaints to procedures performed and lab test results (Evans 1999). Some early research that reported positive effects of electronic medical records (EMRs) was conducted in advanced Integrated Delivery Networks (IDN's) such as Geisinger and Brigham and Womenâs Hospital that developed their own customized IT systems; because their histories and capabilities differ markedly from those of other providers, their results may not be generalizable (Shekelle, Morton, and Keeler 2006). Later research, conducted in a more diverse set of hospital settings, reported much more mixed results.

The American Recovery and Reinvestment Act (ARRA, 2009) authorized the Centers for Medicare and Medicaid Services (CMS) to extend financial incentives to physicians who adopt IT systems and demonstrate meaningful use of them in their clinical practices. Meaningful use had three stages: (1) electronic capture of patient health record data, which could then be used in reporting and tracking clinical conditions; (2) use clinical data to guide and support care processes and coordination; and (3) improve performance and health system outcomes. ARRA required 25 functionalities under the meaningful use regulations; only some of these have been studied. Any summary of the literature needs to take account of these subtle differences in organizational contexts and IT components.

Earlier reviews of the literature on electronic medical records reported mixed effects of health care IT on cost and quality. The evidence for quality-enhancing benefits is greater than the evidence for cost-reducing benefits. There thus continues to be little evidence of the cost-effectiveness of EHR or its ability to support health care reform initiatives such as the accountable care organization or the patient-centered medical home (Burns and Pauly 2012; Buntin et al. 2011). Among physicians, EHR adoption fostered revenue gains for some, but revenue losses for many. Reasons for such losses include increased staffing costs, increased practice costs (hardware, software, implementation), and reduced productivity (Fleming et al. 2014). A national study of physician groups found that EMR use was not associated with the quality of care rendered to chronically-ill patients, a finding replicated in other studies (Shortell et al. 2009). There is some limited evidence of EHR benefit in a context of high team cohesion however (Graetz et al. 2014). This may be relevant when considering EHR in the context of a patient centered medical home.

Patient Centered Medical Home

According to the Agency for Healthcare Research and Quality (AHRQ) The Patient Centered Medical Home (PCMH) is a primary care redesign that includes four key ingredients. First, it includes team-based care, although this team may be virtual. Second, it includes at least two of the following four components: enhanced access, coordinated care, comprehensive care, and a systems-based approach to quality. Third it includes a sustained partnership and personal relationship between the patient and the caregiver. Finally, it includes some sort of structural change to the traditional primary care practice (Williams et al. 2012). This broad definition has created considerable variation across what is considered a medical home (Jackson et al. 2013).

While the concept of a 'medical home' has been around since at least 1967, implementation has grown considerably over the last decade (Sia et al. 2004), perhaps catalyzed by the National Academy of Family Physicians who conducted a national demonstration project in 2006-2008. With the Affordable Care Act changing incentives for quality care, PCMH has become central to primary care reform efforts (Edwards et al. 2014).

With only ten years of data on PCMH, empirical evidence is somewhat limited. However, initial studies have shown mostly positive results. Some studies have found significant reductions in emergency room use (Hoff, Weller, and DePuccio 2012; Hsu et al. 2012; David et al. 2015), lower cost (Grumbach and Grundy 2010) and higher quality (Paustian et al. 2014). There is also some mixed evidence however as other studies have found little reductions in utilization or improvements in quality (Werner et al. 2013). These conflicting results may be attributed to the significant variation in PCMH design and implementation.

Service Line Management

Traditionally, hospitals have been organized based on human capital so that physicians report to a chief of medicine, nurses report to a chief of nursing etc. This input-based organization provided a level of physician autonomy (Jain et al. 2006), but possibly hindered coordination of resource allocation and health care decisions (Shortell, Gillies, and Devers 1995). Based on product line-management pioneered in the manufacturing industry (Parker et al. 2001), the fundamental idea behind service line management is to organize around outputs rather than inputs (Chams and Tewksbury 1993). These can be patient populations such as women or children, specific procedures or services (e.g. primary care). Beginning in the 1980's many hospitals adopted this approach, however it was implemented more as a marketing tool with little change to the internal organization (Jain et al. 2006). Over the last two decades, however, there has been a resurgence in an attempt to better coordinate care within an integrated framework (Parker et al. 2001). Studies to date indicate, however, that these hospitals have not only not achieved their goals, but have actually had worse outcomes (Byrne et al. 2004; Young, Charns, and Heeren 2004), so it is unclear whether this will mitigate or exacerbate continuity concerns.

CHAPTER 3 : Conceptual Framework & Theory

The conceptual framework reflects the fact that medical professionals must balance their time between diagnostic work to determine a patient's ailments and therapeutic work to ameliorate the problem. The patient and the physician, through a shared decision making process, continue diagnostic processes until they reach a sufficient level of certainty regarding the probable cause and best treatment options and then move to therapeutic processes. As the strength of their relationship increases, the physician builds a stock of information about the patient, allowing him to choose the most appropriate diagnostic procedures and more quickly understand what is ailing the patient. More effort can then be spent treating the ailment.

Formally, the provider produces health for the patient using a production function with two types of inputs, information and therapy, so that

$$H = I^{\frac{1}{\alpha}} T$$

and constrained by his supply of labor $L = D + T$. Therapy includes all elements of care designed to increase the patients health rather than discover new information. This includes procedures that treat the patient's ailment as well as counseling and prescribing.

Of course, not all ailments are equal with some being easily observable and others require significant diagnostic effort. For instance a patient with a broken arm may only require a simple x-ray while a patient with an auto-immune disease may require numerous tests to determine the diagnosis. The exponent $\frac{1}{\alpha}$ on I represents the returns to that information so that α increases with patient complexity. The information component is made up of two components: the stock of patient-specific information available to the provider K and diagnostic conversations, tests and procedures meant to gather new information so that

$$H = (D + K)^{\frac{1}{\alpha}} T$$

Considering comparative statics

$$\frac{\partial D}{\partial K} \leq 0$$

An increase in the information available would lead to a decrease in the amount of diagnostic work the provider should optimally engage in. This can be seen conceptually in figure 1 & 2. Here the X axis represents patient complexity and the Y axis represents the providers supply of labor. In Figure 1 the provider has no stock of information about the patient. In the most simple case ($\alpha = 0$), the provider does not need information and spends his full supply of labor treating the ailment. In the most complex case ($\alpha = 1$) however, the provider splits his time equally.

In figure 2, the provider is able to complement his diagnostic work with a stock of patient-specific information. In the simple case, there's no change to the production function. However, as the patient becomes more complex, the share of time spent diagnosing is reduced relative to the case of no stock of information. In this stylized example, instead of splitting his time equally, the stock of information allows the provider to spend 60% of his time treating and only 40% diagnosing.

Next consider the case when information goes up and patient complexity increases.

$$\frac{\partial^2 H}{\partial \alpha \partial K} < 0$$

Even as information increases, more complex patients are likely to have worse health outcomes. However, figure 3 shows outcomes with and without a stock of information for patients of varying complexity. The outcome with information is always as good and frequently greater than the outcome in the absence of information.

However, there is a third choice beyond test and treat. The physician can also refer the patient to specialty care if he does not feel capable of handling the situation. At the extremes, this is easy. A patient with cancer ($\alpha \to 1$) will be referred to oncology; an otherwise healthy patient with the common cold ($\alpha \to 0$) will be treated. However, a physician must balance the well-being of his patient with the additional resource use of specialty care. This means each physician will have some margin for which they feel indifferent about referring or treating a patient.

More formally, the patient and provider have an expected value of the health outcome that the provider can produce given the stock of information and the probability distribution of health outcomes. If this health probability is below some threshold, the provider prefers to refer the patient to a specialist. This is shown in figure 4. The horizontal line at .8 is the provider's refer threshold. [1] As the amount of patient specific information increases, the complexity level at which an expectation of sufficient health outcomes for the physician to treat rather than refer shifts further to the right along the complexity dimension.

The model drives four hypotheses. First, on average the provider will spend more of his time diagnosing and less time treating after a discontinuity.

Hypothesis 1: A discontinuity will lead to a decrease in in the rate of therapeutic procedures and an increase in the rate of diagnostic procedures for primary care physicians.

Because of this, it will take a patient more visits to see his primary care doctor in order to receive an equivalent amount of treatment.

*Hypothesis 2A:*An average patient will require more primary care encounters after a discontinuity in care.

However, there's no conceptual reasons why a discontinuity would cause a patient to become

[1] This is somewhat of a simplification. It would actually be the minimum of either the provider's refer threshold or the patient's choice to seek specialist care.

sick or hurt. Therefore the probability of using any care will not change.

Hypothesis 2B: A patient's probability of using primary care will not increase

Third, although health is a function of both treatment and diagnostic work, treatment is the only part that adds value. That is, the information component of the production function is one at most which reduces to $H = T$. Therefore, on average, patients will always have worse outcomes after a discontinuity.

Hypothesis 3: Patients will have worse outcomes after a discontinuity in care.

Because the expectation of worse outcomes, a provider will be more likely to refer a patient to specialty care after a discontinuity.

Hypothesis 4: There will be an increase in specialty care after a discontinuity

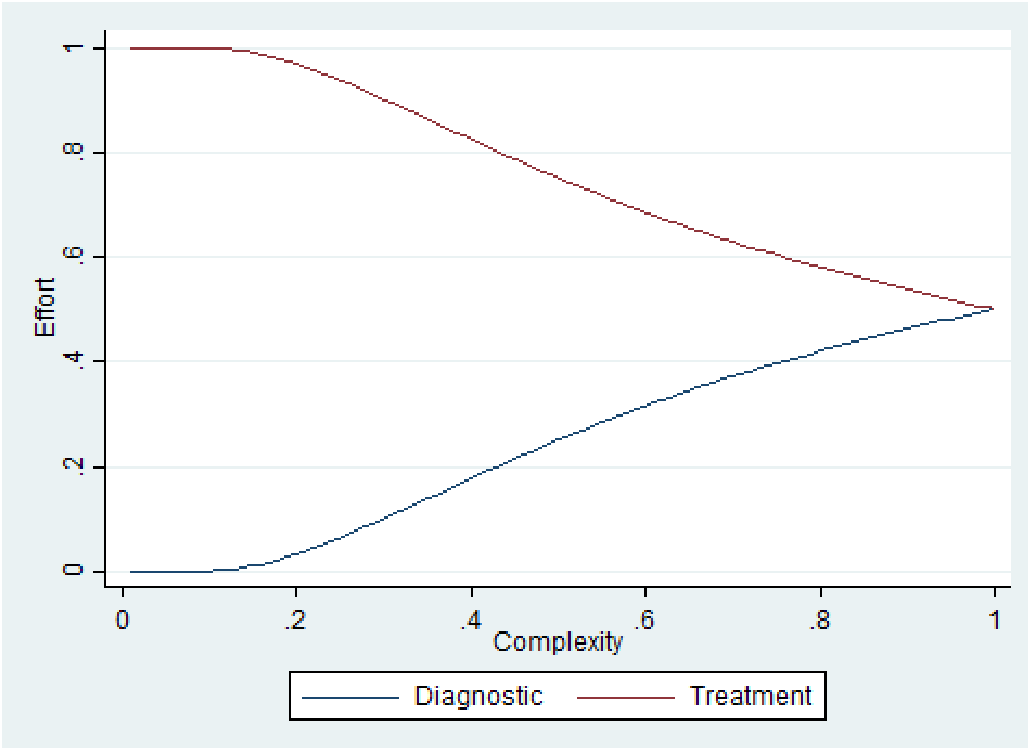


Figure 1: Provider Production Without A Stock OF Patient Specific Information

Notes: Author's rendition of provider production function with two inputs: Diagnostics and Therapies. Complexity on the X axis refers to returns to information in treating a patient. The Y axis is the provider's time constraint

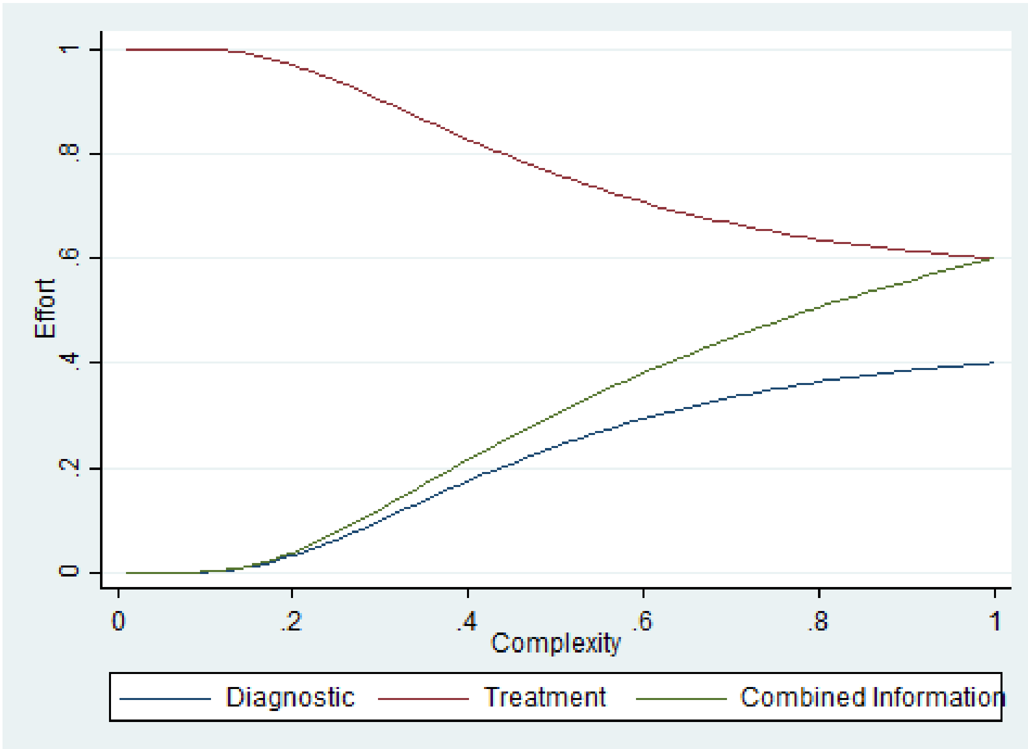


Figure 2: Provider Production With A Stock OF Patient Specific Information

Notes: Author's rendition of provider production function with two inputs: Diagnostics and Therapies and combined value of stock of information and diagnostics. Complexity on the X axis refers to returns to information in treating a patient. The Y axis is the provider's time constraint

