Many Doctors will See You Now: High-referring Physicians and Patient Outcomes

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Abstract

Patient referral rates vary dramatically across primary care physicians, but we know relatively little about the drivers of this variation and how this impacts patient health outcomes. In this paper, I study how physicians with different referring styles impact patient outcomes. To separate the causal effect of physician referring style from patient related factors, I focus on a sample of Medicare patients who switch to a new primary care physician after their original primary care physician exits. I use event study analyses to compare outcomes of patients who switch to new primary care physicians with different referring styles. I find that around 41 percent of the variation in referrals across primary care physicians is due to physician referring style, with the remainder due to patient factors. I also examine the effects by patient race and find slightly larger effects for Black patients. Moreover, I find that high-referring physicians are associated with higher healthcare utilization and poor health outcomes. To understand the mechanisms underlying these results, I characterize high-referring physicians along various dimensions. I find that high-referring physicians work in smaller practices, see more patients, and refer their patients to a large number of providers.

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I Introduction

Primary care physicians (PCPs) play a crucial role in the healthcare system as gatekeepers to specialty care and coordinators of patient health. They have become even more important with the growth of Managed Care Plans and Accountable Care Organizations (Mehrotra et al., 2011; Song et al., 2014). While PCPs have different practice styles in many dimensions, a potentially crucial dimension for patient healthcare utilization and outcomes is the physicians' referring style.[1] Unlike other dimensions of care, PCPs face trade-offs in deciding to refer their patients to another provider. For instance, by referring a patient to another specialist, PCPs might be able to achieve better outcomes for their patient due to specialized care (Doyle, 2020). But PCPs risk losing potential revenue by referring their patients to other providers and potentially incur higher costs due to more challenging patient care coordination (Pham et al., 2009).

Existing evidence suggests that there is wide variation in the number of referrals across Primary Care Physicians (PCPs) with some physicians referring five times as much as others (Mehrotra et al., 2011). From the policy standpoint it is important to understand what drives this variation in referrals as the decision to refer a patient to another provider has a significant impact on healthcare costs (Baicker & Chandra, 2004; Cebul et al., 2008). If this variation reflects physicians' idiosyncratic practice styles, then policies targeting physician behavior could be important. On the other hand, if high-referring physicians see sicker patients or patients who prefer seeing more specialists (Forrest et al., 2006), such policies might be ineffective or even harmful.[2] Moreover, to the extent that this variation does reflect physician referring style, we know little about the types of PCPs that refer more and whether these PCPs impact patient healthcare utilization and health outcomes. Without relating physician effects on the number of referrals to patient outcomes, it is unclear if high-referring or low-referring physicians are providing inefficient care.[3]

In this paper I quantify the extent to which the variation in patient referrals across primary care physicians is attributable to physician referring style, characterize high-referring PCPs along various dimensions, and examine their impact on patient healthcare utilization and health outcomes. I also examine how these effects vary by patient race. To separate

[1] Several papers document variation in physician practice styles: emergency department physicians (Van Parys, 2016; Silver, 2021), obstetricians (Currie & MacLeod, 2017; Epstein & Nicholson, 2009), cardiologists (Molitor, 2018).

[2] See Chandra et al. (2011) for discussion on how various factors impact treatment choices.

[3] While under-referrals are possible, most discussions on referrals suggest that many PCPs "over-refer" their patients (Mehrotra et al., 2011; Forrest et al., 2006; Sirovich et al., 2008; Gadhe, 2021).

the variation in referrals due to patient factors from the variation due to physician referring style, I use administrative records of Medicare patients who switch to a new PCP after their original PCP moves or relocates. As a shorthand, I refer to these events as physician exits. Building on Finkelstein et al. (2016), I use event study analyses to compare outcomes for patients who switch to new PCPs with different referring styles.[4] The underlying assumption is that the trends in referrals for patients who switch to new physicians with different referring styles are similar in the pre-exit period. After subjecting this assumption to numerous tests, I conclude that it is a plausible one in this setting.

My analyses yields three main results. First, I find that physician referring style explains around 41 percent of the variation in patient referrals across physicians. The event study analyses illustrates that there is a sharp change in the number of referrals in the year the patient switches to a new PCP with high-referring practice style. I find that the trends in referrals prior to physician exit are not correlated with the differences in physician referring style and physicians have a larger impact on referrals for disease groups where they likely have more discretion. Moreover, I find that physician referring style explains around 50 percent of the variation in referrals for Black patients and around 41 percent of the variation in referrals for White patients.

Second, I find systematic differences between high- and low-referring PCPs along several dimensions including background characteristics, provider networks, and practice size. I find that high-referring physicians work in smaller practices, see more patients, and refer their patients to a large number of providers and specialists. Moreover, high-referring physicians' practice style is correlated with "low-quality" practice styles: their patients have more Emergency Department (ED) visits, have higher mortality risk, and lower probability of getting influenza immunizations.

Third, I show that high-referring PCPs increase healthcare utilization among patients. Specifically, their patients have more visits with primary care physicians and specialists, see a large number of specialists, and have more surgical procedures. These patients also have more imaging and testing claims, and higher physician payments. Across a range of outcomes, I find that the estimated effect is slightly larger for Black patients compared to White patients. Examining the health outcome implications of moving to a high-referring physician, I find that these patients experience an increase in the number of Emergency

[4]To illustrate the underlying intuition, imagine a patient switches to a high-referring physician after their original PCP exits. If all the the variation in referrals is due to patient factors then we would expect patient's referrals to remain constant after their original PCP exits. If all the variation reflects differences in physician referring styles, we would expect to see a sharp increase in the patients' referrals after switching to a high-referring physician.

Department (ED) visits and mortality risk. Of course the causal effect of being assigned to a high-referring PCP is not the same as the causal effect of an increased tendency to refer on the part of a given PCP. Nevertheless, even when I control for observable patient characteristics and physician practice styles in other dimensions, I consistently find that switching to a high-referring physician is linked to poor outcomes.

My findings yield three broad lessons. First, PCP referring style has a significant impact on patient referrals and other outcomes. This builds on prior work that finds PCP practice style affects patient healthcare utilization (Kwok, 2019; Fadlon & Van Parys, 2020) medical adherence (Simeonova et al., 2020), and prescriptions (Eichmeyer & Zhang, 2021; Laird & Nielsen, 2017; Huang & Ullrich, 2021). Moreover, my results shed light on the possibility that differences in physician utilization might be due to different referring styles. For instance, physicians can have high utilization due to poor management of their patients chronic conditions or they might have higher utilization from actively referring to other specialists. From a policy standpoint, it is important to understand what mechanisms underlie high utilization measures. Moreover, given the prevalence of referrals, the question of how PCP referring styles affect referrals and healthcare utilization is of interest in and of itself.[5]

Second, I find that physician referring style explains around 50 percent of the variation in referrals for Black patients. This relates to the literature that documents health disparities between Black and White patients in the US. For example, there is evidence that Black patients are less likely to be referred to specialists for the same disease diagnosis (LaVeist et al., 2002). While there are many factors underlying these differences, it is possible that some of these differences are due to patient-level factors like mistrust in the healthcare system (Alsan & Wanamaker, 2018) or lack of racial concordance making it less likely that Black patients select certain treatments (Alsan et al., 2019). At the same time, there is a large literature that documents that physicians perceive Black patients differently which might affect Black patient referrals (Bach et al., 2004; Hall et al., 2015; Mukamel et al., 2006). My results suggest that both patient-level and physician-level factors are important in understanding the variation in referrals for Black patients. Moreover, these results suggest that shifting care of Black patients to high-referring physicians might not be the key to reducing health disparities.

Finally, the main finding of this paper is that PCPs with high-referring practice styles have poor patient outcomes. This finding echoes recent work by Currie & Zhang (2021) who find that patients of PCPs who are more effective in preventing hospitalizations or emergency

[5]Around 38 percent of claims in any year are from referrals.

department visits for mental health and circulatory conditions also have fewer referrals to specialists, fewer imaging and lab panels, and see primary care physicians less often. Among other explanations, one possible explanation for poor outcomes is that the care of patients of high-referring physicians is spread across many providers leading to poor coordination and worse outcomes (Agha et al., 2019; Cebul et al., 2008; Agha et al., 2021). My paper suggests that a deeper understanding of these mechanisms could inform policies intended to improve health outcomes by reducing "unnecessary" healthcare utilization.

II Setting and Data

II.a Institutional background

In the US, around 100 million physician referrals are made every year (Barnett et al., 2012). A referral occurs when a physician decides to refer a patient to another provider. While most of the medical literature focuses on referrals from primary care physicians to specialists, specialists also refer their patients to other specialists and patients are also referred to primary care physicians and other providers. A physician might decide to refer a patient if the patient diagnosis is outside of the physicians' expertise or for a procedure that a physician does not perform. This decision is also likely affected by the availability of appropriate providers, urgency of treatment, and liability concerns (Mehrotra et al., 2011). Referring physicians might also use referrals as a substitute for thoroughly evaluating the patients. In addition, financial concerns might also affect the decision to refer as referring physicians potentially lose the income they would have obtained if they treated the patient themselves. Moreover, this decision is also affected by patient-related factors like their health, willingness to see other providers and preferences for specialist care.

In this study I focus on referrals made by primary care physicians for Fee-for-Service patients ages 65 and older covered by Medicare for years 2008-2012.[6] For each patient, I observe detailed information including diagnosis codes, types of services received, and physicians who provide the service. I also observe information on patient demographics, including age, sex, race, and zip code of residence. I count a claim as a referral if there is a referring physician listed for the claim and referring physician is not the same as the person providing the service. Around 38 percent of the claims every year are for referrals. As shown in Appendix Figure A1 referrals constitute a little less than half of the total physician

[6]This time period is before the major shift to Accountable Care Organizations and bundled payments that set up different incentives for providers.

payments in each year.[7]

This is an ideal setting for my paper for several reasons. First, over 90 percent of the individuals over the age of 65 are covered by Medicare insurance making these data representative of the elderly population in the United States (Lohr et al., 1990). Second, a large number of Medicare beneficiaries seek care from primary care physicians, although they are not required to have a designated primary care physician.[8] Third, most primary care physicians in the US accept Medicare patients (Boccuti et al., 2015).

Note that referrals in this population are not constrained by institutional requirements as beneficiaries do not need a referral to see a physician. While, prior research suggests that referrals are common and determine where patients receive care (Barnett et al., 2012), I interpret my results as a lower bound of the effect of primary care physicians. It is likely that primary care physicians have a larger impact on patient referrals in Medicare Advantage plans where patients mostly need a referral to see a specialist.

II.b Sample Construction

To construct my sample I first begin by identifying primary care physicians who either relocate or stop treating Medicare patients. Throughout this paper, I refer to these relocation and retirement events as physician exits. I then identify primary care physicians for the patients and identify my sample as patients affected by physician exits.

My primary data source is the Carrier File that contains claims for a 20 percent random sample of Medicare beneficiaries. I begin by identifying physician exits. For each physician I identify their primary zip code based on the zip code for which the physician has the maximum number of claims in a year. Since most physicians only practice at one zip code, this allows me to identify a unique zip code per year for each physician. I then identify physician relocation if the first two digits of physicians' primary zip code changes during my sample years.[9] Around 80 percent of the physicians relocate only once during my sample years and I limit by analysis to these physicians. I next identify physician retirements. I identify physicians as retiring if they have at least one claim in any of the years but no claims after that. For physicians who moved and retired during my sample years, I choose the event that occurred first.

[7]The mean provider payments for referred claims is around $73.99 per year and for not referred claims it is around $58.33.

[8]Several papers have used the same setting to understand the effect of primary care physicians on healthcare utilization and patient outcomes (Kwok, 2019; Fadlon & Van Parys, 2020)

[9]The first two digits indicate states for smaller states and geographical regions within states for larger states.

I next identify the patients affected by physician exits. I first assign each patient to a primary care physician. I begin by only keeping the evaluation and management visit claims since these identify office visits.[10] I then only keep claims where the provider speciality is family medicine, internal medicine, geriatrics, and general practice as these specialities typically provide primary care services.[11] I assign a PCP to each patient as the primary care physician with whom they had the most claims in any given year. There are some patient-years with no assigned PCP. This is because the patients did not have any evaluation and management visits in that year. It is also possible that these patients were seeking care from a physician in another speciality because fee-for-service patients in Medicare are not required to have a primary care physician.

I then match each patient's PCP to the list of PCPs who exited. I only keep patients who were affected by physician exit and only visited one PCP in the period before the exit to ensure the patients were exposed to one practice style in the pre-exit period. I also limit my analysis to beneficiaries who are at least 65 years of age, have at least 1 month of Part A and Part B coverage in each year. As I want to isolate physician effects from patient effects while keeping place based effects constant, I exclude patients who move across Hospital Referral Regions (HRRs). [12]This leaves me with a sample of around 70,000 beneficiaries who are affected by exits of around 20,000 physicians.[13]

II.c Measure of Physician Referring Style

I next discuss how I construct a measure of physician referring style that I use to estimate the effect of physician referring style on patient referrals and patient outcomes.[14]I first measure the number of referrals for each patient in any given year as claims where the referring physician is listed and the referring physician is not the provider of the service.[15]Essentially,

[10]I identify these based on Betos code starting with M.

[11]Primary care physicians are identified by hcfaspcl codes (general practice (01), family medicine (08), internal medicine (11), and geriatrics (38). Patients in Medicare are not required to have a primary care physician or choose a physician from these specialities as a primary care physician. In the main text, however, I restrict to these physicians to understand how primary care referrals work. It is possible that specialist referrals work differently. In the Appendix I allow for physicians from other specialities to be assigned as the PCP and find slightly larger impact on patient referrals.

