Discontinuity in Care: Practice Closures among Primary Care Providers and Patient Health

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Abstract

This paper investigates the consequences of practice closures among primary care providers on subsequent patient health care utilization and health. Critically, the analysis relies on population-level administrative Danish data facilitating a unique link between all Danes and their family doctor. We start by characterizing the nature of a practice closure, including the change in provider characteristics that occurs when patients change provider. Practice closures lead patients to choose a systematically younger, less experienced primary care provider. Using a difference-in-differences strategy comparing individuals who experience a practice closing with similar individuals enrolled in similar practices that do not close until later, we next investigate the consequences for patient health care utilization and health outcomes. We find that changes in providers due to practice closures increase the detection of chronic illness but do not lead to concurrent changes in primary care utilization. We do detect a considerable increase in the use of emergency care, however. A decomposition exercise shows that both physician practice style and the disruption itself contribute to the total effects but that the direction of their relative influence varies across outcome domains. Importantly, from the patient's perspective, disruption is not always negative.

JEL: I11, I12, I18

Keywords: Physician practice closure; disruption; practice styles

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1. Introduction

There are widespread concerns in many countries that the stock of physicians is growing older. In 2016, for example, it was estimated that 29% (almost 279,000) of all actively licensed physicians in the United States were older than 60 years (Young et al., 2017). The bulge of baby boomers among European doctors is so large that already by 2009, around 30% of doctors were over age 55, years of age and 3.2% of all European doctors are expected to retire *annually* by 2020 (European Commission, 2012). This trend is expected to lead to practice closures, particularly in areas with relatively socio-economically disadvantaged groups (Young et al., 2017). This paper studies practice closures among primary care providers (henceforth PCPs) or family doctors, who are usually the first to see patients and who serve as gatekeepers for specialized medical treatment and care. All of the individuals affected by closures will surely experience a discontinuity in care. Moreover, the disruption of a practice closure may lead to a lack of care, at least for a period, as well as changes in the quality of care. This paper asks two key questions. Firstly, what are the consequences of practice closures, if any, for patient health care utilization and health outcomes? And secondly, to what extent are the effects driven by variations in physician practice styles, and therefore at least partly susceptible to policy, or by the disruption itself?

To answer these questions, we employ population-level administrative Danish data covering the period 1998–2015 and facilitating a unique link between all Danes and their PCP. We start by unpacking the anatomy of a practice closure. To do so, we first describe the patient behavior leading up to a closure and next characterize the change in provider characteristics that occurs when patients change from a closing PCP to another. Using a difference-in-differences strategy whereby we compare individuals who experience a practice closure with similar individuals enrolled in practices that do not close until later, we formally investigate the consequences for patient health care utilization and health outcomes. We study three types of outcomes: Primary care utilization, detection of illness, and substitution into other types of health care. We complete our empirical analysis with a decomposition of the overall effects of practice closure into changes in provider practice style and discontinuity of care. To operationalize this, we first follow a recent literature using patient mobility to infer practice style for closing as well as destination providers from a two-way patient and physician fixed-effects model (Abowd et al., 1999; Finkelstein et al., 2016; Markussen and Røed, 2017) using data from prior to the practice closure to avoid contamination. Next, we use the results from this two-way fixed-effects model to decompose our estimated practice-closure effects into the share explained by changes in practice style and the share explained by the disruption.

While we show that the patients do not react to closures long in advance, practice closures lead patients to be matched with a systematically younger, less experienced PCP. This is hardly surprising given that 52% of our closures are due to doctors retiring. We observe that most patients enrolled in one closing practice typically switch to the same, new health care provider. Importantly, a change in provider due to practice closure leads to a 30–60% increase in the detection of chronic illness (e.g., hypertension, hyperlipidemia, diabetes) immediately following a closure. This corresponds to somewhere between 25 and 100 additional patients initiating treatment for these illnesses for every 10,000 patients experiencing a closure. We do not find that closure leads to any concurrent changes in primary care utilization, and we only detect small and opposing effects on substitution in the use of PCPs outside of normal office hours and the use of specialists. We do see a slight increase in emergency care of between 5–10% relative to the mean in the first 2 years following the disruption.