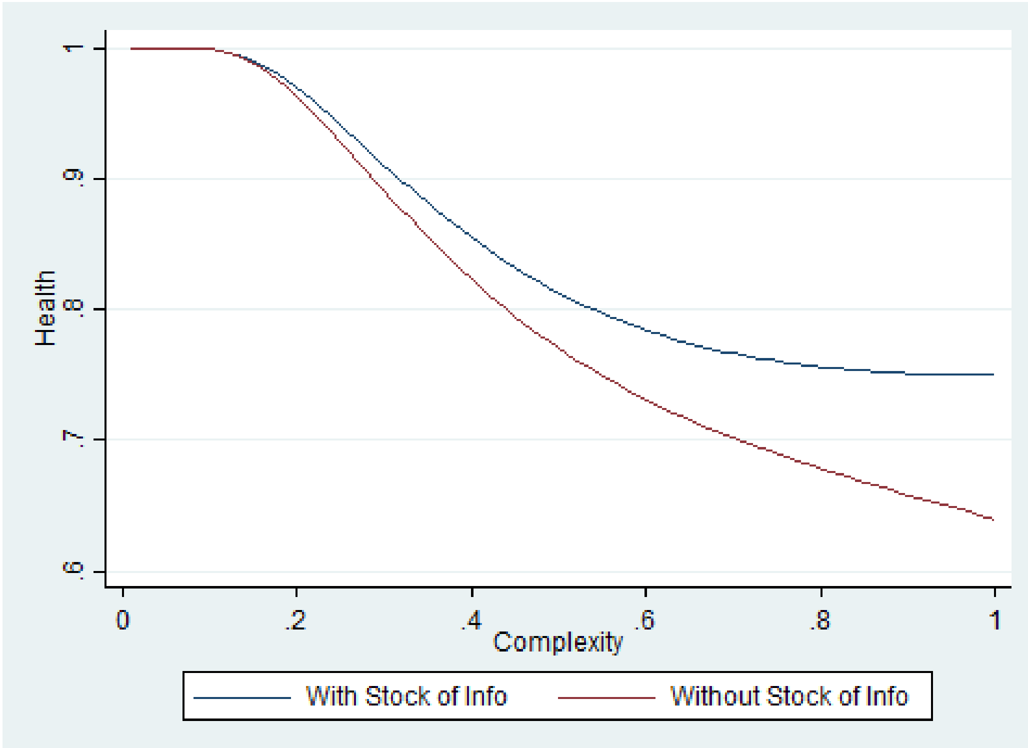
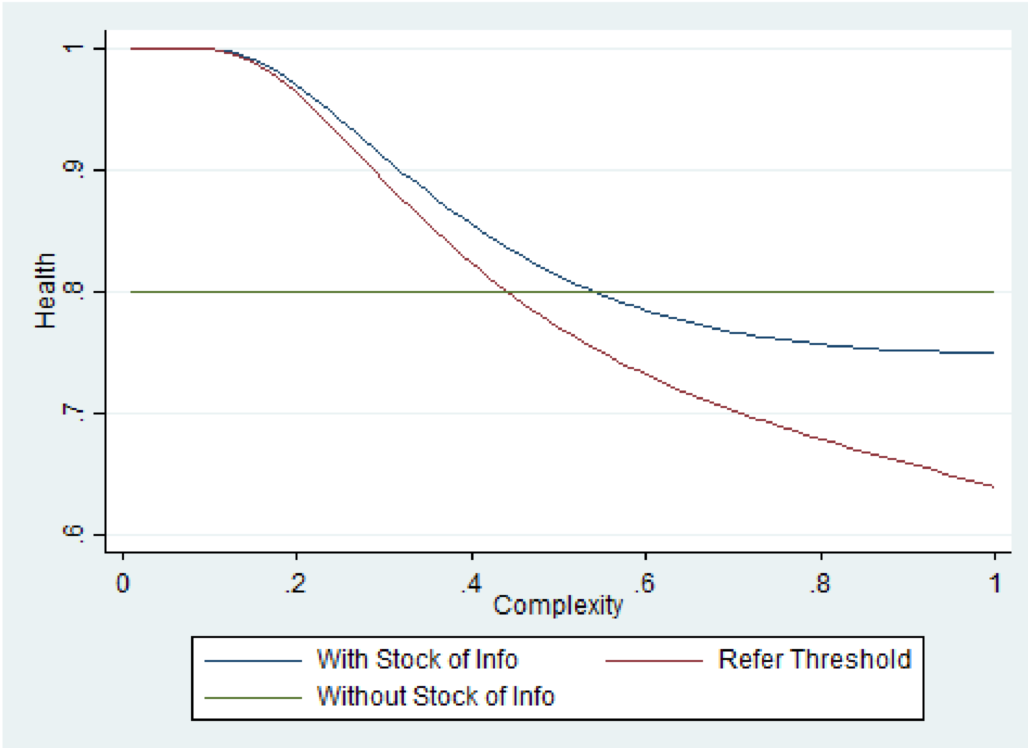


Figure 3: Difference In Outcomes Based on Information

Notes: Author's rendition of provider health outcomes with full information and no information. Health is modeled as a 0-1 variable on the Y axis. Complexity on the X axis refers to returns to information in treating a patient.



Notes: Author's rendition of provider health outcomes with full information and no information. Health is modeled as a 0-1 variable on the Y axis. Complexity on the X axis refers to returns to information in treating a patient. The vertical line at .8 is the provider's referral threshold. Information shifts the complexity level of the marginal referral from about .4 to about .5

Figure 4: Difference In Outcomes Based on Information With Referral Threshold

CHAPTER 4 : The Military Health System

In this chapter I describe the Military Health System with a focus on primary care and care coordination. It's important to note that the MHS has gone through some substantial structural changes in the past five years based on Congressional direction. While I focus on the current make-up, I point out these changes where relevant to either continuity of care or the empirical analysis. Second, while the the three military service medical departments (Navy, Air Force, Army) generally follow the same processes, where there are differences I default to the Army's processes. I do this because both because the Army is the largest department, and because I conduct the empirical analysis using Army data. In order to understand the organizational routines and 'behind the scenes' interactions in the deployment process, I conducted a series of 8 interviews with military physicians. I describe these interviews in more detail in the next chapter.

The Military Health System (MHS) is an integrated system that both delivers health care in military hospitals and clinics ("direct care") and is also a payer for care sought in a non-military setting ("purchased care"). Additionally, the MHS integrates public health, graduate medical education, medical research, and operational medicine departments (*Final Report to the Secretary of Defense: Military Health System Review* 2014). I focus my overview on the direct and purchased care components with primary focus on primary care in the direct care system. Finally, I discuss one particular idiosyncrasy of Army Medicine that disrupts relational continuity of care into order to provide physicians for operational assignments. [1]

4.1. TRICARE Insurance

Tricare is the payment portion of military medicine and operates much like a traditional insurance offering. Tricare beneficiaries have several plans from which to choose, with the exception of active duty military that are required to enroll in Tricare Prime. Tricare Prime

[1] For a more comprehensive review of the Military Health System, see *Evaluation of the TRICARE Program: Fiscal Year 2017 Report to Congress* 2017.

is the staff-model health maintenance organization (HMO) plan associated with the direct care system. Patients are assigned a primary care provider who must provide a referral for specialty care in return for low or zero out of pocket costs. In particular, active duty service members and their families do not pay enrollment fees and have $0 deductibles and co-insurance when care is provided in the direct care system.

Access to care standards require these patients be referred to the purchased care network if a timely appointment is not available in a geographically close military facility. These patients can also use a "point of service" option to seek care in the purchased care network without a referral but face a 50% copay.

Tricare Select is the fee for service offering. For larger out of pocket costs, beneficiaries have the option of foregoing the HMO model and can seek specialty care without a referral.

4.2. Purchased Care

The Purchased care system is dual-tiered. Network providers have agreed to accept Tricare negotiated rates. However, Tricare Select beneficiaries have the option of seeing non-network 'authorized' providers for an additional copay. These providers can also legally charge 15% above the Tricare allowable charge. At times, the patient may have to pay the full cost out of pocket and then file for reimbursement when seeing non-network authorized providers. Similar to Medicare, Tricare allowable inpatient charges are reimbursed according to a diagnosis related group (DRG) prospective payment methodology. Outpatient charges are reimbursed based on resourced based relative value units (RBRVU).

4.3. Direct Care

The direct-care system provides inpatient and outpatient care, as well as optometry, pharmacy and dental services in 55 hospitals and 373 Clinics across the United States and Europe. Figure 6 shows the geographic metropolitan regions where these facilities are located in the Continental United States. Organization follows a hub and spoke model so that below the headquarters there is a "parent" hospital that provides administrative support to individual "children" clinics. While typically located on military posts, in recent years many children clinics have opened have opened off these posts in the communities where military family members live.

The MHS uses three types of employment contracts with its medical providers. First, active military rotate through the various facilities, generally on three year tours though there is considerable variation in how often these individuals move. This makes up about 70% of physician staff. Second, civil service employees have a more traditional employment relationship with the DoD that includes a defined benefit retirement plan and health care benefits. These employees tend to remain in the same clinic or hospital for many years and make up about 25% of the physician staff. Finally, the DoD uses contracted labor to fill in manpower shortfalls. These are generally one year contracts with staffing companies though these contracts are often renewed for multiple years. The government does not provide any benefits for these individuals, though their staffing company might.

Although congress appropriates funding for the direct care hospital system each year, each hospital receives a budget based on workload. This budget is earned based on a combination of fee for service, per-member per-month, and prospective payment methods. However, with some small exceptions, budgets expire at the end of the federal government's fiscal year and any unused funds are returned to the treasury.[2]

4.4. Primary Care

Tricare Prime uses a gatekeeper model for primary care in which the a Primary Care Manager (PCM) is responsible for coordinating a patient's care. In addition to physician's, physician's assistants and nurse practitioners are eligible to serve as primary care managers. Each PCM will have a set panel of patients for whom that provider is responsible. When one of these providers permanently leaves a hospital or clinic, her patients are automatically reassigned to

[2] This is a gross simplification of government budgeting processes

a new provider and a letter is mailed to the patient informing him of the change. Generally, whomever replaces the departed physician will assume her entire panel, although there are many exceptions to this rule.

At times, physicians will be temporarily assigned outside of their assigned clinics. This can be due to other military responsibilities, or to cross-level manpower if a different clinic is short-handed for an extended period of time. When this occurs, the provider remains responsible for her panel of patients and appointments are offered with other providers in the clinic until either the physician returns or the patient requests a change in primary care manager through Tricare.

The MHS uses an empanelment tool to determine the number of patients that should be allotted to each provider. A full time primary care manager is expected to see 17-21 patients a day, although this amount is often adjusted based on administrative workload and employment category (i.e. military, civilian or contracted labor). The empanelment tool considers the total number of providers and beneficiaries assigned to a clinic and patient's average utilization in order to determine the number of beneficiaries in each providers panel.

Public Law 114-328 required standardization of appointing systems across the MHS and 32 CFR 199.17 (p)(5) requires the military to meet access to care time lines. Table 1 shows the standardized process, along with specified access standards, that the Defense Health Agency officially published in January 2018 (*DHA Interim Procedures Memorandum 18-001* 2018) although many locations adopted earlier. The military health system measured compliance by considering the third available appointment. Figure 5 shows an example from the Army 3rd Next Available Quick Start Guide (2016) .

With frequent disruptions to the provider patient relationship, providing continuity of care is a major hurdle for the MHS. Military physicians move between hospitals, as well as operational assignments. Active duty patients also move approximately once every three years. Complicating personnel manning, physicians can be sent for temporary assignment to other facilities based on patient demand. Finally, physicians are pulled from the direct care system in order to meet contingency operations in theaters of war through the professional filler system (PROFIS). The MHS tracks how often patients see their assigned provider. While the organizational goal is 65% of the time, according to internal reports the organizational average is about 58%.

Care fragmentation is also an issue. All of the providers with whom I spoke mentioned that specialty and primary care providers rarely coordinated. As one provider mentioned:

> The communication between primary care and specialist, at least in the Army, is very, very poor in my opinion. I recall from my previous time as a civilian I worked for a specialty service. One of my jobs was to write letters to the primary care manager who had referred to the specialist to keep them informed about what's going on. That just doesn't happen in the military, in the Army, that I'm aware of. The specialists generally just take of whatever patients, there's next to no ... next to no feedback to the PCM about what's going on. Of course, you can always look at the notes in the electronic medical record system if you want to find out what the specialist is thinking, but they do not communicate back to the PCM, unless they have a complaint to make.

As mentioned in the quote, the MHS is on an integrated Electronic Medical Record. In fact the MHS has a fairly robust HIT infrastructure that includes both inpatient EMR and outpatient electronic medical records, an online appointing system and a decision making tool. Prior to 2018, however, the inpatient and outpatient EMR's lacked connectivity creating similar problems to those faced in civilian settings. Additionally, there is a sharp distinction between the direct care and purchased care components. Network providers are asked to upload medical records to the military system, however, there is no incentive for them to do so. Claims are paid regardless so this often does not occur. In interviews it was brought up that this creates a significant coordination issue.

While there is variation in the quality of information input into the EMR, the MHS employs a peer review process. This process requires each provider to have a random sample of his notes reviewed and graded by a similar type provider. However, the EMR may be contributing to the lack of communication between primary care and specialty providers. As I was told:

> Communication with specialists in the military health care system everywhere I've been has been pretty sparse. It's almost purely through the electronic medical record. Very rarely will I engage with somebody through email or pick up the phone.

The MHS, and the Army in particular, have implemented several organizational coordinating mechanisms over the last decade. In 2009, Department of Defense ordered the services to begin a transition to the Patient Centered Medical Home model. The Army began transitioning its primary clinics to a patient centered medical home model in 2010. The transition involved several stages. First, organizations endogenously decided to become medical homes. Once MHS-internally certified as a medical home, these clinics were given a separate cost accounting code. After restructuring they began to go through the levels of National Committee for Quality Assurance (NCQA) certification levels. While use of a cost accounting code does not indicate that certification was achieved, it does indicate submission of an application. By March 2015, 136 of 157 primary care practices had transitioned to the PCMH model and had met NCQA recognition requirements. In 2017, certification was transferred to The Joint Commission.

The Army has also transitioned to a service line management approach with 6 service lines as of 2007. These include primary care, behavioral health, surgical services, telehealth, women's health, physical performance and disability evaluation. [3] Each service line has a Chief at the headquarters level with specific leads at the parent hospitals. Despite being

[3] The integrated disability evaluation system (IDES) a joint system with the Veteran's Administration to help service members obtain disability ratings while still on active duty.

responsible for performance within the service line, the service line chief generally does not have supervisory authority. Beginning in fiscal year 2015 four of the the service lines, including primary care, integrated budget functions into the service line management. The remaining three service lines integrated in 2016.

Professional Filler System

The primary source of discontinuities in this study is through military physician deployments. Deployments in this sense refer to temporarily serving outside of the United States in conjunction with a military operational mission. This could be due to combat or due to a humanitarian aid mission. Military physicians are generally not assigned to operational units so that they can practice medicine in hospitals when not needed in combat. The Army, however, maintains a list of individual physicians that would augment each unit should an operational unit deploy. This system is called the Professional Filler System (PROFIS) and those on this list can be thought of as an "on-call" status for a specific unit (US Army, 2015) . Periodically, hospitals are told that they must provide the names of a certain quantity of physicians for this. Individual hospitals have discretionary power for how they choose, and how often they rotate these individuals. Often the assignment is based on whose 'turn' it is to deploy. That is, who hasn't deployed in the past or whoever is newest to the hospital. About 10% of military physicians are in the PROFIS system. When a deployment is needed, the individual assigned to that unit in the PROFIS system is informed of the location and length of the deployment, generally between 6 months and one year. Only a small proportion of those assigned to a PROFIS unit actually deploy.

Deployments themselves are pseudo-random. For deployments with longer lead-time (e.g 6 months) each hospital chooses the providers that are entered into the PROFIS system but not the unit to which that provider is assigned. Unit deployments are based on operational needs. It is incredibly improbable that Army Forces Command makes deployment decisions based on the assigned medical doctor. At times, the assigned doctor will not be able to deploy with that unit. For example if the provider gets hurt while preparing to deploy.

If this occurs, the hospital is supposed to choose another eligible provider. In practice, however, there is often little choice. As an administrator at a small hospital relayed to me:

> Yeah. It's more, usually more of a warm body scenario. Okay, I've got five active duty providers, three are already in a PROFIS position, one has this other tasking that make them non-PROFIS, so you're left. Guess what, you get to fill this position.

At times, the provider will volunteer for the deployment if she knows that she is 'due' and prefers to have some control by volunteering to go with a particular unit at a particular time.

> . I knew I was at the top of the list, and I hadn't deployed yet. So I knew it was inevitable, and it was with an [good] unit...And the timing was good for my husband and I, cause we had already kind of talked about it, like this is probably the year

Upon learning of deployment, the physician is not officially given any additional administrative time to prepare despite numerous preparatory tasks. For instance a provider pending deployment must update his will, get a power of attorney, go through medical screening, and prove that he is competent with a firearm. There are also additional clinical tasks such as preparing and transitioning patients.

Formally, patients remain assigned to their primary care manager and are not informed of the deployment. When a patient calls to book an appointment, the patient is informed that his physician is unavailable and offered an appointment with an alternative provider. The patient always has the choice to go online and request his primary care provider be changed to another available provider in the clinic. Informally, some providers will inform their patients, especially if they have a longer lead time prior to the deployment.

There is no formal guidance in transitioning patients from one provider to another. From interviews, it seems there is considerable heterogeneity in how the actual transitions occur but that different clinics have developed informal routines for transitioning the more complex patients.