[12]Finkelstein et al. (2016) find that patients who migrate to high utilization regions end up having higher healthcare utilization.

[13]These patients are spread across the 306 Hospital Referral Regions.

[14]These differences in physician referring style might be due to differences in diagnostic skills or preferences (Chan et al., 2019).

[15]I identify referrals for claims where Betos code either starts with M or P indicating the referral was for medical care or a procedure. In 2012, around 74 percent of these claims were for medical care and 14 percent for surgical procedures.

I exclude self-referrals where a provider refers to themselves. For each physician j I then calculate the average number of referrals for all the patients assigned to that physician in year t. I exclude the referrals of patient i from this calculation so patient's own referrals do not affect the measure of physician referring style. I then calculate a time-invariant measure of physician referring style by averaging this measure for all the years of my data. Since some physicians see few patients, I apply Bayesian shrinkage to my measure of physician referring style to reduce measurement errors.[16]. This measure of physician referring style is a combination of patient composition and physician factors that might affect patient referrals. I note that this measure of physician referring style is a mismeasured version of physician's true referring style, and hence I likely underestimate the effect of physician referring style on patient referrals.[17]

Finally, for each patient i who is assigned to a new PCP (j') after their original PCP's (j) exit I calculate the difference between the physician referring styles as $\Delta_i = \delta_{j'} - \delta_j$, the average referrals of new PCP minus the average referrals of the original PCP. This is the primary explanatory variable used in the analysis below. The mean is 0.528 and the standard deviation is 3.738. The distribution is centered at zero suggesting that it is equally common for patients to move from a high-referring physician to a low-referring physician as it is for patients to move from a low-referring physician to a high-referring physician. There is also considerable variation in physician referring styles. To illustrate this further, patients at the 25th percentile of the difference between physician referring styles, Δ_i, switched to a new PCP with 2.996 fewer referrals than their original PCP, while patients at the 75th percentile of the difference switched to a new PCP with 4.492 higher referrals.[18]

II.d Other Outcomes

I measure healthcare utilization outcomes as follows. To measure the probability of a referral, I create an indicator variable that equals 1 in the year a patient has a non-zero referral and zero otherwise. I identify the number of visits with primary care physicians as the claims where physician speciality was either family medicine, internal medicine, geriatrics, or general practice. I identify the number of specialists visits by excluding physicians in primary care

[16]I follow Fadlon and Van Parys 2020 in creating this measure and use Adam Scarny's code to apply Bayesian shrinkage (http://sacarny.com/programs/). In the Appendix I present results without Bayesian shrinkage as well.

[17]The measure of physician referring style encompasses all the physician related factors that might affect patient referrals. It is also not clear how much of this variation in referring style is due to physician diagnostic skills and how much due to physician preferences (Chan et al., 2019).

[18]In Appendix Figure A3 I show that physician referring style exhibits mean reversion. Patients whose original PCPs have higher referral style, on average, switch to PCPs who have lower referring style.

specialities, nurse practitioners, physician assistants, and a few other specialities [19]. I identify surgical procedures using claims where type of service code is 2. I measure provider payments as the sum of the payments from Medicare to providers that provide services to the patient in any give year. Finally, to investigate the effect on health outcomes, I examine the number of Emergency Department (ED) visits and mortality risk. Mortality is equal to one in the year the patient dies and zero otherwise. By construction, patients cannot die before physician exit, and patients have no observations for patient-years after they die.[20]

I present the summary statistics in Table 1. The first column presents summary statistics for patients that were assigned to a PCP and were affected by physician exit. The second column presents statistics for patients that were assigned to a PCP but were not affected by physician exit. The statistics suggests that the two samples are similar. While I do not use the not affected patients in my analysis, it adds to the external validity of the results that the two samples are similar. The average age of patients is around 76 years, and on average patients are covered by Part A and Part B for at least eleven months. The average number of referrals is around 5 per year and the average number of specialist visits is around 7.70 visits per year.

II.e Variation in Referrals Across PCPs

One of the goals of this study is to understand how much of the variation in referrals across PCPs is due to physician referring style. Physician referring style is measured by the average number of referrals of the patients assigned to that PCP. The mean number of referrals by physicians is around 4.70 with a standard deviation of 2.94. This indicates considerable variation in physician referring style: as a fraction of the mean number of referrals by a physician, the standard deviation is around 63 percent. Figure A2 in the Appendix further illustrates that patients of physicians in quartile 1 of physician referring style have an average of 2.598 referrals and patients of physicians in quartile 4 of referring style have an average of 7.613 number of referrals. The mean number of referrals per year for the patients reported in Table 1 also indicates that the number of referrals across patients vary dramatically. Comparing the standard deviation of the number of referrals of patients with the standard deviation of average number of referrals by physicians suggests that moving 1 standard deviation up the physician-referring distribution moves the patient 0.35 standard deviation up the patient-level distribution. This suggests that PCPs referring style could have a

[19] These other specialities include: speech language pathologists, sports medicine, certified nurse midwife, mammography screening center, medical supply companies, optician etc.

[20] I identify claims for ED visits using CPT codes 99281,99282,99283, 99284 and 99285.

significant impact on patient referrals. As I am interested in examining how much of the variation in referrals across PCPs is explained by physician referring style, I next discuss my empirical strategy to isolate the effect of physician referring style on patient referrals.

III Empirical Strategy

III.a Model and Estimating Equations

The goal of this paper is to examine the effect of physician referring style on patient referrals, healthcare utilization, and health outcomes. In this section, I follow Finkelstein et al. (2016) to illustrate a model of demand and supply side factors underlying referral decisions. Patient i gets y_{it} number of referrals in year t. Patient obtains expected utility $u(y|\alpha_i, h_{it})$ from getting y number of referrals where α_i represents patient time-invariant factors. Higher values of α_i indicate preference for more referrals. h_{it} represents patient health with higher values of h_{it} indicating poor patient health. This can be written as

$$u(y|\alpha_i, h_{it}) = \alpha_i y - 1/2(y - h_{it})^2, \qquad (1)$$

so that for patients in good health, higher number of referrals detracts from patient's utility. Each patient is assigned to a primary care physician j in year t. Each physician then chooses y_{it} to maximize the perceived utility of patients from referrals $u_j(y|\tilde{\alpha}_i, h_{it})$ minus the costs of referring patients, $C_{jt}y$. Perceived utility of referrals is a function of true patient utility ($u(y|\alpha_i, h_{it})$) as well as physicians beliefs about the appropriateness of referrals, λ_j. We can write this as

$$y^*_{it} = u(y|\alpha_i, h_{it}) + \lambda_j y - C_{jt}y, \qquad (2)$$

where higher values of λ_j indicate that physicians refer more patients. Among other things, monetary incentives, organization specific factors, and physician training can affect C_{jt} by making it more costly for physicians to refer patients. Then maximization of physician utility gives the following equation:

$$y_{ijt} = \alpha_i + \delta_j + \tau_t + x_{it}\beta + \epsilon_{ijt}, \qquad (3)$$

where the variables $\delta_j + \tau_t = \lambda_j - C_{jt}$. The variable δ_j is the effect of physician referring style on patient referrals and τ_t is the year fixed effect.[21]The variable y is the total number

[21]This measure of physician referring style includes all the factors that might affect physician referring style including physician beliefs, diagnostic ability,training, organization size, organization incentives, and availability of specialists.Cutler et al. (2019) find that physician beliefs rather than other factors are more

of referrals for patient i who has physician j as PCP in year t, α_i is the patient fixed effect, x_{it} includes time-varying patient factors.

The differences in y_{ijt} in equation 3 could be driven by the differences in patient factors and by the differences in physician factors. As the goal of this paper is to estimate the effect of physician referring style on patient outcomes, I need a sample of patients who are exposed to different physician referring styles. In particular, I need an exogenous source of variation in physician referring style that is not correlated with patient health. To achieve this goal, I use physician exits to exogenously vary a patients exposure to different physician referring styles while keeping patient factors constant. The key advantage of this empirical strategy is that it allows me to completely control for time invariant patient factors such as patient demand for healthcare.[22] If all the patients switched from low-referring physicians to high-referring physicians after original PCP exit then just plotting the coefficients of relative time dummies would indicate the effect of switching to a high-referring physician. However, in practice, patients switch from low-referring physicians to high-referring physicians, and from high-referring physicians to low-referring physicians. Moreover, the size of the switch varies across patients. Therefore, in order to produce a more informative plot I follow Finkelstein et al. (2016) and interact event-time dummies with Δ_i, the difference between the referring style of new and original PCPs. I then estimate the following event study specification:

$$y_{it} = \alpha_i + \sum_{r=-4, r\neq -1}^{r=3} \beta_r * I_r * \Delta_i + \tau_t + x_{it}\theta + \epsilon_{it} \quad (4),$$

where r is relative to the year of physician exit. The omitted category is $r = -1$, the year before physician exit. The I_r are indicators for years relative to physician exit. τ_t are calendar year fixed effects to control for secular changes in referrals over time. α_i are patient-fixed effects that control for time-invariant factors related to the patients. x_{it} include time-varying patient characteristics including patient age, age squared, number of months of coverage with Part A and Part B, End-stage renal disease diagnosis indicator, and number of months on HMO. In addition, x_{it} includes indicators for event-time dummies to account for the disruption in care from physician exit and finding a new PCP.

The parameters of interest are β_r that capture the relationship between patient i's number of referrals and the difference in average number of referrals of new and original PCP. These describe the difference in the number of referrals for patients since switching

likely explanations of the variation in physician treatment intensity where intensity is measured by patient expenditures.

[22]The thought experiment is to assign the same patient to PCPs with different referring styles.

to a new physician per unit difference in Δ_i. If there is little relationship between patient referrals and Δ_i then β_r should be close to 0 in the pre-exit period. If the variation in referrals across PCPs is completely explained by physician referring style, the estimated coefficients would be one in the post-exit period. If the variation in referrals across PCPs is entirely due to patient-related factors, the estimated coefficient would be zero in the post-exit period. An intermediate coefficient tells us how much of the variation in referrals across PCPs is attributable to physician referring style.

I also estimate a difference-in-differences model as follows:

$$y_{it} = \alpha_i + \beta * \Delta_i * Post_{it} + \tau_t + x_{it}\theta + \epsilon_{ijt} \quad (5),$$

where $Post_{it}$ is equal to 1 for event times greater than and equal to 1 after original PCP's exit and is 0 for event times less than 0. As patients have not fully transitioned to the new physician in event time 0, I refer to event times greater than 1 as the post physician exit period. x_{it} includes an indicator for post and time-varying patient characteristics including patient age, age squared, number of months of coverage with Part A and Part B, End-stage renal disease diagnosis indicator, and number of months on HMO. I cluster the standard errors at the Hospital Referral Region (HRR) level. The coefficient of interest is β. It measures the share of the variation in the mean referrals across PCP's that is explained by the physician referring style. This coefficient is 0 if the physician referring style has no effect on patient referrals, and is 1 if the entire variation is explained by the physician referring style. If physician referring style explains a fraction of the variation in patient referrals we expect a coefficient between 0 and 1.

The recent literature on two-way-fixed estimators suggests that when treatment effects are heterogeneous across cohorts and treatment timings is staggered, some 2x2 comparisons might be assigned negative weights making it difficult to interpret the estimates (Goodman-Bacon, 2021). I examine if my results are robust to the concerns raised by this literature. In particular, I follow Callaway & Sant'Anna (2020) to allow for heterogeneous treatment effects. I estimate equation 4 separately for each cohort of patients depending on the year of physician move. I then aggregate these estimates weighted by the cohort size. I follow a similar procedure to calculate the standard errors.

III.b Assumptions

The key to separating the effect of physician referring style from patient related factors is to examine the change in referrals when patients switch to a new PCP after their original

PCP exits. The underlying assumption in the above empirical strategy is that the trends in referrals are not correlated with the size of Δ_i. That is, trends in referrals for patients who switch to a high-referring physician would be similar to trends in referrals for patients who switch to a low-referring physician in the absence of physician exit.

This assumption seems reasonable in my setting as patients switch to new PCPs after their original PCP exits rather than due to their own health reasons. However, patients still choose their new primary care physicians and it is possible that the timing of switching to a new PCP coincides with health shocks. For example, if patients switch to high-referring physicians after a negative health shock, I would overstate the role of physician referring style relative to patient factors in explaining the variation in referrals.

While I cannot rule out this bias completely, I examine trends in the pre-exit period for all the patients affected by physician exit. If sicker patients need more referrals and health deteriorates over time, this would be apparent in the pretends. I do not find that referrals for patients who switch to high-referring physicians were on a differential trend compared to patients who switch to low-referring physicians. I also find similar results when I restrict to narrower time windows around physician exit.

IV Effect of Physician Referring Style on Patient Referrals

To examine the effect of physician referring style on patient referrals, I begin by plotting in Figure 1 the relationship between patient referrals and physician referring style. I calculate the difference between the new and original PCP referring style, Δ_i, for each patient affected by physician exit and then divide these into 20 equally sized groups. On the x-axis I plot the mean of Δ_i for each of these groups. In Figure 1a I plot the change in referrals for the patients before the move (the difference between referrals at 1 year and 3 years before physician exit) against the difference in new and original PCP referring style (Δ_i). While the plot has a small upward slope, it is statistically insignificant and economically small. This suggests that prior to physician exit referrals for patients who switch to high-referring physicians and patients who switch to low-referring physicians have similar trends. In Figure 1b I present an identical plot except that I have the difference between referrals at 1 year after the move and 1 year before the move on the y-axis. If all the variation in referrals was due to physician referring style, we would expect a slope of 1. If all the variation in referrals across PCPs was due to patient factors, we would expect a slope of 0.This plot has

an upward slope of 0.376, suggesting a significant relationship between physician referring style and patient referrals.