Since we do not see any drop in primary care utilization (i.e. *coverage*) supervening the closure and because we are empirically unable to detect any changes in either practice size or the distance between patient residence and the new practice compared to the closing, we argue that our main results stem from a combination of discontinuity of care and differences in practice style. In fact, our decomposition analysis shows that both physician practice style and the disruption itself affect the overall effects. In terms of primary care utilization, the two channels are of the same magnitude but pulling in opposite directions: destination physicians typically induce more activity (6% increase relative to pre-closure mean), whereas the disruption is associated with a decline in utilization (6% decrease relative to pre-closure mean). In contrast, the results regarding the detection of chronic illness indicate that both the shift in physician practice style, and to an even greater extent the disruption – a fresh perspective, maybe – are beneficial to the patient. For example, the take-up of statins (targeting hyperlipidemia) increases by 24% relative to the pre-closure mean, with about 20 percentage points explained by the disruption itself. Finally, we find that the practice styles of the destination physicians induce an increase in the use of other types of health care, primarily in the use of other specialists, which increases with 11% relative to the pre-closure mean. This effect is completely offset by the disruption itself, however, which also fully explains the increasing use of emergency services. While the receiving PCPs therefore appear to have a higher propensity to refer patients to specialists, at the same time, the closure in and of itself disturbs or *disrupts* the use of referrals.

Our paper contributes to several strands of literature. First and foremost, it provides the first evidence of the consequences of the imminent wave of PCP practice closures across several crucial outcome domains. Kwok (2018) studies the effects of involuntary PCP switches, including retirement-driven switches, on primary care utilization among Medicare recipients over age 65 and finds increases in take-up around the switch. To the best of our knowledge, however, no one has yet analyzed the outcomes more closely associated with health or studied utilization in a population-wide setting. Secondly, our paper provides new evidence to the literature concerned with the (typically negative) consequences of disruption or fragmentation of care (Cebul et al., 2008; Agha et al., 2017; Schwab, 2018) by showing that, for some outcomes, a mere change in provider may not necessarily work to the patient's disadvantage. Finally, we shed new light on the importance of practice style heterogeneity among PCPs (Koulayev et al., 2017; Kwok, 2018) and physicians more generally (e.g., Doyle et al., 2010; Silver, 2016).

The paper is organized as follows: Section 2 provides relevant background information, Section 3 describes our data and present descriptive statistics, Section 4 explains our formal identification strategy, Section 5 shows our main results, Section 6 investigates channels and performs heterogeneity analyses, and Section 7 concludes.

2. Background

2.1 The link between practice closure and patient outcomes

Little is known about the consequences of PCP practice closures for patient outcomes. As discussed above, Kwok (2018) analyzes the effects of involuntary PCP switches on primary care utilization and finds upticks around the switch. Some Norwegian studies provide evidence that a shift in primary care physician, for example due to physician retirement, leads to changes in claims for sick pay and disability benefits (Markussen et al., 2013) and work absenteeism (Dale-Olsen and Godøy, 2018). Yet to the best of our knowledge, we know less about the health consequences associated with closures among primary care physicians.

In contrast, a few studies exist of the consequences of hospital closures for patient health. Buchmueller et al. (2006) have revealed how, in the US setting, increased distance to the closest hospital increases deaths from heart attacks and unintentional injuries. A Swedish study by Avdic (2016) links the geographical distance from an emergency hospital to the probability of surviving an acute myocardial infarction. Recently, papers have studied the consequences of limited access to specialized clinics, such as abortion clinics, in Texas that also provide other types of women's preventive care. In line with expectations, closing such clinics results in fewer abortions (Cunningham et al. 2017) but also fewer clinical breast exams, mammograms, and Pap smear (Lu and Slusky, 2016).

PCP practice closure may affect patient outcomes through a variety of channels and will undoubtedly lead to discontinuity in care; an issue that has received much attention in the medical literature (van Walraven et al., 2010). Several papers argue that such disruption increases utilization.[1] Schwab (2018) provides compelling evidence of the phenomenon by exploiting how, in the military, physicians are often withdrawn from their practices to be deployed oversees.

Following Haggerty et al. (2003), continuity in care covers both information continuity, management continuity (consistency of patient care), and interpersonal continuity (the patient–provider relationship). In our context, while some types of information (e.g., patient files) could naturally flow from one PCP to the next, due to the institutional setup, private information about treatment response and adherence is unlikely to transfer fully; and interpersonal discontinuity is obviously complete with a practice closure.