> What they do at [clinic name] is they drop consults in the system to request further care, and even though it's what they consider a followup, it's a reevaluation by coding....At [second clinic name], I don't know that had a formal process. I remember making like spreadsheets, probably ... I don't know if that was the right thing ... but I remember making spreadsheets of people

While there are no changes to empanelling or appointing procedures, at least one provider told me he would work with front office staff to only see his empaneled patients while preparing to deploy.

> I can recall multiple patients that when I left I had transferred to [clinic name] to continue care with the recommendation that they get an [medical out processing from the military], and I can recall a couple patients specifically in the [unit] that ... There was one guy, he was like on a cane, not walking very well, so he was not deployed. I came back... and there sits this soldier still there... and still not walking well. It really bothered me that he didn't, you know, he didn't get better. You know, was it my fault because I left? Did he get the care he needed? I have no idea.

In the next chapter I use the PROFIS system as to estimate the impact of discontinuity in patient care.

4.5. Tables & Figures

Appointment Type	Length	Standard
24HR (Urgent)	20/40/60 minutes	Minimum of 3 Appointments Available
FTR (Follow-up/Wellness)	20/40/60 minutes	3 Appointments within 7 days
Specialty (Provided in PC Setting)	20/40/60 minutes	None Specified
Virtual (When Clinically Appropriate)	10 minutes	None Specified
Procedures (in PC Setting)	30/60 minutes	None Specified

Table 1: MHS Primary Care Standardize Appointing

Provider ID	Appointment Date = February 1						
	8:40 am	9:00 am	9:20 am	9:40 am	10:30 am	11:10 am	12:00 pm
A	OPEN	OPEN					
B							OPEN
C	BOOKED	OPEN	OPEN	OPEN			
D		BOOKED	BOOKED	BOOKED			
E	OPEN	BOOKED				OPEN	
F		OPEN	OPEN		OPEN		

The data in Figure 1 is for a single clinic, and for the 24HR appointment type. The observation date and time for this data is February 1, 8:30 am. First Next Available Appointments for each provider are highlighted in blue, Second Next Available Appointments are highlighted in green, and Third Next Available Appointments are highlighted in Yellow. In this example, Provider C has the earliest Third Next Available Appointment (at 9:40 am).

Figure 5: Example 3rd Next Available Appointment

Figure 6: Geographic Location of Military Health System Direct Care Facilities

Figures shows lay out of military hospitals in continental United States. A signifies Army administered hospitals. N signifies Navy administered hospitals. AF signifies Air Force administered hospitals

CHAPTER 5 : Empirical Analysis

In this section I provide an empirical analysis of the effects of disruptions to interpersonal continuity of care. The professional Filler System, described in depth in the previous chapter, provides a plausibly exogenous change in the patient-provider relationship. Using an unbalanced panel of active-duty Soldier-patients, enrolled in Tricare Prime, who were not deployed during the sample period, I use a differences-in-differences approach to consider changes in utilization and health outcomes after a patient's primary care provider deploys.

5.1. Data

The data for this project comes primarily from the Defense Health Agency's medical data repository (MDR) which includes a complete longitudinal record of care for all Tricare beneficiaries. The data is separated by source of care - either through the direct care system or purchased from the civilian network. I combine this data with individual personnel records obtained from the Defense Manpower Data Center (DMDC).

Direct Care Data

Due to the use of a common electronic medical record, detailed encounter-level data is available for the direct care system. Each outpatient observation is a specific patient visit with the national provider identification numbers (NPI) for up to three providers, the provider's specialty and up to 13 distinct common procedural terminology (CPT) codes as well as up to 10 International Classification of Diseases (ICD) diagnosis codes. CPT codes are a reporting mechanism that annotate what a provider did during a patient visit. [1] Other data include the chief complaint, the appointment type such as new or follow-up, the hospital department, and workload values in relative value units (RVU). In addition I observe any hospital inpatient admissions.

[1] The MHS used ICD-9 codes through September 30, 2015 and ICD-10 codes beginning October 1, 2015.

Purchased Care Data

The purchased care data comes from individual claims and provides much less detail compared to the direct care data. However, I am able to observe patient appointments, the location and specialty of the appointment, the CPT codes performed and any diagnoses.

Personnel Files

The military personnel records include demographics such as race, age, gender & education level as well as a where each Soldier was stationed. I am also able to observe patient deployment. While I can't match providers national provider identification code with their personnel files in the main sample, I do have a partial crosswalk that covers about 41% of encounters. This crosswalk includes all Army providers that took a random drug test in 2016. The army tests a random 10% of individuals each month. I use this sample as a robustness check as I can fully observe their deployment date.

Sample Construction

My sample includes all active duty Soldiers that served for at least two years and had patient encounters in the direct care system in at least two years between 2007-2016. I begin with 2007 because provider NPI's were not available prior to late 2006. It's not uncommon for a Soldier to have a "break in service" meaning that one leaves the military and then reenters. In these cases I keep only the first period of service. I also exclude any observations after a Soldier deploys during the panel. If a deployment occurs in the quarter after his provider's deployment then I also exclude that individual. Sample construction is detailed in table 2 below.

I eliminate the first year of data in regressions. I do this because the data is left censored I require at least four quarters to calculate some controls. I also run the analysis with that data and it is not sensitive to the specification.

Dependent Variables

I consider how much care an individual consumes. I quantify this by considering whether patients increase their use in either primary care or specialty care settings. I consider both the extensive margin of the probability of any use of care and the intensive margin of how much care is consumed contingent on using care.

I focus on several aspects of utilization. First, what types of care are provided when a patient sees a physician. I use the Berenson-Eggers Type of Service Code (BETOS) in order to identify the types of procedures being performed. The BETOS uniquely codes each CPT into one of 7 types[2]. I focus on two of these: tests, and procedures. While the codes are not a perfect proxy, theoretically a test should provide additional diagnostic information while a procedure should help ameliorate a condition.

I use resource based relative value units (RVU) as a measure of workload intensity which may proxy for cost. RVU's include workload, practice expense and malpractice insurance components, however, I exclude malpractice as it isn't reimbursed within the direct care system.

Finally, I use inpatient hospital admissions and emergency department visits as measures of patient outcomes.

Independent and Control Variables The primary independent variable for the analysis is an indicator for a patient's primary care provider deploying. Because I lack a full crosswalk from national provider identifiers to military identifiers, I measure primary care provider deployments as any provider that disappears from the data for at least one quarter and then returns at a later date. I also control for several time-varying covariates including education, rank, the length of time a patient been located at a specific installation.

I have several organizational variables that I use to perform subgroup analysis on the data. I have indicator variable for a patient-centered medical home. I also create indicators for the primary purpose of the military installations. Operational military bases are those with

[2]CMS stopped publishing BETOS crosswalks in 2016

a primary mission of training for deployment in support of combat operations. Other bases are those that have missions such as logistic support or research and development.

Table 3 shows descriptive statistics. The median patient is 26 and uses three primary care appointments each year. This seems a bit high but is likely a function of my setting. Active duty military do not receive a set number of sick days. Instead, they must see a primary care physician to be excused from training whenever they fall ill.

Table 4 displays a comparison of means for those who do and do not experience a provider deploying. Those who experience a discontinuity are slightly different demographically. They are slightly less white and about two years older. While they use more primary care, other utilization metrics are similar between the groups. Similarly, I compare physicians that do and do not deploy. Table 5 shows this comparison of means. Patient complexity and how they treat them tend to be quite similar.

Other Variables I form several variables that conceptually interact with the effects of a disruption. These include a measure of how fragmented a patient's care is across specialty physicians, a measure of primary care continuity, and a measure of patient complexity. Each of these are measured prior to the discontinuity. I describe these measures in further detail later in the paper.

5.2. Methodology

My primarily analysis uses a difference in differences approach that treats a physician deployment as a discrete event. Because the treatments occur at different time periods for different individuals I follow Bertrand and Mullainathan (2003) and use the base form:

$$Y_{it} = \alpha + \beta_2^* I(t \geq deployment) + \beta_2^* 1(t = notification) + \gamma^* X_{it} + \theta_i + \delta_t + \epsilon_{it}$$

where y_{it} represents an outcome of interest for individual i at time t, and β_1 represents the effect of the PCM deployment. β_2 represents any anticipatory effects. X_{it} are a vector of time-varying controls. θ represents a vector individual fixed-effects and δ_t represent a vector of quarter-year fixed-effects. Standard errors are clustered at the military installation level to account for potential serial correlation among individuals that are affected by the same deployment. In some specifications I include an indicator variable that is equal to 1 if an encounter with patient i is within a year prior to the deployment. I do this in order to identify any anticipatory responses to a pending deployment. I don't observe the date a physician is selected for a deployment however. In discussions with military providers, one year seems to be the earliest an individual is likely to know of a deployment. I return to this in the section on anticipatory behavior.

All of the dependent variables are heavily skewed. I therefore conduct a log transformation to allow for linear estimation. I add one to each observation in order to deal with the numerous zeros. In some specifications, I also include a linear probability model where the left side variable is one for any value greater than zero. This allows me to estimate the change in the extensive margin of how likely an event is to occur in addition to the overall volume change. In the appendix I offer a Poisson maximum likelihood estimation as well that is able to handle the numerous zero values without requiring a transformation. The results aren't sensitive to the specification.

A key assumption of differences in differences is the parallel trends assumption. The timing of the deployment should not be correlated with the patient's health or physician's performance prior to the deployment. I use an event-study methodology to evaluate the these assumptions. The event study takes the form:

$$Y_{it} = \beta_{Q=t-t*} + \theta_i + \delta_t + \epsilon_{it}$$

Where Q is the quarter relative to the quarter of the physician deployment $t*$. This allows me to consider the incremental changes over time before and after the deployment. I omit the time period $t * -5$ as that is the time-period prior to the earliest likely notification of a deployment and simplifies interpretation of the coefficient estimates as a difference relative to a baseline pre-period regardless of any anticipatory effects. In some specification I add in a functional approximation of the pre-trend line and continue it into the post period. This trend line represents the counter-factual $\hat{\beta}$ during the post period had there not been a discontinuity and excluding the notification period. I approximate this by regressing the β coefficients from the event-study on the time period Q, for all time periods before the notification period so that

$$\beta = XQ_{Q<-4} + \epsilon$$

$$\hat{\beta} = XQ$$

5.3. Results

Utilization

Hypothesis 2A predicts that there will be an overall increase in primary care visits. Figure 7 shows the change in primary care usage over time relative to the discontinuity. The grey box represents the reasonable notification period. The dashed line represents the linear trend-line of the pre-period projected into the post-period. There's a small increase over the trend line that dissipates over the course of two to three quarters. This seems consistent with the conceptual story of an increase in primary care visits that may degrade over time as more information is generated in a new patient-physician relationship.

Table 6 shows results for primary care. Column 1 includes only an indicator for the post-discontinuity period as well as the person and time fixed-effects. Column 2 adds an indicator for the anticipatory period. Column 3 includes this indicator for the notification period as well as controls. The .031 coefficient indicates a small but significant 3% increase over a base of approximately 4.26 primary care visits a year. the equates to about one additional primary care visit for every 8 individuals annually. With an average of 6,400 patient discontinuities each year in my sample, this equates to over 800 additional primary care visits each year.

Hypothesis 2B predicts that there will be no increase, however, on the extensive margin. In other words, those who are using care will use more of it, but an individual's probability of needing any care is unlikely to increase based on a discontinuity. I test this with the linear probability model of primary care utilization. Table 6 column 4 shows the results of this regression. The post-discontinuity coefficient is extremely small and not significant. This would seem to support the hypothesis that those who need some primary care will require more primary care after a discontinuity than they would have otherwise, but that a discontinuity will not drive a need for primary care.

My theory offers a mechanism for this change as a loss of information about the patient. A patient gets sick and needs care, but the physician must spend more of the appointment learning about the patient than he would otherwise. Given time constraints, less time is spent treating the patient creating the need for additional visits. Hypothesis 1 therefore offers the dual predictions that information seeking will increase while therapeutic actions will decrease. I operationalize this by considering the number of tests and procedures per encounter. Figures 8 & 9 show the event studies for tests and procedures per encounter respectively. Contrary to the theory, both measures decrease after a discontinuity. A plausible explanation is that the physician is substituting to evaluation and management. However, given the nature of E & M codes which include both information-seeking and medical decision making, it's not clear whether they are a complement to or a substitute for testing and procedures.

Table 7 shows the results of the difference-in-differences regressions for the rates of tests. Column 3 is the preferred specification that includes the notification period indicator and control variables. The drop in tests is not significant. Conversely the same column in table 8 shows that there is about a 1% drop in procedures per encounter on a base of approximately .10 procedures per encounter. While the overall magnitude of this change is small, it does provide supporting evidence to the hypothesis that less therapeutic work will be done after a discontinuity.

Hypothesis 4 predicts an increase in specialty care after a discontinuity if providers expect that lack of patient-specific information could cause worse outcomes. Figures 10 shows the change in specialty care utilization over time relative to the discontinuity. The visual increase is not only stark, but also appears to be enduring. Table 9 shows the main equation regression results. Once again column 3 is the preferred log model specification. The coefficient on the post estimator indicates a 16% increase in utilization. On a base of 2.75 specialty care visits per year, this equates to an additional 2816 specialty care visits each year in my setting. Column 4 of table 9 shows the linear probability model results. The probability of any visit increases 8.3 percentage points after a discontinuity from 39% to 47% probability of using specialty care. This finding is consistent with the model's prediction, although the timing of the increase presents questions regarding the mechanism. I return to this in the anticipatory behavior section.

The final hypothesis is that patients will have worse health outcomes after a discontinuity. I operationalize health outcomes using two conventional measures: emergency department visits and inpatient admissions. Both outcomes are expensive for the health system and generally considered undesirable for the patient.

Figure 11 show the event study of emergency room use. The patterns is similar to specialty care in that there is a rise during the notification period that levels out in the post-period but does not return to pre-period levels. This increase may be due to reduced access to care as physicians prepare for deployment. I'll address this more in the access to care section below. Table 10 shows the regression coefficients for the log of emergency department utilization. Column 3 indicates about a 2 % increase on an average of just under half a visit a year for an overall 1 percentage point increase in ED use or about 640 additional Emergency Department visits each year within the military setting. Column 4 shows the linear probability model which indicates a 1.73 percentage point increase in the probability of using the emergency department each year.

Figure 12 shows the change over time in inpatient admissions. While there is a visual increase, it appears to be small in magnitude. This interpretation is reinforced by the difference in differences regression coefficients portrayed in table 11. The coefficient in column 3 indicates about a .004 percent increase in inpatient admissions after a discontinuity. The base is small however, about one inpatient admission for every twenty five patient-years equates to about one additional inpatient admission each year in my sample. The linear probability estimate in column four shows a similar half percentage point increase, raising an individuals probability of being admitted in a given year from .04 to .045. Taken together, the increases in emergency department utilization and inpatient admissions support the theory that discontinuities lead to negative health outcomes, but suggest that, at least in the fairly healthy military population, the effects are quite modest.

While I cannot directly measure cost, the evidence of increases in primary care, specialty care, emergency department utilization and inpatient admissions are likely to have a significant impact on the organization. I use relative value units as a proxy for cost. Figure 13 shows the change visually. Table 12 shows the main equation estimates. Column 3 indicates about a 10.8% increase in RVU's. On a base of 25.5 this equates to an increase of about a 2.8 RVU's increase per person. Interestingly, the coefficient on the linear probability model is close to zero and not significant. This would support the contention that discontinuities effect the intensive margin of how much care individuals seek rather than the extensive margin of whether to seek care. The converse argument though is that the probability of generating an RVU is already extremely high so there's simply not much room on that margin.

Anticipatory Behavior

While the evidence is supportive of a causal relationship between a discontinuity and increased utilization, the increase during the notification period presents questions regarding the causal impact and mechanisms of the discontinuity. The purpose of this section is to explain the patterns found during the notification period. To understand this, I return to the interviews initially discussed in Chapter 4. I conducted a series of eight semi-structured interviews with providers in the Military Health System. This included an even split of four primary care providers (including one pediatrician) and four specialists. Seven of the individuals had deployed at least once. The one who had not deployed was the chief of primary care for her clinic and was responsible for the management of primary care after a provider deployed. The providers were assigned to five different military posts spanning the continental United States. The individual notification periods for these providers varied from 9 months to 23 days. The qualitative interviews were suggestive so I present select comments as well as complementary empirical tests in this section.