I then present my main event-study results in Figure 2, which shows the estimated coefficients β_r from equation (4). The dependent variable is the number of referrals for a patient in a given year. The plot shows a significant, discontinuous jump at the time of the switch, indicating approximately 40 percent of the variation in patient referrals across PCPs is due to physician referring style, with the remaining variation due to patient related factors. Moreover, the plot is relatively flat in the years before and after the switch. I present difference-in-differences estimates in Column 1 of Table 2. Event time 1 is the first post-period as this is the first year that patients have fully switched to the new PCP. The rest of the discussion, therefore, refers to event times 1 to 3 as the post-exit period. These results indicate that 1 unit increase in Δ_i increases patient referrals by 0.411, an increase of 8.70 percent relative to the mean of 4.723. Put differently, this suggests that an average switch between new and original PCP is associated with 0.217 more referrals where the average difference between new and original PCPs mean referrals is 0.528 referrals. [23]

Robustness- To check the robustness of my estimates I first include controls for patient characteristics including age, age squared, ESRD indicator, HMO months, Part A and Part B coverage months. Estimates in Column 2 of Table 2 and Figure A4 present these results. These results are similar to my main results reported in the first Column of Table 2 . I next limit my sample to patients with full coverage of Part A and Part B throughout the year. These estimates are shown in Column 3 of Table 2 and are again similar to my main results. In Column 4 of Table 2 and Figure A4 I allow for heterogeneous treatment effects following Callaway and SantAnna(2020) and get similar results.

I conduct additional robustness checks that are reported in the Appendix. I also examine the effect of physician referring style on patient referrals by excluding patients who exit the sample due to patient death in A4. In Appendix Table A2, I show my results are robust to using alternate functional forms for the dependent variable. I also show that limiting sample to event times closer to physician exit year yields similar results suggesting that results are not driven by differential trends across patients. Finally, I exclude observations for patients where the difference in new and original PCPs referring style is more than 50 to ensure my results are not driven by outliers and find similar results.

[23]In the Appendix Table A3 I show that the estimated effect is larger if I include specialists in any speciality to be the primary care physician. In particular, I find that physician practice style explains around 57 percent of the variation in patient referrals. I restrict to PCPs in the main text as it is possible that PCP and specialists have different referral patterns and styles.

I next estimate equation (4) separately for patients affected by physician relocation and physician retirement in Appendix Figure A5.In Appendix Figure A6 I also examine how the effect varies by the referring style of the original PCP. I divide my sample into two groups based on the referring style of the original PCP. The figure on the left is estimated on patients whose original PCP's average number of referrals was below the median number of referrals by PCPs. The figure on the right is estimated on patients whose original PCP has above the median number of referrals. The results are similar to the main estimates reported in Figure 2.

IV.a Effect of physician referring style on patient referrals by disease diagnosis

So far I have shown that PCP referring style explains around 41 percent of the variation in patient referrals across PCPs. I next examine if physician referring style impact patient referrals differently depending on the disease diagnosis. The decision to refer a patient to another provider involves trade offs for a primary care physician and these trade offs might vary by the disease diagnosis. On the one hand, referring a patient to another provider can lead to better outcomes because of more specialized care or second opinion from another physician. On the other, PCPs risk losing potential revenue by referring the patient. Especially in Medicare where patients are not required to have a primary care physician, this risk might be salient for PCPs. Moreover, coordination of care can become more challenging for PCPs when additional providers are involved. These problems are more likely to affect referrals for diseases where there is an overlap between the services provided by the primary care physician and the specialists. For example, we do not expect a PCP to perform a cancer surgery, but PCPs might have more discretion in referring a patient to cardiologist for heart related problems or an endocrinologist for diabetes management.

For this analysis, I use primary diagnosis ICD-9 codes collapsed into 18 clinically meaningful categories to create diagnosis-specific referring style measure for each physician[24]. I present estimates for five disease groups in Table 3 as these groups contain some of the chronic conditions affecting patients over the age of 65. Neoplasms include cancer diagnosis, circulatory system include heart disease, respiratory system include diagnosis for lung disease, endocrine include diabetes and thyroid disease management, and genitourinary include kidney diseases. For each disease group, I create a separate measure of Δ_i using

[24]ICD-9 codes are very detailed and specific so to make the data manageable I use AHRQ definitions of clinically meaningful categories (CCS) to group ICD-9 codes. There are 18 CCS groups. In Table A4 in the Appendix I include details of these categories.

referrals for that particular disease. For example, Δ_i for neoplasms disease category is the difference in new and original PCPs referring measure for neoplasm diagnosis.

There are two main points to note about the estimates presented in Table 3. First, they suggest that there is variation in physician referring style by disease groups. For example, the standard deviation of physician referring style is 0.722 for endocrine diseases and 1.740 for neoplasms. Among other factors, this variation could be due to physician beliefs and human capital, or due to external factors like specialist availability. Second, the results suggest that physician referring style explains around 2.6 percent of the variation in referrals for neoplasms across PCPs and around 26 percent for circulatory system diseases. Intuitively, these results suggest that physician referring style has a larger impact on referrals for disease diagnosis for which we think more discretion lies with the physician. For example, circulatory system diseases, respiratory system diseases and endocrine system diseases can be managed by primary care physician to some extent.

IV.b Effect of physician referring style on patient referrals by Patient Race

I next examine if physician referring style impact on patient referrals varies by patient race. Given the large literature that documents health disparities between Black and White patients in the United States, it is important to understand how much of that variation is driven by patient factors like preferences, health status, prior experiences with healthcare system, discrimination (Alsan & Wanamaker, 2018; Alsan et al., 2019), and how much is driven by physician specific factors that include physician preferences, experience treating minority patients, resource constraints, and implicit bias (Bach et al., 2004).

I begin by examining the effect of physician referring style on referrals for Black patients and White patients. Results in Table 4 and Figure 3 suggest that physician referring style explains around 50 percent of the variation in referrals for Black patients. For White patients, the physician referring style explains about 41 percent of the variation in referrals. In Appendix Table A5 I present estimates for Black and White patients by the disease system. Overall, these results suggest that physician referring style has a significant impact on patient referrals with estimates slightly larger for Black patients. Moreover, the variation in physician referring style is slightly larger for Black patients as compared to White patients. For example, the standard deviation of the difference in new and original PCP's referring styles for neoplasms is 2.358 for Black patients and 1.648 for White patients.

IV.c How are patients choosing their new physician?

So far I have shown that physician referring style explains around 41 percent of the variation in patient referrals with some heterogeneity across disease groups and patient race. One concern is that these patients might be selectively sorting to physicians based on their prior behavior. For example, if patients with high referrals systematically sort to referring physicians with high-referring style, I would overstate the effect of physician referring style on patient referrals. This sorting might occur because physician exit timing might coincide with a health shock for patients that leads them to high-referring physicians. This sorting is unlikely in my setting as patients are choosing a new physician in response to physician exit rather than patient-related factors and it is unlikely that patients would be able to accurately predict any physicians' referring style. Moreover, these patients are not restricted to choose a primary care physician from the primary care specialities. For example, if a patient is diagnosed with cancer these patients can choose a medical oncologist as their primary care physician.

However, patients are still choosing their new PCP. While the event-study in Figure 2 suggests that the trends in referrals are not systematically different for patients who switch to high-referring physicians and patients who switch to low-referring physicians, I next present a scatterplot of the relationship between the difference in the new and original PCP referring styles,Δ_i, and the number of referrals in the pre-exit period in Figure A7. The figure does not indicate any systematic relationship between the two variables. If the number of referrals are an indication of patient health, this further suggests that patients are not sorting to physicians based on their health. I also follow a similar strategy as Fadlon and Van Parys (2020) to test for selective sorting based on patient characteristics. In particular, I use my analysis sample to first estimate the predicted number of referrals based on patient age,race, sex, insurance coverage, and Elixhauser index for the pre-period. I then regress standardized predicted referrals on the standardized difference between the new and original PCP referring styles. I include time fixed effect and cluster the standard errors at the Hospital Referral Region level. The estimated coefficient is 0.019. In my main analysis the estimate for the effect of 1 standard deviation higher physician referring style on standardized number of referrals is 0.182. This again suggests that patients sorting to high-referring physicians is not a major concern in this setting. Finally, in Figure A8 I also estimate the effect of physician referring style on patient referrals separately for high and low risk patients where risk is measured by the average value of Elixhauser index in the pre-period. Higher values of Elixhauser index indicate patient is high-risk. The results are similar for the two groups

with around 40.2 percent of the variation in referrals for low-risk patients and around 42.1 percent of the variation in referrals for high-risk patients being explained by the physician referring style.

V Factors correlated with PCP Referring Style

So far I have shown that physician referring style explains around 41 percent of the variation in patient referrals across PCPs. I next explore observable factors that are correlated with physician referring style. In particular, I am interested in examining factors that correlate with C_{jt},the costs of referring for physicians, and λ_j, physician beliefs about the appropriateness of referrals. I begin by gauging the role of physician practices on physician referring style as prior literature suggests that environmental factors explain a large share of variation in physician practice styles (Molitor, 2018). I separately examine the effect of switching to a high-referring physician for patients who switch to PCPs within the same practice as their original PCP and for patients who switch to PCPs outside their original PCP's practice. I identify physician practices by using the Tax Identification number in my data. In my sample around 60 percent of the patients switch to PCPs outside their original PCP's practice. Not surprisingly, the difference between the new and original PCPs practice styles is larger when patients switch to a PCP outside their original PCP's practice. For instance, the standard deviation of Δ_i for switches to different practices is 4.257 and for within original PCP's practice switches it is 2.726. This suggests there is variation in physician referring styles both across and within physician practices. The event study graphs in Figure 4 and Table 5 present these results. The results suggest that switching to a PCP outside original PCP's practice increases patient referrals by 0.423 while switching to a PCP within original PCP's practice increases patient referrals by 0.373. In column 3 of Table 5 I use the full sample and include practice fixed effects. The estimated coefficient of 0.358 is slightly smaller compared to the estimate of 0.411 without practice fixed effect indicating some of the variation in physician referring styles might be due to external factors associated with organizational factors related to the practices these physicians work in.

I next examine how physician referring style correlates with observed physician and practice characteristics. I use my analysis sample to estimate physician fixed effects for the number of referrals. Essentially, I estimate a regression with physician and patient fixed effects, and controls for patient age, age square, Part A and Part B months, HMO months, ESRD indicator and Elixhauser Index. The intuition is that estimated physician effect measures a risk-adjusted effect of the physician on patient referrals. I then regress

the estimated physician fixed effect on the number of patients, the number of providers in practice, the number of unique providers physician refers to, and the number of unique specialists that the physician refers to.[25] Each regression is at the physician level and I standardize all the variables to have a mean of zero and standard deviation of 1 before running the regression for easier interpretation.

Figure 5 presents these results. Each dot is from a separate regression where the dependent variable is the standardized physician fixed effect on the number of referrals. These results indicate that a large number of patients is positively associated with high-referring practice style.[26] One possible interpretation of these results is that primary care physicians who see a large number of patients refer more patients because of time constraints. This is also supported by survey evidence that reports around 42 percent of the PCPs say they do not spend enough time with their patients (Bodenheimer, 2008). [27] The number of physicians in the practice as measured by the practice size is negatively correlated with the physician referring style.[28] A negative association between practice size and the physician referring style could indicate that in large practices physicians can share information and get opinion on diagnosis without formally referring patients.[29] For example, it is possible these practices use electronic referrals where primary care physicians can get specialist opinion without their patient physically seeing the specialist (Bodenheimer, 2008). An equally valid interpretation is that larger practices have more resources within their systems reducing the need for referrals. Moreover, I find that a larger network of providers and specialists is associated with high-referring style.[30] While the estimated correlation direction suggests that male PCPs are more likely to refer and graduates from bottom 20 medical schools are more likely to refer than from top 20 medical schools, these estimates are statistically insignificant. [31] I also find that physicians who treat Black patients see fewer patients, work in larger practices, have smaller network of providers and specialists as shown in Table A6.

As PCPs practices are multi-dimensional, I next examine the relationship between PCP

[25]These providers are not necessarily in physician's practice. I estimate the size of the network by finding the number of providers and specialists they refer to irrespective of whether these providers and specialists are in PCPs practice. On average, PCPs refer to 30.98 different providers and 26.07 different specialists.

[26]The mean number of patients seen by a PCP is 21.26 with a standard deviation of 23.34.

[27]Silver (2021) finds that in emergency department physicians assigned to faster peer groups work faster and spend less money, but these reductions lead to large reductions in quality of care.

[28]An average practice has around 167 providers over the sample years.

[29]This is also consistent with physicians in solo or two-person practices having more aggressive treatment style and being high follow-up doctors than doctors in multi-specialty groups (Cutler et al., 2019)

[30]Landon et al. (2018) find that patients of physicians who are linked to more physicians have more hospital visits, emergency department visits, specialists and primary care visits.