Practice closure possibly also leads to periods without access to care and may affect the quality of care or cause management discontinuity, for example via changes in distance to care, practice size, or provider characteristics and practice style. The practice style of physicians varies (Chandra et al., 2011), just as physicians have been shown to adapt their practice style to the practice environment upon moving (Molitor, 2018). A few studies have shown PCP practice style to be of major importance for patient outcomes. Koulayev et al. (2017) document this in their study of the PCP's role in drug adherence, while Laird and Nielsen (2016) are concerned with the propensity of PCPs to prescribe prescription drugs and the subsequent link to labor supply. Kwok (2018), on the other hand, focuses on primary care utilization. More evidence exists for physicians more broadly. Doyle et al. (2010) study a setting in which patients arriving at a large medical center are randomly assigned to one of two medical groups. One of these groups is affiliated with a prestigious medical school while the other is not. They find that providers from the higher-ranked medical schools systematically conduct fewer tests and have lower costs, even though both groups have similar patient outcomes. Currie et al. (2015) investigate emergency room practice style and patient outcomes, documenting that patients assigned to providers who are more likely to use invasive procedures have consistently higher costs

[1] A version of this is fragmentation, where patients are exposed to multiple physicians or types of specialists. Agha et al. (2017), for example, exploit Medicare enrollees who move across regions with variation in care fragmentation and find that increases in regional fragmentation are associated with corresponding increases in care utilization.

and better outcomes. Similarly, Silver (2016) studies emergency departments and shows that physicians exogenously exposed to fast-paced team environments ration care, resulting in increases in mortality in several patient groups.

Our analysis below combines knowledge about institutional features as well as access to comprehensive register data informative about providers and patients to shed light on which channels appear more important in our context. Importantly, our data enables the testing of the extent to which results are driven by changes in practice and provider characteristics.

2.2 Institutional setting: health care and primary care physicians in Denmark

The Danish public health insurance provides visits to and services from the primary care physician free of charge. PCPs engage in primary disease prevention and health maintenance as well as diagnosis and the treatment of minor acute and chronic illnesses. In Denmark, PCPs additionally serve as gatekeepers to the rest of the health care system in the sense that they refer to specialists and hospital admissions. There are approximately 3,500 PCPs in Denmark serving roughly 1,800 patients each. Some 2,200 of these PCPs are organized in single-physician practices. While PCPs are self-employed, they must acquire a practice authorization number (*ydernummer*) in order to receive reimbursement from the national insurance. The state controls the number of practice authorizations based on factors such as the population density in a given area.

Physician income is generated from a mixed payment system from the government: a fixed capitation fee per patient listed with them (DKK 445 or around USD 70 in 2018) together with fee-for-service payments. Around one-third of the income stems from the fixed capitation and two-thirds from fee-for-service. The fees are negotiated yearly between the Danish Medical Association and the government. Importantly, the physician receives no fee in connection with outpatient prescriptions; nevertheless, PCPs are responsible for approximately 90% of all outpatient prescriptions. Variation in this domain of practice style may therefore have important implications for take-up, adherence, and subsequent patient health.

Continued training of primary care physicians

Another important dimension regarding (changes in) practice style is access to and use of research-based knowledge dissemination and the continued education of PCPs. PCPs were not obliged to participate in continued training programs during the period we study below, which may in itself induce differences in practice style across providers, most obviously between younger and older physicians.[2] However, a variety of short courses on topics within general medicine were offered through the organization of private practicing doctors. Additionally, a monthly journal (*Månedsskriftet for Almen Praksis*) is distributed to all primary care physicians, the main focus of which is to keep physicians up to date on advances in treatments and research in all areas of medicine. As in most other countries, pharmaceutical companies target primary care physicians.