A primary concern is what types of patients are seen during the notification period. one provider indicated that he prioritizes more complex patients during this period:

> "I'll take a look at where my patients are and I'll work with my nurses and front desk staff to move these people around and shift some of the ones that I think, while they may need to see someone they don't necessarily need to see me."

I empirically test this by reforming my panel so that the unit of analysis is the physician quarter. I consider all patients that a physician sees and whether these are new or existing patients based on whether there have been any previous dyadic interactions. For consistency with my definition of treated, I use a three total (two previous) interactions to define an existing patient. I then conduct an event study on the proportion of existing patients that a physician sees each quarter. Figure 14 shows the results of the event-study. A clear pattern emerges that supports the assertion that a provider sees more of his existing patients during the notification period, and that the magnitude increases as the physician gets closer to deploying.

Several providers mentioned that even though they may not deploy until a specific date, there are numerous training requirements that limit a physician's availability for patient encounters.

> I got selected for it in March, I had to do some train ups, so that's actually around that time, I told patients, "Hey, I'm going to be leaving in August, but I do have some train ups where I'll be out of the office." I mean, I was out of the office about two months before that, had to go for a week in, I think it was April, I went for a week, and then in end of May, early June, I was gone for two weeks, and then I left in August.

Figure 15 shows an event-study of patient encounters before and during the notification period. As suggested by the provider, encounters per quarter diminishes in advance of the deployment. There was also evidence that discussing the physician's upcoming departure disrupted the encounter.

> "When you have complicated patients and you've a got 20-minute visit, the standard length under which I've operated, and you're spending 5-10 minutes talking about [upcoming deployment], you really are cutting down in doing the other things you need to do."

Figures 16 & 17 show the number of procedures and tests per encounter for deploying providers. There's no change in procedures up until the disruption, but there's a drop off in test in the quarter prior to deployment. It's not immediately clear why one would be impacted and not the other, but its plausible that it is easier to substitute for tests than procedures if procedures require more planning and resources.

Both the reduction in encounters, and this disruption within an encounter from discussing the upcoming deployment, could plausibly reduce access to care, something I will address in the next section.

Another avenue that seems to indicate anticipatory behavior is the increase in specialty care visits during the pre-period. As a provider mentioned

> "If I'm getting ready to leave and I've got some questions as to whether I should

> or should not refer, that does have an impact. In general, I will refer because it helps me ensure that the best possible things are going to happen for the patient. He's going to have a good outcome because I've already referred him. There won't be any question or problem with the new person coming in having to make that decision because I'll have already made it and written the consult."

This would seem to indicate that the increase in specialty care during the pre-period is likely to be initial specialty visits while the sustained increase in the post-period is more likely the continuation of these visits.

I empirically test this theory using a linear probability model that regresses the probability of a first specialty visit among only the patients that had any specialty visits in a quarter. Table 13 shows the results of this regression. Looking at the coefficients on both the Post and notification indicators, the probability increases in both periods. However, while there is an approximately 1.6 percentage point increase after the discontinuity, the percentage point increase in probability of a first specialty visit is more than four times as high, 7 percentage points, during the notification period.

Combining this qualitative and quantitative evidence, a story emerges that providers change their behavior in anticipation of an upcoming discontinuity. However, even after accounting for this period, the discontinuity still has an effect on patient care and utilization.

Sub-Group Analysis

In this section, I run analysis on groups that may be differentially impacted by a discontinuity

Concentration of Care

Concentration of care is both an outcome and a control. That is, discontinuous care will mechanically decrease a patient's care concentration. I subset based on the value two quarters prior to the discontinuity. I chose this period to balance the explanatory nature of an index with the impact of the notification period. Because I use four quarters of data to calculate each index, going back to the beginning of the notification period would include two year old data. This could provide a weak identification in a generally healthy population. However, we see strong effects begin to occur in the two quarters prior to the discontinuity so I want to limit the enogeneity of the metric as well.

I use two different indices that mechanically measure different aspects. First I consider a specialty care fragmentation rate. Conceptually, this is going to indicate a need for care coordination. I calculate this using a standard Herfindahl-Hirschman Index that measures how concentrated a patient's care is with a particular specialist using the form:

$$HHI = \sum_{d=1}^{D} share_{it}^2$$

Figure 18 shows the distribution of fragmentation rates. There's a large clump at 1 representing about half my sample. That generally consists of patients with a single specialty care visit each year. The remaining individuals follow a somewhat normal distribution and average about 7 specialty visits per year.

Tables 14 - 17 show the regression results subsetting on specialty care fragmentation rates. I separate as above or below the median. I run a separate regression for those with an HHI of 1. This with the highest concentration in specialty care tend to also increase their use of primary care the most. ED visits are similar across groups. Specialty care also goes up more with higher care concentration levels. It's plausible that those with higher concentration of specialty care tend to lean on their specialist more than those who are fragmented care. Still, the increase in primary care use among this group is puzzling.

Second, I measure primary care concentration using a Bice-Boxerman (Bice and Boxerman 1977) index that calculates the amount of within primary care fragmentation while also controlling for the relative frequency of visits. This measure captures the strength of a relationship with a particular provider.

The Bice-Boxerman index uses the following equation:

$$\frac{\sum_1^s n_j^2 - n}{n(n-1)}$$

where j indexes providers, s is the total of all providers the patient sees and n is the total number of visits in the period.

Figure 19 shows the distribution of continuity. The large clump at zero are patients that see a different primary care provider for each visit. A second clump at one represents patients with perfect continuity and at least two visits. [3] Patients in each of these ends of the distribution tend to use less primary care - two visits both on average and at the median. [4] However, those away from the extremes tend to use much more, 7 annual visits on average and 5 at the median.

Tables 18 - 21 subset the data by Bice Boxerman index. I separate those at the extremes, 0 & 1, as well as those above and below the median value but not at the extremes. I would expect those with more continuous care to be affected more than those with less continuous care. I get counter-intuitive results though. Focusing on columns 2 and 3, those with less continuous care increase their use of primary care while those that have more concentrated care reduce their use. In all other measures, both groups have positive coefficients, but the less continuous care group have greater rates of change. One plausible explanation is the individuals with more continuous care are better prepared for the deployment by their physicians. This group has a higher increase in the use of specialized care during the notification period. They may substitute specialists for primary care after the discontinuity. Of note, this same pattern emerges when sub-setting by patient complexity as I'll discuss in the next section.

[3] Providers who only have one visit are not defined.

[4] The difference between these groups is only the second visit. If the patient saw the same provider as his first visit, his score is 1 and if he saw someone different his score is 0.

Patient Complexity

Theoretically, a more complex patient should be more affected by a discontinuity than healthy patients. A conventional way of measuring complexity is through a comorbidity index such as the Charlson index. However, given the nature of my population I lack enough chronically ill individuals to estimate the equation.

Instead, I construct a measure of patient complexity using the the average evaluation and management code for each chief complaint. Chief complaints are the reason for the patient's visit and are coded using the most closely matching ICD-9/10 diagnosis code. Importantly, complaint codes are not the physician's diagnosis but the patient's stated reason for the visit. Every office visit also requires an E&M code. These codes vary in several dimensions, but most importantly for my identification, they use a five point scale that is associated with patient complexity. For each complaint code in the data set, I took the average of all E&M codes ever logged for that complaint. While a physician may be able to up or down code patient complexity based on his knowledge of the patient, taking an average across physicians and patients at different clinics over a ten year period should provide a reasonable approximation of the complexity of a particular problem. I then looked at each patient's visits in a quarter and assigned a complexity score based on their average complaint score. The median score is 2.5. I subset the sample as above or below the median two quarters prior to the discontinuity.

I test the plausibility of the measure by looking at summary utilization statistics of high and low complexity patients. I'd expect that high complex patients have higher measures in every category. Table 24 shows the comparison. The measure passes this test everywhere except primary care. It's plausible though that these high acuity patients are substituting specialty care for primary care.

Tables 25 26 show the results of the main equation regressions for high and low complexity patients respectively. A stark finding is that for specialty care, ED utilization and inpatient admissions both groups have similar results in the post period. However, the notification period effects disappear in the low complexity sample for inpatient admissions and specialty use, and much smaller and only marginally significant for ED use. This would seem to fit the story of deploying physicians paying more attention to their high acuity patients. As one primary care physician told me:

> There's an informal process that you can do, and then a formal process as well. So, the informal process is when I would see the patient and I knew I was going to be leaving. I would tell them, "Hey, just so you know, I'll be leaving in X time for X reason, and I'm going to actually have you see Dr. So and So now. I've talked to them about you, I've let them know what's going on....but these are the onesie-twosie situations. This isn't for your normal comes sees you once or twice a year type of patient. These are patients who have higher acuity health care needs than the average Joe.

For primary care visits, both groups have large increases during the notification period but the high complexity patients actually reduce their use of primary care in the post period. This may be explained if high complexity individuals rely on specialists more than low complexity individuals but is a subject of future analysis.

Patient Centered Medical Home

As mentioned in Chapter 2, one of the joint principles of PCMH is an ongoing relationship with a personal physician (American Academy of Family Physicians, American College of Physicians, the American Academy of Pediatrics, and the American Osteopathic Association). However, another principle is that care is coordinated and integrated. For instance, one provider described a morning meeting among the staff to discuss that day's patients.

> And then morning huddle, like 15 minutes before the clinic starts. The whole provider team, nurses, front desk staff, everybody's there at the huddle. And then we review. In [clinic name] we just reviewed everybody we were seeing that

> day. And we talked through every single patient... The PCMH model forces you to do that now, and there's actually the huddle checklist. And it's Joint Commission inspected.

If, as theory suggests, the role of the personal physician is to better coordinate care, then the PCMH model should mitigate the impact from discontinuity with a personal physician. Table 22 compares utilization means between patient-quarters when the patient is enrolled or not enrolled in a PCMH. PCMH-enrolled patients tend to use the ED and primary care more than the non-enrolled population. I run an analysis on the impact of physician discontinuity for patients enrolled in a PCMH. Table 23 shows the results of these regressions. In the post period, only specialist visits remain significant, with a much smaller coefficient than the main sample. The notification behavior is much less pronounced as well. Primary care utilization and emergency department visits each show small increases. However, the notification period has no effect on the other measures. Taken together, PCMH seems to ameliorate the impact of a discontinuity to a fairly high degree providing supportive evidence that the discontinuity is primarily creating a coordination problem.

Access to Care

Access to care is an alternative mechanism that could affect patients after a deployment. If the remaining providers in a practice must assume the deploying provider's patient panel, it may limit access for all patients in the practice. In this section I want to estimate the effects of access to care separate from the effects of discontinuities in care.

Because access to care would theoretically effect any patient in a practice even if that person's provider does not deploy, I am able to use the effect of a provider's deployment on other patients in the same clinic to estimate the impact of reduced access to care. I use the same main equation I as in the main sample with several differences. First, I exclude the treated group once they enter the notification period. Second, I code the post indicator to all individuals in a clinic when a physician from that clinic deploys. I drop the observations from the sample, the second quarter in which a provider deploys so that an individual is only treated once. There are instances in which multiple providers deploy from the same clinic in the same quarter. I code these as a single disruption and include them. To account for the notification period, I also include an indicator for whether any provider in the patient's clinic in currently in the notification period.Table 27 shows the results of the regressions. The coefficients indicate a drop off in primary care after the discontinuity which seems plausible given that there are fewer providers and the treated individuals are using more primary care, and a small increase in specialty care. There's no effect on the outcome variables. While a more detailed analysis of access to care is needed, this would seem to support the contention that restricted access to care is not driving the results.

5.4. Robustness

I run several robustness checks. For brevity, I run the robustness checks only using the main equation and four dependent variables: primary care visits, specialty care visits, emergency department use, and inpatient admissions. First, I want to consider whether the model is sensitive to the definition of a discontinuity In the main analysis I define a disruption as any patient that sees a provider within a year of that provider's deployment and has at least three lifetime visits with that provider. Here I drop the restriction for three life-time visits. Table 28 shows the coefficient estimates which maintain their signs but reduce in magnitude and the coefficient on primary care loses significance.

Second, I want to check if the model is sensitive to the definition of a deployment. In the main analysis I define a deployment as any provider with zero encounters for at least one quarter and then returning. However, I have a sub-sample of providers that includes descriptive information and fully identifies deployments based on personnel records. This sample is derived from random drug tests given by the military. I use this fully identified sample in order to test the sensitivity of this definition.

Table 29 shows the regression coefficients for this sample that only includes patients of fully identified providers. The magnitude of the coefficients tend to be somewhat higher than my estimates but follow the same general pattern.

Finally, I want to consider any correlation between provider deployment and patient accidents. This could be a confounding variable if the patient in the sample would have deployed with their physicians but were hurt while training for deployment. If that were to happen, the patient may stay in the United States while the provider deployed creating a discontinuity but would also be correlated with a change in the patient's health status that was not created by the discontinuity. I test for this by using variation in military posts. The Army differentiates functions across different posts according to their primary function. For example, Fort Hood and Fort Bragg are primarily operational posts. The Soldiers stationed there mostly belong to combat units whose primary function is to deploy as needed. Conversely, posts like Fort Detrick and Fort Lee provide research & development and logistic support respectively. I classify these latter posts as non-operational. While some Soldiers at these non-operational bases may occasionally deploy, that is not the primary function, this is a much smaller proportion of the Soldiers assigned to them. I restrict my sample to these non-operational bases. Table 30 shows the results of these regressions. The results are largely the same as in the full sample, with all of the coefficients maintaining statistical significance, although the magnitudes are somewhat reduced.

5.5. Tables

	Individuals	Observations
Initial Sample	2,029,511	
With Records	1,173,618	21,079,720
Before Break in Service	1,173,618	20,933,143
8 quarters of data	892,195	19,877,216
Within 12 quarters of deployment if treated	745,161	6,730,509
No deployment within 1 quarter of discontinuity	718,795	6,474,006
Not all controls available	698,971	5,940,060

Notes: Individuals includes all patients with at least one encounter in the dataset. Patients without records are not service-members. Observations are patient quarter-years. Deploying patients are dropped in the quarter in which they deploy. The first four quarters are dropped to avoid left censoring with the time on station control

Table 2: Sample Construction

Interview	Specialty	Facility Size	Military
Interview 1	Obstetrics	Large	Military
Interview 2	Physical Therapy	Large	Military
Interview 3	Primary Care	Small	Military
Interview 4	General Surgery	Large	Military
Interview 5	Primary Care	Small	Civilian
Interview 6	Primary Care	Large	Military
Interview 7	Pediatrics	Small	Military
Interview 8	General Surgery	Large	Military

	Median	Mean	Standard Dev	Probability
Emergency Dept Visits per Year	0	.46	1.41	.21
Specialty Visits per Year	0	2.75	8.34	.39
Primary Care Visits per Year	3	4.26	5.42	.81
Encounters per Year	3	7.00	11.62	.84
Tests	0	.58	1.29	.30
Procedures	0	.62	2.78	.31
Inpatient Admissions	0	.04	.26	.04
Total RVU's	11	25.47	45.11	.88
Charlson Index	0	.01	.17	
Primary Care Continuity	.13	.22	.27	
Specialty Care Fragmentation	.65	.69	.25	
Age	26	28.33	8.05	
N	2,541,301			

Notes: Yearly values are calculated as the average for each patient-year. These may understate the true mean as individuals may not be in the data for all quarters each year. Tests and procedures are the total number of each when mapping CPT codes to BETOS categories. Primary care continuity is calculated as a rolling four quarter Bice-Boxerman index and specialty care fragmentation is calculated as a rolling four quarter Herfindahl-Hirschman index (HHI)

Table 3: Summary Statistics

Variable	Control	Treatment	T_Statistic
Male	0.842	0.731	-14.63
White	0.678	0.620	-12.7
College	0.219	0.198	-2.74
Age	28.13	28.83	2.34
Charlson Index	0.013	0.011	-1.61
Complexity (E&M)	2.45	2.41	-5.78
Fragmentation (HHI)	0.68	.703	8.88
Continuity (BB)	0.214	0.20	-4.13
ED Visits per Quarter	0.165	0.195	4.34
Specialty Visits per Quarter	0.957	0.872	-2.29
PC Visits per Quarter	1.515	1.88	11.23
Tests per Quarter	0.218	0.267	2.58
Procedures per Quarter	0.229	0.266	2.35
Inpatient Admissions per Quarter	0.016	0.016	1.47
Total RVU's per Quarter	9.11	9.91	5.09
Individuals	639,795	53,750	