[31]This relates to work that finds PCPs from lower ranked medical schools are more likely to prescribe opioids (Schnell & Currie, 2018).

referring style and other practice measures in Figure 6. Similar to physician fixed effect on referrals, I estimate physician fixed effects for ED visits, mortality, probability of flu vaccinations,imaging, tests, number of primary care visits and physician payments. I then regress standardized physician fixed effect for referrals on standardized fixed effects for other outcomes to get correlations reported in Figure 6. Each dot presents an estimate from a separate regression. These suggest that high-referring style is associated with a more aggressive treatment style as high-referring style is positively associated with the number of primary care visits, and the number of imaging and lab claims. For example, patients of physicians whose patients have 1 standard deviation higher number of primary care visits have around 0.4 standard deviation more referrals. Moreover, these results suggest that high-referring practice style is associated with "low-quality" practice style: physicians whose patients have more ED visits and higher mortality risk refer more and physicians whose patient are less likely to get flu immunizations refer more.

VI Effect on Patient Healthcare Utilization and Health Outcomes

VI.a Effect on Healthcare Utilization

So far I have shown that physician referring style has a significant impact on patient referrals. I next examine how switching to a physician with high-referring practice style affects patient healthcare utilization. I estimate equations 4 and 5 where the dependent variable is a measure of healthcare utilization. I estimate Column 1 of Table 6 presents the estimates of the impact of switching to a physician with high-referring practice style on patient healthcare utilization measures for the patients affected by physician exit. Column 2 presents these estimates for Black patients and estimates for White patients are included in Column 3. The event study graphs for the full sample are included in Figure 7. Across the eight figures, pre-trends are relatively flat and there is a visible jump after PCP exits.

Across measures of healthcare utilization, these estimates suggest that switching to a physician with high-referring practice style has a significant impact on patient healthcare utilization. For example, first row of Table 6 suggests that switching to a physician with high-referring practice style increases the probability of a referral during a given year by 0.012. Figure (a) in Figure 7 shows that the estimates are stable in the post-exit period. Other results suggest that switching to a PCP with one additional referral per patient is associated with 0.274 more primary care visits, 0.280 more specialist visits, 0.224 additional

providers seen, and 0.033 additional surgical procedures. It is worth noting that switching to a physician with high-referring practice style is associated with an increase in the number of primary care visits and specialist visits indicating that these two sources of care are complements.[32] I also find that physicians payments are higher after patients switch to a high-referring physician. The effect on payments is likely even larger when inpatient visits are included. Finally, results also indicate a significant increase in the number of imaging and tests claims.The event study graphs in Figure 7 indicate that the physician referring style has the largest impact in the first year of the switch after which the estimated effect decreases a little.

Looking at the effect by patient race, I find that switching to a high-referring physician increases healthcare utilization for both Black and White patients. Overall, the results indicate the effect of switching to a high-referring physician is slightly larger for Black patients compared to White patients. For example, switching to a PCP with 1 unit higher referring style increases primary care visits for Black patients by 0.368 and for White patients by 0.268. Given that I find that PCP referring style has a larger impact on referrals for Black patients compared to White patients, it is not surprising that the effect on healthcare utilization is also larger for Black patients. The event study graphs for Black and White patients are included in Figure A9 and Figure A10 in the appendix. These also show that there is a discontinuous jump at the time of the switch.

VI.b Effect on Patient Health Outcomes

In the analysis above I have shown that switching to a physician with high-referring practice style increases patient referrals and healthcare utilization. I next examine how switching to a high referring physician affects patient health outcomes. In the first row of Table 7 I examine the effect of physician referring style on the probability of any Emergency Department (ED) visits. These results suggest that switching to a high-referring physician increases the probability of ED visit by 0.008. The estimates in the second row suggest that switching to a PCP with 1 unit higher referring style is associated with 0.024 additional ED visits- an increase of around 5 percent relative to the mean of 0.479. I also find that switching to a high-referring physician is associated with a 3.07 percent increase in the mortality risk. I find similarly large effects for Black and White patients in column 2 and 3. The event study graphs for the effect of physician referring style on patient health outcomes are shown in

[32]Sabety et al. (2021) find that loss of PCP is associated with lower primary care use and increased specialist use. Agha et al. (2019) finding that moving to a high-fragmented region results in patients getting more care from specialists rather than primary care physicians.

Figure 8 and mostly have flat pre-trends. Figure A11 in the appendix presents these figures for Black and White patients.[33]

While these results suggest that switching to a PCP with high-referring practice style is associated with poor health outcomes, I want to be careful in not interpreting these results as the causal effect of the number of referrals of these physicians. It is likely that high-referring practice style is correlated with other practice styles that contribute to worse health outcomes. While physicians might differ in unobserved styles, I next explicitly control for other observed practice styles and physician characteristics. In Table 8, I present results for the same patient health outcomes with additional controls. I create measures of physician practice styles for primary care visits, flu vaccinations, images and tests claims, and physician payments. In the first column I include estimates for the full sample from Table 7. These estimates already control for patient time-varying characteristics and time invariant characteristics. In the second column I include controls for various practice styles and in the third column I include controls for other physician practice characteristics like the number of patients. Overall, these results suggests that switching to a PCP with higher number of referrals is associated with poor health outcomes. [34]

VII Discussion

The results in the previous section indicate that switching to a high-referring physician significantly increases patient referrals and healthcare utilization, but negatively affects patient health outcomes. Here, I briefly discuss some of the possible mechanisms underlying the negative association between high-referring physician practice style and patient health outcomes.

I find that physicians with high-referring practice style see more patients and work in smaller practices. This suggests that one possible explanation for the negative association between high-referring practice style and patient health outcomes is that these physicians have limited time to properly evaluate patients and coordinate patient care across providers. Moreover, these physicians might have fewer resources available within their practices to provide patient care themselves. For example, Huang & Ullrich (2021) find that availability of diagnostic tools is negatively associated with antibiotic prescriptions by physicians.

It is also possible that the negative relationship between high-referring practice style

[33]In Figure A12 in the Appendix I present the relationship between patient health outcomes (ED visits and mortality risk) and the difference in physician referring styles of new and original PCPs.

[34]Table A7 in the appendix presents these results for other healthcare utilization outcomes.

and patient health outcomes is a function of the number of providers involved in caring for patients. While a large literature associates healthcare fragmentation with poor outcomes (Cebul et al., 2008), recent studies suggest that the welfare impacts of high-fragmentation are not clear. For example, Agha et al. (2019) find that patients who move to a more fragmented region have more Emergency Department visits and hospitalizations, but these patients also have more vaccinations. At the same time, there is some evidence that suggests physicians with higher organizational concentration have lower healthcare utilization and provide better care for diabetes (Agha et al., 2021). Moreover, it is not clear if less fragmented or more integrated systems would lead to lower referrals. For example, a lower cost in terms of time and effort in communicating with specialists in integrated systems could potentially encourage PCPs to refer more.

Yet another explanation is that high referring physicians transfer patients who need primary care services to specialists who might not be trained to provide primary care services. [35] In my analysis I do not find that patients substitute away from primary care physicians to specialists as both primary care visits and specialists visits increase after switching to a high-referring physician. Finally, it is possible that physicians with low-referring style are better able to communicate with their patients reducing the need for referrals (Alsan et al., 2019). More work is needed to understand these mechanisms to design policies that lead to better patient outcomes.

VIII Conclusion

In this paper I examine the effect of physician referring style on patient referrals, healthcare utilization and patient outcomes. I find that PCP referring style explains around 41-50 percent of the variation in patient referrals across PCPs, with the remainder due to patient-related factors. I also find that switching to a PCP with high-referring practice style is associated with higher healthcare utilization and poor patient outcomes. While physician referring style has a significant impact on patient referrals, I have been careful to not interpret patient healthcare utilization and health outcomes results as the causal effect of the number of referrals as other physician characteristics might affect these outcomes as well. However, across specifications, I consistently find that high-referring physicians are linked to poor health outcomes.

I also find that physician referring style explains around 50 percent of the variation

[35] Heebsh (2020) finds that patients who are managed by integrated cardiologists have high mortality and hospitalization possibly because of lower quality of care provided to medically managed patients.

in Black patients' referrals indicating that both patient factors and physician factors are important in explaining the variation in referrals for Black patients. Overall, my results suggest that high-referring physicians might not be the key to reducing health disparities given that high-referring physicians are associated with poor health outcomes, but more work is needed to understand the mechanisms underlying this negative association between physician referring style and patient health outcomes.

There are a few limitations of this study. First, I focus on realized referrals where a referring physician referred their patients to another provider and the patient visited the other provider. Every referral may not end with a patient visiting another provider. Electronic health records could enable researchers to examine how PCPs affect patients adherence to referral recommendations. Second, I do not examine socioeconomic factors and geographical factors outside a physician's practice that might affect patient referrals. Third, my results do not speak to the appropriateness of referrals. In addition to the decision to refer, appropriateness of referrals is likely dependent on the choice of providers for a given condition. Moreover, I want to emphasize that my results do not suggest that referrals from all physicians should be reduced. While the results suggest that high-referring practice style is correlated with poor health outcomes, it is important to note that physician referring styles vary across disease groups so for different disease groups and individual patients, more referrals might be needed. Furthermore, referring physicians might vary in their underlying productivity leading them to use different quantity of resources to achieve the same output (Silver, 2021). More work is needed to understand the mechanisms that explain the negative association between high-referring physicians and patient outcomes.

Despite these limitations, overall my results suggest that physician referring style explains considerable variation in the number of referrals across PCPs. However, the policy implication of this result is not clear without understanding the mechanisms that underlie the negative association between physician-referring style and patient health outcomes. If, for example, the underlying mechanism is that fragmentation of care is leading to worse outcomes then training programs that encourage coordination and better communication across providers might be helpful. On the other hand, if this is due to time constraint and poor diagnostic skills then systems that aid physician decision making might help physicians provide better care. Moreover, the measure of physician referring style includes all the factors that might affect physician referring style including physician beliefs and organizational factors. While I find that high-referring physicians see more patients, work in smaller practices, and refer to a large number of providers, more work is needed to identify the role of these factors in

contributing to the variation in the physician referring styles to inform policies that limit unnecessary utilization and have a positive impact on patient health outcomes.

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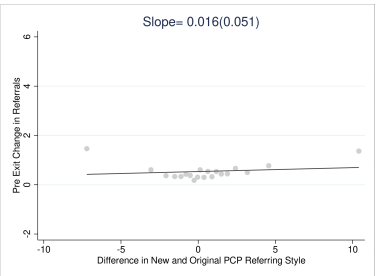
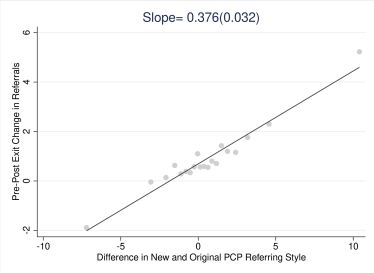
Figure 1: Differences in Referrals before and after PCP Exit for Patients affected by Physician Exit



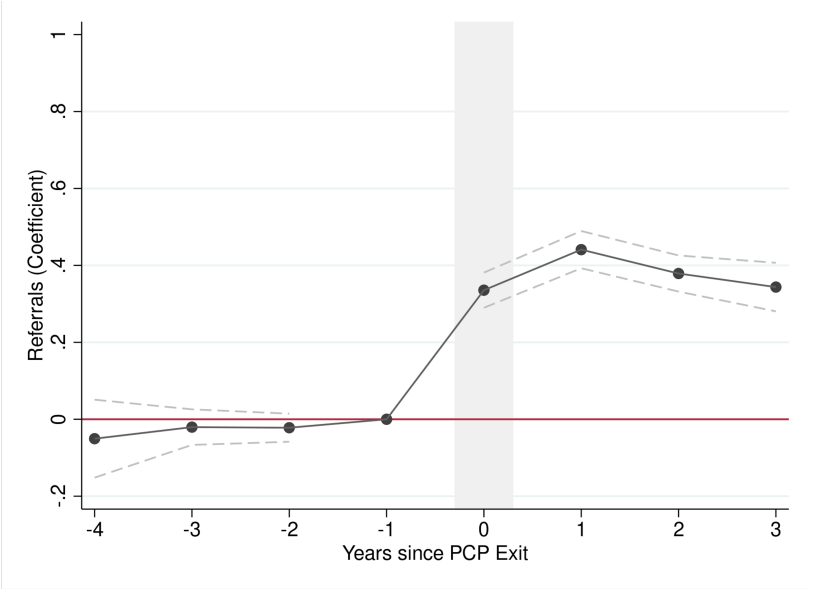
(a) Differences in referrals before PCP exit



(b) Change in referrals after PCP exit

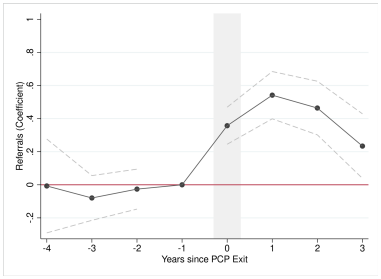
Notes: Figure (a) shows the level of pre-exit referrals for patients affected by physician exit by the size of Δ_i. For each patient affected by physician exit, I calculate the difference between the referring style of new and original PCP. I then group these into twenty groups. The x-axis shows the mean of Δ_i for patients affected by physician exit in each group. The y-axis shows the the difference in referrals at event times -1 and -3 where event times is defined relative to the year of physician exit. Figure (b) shows the mean of Δ_i on the x-axis and the difference in referrals at event times 1 and -1 on the y-axis. The line of best fit is obtained from OLS regression using the 20 groups.