Patient allocation

Patients are listed with a specific practice, which is the only practice they can visit. It is possible to change practice for a modest fee (DKK 150, roughly USD 20). Patients are free to choose between the physicians who are taking new patients as long as the practice is located within 15 km of the patient's home. Physicians cannot selectively turn away individual patients; however, they can close their list for general intake when it reaches 1,600 patients (per physician in the practice). If a physician closes their practice for intake, they cannot discretionarily add a patient. Under some circumstances, a physician can terminate the physician–patient relationship, as in the case of a patient who does not comply with treatment, or if they are violent or aggressive toward the physician. In either case, the relationship is terminated by application to the authorities.[3]

The local government is required by law to assist patients when a practice closes (e.g., if a physician retires). When a practice closes, one of two things can happen: 1) the patient list is either sold by the retiring physician in a private market (often in conjunction with the physical practice) or 2) patients are distributed randomly to nearby practices with available capacity. If two (or more) physicians work in the same practice and one retires, the remaining physician(s) can continue the practice. If they want to reduce the number of patients listed, *all* patients are dismissed from the practice and need to apply to be listed with the practice again on a first-come, first-served basis. Importantly, a new physician cannot selectively turn patients away in either case. Patients are informed that they are allowed to choose a new practice within their choice set (without paying the token fee), and the local government is responsible to ensure that each patient has at least two different practices with open lists within 15 km. Closing physicians are not obligated to communicate the upcoming closing to their patients. In the scenario where a new physician only acquires the patient list and not the physical practice, the

[2] Mandatory continued training was introduced as part of the collective agreement made between the local governments and the primary care physicians in 2014, which is after the period under consideration in this study.
[3] This is a rare outcome with a total of 458 reported cases in 2017.

acquiring physician cannot freely determine the location of the new practice. Instead, location is negotiated on a case-by-case basis with the local government. The impact on distances for the listed patients and the concentration of other practices are two of the considerations.

It is crucial to stress that no patients in Denmark will lose access to primary care because a practice closes – even in areas with a sparse supply of (open) practices. The local governments are obligated by law (the Danish Health Act, Chapter 13) to guarantee that all citizens have access to care. If no practices are open for intake, the local government itself can establish a practice and contract with physicians to see patients.[4] To the extent that the quality of the service received is lower after experiencing a practice closure, this will obviously comprise part of the effects we estimate in our analyses below.

Information transfer

When a patient–physician relationship is terminated, vital information about the patient's health status is at risk of being lost. To mitigate this information discontinuity, formally recorded information (patient records) is automatically transferred to the new physician. Patients can choose *not* to have their records transferred but must actively do so (a patient has a 14-day window after being listed with the new physician to do so[5]). However, tacit knowledge about patient preferences and the like is less easily transferrable between physicians.

3. Data, samples, and descriptive statistics

To investigate how practice closures affect patient outcomes, we leverage Danish administrative register data that covers the entire adult (18+) population and is available through Statistics Denmark. Focal to this study is the fee-for-services data covering the entire universe of reimbursements paid out to all PCPs active in Denmark. Crucially, this data is informative about physician and patient identity alike: for each reimbursement, we observe the exact time of the interaction and the provider. This enables us to observe the evolution of patient–provider links over time. We augment this data with socio-economic information describing demographics, income, and education, just as we exploit information about health-care service use and diagnoses associated with hospital interactions (ICD10). Finally, for the period 2004–2010, we also have access to a unique dataset containing

[4] In the timeframe of this study, this is a rare event: The first clinic established directly by a local government was in 2008. This has since increased such that 53 government-run clinics now exist, with an average of 2,200 patients listed in each.

[5] Personal communications with both the organization of private practicing doctors (PLO) and Local Government Denmark (KL) reveal that this is so rare that no such information is systematically collected.

information on distances between individuals and physicians in Denmark. Based on address-specific geocodes, Statistics Denmark has calculated distances between the home addresses of all individuals and the (up to) 50 closest physicians within a 20 km travel distance of residence (using public roads).

We use patient–physician interactions to infer the identity of the primary physician, in line with Kjærsgaard et al. (2016). Their algorithm successfully links individuals to their primary care physician in as many as 98.6% of all cases.[6] Our starting point is a dataset containing patient–physician spells covering the period 1998–2015.

The next step is to determine the exact date of a practice closure. Having established patient–physician links, we define a practice as closing in the last month in which we observe patient–practice contact.[7] Figure 1 illustrates how practice closures are common and that rates are increasing over time. Thus, potential consequences of closures are a real concern, also in our context.