Notes: Control group are patients who never undergo a deployment-related discontinuity. Treatment group are dropped at the point of a second discontinuity. Means are calculated four quarters before a patient undergoes a discontinuity. Standard errors are clustered by military post. Complexity metric is an average of the complexity level of a patient's complaints. Tests and procedures are the total number of each when mapping CPT codes to BETOS categories. Primary care continuity is calculated as a rolling four quarter Bice-Boxerman index and specialty care fragmentation is calculated as a rolling four quarter Herfindahl-Hirschman index (HHI)

Table 4: Comparison of Patients Who Do and Do Not Undergo A Deployment Related Discontinuity in Primary Care

Variable	Control	Treatment	T_Statistic
Encounters per Quarter	127.78	125.12	-0.27
Tests per Encounter	0.098	0.095	-0.48
Procedures per Encounter	0.099	0.098	-0.062
Patient Complexity (E&M)	2.68	2.67	-1.75
Patient Charlson Index	.017	.013	-3.68
Unique Providers	10,838	11,571	

Notes: Table shows average for all of a provider's encounters. Control group is physician's who never deploy. Treatment is physician's who ever deploy. Means are calculated four quarters before a physician deploys. Standard Errors are clustered by Military Post. Tests and Procedures per encounter are calculated based on number of each per patient-encounter

Table 5: Comparison of Providers By Deployment Status

	(1)	(2)	(3)	(4)
	Log PC Visits	Log PC Visits	Log PC Visits	Prob PC Visit
Post	-0.081***	0.029**	0.031**	0.002
	(0.008)	(0.010)	(0.010)	(0.006)
Notification		0.190***	0.192***	0.098***
		(0.010)	(0.009)	(0.006)
Controls	No	No	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	5,940,060	5,940,060	5,940,060	5,940,060
adj. R^2	0.261	0.262	0.263	0.177

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in columns 1 through 3 is the log of primary care visits. Dependent variable in column 4 is an indicator variable for any primary care visits in a quarter. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 6: Effect of Discontinuity on Primary Care Utilization

	(1) Log Rate of Tests	(2) Log Rate of Tests	(3) Log Rate of Tests
Post	-0.008	-0.007*	-0.006
	(0.007)	(0.005)	(0.005)
Notification Period		.001	0.002
		(0.006)	(0.005)
Controls	No	No	Yes
Person FE	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes
N	5,940,060	5,940,060	5,940,060
adj. R^2	0.051	0.051	0.054

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of tests per primary care visit based on a crosswalk between CPT and BETOS codes. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 7: Effect of Discontinuity on Tests per Primary Care Encounter

	(1)	(2)	(3)
	Log Rate of Procedures	Log Rate of Procedures	Log Rate of Procedures
Post	-0.015*	-0.0129**	-0.011**
	(0.006)	(0.004)	(0.004)
Notification Period		0.003	0.004
		(0.005)	(0.005)
Controls	No	No	Yes
Person FE	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes
N	5,940,060	5,940,060	5,940,060
adj. R^2	0.056	0.056	0.058

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of procedures per primary care visit based on a crosswalk between CPT and BETOS codes. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 8: Effect of Discontinuity on Procedures per Primary Care Encounter

	(1)	(2)	(3)	(4)
	Log Specialty	Log Specialty	Log Specialty	Prob Specialty
Post	0.132***	0.166***	0.161***	0.083***
	(0.006)	(0.009)	(0.008)	(0.005)
Notification Period		0.058***	0.055***	0.040***
		(0.008)	(0.007)	(0.004)
Controls	No	No	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	5,940,060	5,940,060	5,940,060	5,940,060
adj. R^2	0.362	0.362	0.363	0.279

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in columns 1 through 3 is the log of specialty care visits. Dependent variable in column 4 is an indicator variable for any specialty care visits in a quarter. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 9: Effect of Discontinuity on Specialty Care Utilization

	(1)	(2)	(3)	(4)
	Log ED Use	Log ED Use	Log ED Use	Prob ED Use
Post	0.008**	0.020***	0.020***	0.0173***
	(0.003)	(0.004)	(0.004)	(.004)
Notification Period		0.020***	0.020***	0.020***
		(0.004)	(0.004)	(0.004)
Controls	No	No	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	5,940,060	5,940,060	5,940,060	5,940,060
adj. R^2	0.142	0.142	0.142	0.119

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in columns 1 through 3 is the log of Emergency Department Visits. Dependent variable in column 4 is an indicator variable for any Emergency Department use in a quarter. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 10: Effect of Discontinuity on Emergency Department Usage

	(1)	(2)	(3)	(4)
	Log Admission	Log Admission	Log Admission	Prob Admission
Post	0.003***	0.004***	0.004***	0.005***
	(0.000)	(0.001)	(0.001)	(0.001)
Notification Period		0.00300***	0.002***	0.003***
		(0.001)	(0.001)	(0.001)
Controls	No	No	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	5,940,060	5,940,060	5,940,060	5,940,060
adj. R^2	0.031	0.031	0.031	0.023

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in columns 1 through 3 is the log of inpatient admissions per quarter. Dependent variable in column 4 is an indicator variable for any inpatient admission in a quarter. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 11: Effect of Discontinuity on Inpatient Admissions

	(1)	(2)	(3)	(4)
	Log RVU	Log RVU	Log RVU	Prob RVU
Post	-0.008	0.108***	0.108***	0.006
	(0.011)	(0.010)	(0.011)	(0.003)
Notification Period		0.201***	0.203***	0.055 ***
		(0.008)	(0.009)	(0.003)
Controls	No	No	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	5,940,060	5,940,060	5,940,060	5,940,060
adj. R^2	0.319	0.320	0.320	0.198

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in columns 1 through 3 is the log of total relative value units per quarter. Dependent variable in column 4 is an indicator variable for any relative value unit in a quarter. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 12: Effect of Discontinuity on Relative Value Unit Generation

	(1)	(2)	(3)
	Prob First Spec	Prob First Spec	Prob First Spec
Post	-0.022***	0.017***	0.016***
	(0.005)	(0.005)	(0.004)
Notification Period		0.071***	0.071***
		(0.004)	(0.003)
Controls	No	No	Yes
Person FE	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes
N	3,329,554	3,329,554	3,329,554
adj. R^2	0.172	0.172	0.172

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the probability that a specialist visit is an initial encounter with a specialty clinic conditional on having any specialty care appointment. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 13: Effect of Discontinuity on Probability of First Specialty Care Visit

	(1)	(2)	(3)
	Log PC Visits	Log PC Visits	Log PC Visits
	HHI $< .5$	$.5 \leq HHI < 1$	HHI=1
Post	-0.002	0.033**	0.079***
	(0.009)	(0.010)	(0.013)
Notification Period	0.165***	0.182***	0.190***
	(0.012)	(0.012)	(0.011)
Controls	Yes	Yes	Yes
Person FE	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes
N	863,500	1,183,208	2,251,543
adj. R^2	0.294	0.272	0.219

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of primary care visits. First column includes individuals that have more fragmented specialty care than the median. Column two includes individuals who have are less than or equal to the median specialty care fragmentation rate. Column three includes individuals who only see one specialist. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 14: Effects of Discontinuity on PC Utilization Separated by Specialty Care Fragmentation Rate

	(1)	(2)	(3)
	Log ED Use	Log ED Use	Log ED Use
	HHI < .5	$.5 \leq HHI < 1$	HHI=1
Post	0.032***	0.028***	0.025***
	(0.008)	(0.006)	(0.005)
Notification Period	0.064***	0.035***	0.015***
	(0.009)	(0.006)	(0.004)
Controls	Yes	Yes	Yes
Person FE	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes
N	863,500	1,183,208	2,251,543
adj. R^2	0.182	0.149	0.086

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of emergency department visits. First column includes individuals that have more fragmented specialty care than the median. Column two includes individuals who have are less than or equal to the median specialty care fragmentation rate. Column three includes individuals who only see one specialist. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 15: Effects of Discontinuity on ED Utilization Separated by Specialty Care Fragmentation Rate

	(1)	(2)	(3)
	Log Specialty	Log Specialty	Log Specialty
	HHI < .5	$.5 \leq HHI < 1$	HHI=1
Post	0.145***	0.188***	0.240***
	(0.016)	(0.014)	(0.014)
Notification Period	0.015***	0.221***	0.094***
	(0.018)	(0.013)	(0.009)
Controls	Yes	Yes	Yes
Person FE	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes
N	863,500	1,183,208	2,251,543
adj. R^2	0.395	0.349	0.271

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of specialty department visits. First column includes individuals that have more fragmented specialty care than the median. Column two includes individuals who have are less than or equal to the median specialty care fragmentation rate. Column three includes individuals who only see one specialist. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 16: Effects of Discontinuity on Specialty Utilization Separated by Specialty Care Fragmentation Rate

	(1)	(2)	(3)
	Log Admission	Log Admission	Log Admission
	HHI < .5	$.5 \leq HHI < 1$	HHI=1
Post	0.005***	0.00466***	0.00585***
	(0.00106)	(0.000896)	(0.00103)
Notification Period	0.00868***	0.00383***	-0.000665
	(0.00132)	(0.00100)	(0.000794)
Controls	Yes	Yes	Yes
Person FE	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes
N	863,500	1,183,208	2,251,543
adj. R^2	0.032	0.036	0.050

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of inpatient admissions. First column includes individuals that have more fragmented specialty care than the median. Column two includes individuals who have are less than or equal to the median specialty care fragmentation rate. Column three includes individuals who only see one specialist. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 17: Effects of Discontinuity on Inpatient Admissions Separated by Specialty Care Fragmentation Rate

	(1)	(2)	(3)	(4)
	Log PC Visits	Log PC Visits	Log PC Visits	Log PC Visits
	BB=0	0<BB<.2206	$.2206 \leq BB < 1$	BB =1
Post	0.136***	0.050**	-0.025*	0.082***
	(0.022)	(0.016)	(0.012)	(0.0134)
Notification Period	0.135 ***	0.229***	0.178***	0.101***
	(0.011)	(0.018)	(0.009)	(0.012)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	1,366,642	1,341,765	1,304,504	704,935
adj. R^2	0.064	0.161	0.189	.135

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of primary care visits. First column includes individuals who never see the same physician more than once. Column two includes individuals that have more less concentrated primary care than the median according to a modified Bice-Boxerman Index. Column three includes individuals whose primary care is more concentrated than the median. Column four includes individuals who only see one primary care provider. Only individuals with at least two primary care visits are included. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 18: Effects of Discontinuity on PC Utilization Separated by Primary Care Concentration

	(1)	(2)	(3)	(4)
	Log ED Use	Log ED Use	Log ED Use	Log ED Use
	BB=0	0<BB<.2206	.2206$\leq BB < 1$	BB =1
Post	0.023***	0.023***	0.008***	0.009*
	(0.004)	(0.007)	(0.002)	(0.004)
Notification Period	0.010***	0.030***	0.018***	0.009*
	(0.003)	(0.007)	(0.004)	(0.004)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	1,366,642	1,341,765	1,304,504	704,935
adj. R^2	0.123	0.166	0.151	0.100

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of emergency department visits. First column includes individuals who never see the same physician more than once. Column two includes individuals that have more less concentrated primary care than the median according to a modified Bice-Boxerman Index. Column three includes individuals whose primary care is more concentrated than the median. Column four includes individuals who only see one primary care provider. Only individuals with at least two primary care visits are included. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 19: Effects of Discontinuity on ED Utilization Separated by Primary Care Concentration

	(1)	(2)	(3)	(4)
	Log Specialty	Log Specialty	Log Specialty	Log Specialty
	BB=0	0<BB<.2206	$.2206 \leq BB < 1$	BB =1
Post	0.151***	0.137***	0.122***	0.126***
	(0.010)	(0.014)	(0.006)	(0.011)
Notification Period	-0.004	0.050***	0.083***	0.039***
	(0.006)	(0.014)	(0.007)	(0.008)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	1,366,642	1,341,765	1,304,504	704,935
adj. R^2	0.343	0.403	0.416	0.322

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of specialty care visits. First column includes individuals who never see the same physician more than once. Column two includes individuals that have more less concentrated primary care than the median according to a modified Bice-Boxerman Index. Column three includes individuals whose primary care is more concentrated than the median. Column four includes individuals who only see one primary care provider. Only individuals with at least two primary care visits are included. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 20: Effects of Discontinuity on Specialty Care Utilization Separated by Primary Care Concentration

	(1)	(2)	(3)	(4)
	Log of PC Visits	Log of ED Visits	Log of Spec Visits	Log of Admissions
	BB=0	0<BB<.2206	$.2206 \leq BB < 1$	BB =1
Post	0.005***	0.004***	0.002***	0.003*
	(0.001)	(0.001)	(0.001)	(0.001)
Notification Period	0.001	0.002	0.004***	0.003*
	(0.001)	(0.001)	(0.001)	(0.001)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	1,366,642	1,341,765	1,304,504	704,935
adj. R^2	0.051	0.027	0.037	0.056

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Dependent variable in all columns is the log of inpatient admissions. First column includes individuals who never see the same physician more than once. Column two includes individuals that have more less concentrated primary care than the median according to a modified Bice-Boxerman Index. Column three includes individuals whose primary care is more concentrated than the median. Column four includes individuals who only see one primary care provider. Only individuals with at least two primary care visits are included. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 21: Effects of Discontinuity on Admissions Separated by Primary Care Concentration

Variable	Not-Enrolled	Enrolled	T_Statistic
ED Visits per Quarter	0.178	0.209	3.45
Specialty Visits per Quarter	1.07	1.19	1.60
PC Visits per Quarter	1.64	1.90	5.03
Inpatient Admissions per Quarter	.018	.018	0.91
Total RVU's per Year	9.9	10.88	2.60
Observations	4,323,320	1,588,363	

Notes: PCMH enrollment is determined by modal cost accounting code for primary care encounters in a quarter. Cost accounting coding does not imply NCQA certification. Observations are patient quarters.

Table 22: Variable Means for Patient Centered Medical Home Enrollees Compared to Non-Enrollees

	(1)	(2)	(3)	(4)
	Log of PC Visits	Log of ED Visits	Log of Spec Visits	Log of Admissions
Post	0.00320	0.00152	0.0665***	.00144
	(0.00754)	(0.00305)	(0.00613)	(0.000955)
Notification Period	0.144 ***	0.00744*	-0.00886	.0000871
	(0.00800)	(0.00331)	(0.00535)	(0.000864)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	1,591,217	1,591,217	1,591,217	1,591,217
adj. R^2	0.313	0.165	0.421	.036

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table restricted to individuals that are enrolled in a patient centered medical home. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 23: Main Equations Restricted to PCMH

Variable	Low Complexity	High Complexity	T_Statistic
ED Visits per Year	.107	.205	20.86
Specialty Visits per Year	0.411	1.31	16.47
PC Visits per Year	1.614	1.475	-3.083
Inpatient Admissions per Year	0.006	0.022	28.33
Total RVU's per Year	7.002	29.74	13.025

Notes: Patient complexity is determined by average complexity of all of the patient's chief complaints in a quarter. Sample is subset by the complexity score 2 quarters prior to the discontinuity. The median score is 2.5.