Figure 2: Event Study for the Effect of Physician Referring Style on Patient Referrals

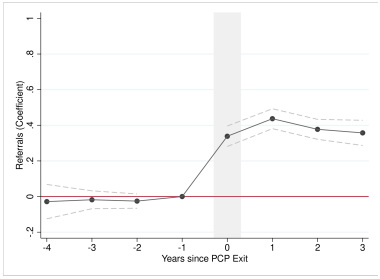


Notes: This figure shows the coefficients β_r estimated from equation (4) including controls for patient age, age squared, ESRD indicator, HMO months, Part A and Part B months. The dependent variable is the number of referrals. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero. The dashed lines present the upper and lower bounds of the 95% confidence interval. Regression includes controls for patient characteristics, indicators for years relative to physician exit, patient fixed effect, and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.

Figure 3: Event Study for the Effect of Physician Referring Style on Referrals for Black and White Patients



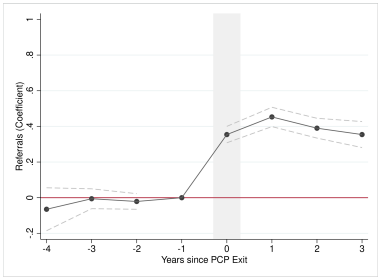
(a) Effect on referrals for Black patients



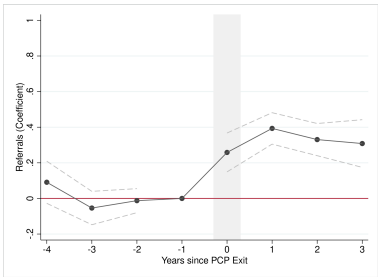
(b) Effect on Referrals for White patients

Notes: This figure shows the coefficients β_r estimated from equation (4) separately for Black patients in Figure (a) and for White patients in Figure (b). The dependent variable is the number of referrals. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero.The dashed lines present the upper and lower bounds of the 95% confidence interval. Regression includes controls for patient characteristics, indicators for years relative to physician exit, patient fixed effect, and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.

Figure 4: Event Study for the Effect of Physician Referring Style on Patient Referrals for within and outside original PCP practice moves



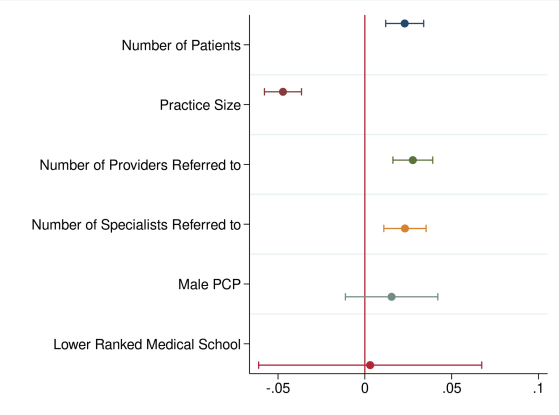
(a) Move to a PCP outside the original PCP's practice



(b) Move to a PCP within the original PCP's practice

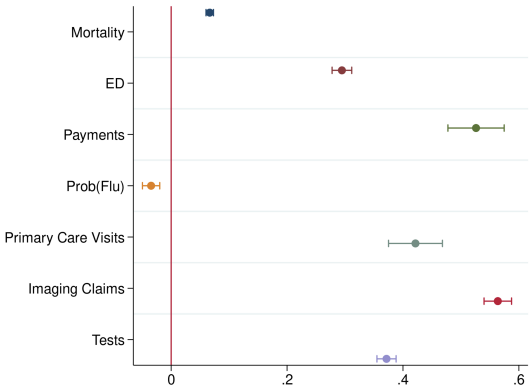
Notes: This figure shows the coefficients β_r estimated from equation (3) separately for switches outside original PCP's practice in Figure (a) and for switches to other PCP in original PCP's practice in Figure (b). The dependent variable is the number of referrals. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero. The dashed lines present the upper and lower bounds of the 95% confidence interval. Regression includes controls for patient characteristics, indicators for years relative to physician exit, patient fixed effect, and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.

Figure 5: Correlations between Average Physician Effects and Physician Characteristics



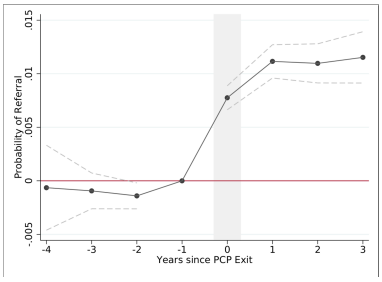
Notes: This figure presents estimates and 95% confidence intervals from bivariate OLS regressions of average physician effect on physician characteristics. Average physician effects come from a regression of the number of referrals on physician and patient fixed effects, and controls for patient age, age square, Part A and Part B months, HMO months,ESRD indicator and Elixhauser Index. In the regressions reported in the figure the unit of observation is a physician. Number of patients is the average of the number of unique patients assigned to PCP over the years. Practice size is the average number of providers in the practice that physician is assigned to where practices are identified from Tax Identification Numbers. Number of providers and number of specialists are average number of unique providers and specialists a physician refers to. Male PCP equals 1 if the physician is Male and 0 if the physician is Female. Lower Ranked Medical School is the estimate from a regression limited to providers from bottom twenty medical schools and top twenty medical schools. All variables (except Male PCP and Lower Ranked Medical School) are standardized to have a mean of 0 and standard deviation of 1.

Figure 6: Correlations between Average Physician Effects and Other Practice Style Measures

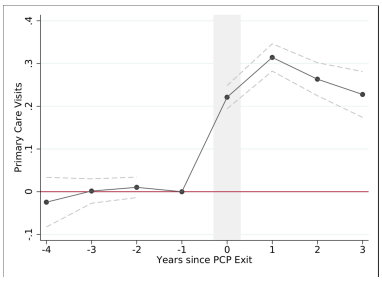


Notes: This figure presents estimates and 95% confidence intervals from bivariate OLS regressions of average physician effect on other practice style measures. Average physician effects come from a regression of the number of referrals on physician and patient fixed effects, and controls for patient age, age square, Part A and Part B months, HMO months,ESRD indicator and Elixhauser Index. I estimate physician fixed effects on mortality, emergency department visits, payments, probability of flu immunization, primary care visits, imaging claims, and lab test in the same manner. Each dot in this figure is from a separate regression with average physician effect on referrals as the dependent variable. All variables are standardized to have a mean of 0 and standard deviation of 1.

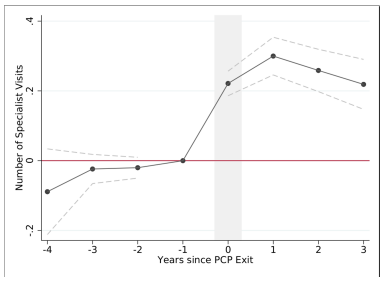
Figure 7: Event Study Graphs for the Effect of Physician Referring Style on Healthcare Utilization



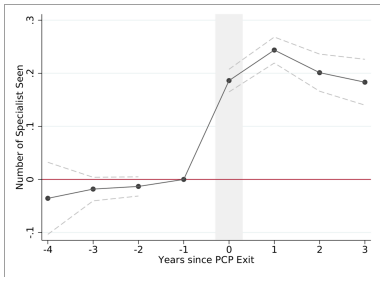
(a) Effect on the Probability of Any Referral



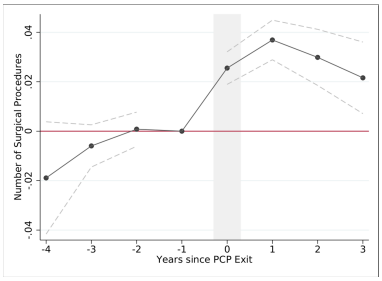
(b) Effect on the Number of Primary Care Visits



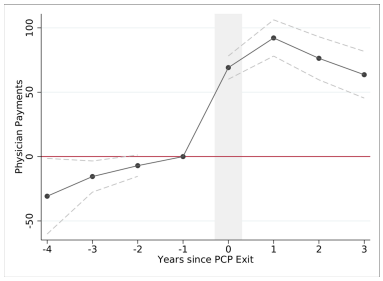
(c) Effect on the Number of Specialist Visits



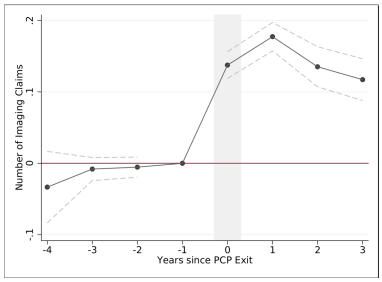
(d) Effect on the Number of Specialists Seen



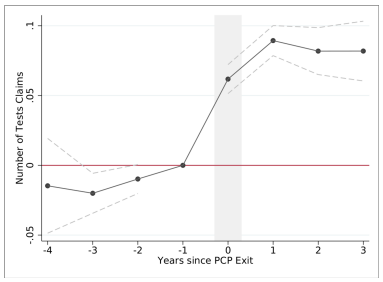
(e) Effect on the Number of Surgical Procedures



(f) Effect on the Physician Payments



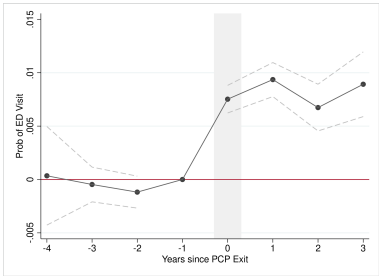
(g) Effect on the Number of Imaging Claims



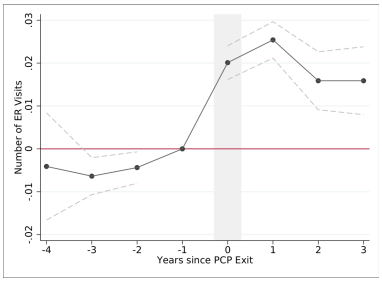
(h) Effect on the Number of Test Claims

Notes: This figure shows the coefficients β_r estimated from equation (3) separately for patient health care utilization measures. The dependent variable is the number of y_{it} and for payments the dependent variable is sum of physician payments. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero. The dashed lines present the upper and lower bounds of the 95% confidence interval. Regression includes controls for patient characteristics, indicators for years relative to physician exit, patient fixed effect, and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.

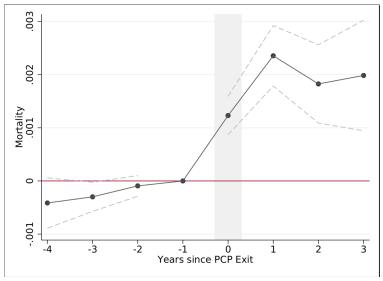
Figure 8: Event Study Graphs for the Effect of Physician Referring Style on Patient Health Outcomes



(a) Probability of any ED Visit



(b) Effect on the Number of ED Visits



(c) Effect on 3-Year Mortality Risk

Notes: This figure shows the effect of physician referring style on patient health outcomes. Probability of any ED visits is an indicator variable that equals 1 if the patient has non-zero number of ED visits in that year and is 0 otherwise. ED visits is the number of Emergency Department (ED) visits. Mortality is equal to 1 for the year the patient dies and zero otherwise. The x-axis shows years relative to physician exit. The The dashed lines present the upper and lower bounds of the 95% confidence interval. Regression includes controls for patient characteristics, indicators for years relative to physician exit, patient fixed effect, and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.

Table 1: Summary Statistics

	Patients affected by PCP Exit	Patients not affected by PCP Exit
Patient Demographics		
Age	76.85(7.69)	76.36(8.09)
Black	0.08(0.27)	0.08(0.27)
Male	0.39(0.48)	0.40(0.49)
Part A coverage (months)	11.74(1.37)	11.53(1.79)
Part B coverage(months)	11.72(1.42)	11.48(1.86)
HMO coverage (months)	0.08(1.41)	0.08(1.37)
ESRD	0.05(0.07)	0.06(0.08)
Patient Healthcare Utilization and Outcomes Per Year		
Number of Referrals	5.00(8.49)	5.01(8.47)
Number of Primary Care Visits	5.40(6.26)	6.49(6.83)
Number of ED visits	0.50(1.18)	0.52(1.19)
Number of Specialist Visits	7.70(9.74)	7.27(9.32)
Number of Specialists Seen	6.27(5.69)	6.30(5.71)
Sum of Physician Payments	1643.18(2845.16)	1681.29(2758.21)
Number of Surgical Procedures	1.75(2.58)	1.74(2.57)
Number of Imaging Claims	3.23(4.24)	3.38(4.38)
Number of Tests Claims	4.43(4.36)	4.67(4.36)
Pr(Flu)	0.23(0.42)	0.24(0.43)
Physician Referring Style		
Physician Referring Style	4.70(2.94)	5.01(2.99)
Patients	70,115	5,455,652
Observations=Patients× years	334,136	14,503,023

Notes: This table presents summary statistics for patient characteristics and healthcare utilization for patients affected by PCP exit in Column 1 and for patients not affected by PCP exit in Column 2. PCP exit include physician relocation and retirement. Part A coverage, Part B Coverage, and HMO coverage is the number of months in a year patient was covered by these insurance types. ESRD is an indicator that equals 1 if the patient is diagnosed with End Stage Renal Disease in that year. Patient healthcare utilization measures are based on patient-level observations. Sum of physician payments is the sum of payments to providers from the Carrier File. Pr(Flu) is the probability of getting influenza immunization. Patient demographics are obtained from Master Beneficiary Summary File and patient healthcare utilization measures are based on 20% Carrier File for the years 2008 to 2012. Physician referring style is a time invariant measure of physician referring style that is computed by taking the average of the number of referrals across all patients assigned to that PCP in each year and then taking a simple average across the sample years.