Table 24: Comparison of Means for High and Low Complexity Patients

	(1)	(2)	(3)	(4)
	Log of PC Visits	Log of ED Visits	Log of Spec Visits	Log of Admissions
Post	-0.035*	0.023***	0.16***	.005***
	(0.016)	(0.005)	(0.011)	(0.001)
Notification Period	0.173 ***	0.029***	0.100***	.004***
	(0.011)	(0.005)	(0.009)	(0.001)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	3,384,377	3,384,377	3,384,377	3,384,377
adj. R^2	0.349	0.158	0.402	0.037

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table restricted to individuals that have a complexity score of at least 2.5 two quarters prior to the physician discontinuity. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 25: Main Equations Restricted to High Complexity Patients

	(1)	(2)	(3)	(4)
	Log of PC Visits	Log of ED Visits	Log of Spec Visits	Log of Admissions
Post	0.075***	0.025***	0.209***	0.004***
	(0.013)	(0.005)	(0.009)	(0.001)
Notification Period	0.200 ***	0.009*	0.003	0.000
	(0.010)	(0.004)	(0.008)	(0.0005)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	2,332,352	2,332,352	2,332,352	2,332,352
adj. R^2	0.200	0.107	0.295	-0.005

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table restricted to individuals that have a complexity score of less than 2.5 two quarters prior to the physician discontinuity. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 26: Main Equations Restricted to Low Complexity Patients

	(1)	(2)	(3)	(4)
	Log of PC Visits	Log of ED Visits	Log of Spec Visits	Log of Admissions
Post Disruption	-0.220***	0.000	0.026***	0.001***
	(0.017)	(0.0024)	(0.005)	(0.000)
Lagged Disruptions	0.017***	0.001***	0.003***	0.000*
	(0.003)	(0.000)	(0.001)	(0.000)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	3,605,347	3,605,347	3,605,347	3,605,347
adj. R^2	0.252	0.130	0.332	0.036

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Regression restricted to those that were not in the treated group. Post Disruption is an indicator variable for at least one provider deploying out of a patient's clinic. Lagged disruptions is an indicator for the individual's clinic having at least one physician deploy over the next four quarters. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 27: Main Equations Restricted to Non Treated Patients

	(1)	(2)	(3)	(4)
	Log of PC Visits	Log of ED Visits	Log of Spec Visits	Log of Admissions
Post	0.004	0.016***	0.115***	0.004***
	(0.010)	(0.004)	(0.009)	(0.001)
Notification Period	0.146***	0.0102 *	0.091***	0.000
	(0.007)	(0.002)	(0.007)	(0.000)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	5,378,336	5,378,336	5,378,336	5,378,336
adj. R^2	0.265	0.146	0.358	0.033

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Regressions are robust to individuals who had one encounter with a deploying physician in the year prior to the physician's deployment. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 28: Main Equations Robust to Treatment Choice

	(1)	(2)	(3)	(4)
	Log of PC Visits	Log of ED Visits	Log of Spec Visits	Log of Admissions
Post	0.075***	0.033***	0.210***	0.008***
	(0.016)	(0.007)	(0.014)	(0.001)
Notification Period	0.183***	0.027***	0.087***	0.004***
	(0.012)	(0.006)	(0.010)	(0.001)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	6,024,408	6,024,408	6,024,408	6,024,408
adj. R^2	0.261	0.140	0.337	0.033

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Regressions are robust to sub-sample of providers with fully observable deployments. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 29: Main Equations Restricted to Fully Identified Deployments

	(1)	(2)	(3)	(4)
	Log of PC Visits	Log of ED Visits	Log of Spec Visits	Log of Admissions
Post	0.022^{*}	0.015^{***}	0.142^{***}	0.004^{***}
	(0.011)	(0.004)	(0.008)	(0.0005)
Notification Period	0.181^{***}	0.014^{***}	0.052^{***}	0.003^{***}
	(0.011)	(0.004)	(0.006)	(0.001)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	3,803,604	3,803,604	3,803,604	3,803,604
adj. R^2	0.267	0.137	0.365	0.024

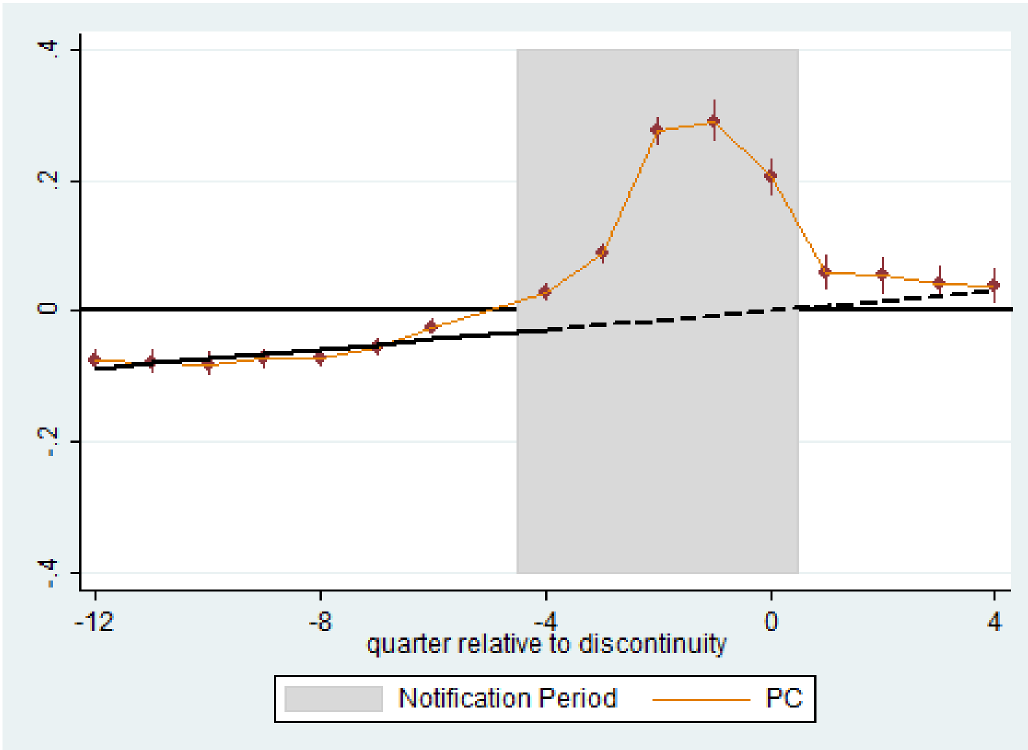
Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Regressions are robust to sub-sample of patients assigned to non-operational Army posts. Excluded posts include Fort Hood, Fort Bragg, Fort Stewart, Fort Carson, Fort Sill, Fort Riley, Fort Irwin, Fort Polk, Fort Campbell, Fort Benning and Fort Drum. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

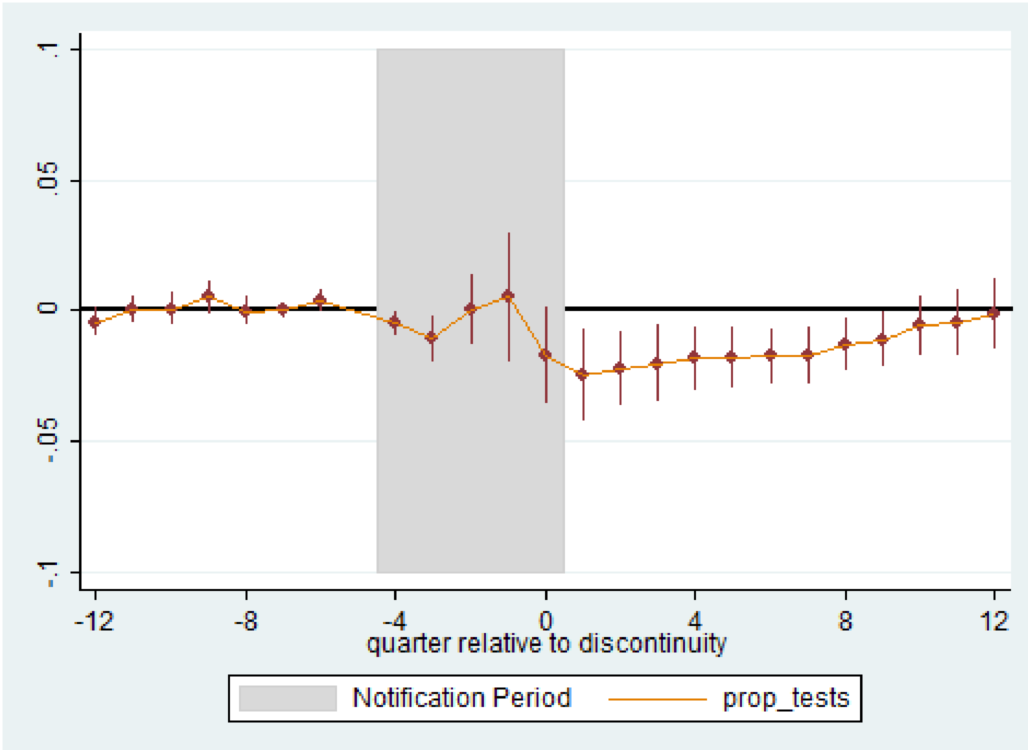
Table 30: Main Equations Restricted to Non-Operational Installations

5.6. Figures



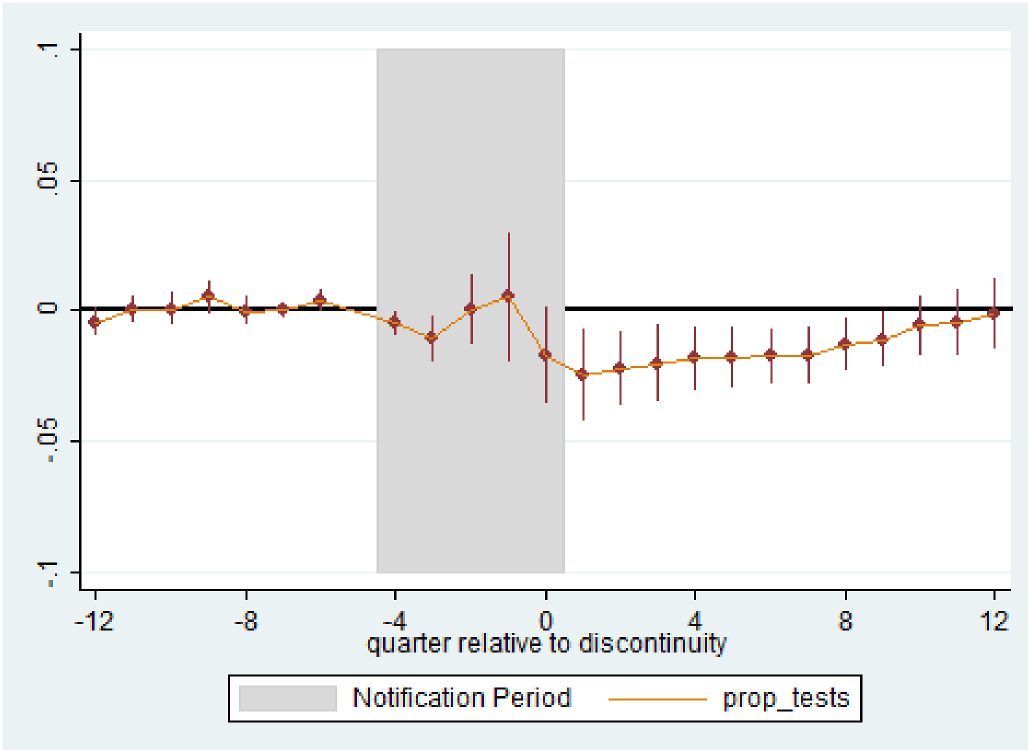
Notes: Graphical portrayal of change in log of primary care utilization. X axis is quarter-years relative to provider deployment. Y access is log of primary care visits. Dots are point estimates. Vertical lines are 95% confidence intervals. Dashed line is a functional approximation of the utilization in absence of a discontinuity. Grey box is the notification period. Regression includes person and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 7: Effect Of Discontinuity On Primary Care Visits



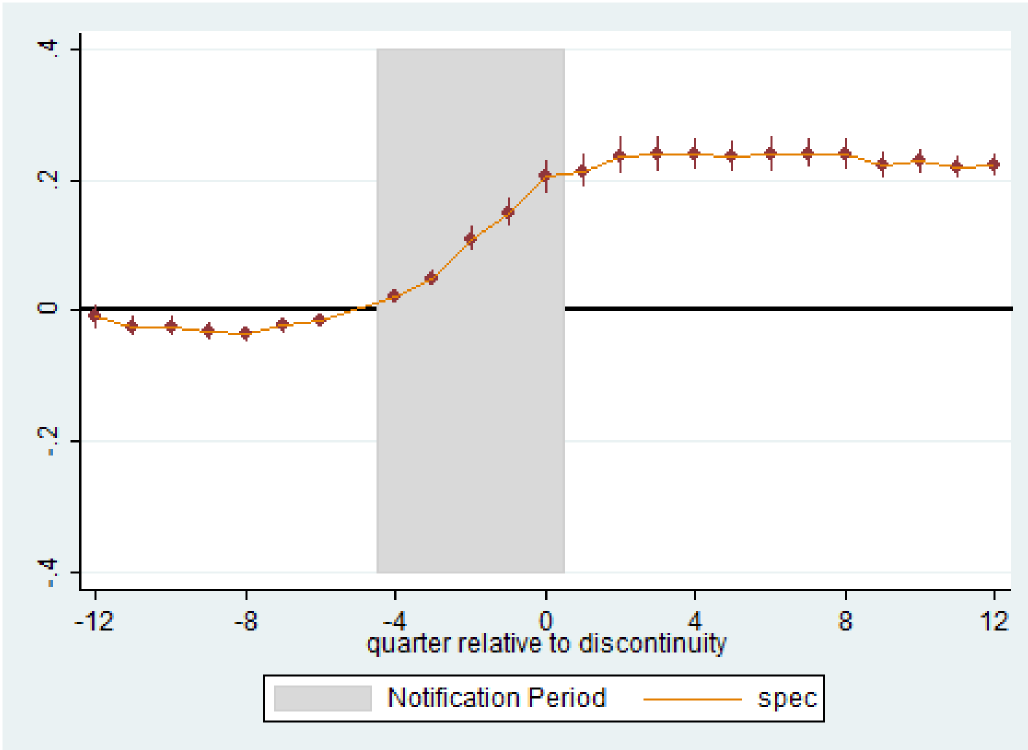
Notes: Graphical portrayal of change in tests per encounter. X axis is quarter-years relative to provider deployment. Y access is log of tests per a primary care encounter. Dots are point estimates. Vertical lines are 95% confidence intervals. Grey box is the notification period. Regression includes person and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 8: Effect of Discontinuity On Tests Per Encounter



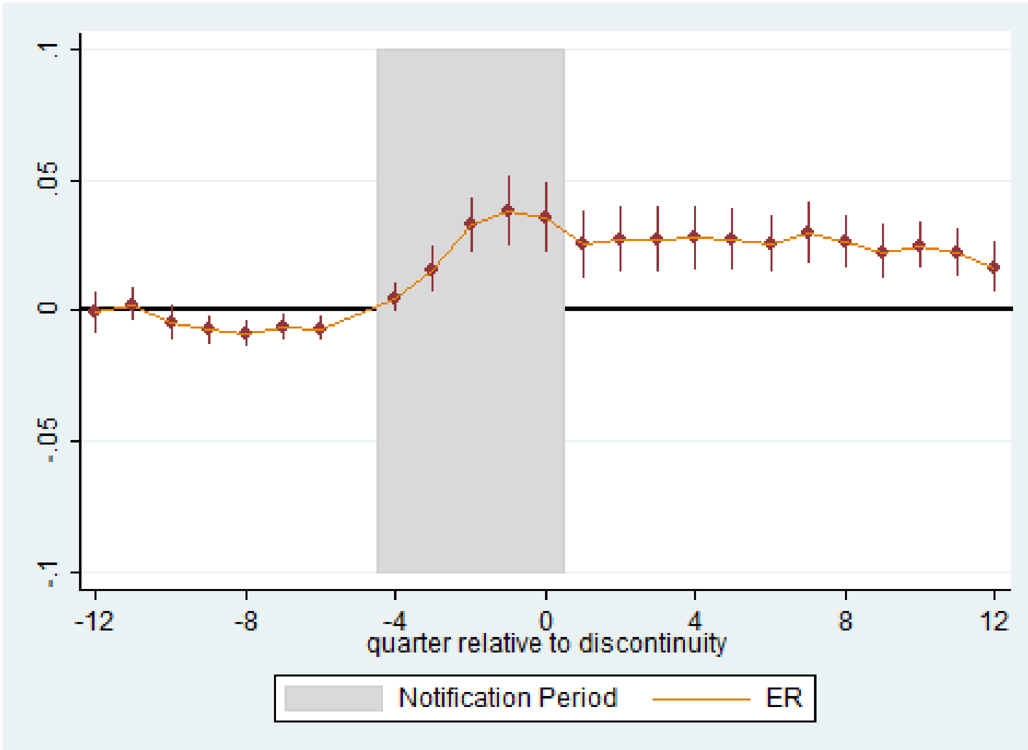
Notes: Graphical portrayal of change in procedures per encounter on time relative to discontinuity. X axis is quarter-years relative to provider deployment. Y access is log of procedures per a primary care encounter. Dots are point estimates. Vertical lines are 95% confidence intervals. Grey box is the notification period. Regression includes person and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 9: Effect of Discontinuity on Procedures per Encounter



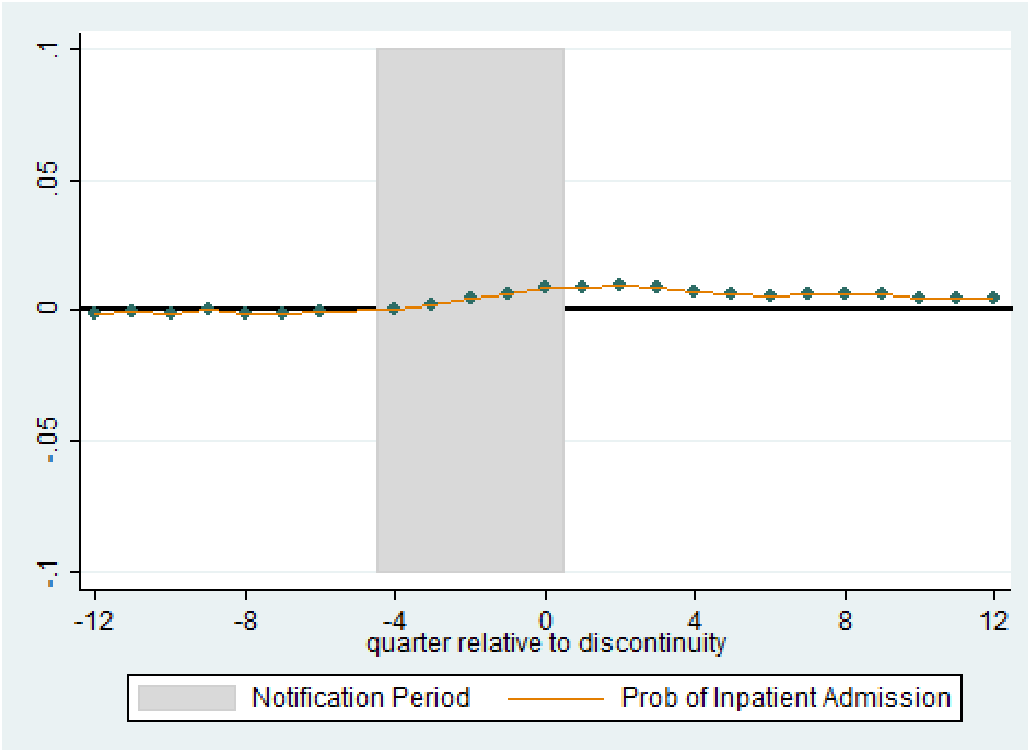
Notes: Graphical portrayal of change in specialty encounters on time relative to discontinuity. X axis is quarter-years relative to provider deployment. Y access is log of specialty visits. Dots are point estimates. Vertical lines are 95% confidence intervals. Grey box is the notification period. Regression includes person and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 10: Effect of Discontinuity on Specialty Care Utilization



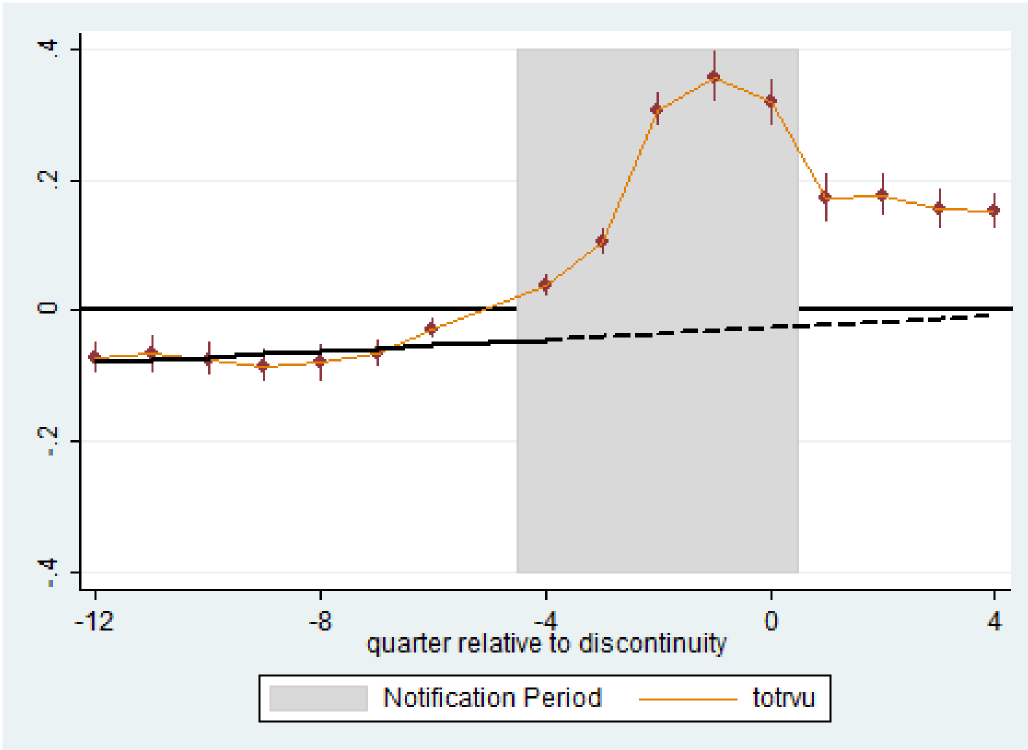
Notes: Graphical portrayal of change in emergency department use on time relative to discontinuity. X axis is quarter-years relative to provider deployment. Y access is log of emergency department visits. Dots are point estimates. Vertical lines are 95% confidence intervals. Grey box is the notification period. Regression includes person and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 11: Effect of Discontinuity on Emergency Department Utilization



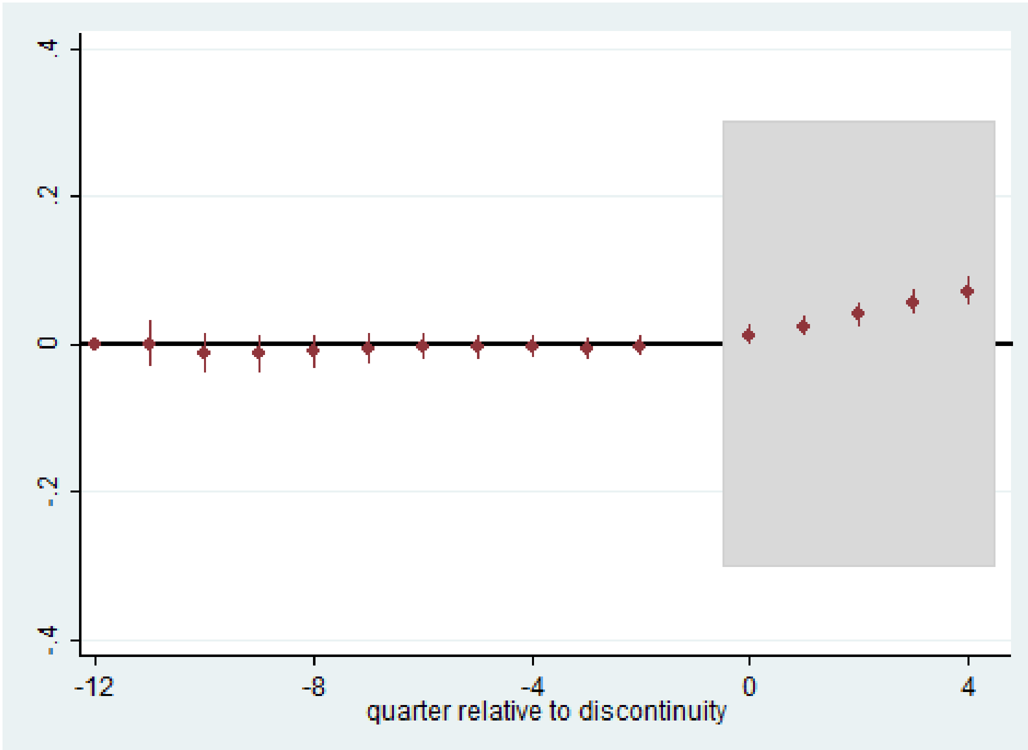
Notes: Graphical portrayal of change in inpatient admissions on time relative to discontinuity. X axis is quarter-years relative to provider deployment. Y access is log of inpatient admissions. Dots are point estimates. Vertical lines are 95% confidence intervals. Grey box is the notification period. Regression includes person and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 12: Effect of Discontinuity on Inpatient Admission



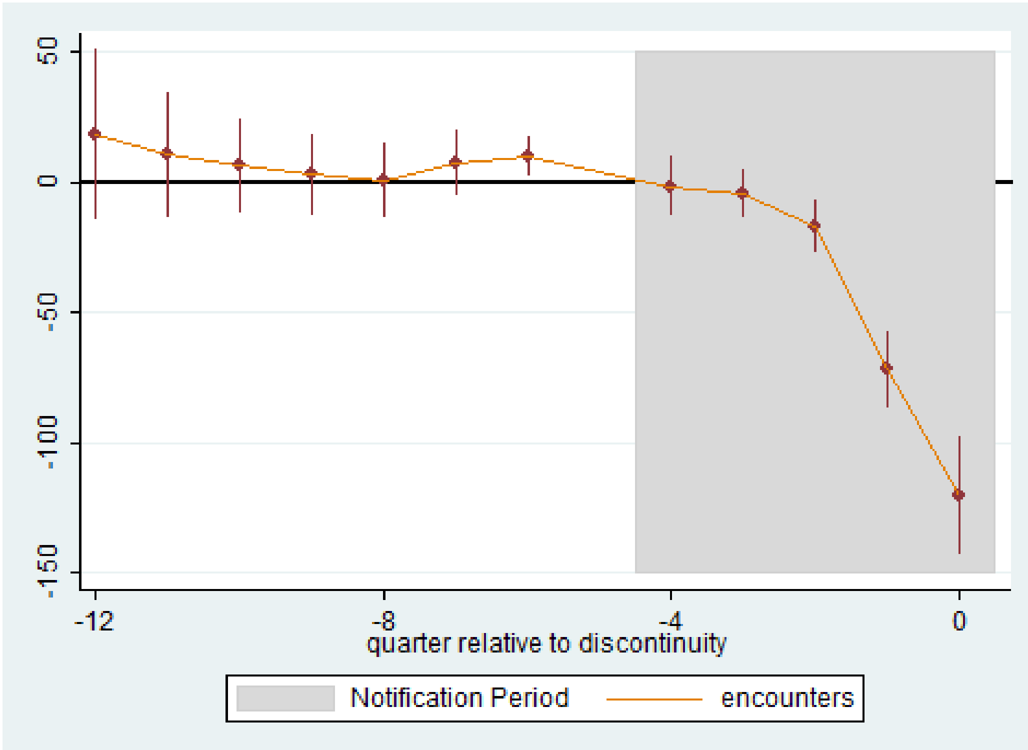
Notes: Graphical portrayal of change in log of total relative value units (RVU). X axis is quarter-years relative to provider deployment. Y access is log of RVU's. Dots are point estimates. Vertical lines are 95% confidence intervals. Dashed line is a functional approximation of RVU generation in absence of a discontinuity. Grey box is the notification period. Regression includes person and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 13: Effect of Discontinuity on Relative Value Units



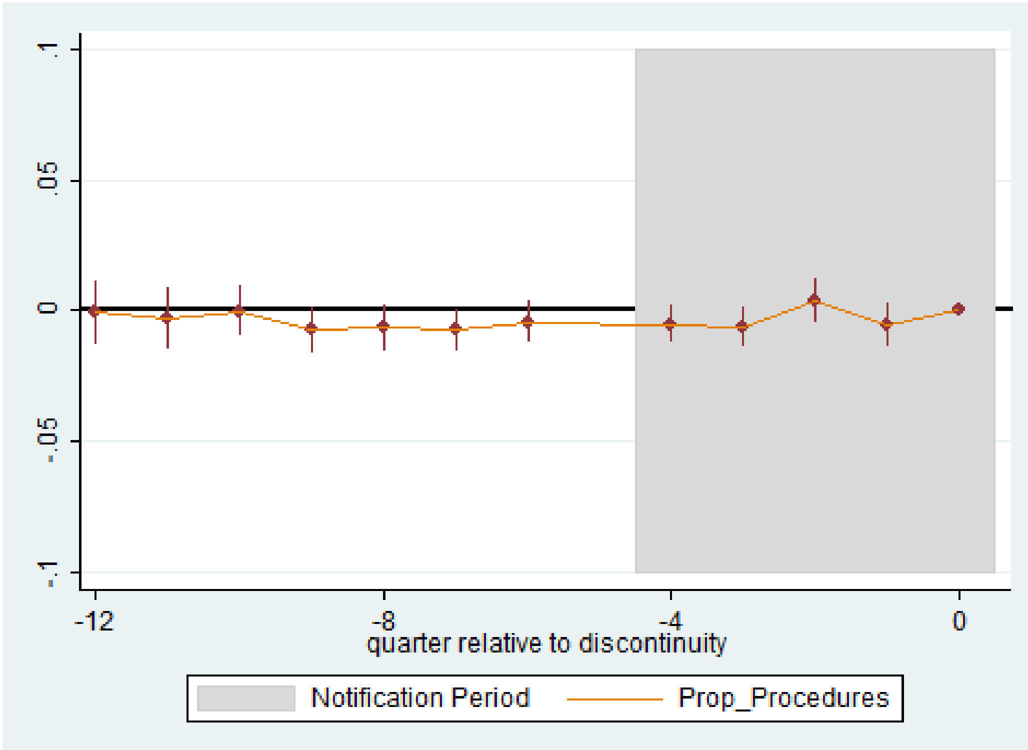
Notes: Graphical portrayal of change in which patients a physician sees. X axis is quarter-years relative to provider notification. Y proportion of existing patients among all a provider's patient encounters. Existing patients are those that have seen the provider at least twice previously. Dots are point estimates. Vertical lines are 95% confidence intervals. Grey box is the notification period. Regression includes provider and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 14: Proportion of Existing Patients in Deploying Provider Encounters



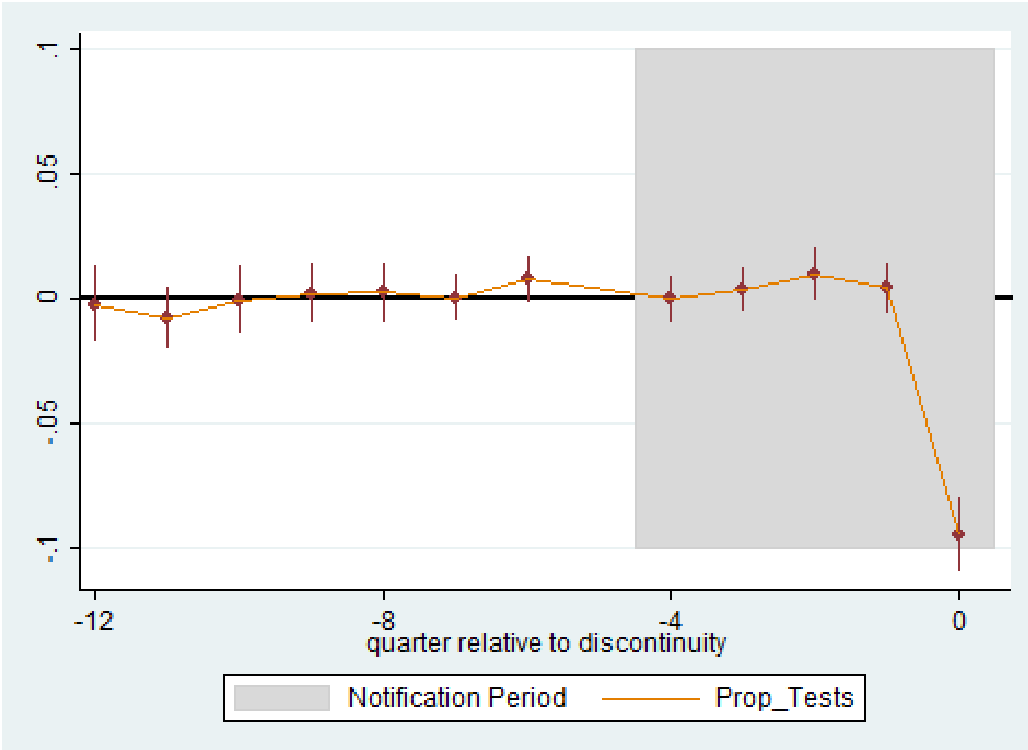
Notes: Graphical portrayal of change in number of patient encounters as a provider prepares to deploy. X axis is quarter-years relative to provider deployment. Y is number of patient encounters a provider sees centered at 0. Dots are point estimates. Vertical lines are 95% confidence intervals. Grey box is the notification period. Regression includes provider and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 15: Patient Encounters Relative to Physician Deployment