Table 2: Effect of Physician Referring Style on Patient Referrals

	Full Sample	Full Sample With Controls	Patients with 12 mths Part A and Part B	C and S(2020)
$\Delta_i * Post_{it}$	0.411^{***}	0.414^{***}	0.395^{***}	0.410^{***}
	(0.020)	(0.023)	(0.023)	(0.032)
Standard Deviation of Δ_i	3.738	3.738	3.738	3.738
Mean of DV	4.723	4.723	4.723	4.723
Patient Characteristics		x	x	
N	262,927	262,927	248,414	262,927

Notes: The estimates report the effect of physician referring style on patient referrals for patients affected by physician exit. Regressions are at the patient-year level. The dependent variable is the number of referrals for patient i in year t. Δ_i is the difference between referring styles of new and original PCP where physician referring style is a time-invariant measure of physician referring style based on their patients referrals. $Post_{it}$ equals one for event times greater than and equal to one and is zero for event times less than zero. As patients have not fully transitioned to the new PCP at event time 0, it is excluded from these regressions. Column 1 includes the full sample of patients affected by PCP exit. Column 2 includes controls for patient age, age-squared, HMO months, Part A and Part B months, ESRD indicator. Column 3 restricts the sample to patients who have twelve months for coverage for Part A and Part B in any given year. Column 4 follows Callaway and SantAnna(2020) by allowing for heterogeneous treatment effects to estimate the average treatment effect on the treated. Mean of DV is the mean of the dependent variable 1 year before physician exit. All regressions include an indicator for post, year fixed effects and patient fixed effects. Standard errors are clustered at the Hospital Referral Region level.$***p < 0.001, **p < 0.01, *p < 0.05$.

Table 3: Effect of Physician Referring Style on Patient Referrals by Disease System

Less Discretion			More Discretion		
	Neoplasms	Genitourinary	Circulatory	Respiratory	Endocrine
$\Delta_i * Post_{it}$	0.026^{****}	0.053^{***}	0.262^{***}	0.127^{***}	0.124^{***}
	(0.009)	(0.011)	(0.017)	(0.035)	(0.016)
Standard Deviation of Δ_i	1.740	1.455	1.141	1.363	0.722
Mean of DV	0.404	0.298	0.758	0.249	0.219
N	261,825	262,443	262,802	262,746	262,583

Notes: The estimates report the effect of physician referring style on patient referrals by disease diagnosis. ICD-9 for primary diagnosis are grouped into large disease categories following AHRQ definitions of clinically meaningful categories (CCS). This table presents results for five groups that contain some of the main chronic conditions affecting patient over the age of 65. Neoplasms include cancer diagnosis,circulatory system include heart disease, respiratory system include diagnosis for lung disease,endocrine include diabetes and thyroid disease management, and genitourinary include kidney diseases. Neoplasms and Genitourinary diseases are grouped under less discretion as PCPs are less likely to treat these diseases by themselves. Circulatory, Respiratory, and Endocrine are labeled as more discretion as these disease groups contain diseases that PCPs can potentially treat as well allowing for more physician discretion in referring patients. The dependent variable is the number of referrals for particular disease group. Δ_i is the difference between referring style of new and original PCP for particular disease group. $Post_{it}$ equals one for event times greater than and equal to one and is zero for event times less than zero. Mean of DV is the mean of the dependent variable 1 year before physician exit. All regressions includes controls for patient age, age-squared, HMO months, Part A and Part B months, ESRD indicator. All regressions include an indicator for post, year fixed effects and patient fixed effects. Standard errors are clustered at the Hospital Referral Region (HRR) level.$***p < 0.001, **p < 0.01, *p < 0.05$.

Table 4: Effect of Physician Referring Style on Patient Referrals by Patient Race

	All	Black Patients	White Patients
$\Delta_i \times Post_{it}$	0.414^{***}	0.496^{***}	0.414^{***}
	(0.020)	(0.057)	(0.022)
Standard Deviation of Δ_i	3.738	4.232	3.654
Mean of DV	4.723	4.405	4.798
N	262,927	21,442	228,561

Notes: The estimates report the effect of physician referring style on patient referrals by patient race. The dependent variable is the number of referrals for patient i in year t. Δ_i is the difference between referring style of new and original PCP. $Post_{it}$ equals one for event times greater than and equal to one and is zero for event times less than zero. Column 1 presents the results for the full sample, Column 2 presents the results for Black patients and Column 3 presents the results for White patients. Mean of DV is the mean of the dependent variable 1 year before physician exit.All regressions includes controls for patient age, age-squared, HMO months, Part A and Part B months, ESRD indicator. All regressions include an indicator for post, year fixed effects and patient fixed effects. Standard errors are clustered at the Hospital Referral Region (HRR) level.$***p < 0.001, **p < 0.01, *p < 0.05$.

Table 5: Effect of Physician Referring Style on Patient Referrals for Switches to New PCPs within and outside original PCP's practice

	Different Practice	Same Practice	Practice Fixed Effect
$\Delta_i \times Post_{it}$	0.423^{***}	0.373^{***}	0.358^{***}
	(0.022)	(0.036)	(0.0276)
N	159,570	103,357	246,638

Notes: The estimates report the effect of physician referring style on patient referrals for patients who switch to new PCPs within and outside original PCP's practice. Around 60 percent of the patients switch to a new PCP outside original PCP's practice.The dependent variable is the number of referrals for patient i in year t. Δ_i is the difference between referring style of new and original PCP. $Post_{it}$ equals one for event times greater than and equal to one and is zero for event times less than zero. Column 1 presents the results for switches outside original PCP's practice and Column 2 presents the results for switches within original PCP's practice. Column 3 uses the full sample and includes a practice fixed effect. All regressions includes controls for patient age, age-squared, HMO months, Part A and Part B months, ESRD indicator. All regressions include an indicator for post, year fixed effects and patient fixed effects. Standard errors are clustered at the Hospital Referral Region (HRR) level.$***p < 0.001, **p < 0.01, *p < 0.05$.

Table 6: Effect of Physician Referring Style on Patient Healthcare Utilization

	Full Sample	Black Patients	White Patients
Probability of Any Referral	0.012***	0.014***	0.011***
	(0.001)	(0.002)	(0.001)
Mean of DV	0.677	0.630	0.687
Number of Primary Care Visits	0.274***	0.369***	0.268***
	(0.016)	(0.044)	(0.018)
Mean of DV	5.483	5.993	5.401
Number of Specialist Visits	0.280***	0.462***	0.266***
	(0.024)	(0.059)	(0.025)
Mean of DV	7.318	7.092	7.395
Number of Specialists Seen	0.224***	0.290***	0.221***
	(0.013)	(0.031)	(0.014)
Mean of DV	6.062	5.909	6.116
Number of Surgical Procedures	0.033***	0.048***	0.032***
	(0.004)	(0.011)	(0.004)
Mean of DV	1.709	1.365	1.771
Payments	86.048***	130.251***	82.175***
	(6.230)	(19.419)	(6.267)
Mean of DV	1524.009	1466.72	1530.37
Number of Imaging Claims	0.157***	0.214***	0.153***
	(0.009)	(0.025)	(0.010)
Mean of DV	3.086	3.145	3.101
Number of Tests Claims	0.091***	0.129***	0.090***
	(0.005)	(0.017)	(0.006)
Mean of DV	4.338	4.209	4.382
N	262,927	21,442	228,561

Notes: This tables presents the estimates for the effect of switching to a high referring physician on patient healthcare utilization.Column 1 presents the results for the full sample, Column 2 presents the results for Black patients and Column 3 presents the results for White patients. Probability of referrals equals 1 if the patient had at least 1 referral in that year and is zero otherwise. Number of primary care visits is the number of visits with physicians working in primary care specialities. Number of specialist visits is the number of visits with a specialist. Number of specialist seen is the number of unique specialists seen. Number of surgical procedures is the number surgical procedures. Payments is the amount paid to the providers. Number of imaging claims is the number of imaging claims. Number of tests claims is the the number of tests claims. Mean of DV is the mean of the dependent variable 1 year before physician exit. Regressions include controls for patient-time varying factors,an indicator for post, patient fixed effect and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.$***p < 0.001, **p < 0.01, *p < 0.05$.

Table 7: Effect of Physician Referring Style on Patient Health Outcomes

	Full Sample	Black Patients	White Patients
Probability of any ED Visits	0.008^{***}	0.007^{***}	0.009^{***}
	(0.001)	(0.002)	(0.001)
Mean of DV	0.266	0.344	0.258
Number of ED Visits	0.024^{***}	0.042^{***}	0.022^{***}
	(0.002)	(0.009)	(0.002)
Mean of DV	0.479	0.690	0.457
Mortality	0.002^{***}	0.002^{***}	0.002^{***}
	(0.000)	(0.001)	(0.000)
Mean of DV	0.065	0.070	0.065

Notes: This tables presents the estimates for the effect of switching to a high referring physician on patient health outcomes. Probability of any ED visits is an indicator variable that equals 1 if the patient has non-zero number of ED visits in that year and is 0 otherwise. Number of ED visits is the number of visits to the Emergency Department Visits. Mortality is equal to 1 if the patient died in that year. Regressions include controls for patient-time varying factors, an indicator for post, patient fixed effect and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.$***p < 0.001, **p < 0.01, *p < 0.05$.

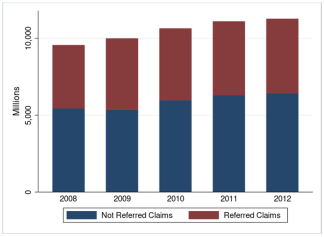
Table 8: Effect of Physician Referring Style on Patient Health Outcomes Controlling for Other Physician Characteristics

Prob of	0.008***	0.003***	0.004***
ED Visits	(0.001)	(0.001)	(0.001)
Mean of DV	0.266		
Number of	0.024***	0.010***	0.015***
ED Visits	(0.002)	(0.003)	(0.004)
Mean of DV	0.479		
Mortality	0.002***	0.001^a	0.001
	(0.000)	(0.000)	(0.001)
Mean of DV	0.065		
Other Practice Styles		x	x
Practice Characteristics			x
N	262877	262877	168814

Notes: This tables presents the estimates for the effect of switching to a high-referring physician on patient health outcomes controlling for other physician characteristics. Probability of any ED visits is an indicator variable that equals 1 if the patient has non-zero number of ED visits in that year and is 0 otherwise. Number of ED visits is the number of visits to the Emergency Department Visits. Mortality is equal to 1 if the patient died in that year. Column 2 includes controls for physician practice styles for primary care, flu vaccinations, imaging, tests, and payments. Column 3 includes controls for physician practice styles and other characteristics including the number of patients seen, practice size, and the number of providers in the network. There are fewer observations in the Column 3 as physician characteristics are not available for every year. Regressions include controls for patient-time varying factors, an indicator for post, patient fixed effect and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.$***p < 0.001, **p < 0.01, *p < 0.05ap < 0.10$.

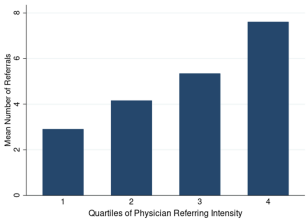
IX Appendix

Figure A1: Provider payments for Referred and Not Referred Claims



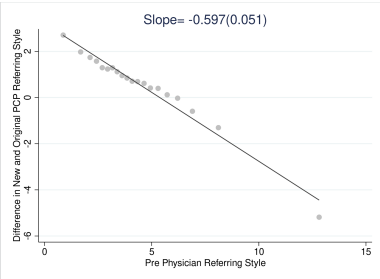
Notes: This figure presents the total provider payments for referred and not-referred claims in each year. The y-axis is in millions of dollars.

Figure A2: Mean Number of Referrals by Physician Referring Style



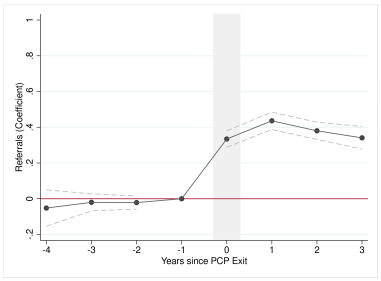
Notes: This figure presents the mean number of referrals by quartiles of physician referring style. Physician referring style is a time invariant measure of physician referring style that is computed by taking the average of the number of referrals across all patients assigned to that PCP in each year and then taking a simple average across the sample years.

Figure A3: Mean Reversion in Physician Referring Style

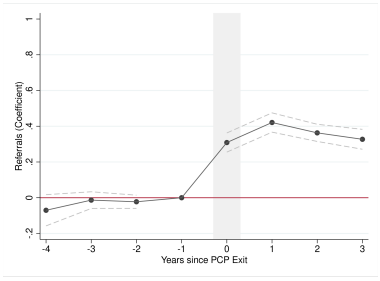


Notes: The figure presents the change in physician referring style relative to the referring style of the original PCP. I group original PCP's referring style into 20 equal sized bins. The x-axis shows the mean of PCP referring style for each of these groups. The y-axis shows the mean change in the referring style of new and original PCPs. The line of best fit is obtained from OLS regression using the 20 groups.

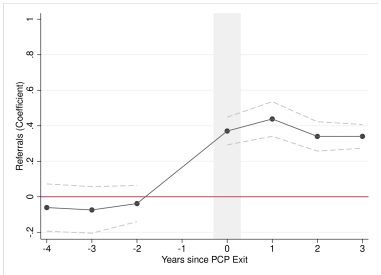
Figure A4: Effect of Physician Referring Style on Patient Referrals-Robustness



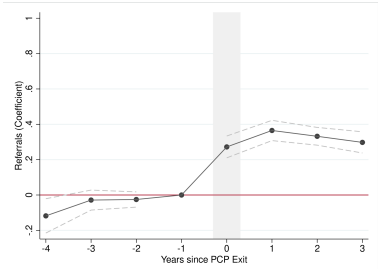
(a) No Controls



(b) Full Part A and Part B Coverage



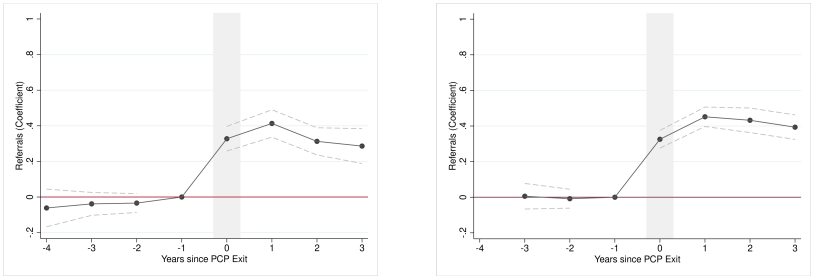
(c) Callaway and Sant'Anna (2020)



(d) Excluding patients who exit sample due to death

Notes: Figure (a) shows the coefficients from estimating equation (4) without controlling for patient time-varying factors. Figure (b) shows the coefficients from estimating equation (4) on the sample of patients who had full 12 months Part A and Part B Coverage. Figure (c) shows the coefficients from following Callaway and Sant'Anna (2020). I estimate event studies separately for each cohort using equation (3) and then aggregate the estimates by cohort size. Figure (d) shows the coefficients after excluding the patients who exit the sample due to patient death. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero. The dashed lines present the upper and lower bounds of the 95% confidence interval. Standard errors are clustered at the Hospital Referral Region (HRR) level.

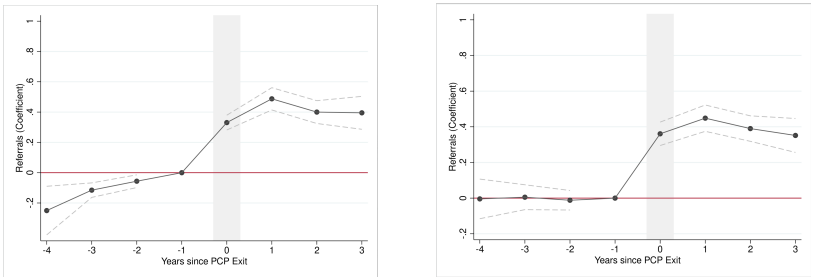
Figure A5: Effect of Physician Referring Style on Patient Referrals by Type of Physician Exit



(a) Physician Relocation (b) Physician Retirement

Notes: Figure (a) shows the coefficients from estimating equation (4)for patients affected by physician relocation where relocation is defined as change in the first two digits of physician zip code from one year to the next. Figure (b) shows the coefficients from estimating equation (4) for patients affected by physician retirement where retirement is defined as physician having at least one claim in prior years and no claims in 2012. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero. The dashed lines present the upper and lower bounds of the 95% confidence interval. Standard errors are clustered at the Hospital Referral Region (HRR) level.

Figure A6: Effect of Physician Referring Style on Patient Referrals by Original PCP Referring Style

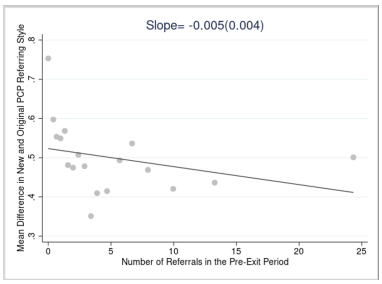


(a) Original PCP's Average Number of Referrals Below Median

(b) Original PCP's Average Number of Referrals Above Median

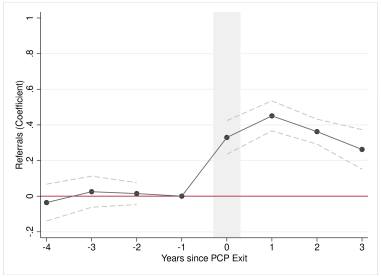
Notes: Figure (a) shows the coefficients from estimating equation (4)for patients affected whose original PCP's referring style was below median of the distribution of the original PCP referring styles. Figure (b) shows the coefficients from estimating equation (4)for patients affected whose original PCP's referring style was above median of the distribution of the original PCP referring styles. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero. The dashed lines present the upper and lower bounds of the 95% confidence interval. Standard errors are clustered at the Hospital Referral Region (HRR) level.

Figure A7: Correlation between the number of referrals in the pre-exit period and Δ_i

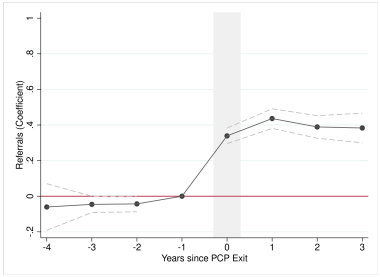


Notes: This figure shows the relationship between the number of referrals in the pre-physician exit period and the mean difference in new and original PCP referring style. I group patients into twenty equally sized groups based on the number of referrals in the pre-exit period. On the x-axis is the mean number of referrals for each of these groups. On the y-axis is the mean change in the physician referring style calculated of each of the group.

Figure A8: Effect of Physician Referring Style on Patient Referrals by Patient Risk



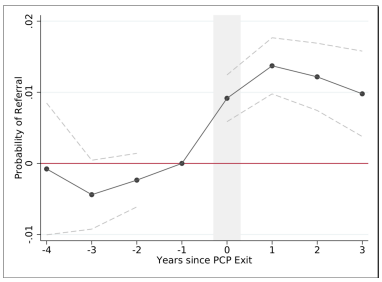
(a) Average Elixhauser Index Below Median in the Pre-Period



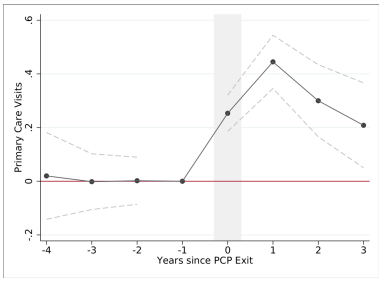
(b) Average Elixhauser Index Above Median in the Pre-Period

Notes: The figures shows the coefficients from estimating equation (4) separately by patient risk. Patient risk is measured by the average Elixhauser index in the pre-exit period. Higher values of Elixhauser index indicate patient has higher risk of mortality and in-hospital expenditures. Low risk patients are patients whose average Elixhauser index is below median in the pre-period and high risk patients are patients whose average Elixhauser index is above median in the pre-period. Figure (a) shows the coefficients from estimating equation (4) for patients who were lower risk in the pre-period . Figure (b) shows the coefficients from estimating equation (4) for patients who were higher risk in the pre-period, The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero.The dashed lines present the upper and lower bounds of the 95% confidence interval. Standard errors are clustered at the Hospital Referral Region (HRR) level.

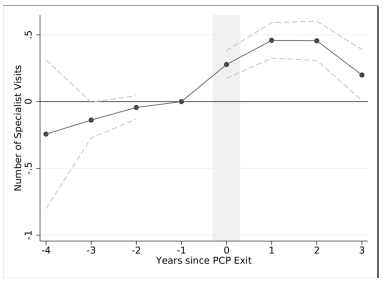
Figure A9: Event Study Graphs for the Effect of Physician Referring Style on Healthcare Utilization for Black Patients



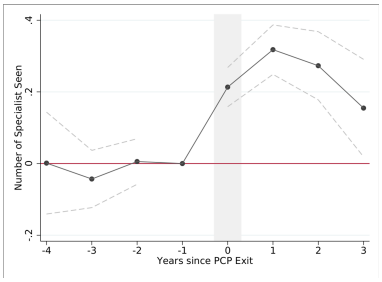
(a) Effect on the Probability of Any Referral



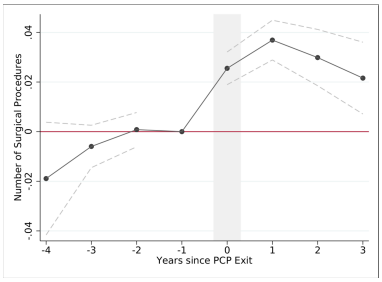
(b) Effect on the Number of Primary Care Visits



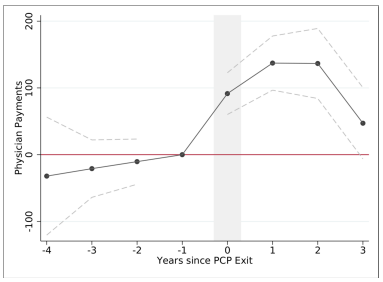
(c) Effect on the Number of Specialist Visits



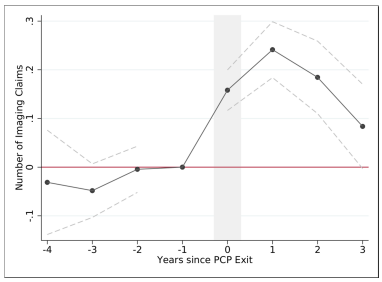
(d) Effect on the Number of Specialists Seen



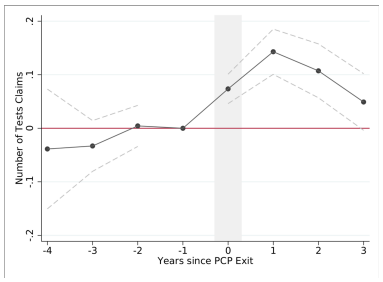
(e) Effect on the Number of Surgical Procedures



(f) Effect on the Physician Payments



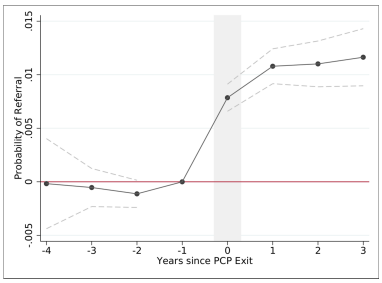
(g) Effect on the Number of Imaging Claims



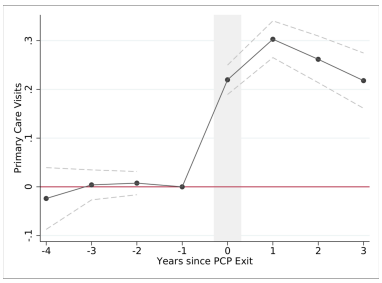
(h) Effect on the Number of Test Claims

Notes: This figure shows the coefficients β_r estimated from equation (4) separately for patient health care utilization measures for Black Patients. The dependent variable is the number of y_{it}, sum of physician payments for payments, and and indicator variable for the probability of referral. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero. The dashed lines present the upper and lower bounds of the 95% confidence interval.Regressions include controls for patient characteristics, patient fixed effect, and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.

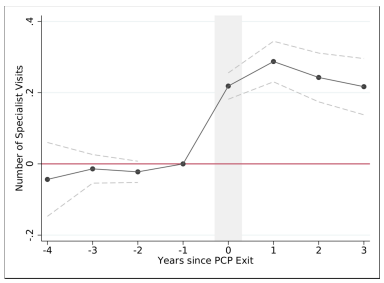
Figure A10: Event Study Graphs for the Effect of Physician Referring Style on Healthcare Utilization for White Patients



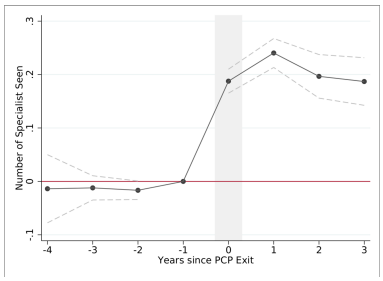
(a) Effect on the Probability of Any Referral



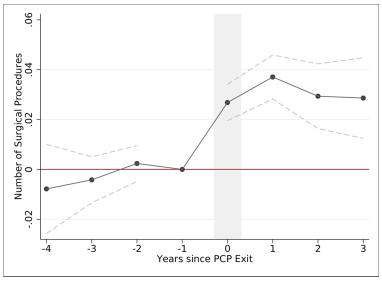
(b) Effect on the Number of Primary Care Visits



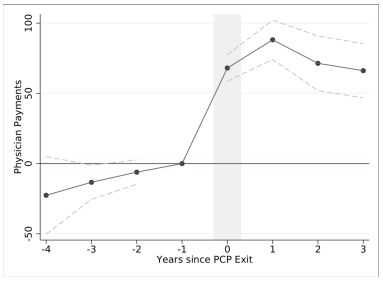
(c) Effect on the Number of Specialist Visits



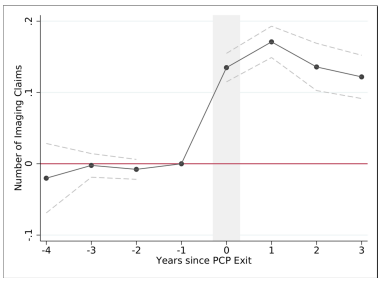
(d) Effect on the Number of Specialists Seen



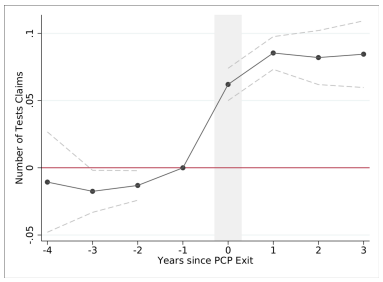
(e) Effect on the Number of Surgical Procedures



(f) Effect on the Physician Payments



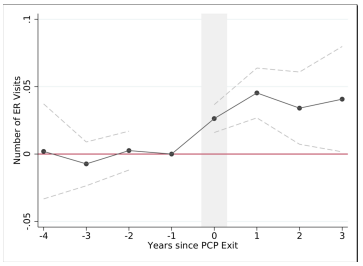
(g) Effect on the Number of Imaging Claims



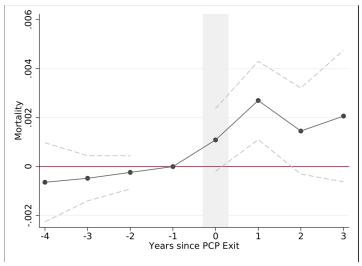
(h) Effect on the Number of Test Claims

Notes: This figure shows the coefficients β_r estimated from equation (4) separately for patient health care utilization measures for White patients. The dependent variable is the number of y_{it}, sum of physician payments for payments, and and indicator variable for the probability of referral. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero. The dashed lines present the upper and lower bounds of the 95% confidence interval. Regressions include controls for patient characteristics, patient fixed effect, and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR)level.