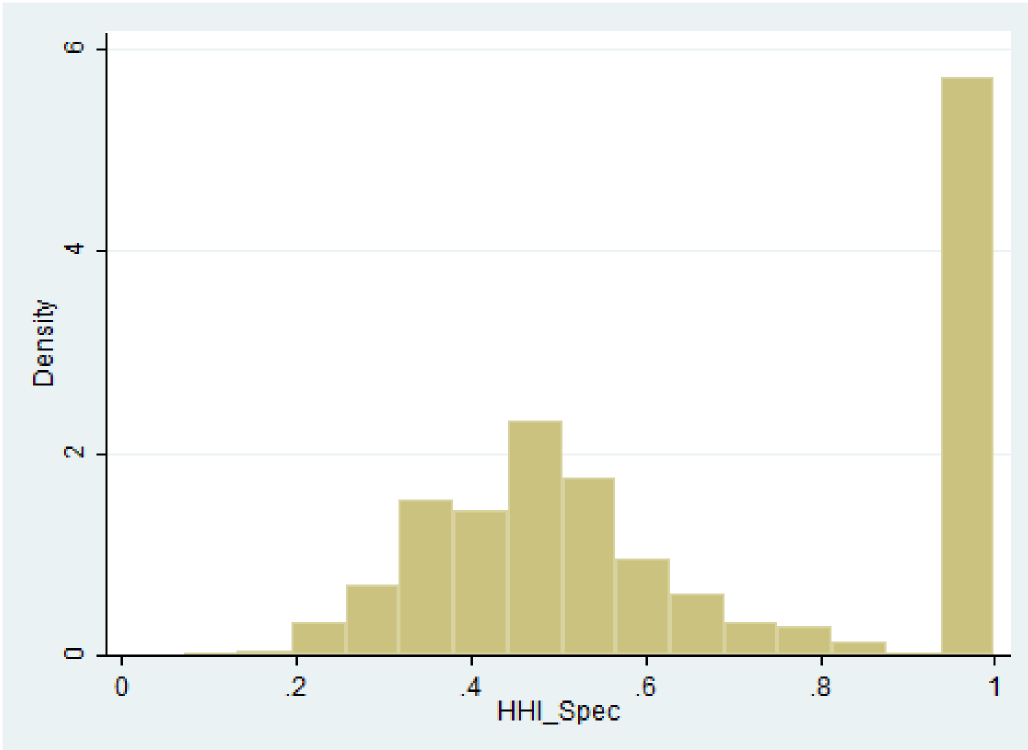
Notes: Graphical portrayal of change in number of procedures per a patient encounter that a provider performs. X axis is quarter-years relative to provider deployment. Y is log of procedures per an encounter a provider sees. Dots are point estimates. Vertical lines are 95% confidence intervals. Grey box is the notification period. Regression includes provider and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 16: Procedures per Encounter Physician Perform Relative to Deployment



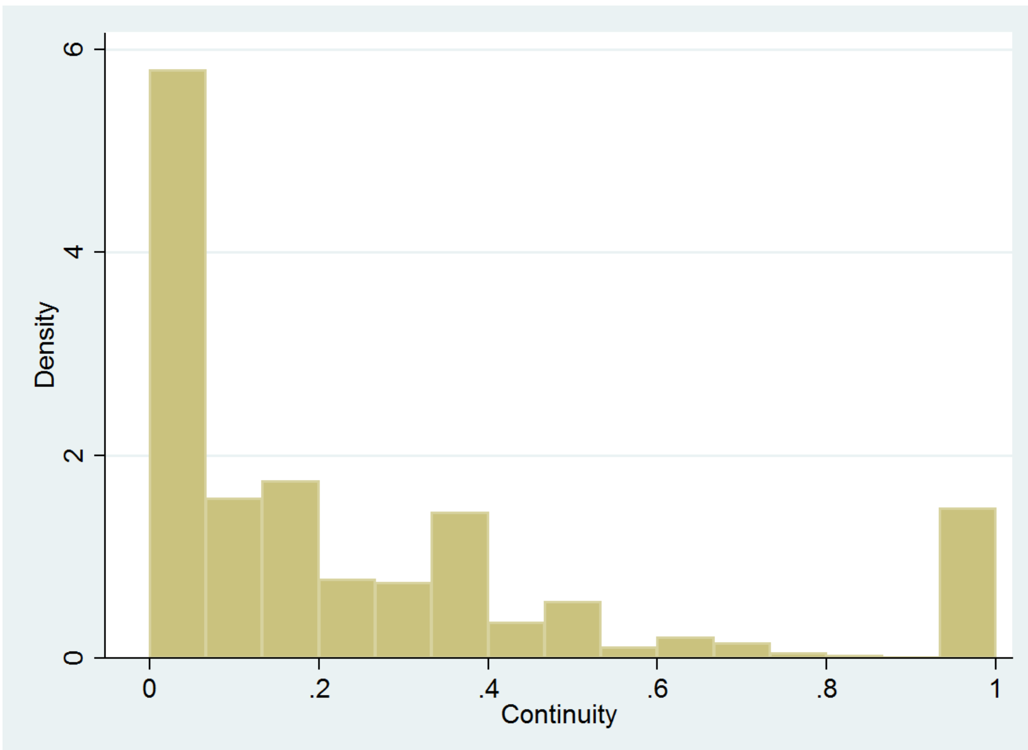
Notes: Graphical portrayal of change in number of tests per a patient encounter that a provider performs. X axis is quarter-years relative to provider deployment. Y is log of tests per an encounter a provider sees. Dots are point estimates. Vertical lines are 95% confidence intervals. Grey box is the notification period. Regression includes provider and quarter-year fixed effects. Standard Errors are clustered by military installation.

Figure 17: Tests per Encounter Physicians Perform Relative to Deployment



notes: Histogram of Herfindahl-Hirschman index (HHI). HHI are calculated on a rolling four quarter basis. HHI of 1 is fully concentrated care with only one specialist. Primary care encounters are not included in the calculations

Figure 18: Fragmentation of Specialty Care



notes: Histogram of Bice-Boxerman (BB) continuity of care index. BB are calculated on a rolling four quarter basis. BB of 1 is fully concentrated care with only one primary care provider. BB of 0 implies every visit is with a different provider. Specialty encounters are not included in the calculations

Figure 19: Continuity of Primary Care

CHAPTER 6 : Discussion and Conclusions

This study has provided an examination of the effects of disruptions to the patient physician relationship through a natural experiment peculiar to the military. Using plausibly exogenous physician deployments, I test for a relationship between discontinuity of primary care and health care utilization. Overall, I find a 30 percent increase in specialty care (8.3 percentage points) and a 15 percent increase in emergency department use (1.7 percentage points). While my data doesn't support a particular cost estimate, these sites tend to be significantly more expensive than primary care. These estimates are also likely a lower bound estimate as military Soldiers tend to be a particularly young and healthy population, have access to a consistent electronic medical record and are required to maintain a healthy weight and an exercise regime.

While the military may not be fully generalizable, these effects are particularly relevant given that the the military uses an HMO staffing model similar to Kaiser-Permanente and Geisinger (*Final Report to the Secretary of Defense: Military Health System Review* 2014). This model has been upheld as the gold standard in integrated care (Curry and Ham 2010). Yet the findings indicate that even in this setting there can be a lack of care coordination with provider turnover potentially leading to negative consequences.

The findings are also applicable to current policy discussions around care coordination. Specifically, the accountable care organizational model has focused on coordinating care, yet early research shows that it may increase physician turnover and patient churn (Hsu et al. 2017). Alternatively, though, the patient centered medical home organizational model buffered the effects to a substantial degree and may offer a method for increased coordination.

Additionally, this study has implications for Medicare Advantage. Medicare Advantage (MA) is the Medicare managed care option with about two thirds of enrollees in HMO plans (Hackbarth, Berenson, and Miller 2009). A defining trade-off of these types of plans is lower premiums for a narrower network of providers. As providers opt in and out of these networks, this research presents potential downsides to narrow network plans.

This study also found that providers anticipate their turnover and attempt to prepare some of their patients for the change with a 15 percent (4 percentage point) increase in specialty care during the anticipatory period. Most of the increase coming from new referrals to a particular specialty. These new referrals tend to endure however. As organizations prepare for provider turnover they may consider developing a plan to transition patients to a new primary care provider that could potentially limit any unnecessary referrals.

Limitations

There are some limitations to this work. First, caution should be taken in generalizing from a military setting. The patients in my panel are universally insured with zero co-pays or deductibles. The physicians in my setting are salaried and not subject to typical fee for service incentives. Both patients and physicians in my setting move frequently. They are likely more used to discontinuous care than in a typical civilian setting. This may bias my estimates toward zero.

A further limitation is that I am not able to observe the exact date a provider is notified that he will deploy. Nor can I include any demographic information about the providers. Also, the measures I use of diagnostic and therapeutic procedures are crude and PCMH is self-identified. Future work will want to use a more detailed algorithm, to determine the types of procedures being conducted.

Future Work

While my research has expanded on one aspect of the effects of physician turnover, it also opens up several avenues for further research. This study focused on the macro effects of turnover, yet future work will want to consider how organizational management changes affect the consequences of turnover. For instance adoption of service line management or changes in other forms of continuity may impact the affects of discontinuity. Future work will also want to consider other disruptions to the provider patient relationship. For instance the increased use of hospitalists highlight the trade-off between specialization and relational continuity. Likewise, changes in access policies may impact the relationship.

Additionally work will also want to expand relational continuity beyond primary care. Many patients, especially those who are chronically ill, may rely more on their specialist than on their primary care physician. Future work should consider disruptions to specialty care relationships.

Finally, physician turnover may not only affect patients, but could have an impact on work teams. The sub-analysis on patient centered medical home provided preliminary evidence that teams can reduce coordination costs. Future research may consider how disruptions in medical teams affect coordination of care.

APPENDIX

A.1. Tables & Figures

	(1) Log of PC Visits	(2) Log of ED Visits	(3) Log of Spec Visits	(4) Log of Admissions
Post	0.034*	0.117***	0.187***	.114***
	(0.0135)	(0.026)	(0.023)	(0.027)
Notification Period	0.247 ***	0.172***	0.095***	0.159***
	(0.012)	(0.027)	(0.022)	(0.030)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	6,295,301	4,007,966	5,031,064	1,248,347

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Poisson regression estimates. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation. Observations change due to dropping groups that that do not have enough variation to add to the model.

Table 31: Differences in Differences Using Poisson Maximum Likelihood Estimation

	(1)	(2)	(3)	(4)
	Log of PC Visits	Log of ED Visits	Log of Spec Visits	Log of Admissions
Post	.024	0.027***	0.182***	.007***
	(0.017)	(0.004)	(0.011)	(0.001)
Notification Period	0.147 ***	0.015***	0.096***	0.005***
	(0.012)	(0.004)	(0.007)	(0.001)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	5,926,897	5,926,897	5,926,897	5,926,897
adj. R^2	0.259	0.139	0.337	0.033

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table restricted to individuals whose provider deploys for at least 2 quarters using the robust sample with fully observable deployments. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 32: Robust Sample Of Fully Observable Provider Deployments Restricted To Long Duration Deployments

	(1) Log of PC Visits	(2) Log of ED Visits	(3) Log of Spec Visits	(4) Log of Admissions
Post	-0.035	0.012***	0.011	.004***
	(0.019)	(0.003)	(0.007)	(0.001)
Notification Period	0.102***	0.008***	0.096***	0.001
	(0.018)	(0.003)	(0.007)	(0.000)
Controls	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
N	5,765,929	5,765,929	5,765,929	5,765,929
adj. R^2	0.256	0.136	0.333	0.033

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Table restricted to individuals whose provider deploys for at less than 2 quarters using the robust sample with fully observable deployments. Dependent variable in column 1 is the log of primary care visits. Dependent variable in column 2 is the log of emergency department visits. Dependent variable in column 3 is the log of specialty care visits. Dependent variable in column 4 is the log of inpatient admissions. Post indicator indicates individual has undergone a discontinuity in care due to a provider deployment. Notification period indicator is 1 if within four quarters before a discontinuity. Control variables include age, education level, military rank group, and an indicator for whether a patient has been as the same installation for at least one year. Standard errors are clustered by military installation.

Table 33: Robust Sample Of Fully Observable Provider Deployments Restricted To Short Duration Deployments

A.2. Qualitative interview Script

The purpose of our conversation today is to hear your perspective regarding discontinuity in patient care due to the PROFIS system. My plan is to use your observations and insights in order to better understand how disruptions impact both patients and providers. I'll be doing a series of interviews with providers and then intend to summarize the lessons learned in my dissertation, publications and presentations.

Nothing you say will be attributed to you or your center verbally or in writing. Your participation is completely voluntary. You can decline to answer any question that makes you feel uncomfortable and can stop participating at any time you wish. If it is okay with you, to make it easier to capture your comments, I would like to record our conversation. The recording will be used for transcription purposes only. If you are uncomfortable with recording, I will not. I'll instead rely on handwritten notes. Do I have your permission to record? Great. Let's begin.

Goal 1: Gain understanding in how providers prepare their patients for the transition to a new care provider

Experience 1. Tell me about your experience with the PROFIS system. Talk me through the time-line as much as possible. How much notice were you given that you would deploy (or receive patients)? How long did you anticipate to deploy? When did you begin to notify patients? What clinic and panel size? What is your specialty?

Did your organization offer you ways of transitioning your patients? If not, did you offer your own ideas?

Did any operations/SOP's change as a result of your notification? For instance were patient encounters lengthened to account for transitioning patients?

Thoughts 2. What were your thoughts relative to patient care when you found out you were going to deploy (or receive deployers patients)?

Patients 3. Were there particular patients that concerned you?

Story 4. Can you think about your most complex patient (or receiving patient) at the time. Can you walk me through your efforts to transition that patient?

Simple 5. Did you take any steps to transition less complex patients?

Reaction 6. How did your patients react when you informed them you would deploy? Can you provide some specific examples?

Goal 2: Gain understanding in how providers balance patient care while also preparing to deploy

Obstacles 1. What were your biggest obstacles to continuing patient care while you were preparing to deploy?

Time-line 2. Can you walk me through the time line and what you had to accomplish outside of patient care from when you were first notified through your deployment?

Panel 3. Did you continue to receive new patients while you were preparing to deploy? If so did you inform them of your pending deployment?

Encounters 4. How long would you typically spend in a patient encounter before learning of deployment? Did this change at all while you were preparing to deploy How long would you spend discussing your deployment?

5. (receiving physician) What affect did receiving new patients have on your existing panel?

decisions 6. How did it affect your clinical decision making? (e.g. were you more likely to refer a patient due to time constraints?) Can you offer a specific example?

7. Have you received patients as well? How many physicians have you seen deploy? Have you noticed different strategies for transition? Have any worked better than others?

8. Are there any other comments you'd like to make? Anything else you think I should know?

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