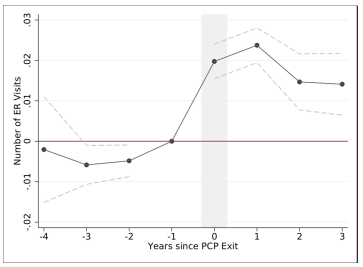
Figure A11: Event Study Graphs for the Effect of Physician Referring Style on Patient Health Outcomes for Black and White Patients



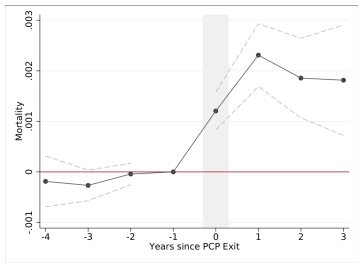
(a) Number of ER Visits-Black Patients



(b) 3-Year Mortality Risk-Black Patients



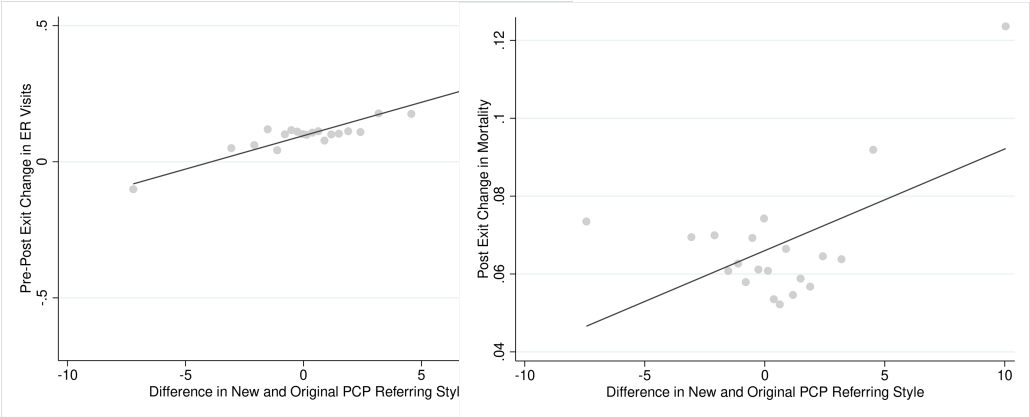
(c) Number of ER Visits-White Patients



(d) 3-Year Mortality Risk-White Patients

Notes: This figure shows the effect of physician referring style on patient health outcomes for Black patients in the top panel and for White patients in the bottom panel.ER visits is the number of ER visits.Mortality is equal to 1 for the year the patient dies. The x-axis shows years relative to physician exit. The coefficient for relative year -1 is normalized to zero. The dashed lines present the upper and lower bounds of the 95% confidence interval. Regressions include controls for patient characteristics, patient fixed effect, and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.

Figure A12: Differences in Patient Outcomes after PCP Exit for Patients affected by Physician Exits



(a) Change in ED Visits after PCP Exits

(b) Mortality Risk after PCP Exits

Notes: Figure (a) shows the difference in the number of Emergency Department visits at event time 1 and -1. For each patient affected by physician exit, I calculate the difference between the referring style of new and original PCP. I then group these into twenty groups. The x-axis shows the mean of Δ_i for patients affected by physician exit in each group. Figure (b) plots the average mortality risk by the difference in New and Original PCP referring style in the post-exit period. By construction, patients cannot die before beings assigned to the new PCP. The y-axis shows the mean mortality risk for each of these 20 groups. The line of best fit is obtained from OLS regression using the 20 groups.

Table A1: Effect of Physician Referring Style on Patient Referrals-Broader definition of PCP

	Full Sample	Full Sample With Controls	Patients with 12 mths Part A and Part B
$\Delta_i * Post_{it}$	0.574^{***}	0.577^{***}	0.549^{***}
	(0.014)	(0.014)	(0.015)
Mean of DV	4.027		
Patient Characteristics		x	x
N	289791	289791	261,692

Notes: The estimates report the effect of physician referring style on patient referrals. This is similar to Table 2 in the main text but instead of limiting primary care physicians in the specialities of internal medicine, family practice, general practice, and geriatrics, I include any specialist with whom the patient has the highest number of evaluation and management visits as the main PCP. The dependent variable is the number of referrals for patient i in year t. Δ_i is the difference between referring style of new and original PCP. $Post_{it}$ equals one for event times greater than and equal to one and is zero for event times less than zero. Column 1 includes the full sample of patients affected by PCP exit. Column 2 includes controls for All regressions include control for patient age, age squared, HMO months, Part A and Part B coverage months, and ESRD indicator. Column 3 restricts the sample to patients who have twelve months for coverage for Part A and Part B in any given year. Regressions include an indicator for post, year fixed effect and patient fixed effects. Standard errors are clustered at the Hospital Referral Region (HRR)level.$***p < 0.001, **p < 0.01, *p < 0.05$.

Table A2: Effect of Physician Referring Style on Patient Referrals-Robustness to alternate samples

	Log Referrals	eventtime $-1\&1$	eventtime $-2\&2$	$-50 <= \Delta_i <= 50$
$\Delta_i * Post_{it}$	0.385^{***}	0.433^{***}	0.418^{***}	0.406^{***}
	(0.012)	(0.027)	(0.020)	(0.018)
Patient Characteristics	x	x	x	x
N	262,927	120,532	215,388	262,886

Notes: The estimates report the effect of physician referring style on patient referrals using alternate functional forms and sample. This is similar to Table 2 in the main text but instead of using referrals in the first column the dependent variable is log of referrals plus 1. In the second column, the dependant variable is referrals but the sample is limited to event time -1 & 1. In the third column ,the dependant variable is referrals but the sample is limited to event time -2 & 2. In the fourth column the dependant variable is referrals but the sample is limited to pairs where the difference between new and original PCP referring style is between -50 and 50 to ensure the results are not driven by outliers. All regressions include control for patient age, age squared, HMO months, Part A and Part B coverage months, and ESRD indicator. Regressions include an indicator for post, year fixed effects and patient fixed effects. Standard errors are clustered at the Hospital Referral Region (HRR) level.$***p < 0.001, **p < 0.01, *p < 0.05$.

Table A3: Effect of Physician Referring Style on Patient Referrals-Without Bayesian Shrinkage

	Full Sample	Full Sample With Controls	Patients with 12 mths Part A and Part B
$\Delta_i * Post_{it}$	0.407***	0.409***	0.391***
	(0.019)	(0.019)	(0.023)
Mean of DV	0.921	0.921	0.921
Patient Characteristics		x	x
N	262,922	262,922	248,409

Notes: The estimates report the effect of physician referring style on patient referrals without applying Bayesian Shrinkage to the physician referring style. This is similar to Table 2 in the main text. The dependent variable is the number of referrals for patient i in year t. Δ_i is the difference between referring styles of new and original PCP where physician referring style is a time-invariant measure of physician referring style based on their patients referrals. $Post_{it}$ equals one for event times greater than equal to one and is zero for event times less than zero. As patients have not fully transitioned to the new PCP at event time 0, it is excluded from these regressions. Column 1 includes the full sample of patients affected by PCP exit. Column 2 includes controls for patient age, age-squared, HMO months, Part A and Part B months, ESRD indicator. Column 3 restricts the sample to patients who have twelve months for coverage for Part A and Part B in any given year. Mean of DV is the mean of the dependent variable 1 year before physician exit. All regressions include an indicator for post, year fixed effect and patient fixed effects. Standard errors are clustered at the Hospital Referral Region level.$***p < 0.001, **p < 0.01, *p < 0.05$.

Table A4: Disease System

1	Infections and parasitic diseases	Tuberculosis
2	Neoplasms	Cancers of stomach, colon,Leukemias
3	Endocrine,nutritional, and metabolic diseases	Thyroid disorders, Diabetes
4	Diseases of the blood and blood-forming organs	Anemia
5	Mental Illness	Anxiety disorders
6	Diseases of the nervous system and sense organs	Parkinsons
7	Diseases of the circulatory system	Hypertension,diseases of the heart
8	Diseases of the respiratory system	Chronis sinusitis, Asthma
9	Diseases of the digestive system	gastritis;abdominal hernia
10	Disease of the genitourinary system	renal failure, infections of kidney
11	Complications of pregnancy; childbirth	sterilization; abortion-related disorders
12	Diseases of the skin and subcutaneous tissue	cellulitis
13	Diseases of the musculoskeletal system and connective tissue	arthritis;non-traumatic joint disorders
14	Congenital anomalies	
16	Injury and poisoning	
17	Symptoms; signs; and ill-defined conditions	Fever of unknown origin
18	Residual codes	

Notes: This tables includes details of 18 CCS diagnosis category labels with some examples of diagnosis included in each category.

Table A5: Effect of Physician Referring Style by Disease System and Patient Race

	Neoplasms	Circulatory	Respiratory	Endocrine	Genitourinary
Panel A: Black Patients					
$\Delta_i * Post_{it}$	0.026***	0.316***	0.138***	0.188***	0.056***
	(0.016)	(0.058)	(0.059)	(0.039)	(0.019))
Standard Deviation of Δ_i	2.358	1.259	1.520	1.687	0.782
Mean of DV	0.368	0.845	0.266	0.432	0.324
N	21,271	21,428	21,409	21,271	21,394
Panel B: White Patients					
$\Delta_i * Post_{it}$	0.028***	0.264***	0.133***	0.115***	0.052***
	(0.012)	(0.019)	(0.036)	(0.017)	(0.013)
Standard Deviation of Δ_i	1.648	1.124	1.350	1.421	0.715
Mean of DV	0.432	0.821	0.291	0.319	0.218
N	227,803	228,469	228,441	228,228	228,186

Notes: The estimates report the effect of physician referring style on patient referrals by disease diagnosis.Panel A presents the estimates for Black patients and Panel B presents the estimates for White patients. The dependent variable is the number of referrals for particular disease group. Δ_i is the difference between referring style of new and original PCP for particular disease group. $Post_{it}$ equals one for event times greater than equal to one and is zero for event times less than zero. All regressions includes controls for patient age, age-squared, HMO months, Part A and Part B months, ESRD indicator. Regressions include an indicator for post, year fixed effects and patient fixed effects. Standard errors are clustered at the Hospital Referral Region (HRR) level.

Table A6: Physician Characteristics by Patient Race

	Black Patients	White Patients
Physician Referring Style	4.796	4.716
Number of Patients Assigned	33.78	37.85
Practice Size	110.493	100.075
Network of Providers	41.48	48.81
Network of Specialists	34.81	40.24

Notes: This table presents the summary statistics for primary care physicians of patients in my sample. The first column presents statistics for original and new PCPs for Black patients and the second column presents the same statistics for White patients. Across characteristics, physicians that treat Black patients are statistically different from physicians that treat White patients.

Table A7: Effect of Physician Referring Style on Healthcare utilization Controlling for Other Physician Characteristics

Probability of a Referral	0.010***	0.013***
	(0.001)	(0.001)
Primary Care Visits	0.028	0.082***
	(0.019)	(0.025)
Specialist Visits	0.132***	0.190***
	(0.032)	(0.190)
Number of Unique Specialists Seen	0.117***	0.158***
	(0.013)	(0.020)
Number of Surgical Procedures	0.008	0.009
	(0.005)	(0.007)
Payments	18.882*	32.114***
	(8.123)	(8.865)
Imaging Claims	0.046***	0.059***
	(0.010)	(0.016)
Tests Claims	0.025**	0.032**
	(0.009)	(0.011)
Other Practice Styles	x	x
Practice Characteristics		x

Notes: This tables presents the estimates for the effect of switching to a high-referring physician on healthcare utilization measures controlling for other physician characteristics. Column 1 includes controls for physician practice styles for primary care, flu vaccinations, imaging, tests, and payments. Column 2 includes controls for physician practice styles and other characteristics including the number of patients seen, practice size, and the number of providers in the network. There are fewer observations in the Column 2 as physician characteristics are not available for every year. Regressions include controls for patient-time varying factors, an indicator for post, patient fixed effect and year fixed effect. Standard errors are clustered at the Hospital Referral Region (HRR) level.$***p < 0.001, **p < 0.01, *p < 0.05ap < 0.10$.