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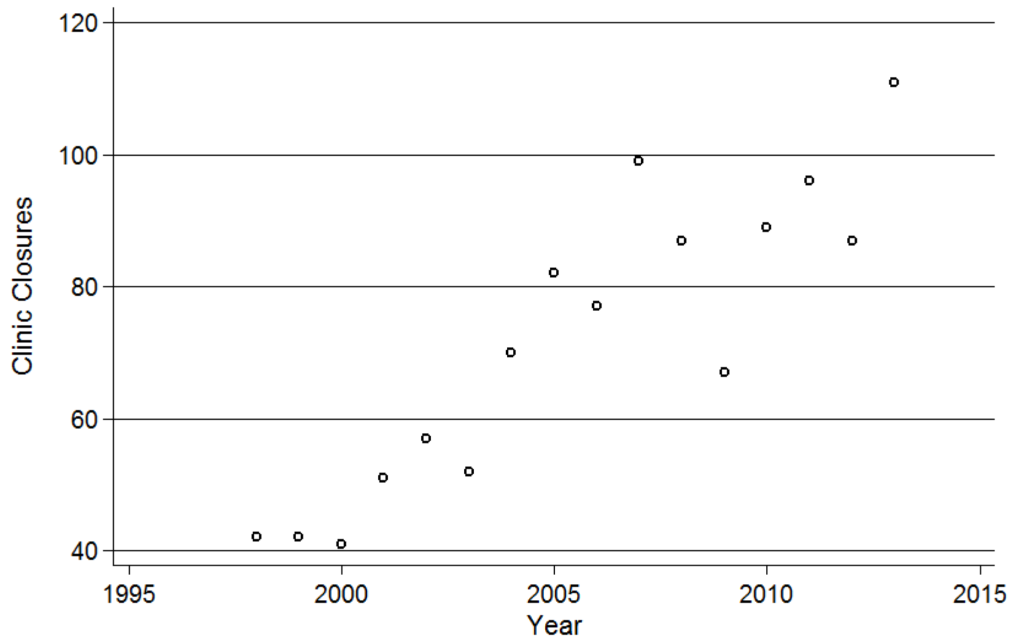
[6] Kjærsgaard et al. (2016) train and evaluate their algorithm on a list of actual switching dates for a subset of years. The details of our implementation are described in online supplement A.

[7] Online supplement Figure B1 shows corresponding reductions in practice-level reimbursement from national insurance leading up to the closure.

FIGURE 1

CLOSURES ACROSS TIME



Notes: This figure shows the number of primary physician practice closures across calendar year. A practice is defined as being closed in the first month in which no services are provided. In comparison, at the start of the estimation period (1998–2000), 2,401 practices operate in Denmark.

Combining the closure dates with the physician–patient spell data, we construct a balanced panel of patients exposed to a practice closure, where we observe individuals for 2 years prior to and after the practice closure. Roughly 20% of the adult population (811,649 individuals) experience a practice closure at least once during our observation period. These individuals are distributed across 770 closing practices. 6.5% of the individuals experience multiple practice closures over the 4 years. Our analyses always consider the effects of the first practice closure.

To characterize the individuals listed at closing practices and for the purpose of our formal analysis below, we follow Guryan (2004) and match individuals exposed to a closure to a comparison group consisting of the 877,547 individuals (distributed across 915 practices) who experience a practice closure *3 years into the future*. Our comparison is based on a rich set of patient demographics, health behaviors, and health outcomes, as well as the demographics of the origin and destination physicians around the time of practice closure. The comparison group is assigned a synthetic (random) closing data in the year of the match. Synthetic closing dates are drawn from a distribution that mimics the actual observed distribution of closing dates.[8] We do this so as not to conflate any seasonal variation in PCP utilization with behavioral responses to the actual practice closure.

We study three types of outcomes related to primary care utilization, start-up of prescription drug treatments targeting chronic diseases, and substitution into other – and more expensive – types of health care (or offset effects). Primary care utilization is measured via indicators for physician visits and total government reimbursement associated with primary physician services. The detection of illness is measured as the take-up of ACE inhibitors, statins, and metformin. These medications are considered first-line[9] treatments targeting the major chronic conditions hypertension (ACE-inhibitors), hyperlipidemia (statins), and diabetes (metformin). It is well-established that these conditions are significant risk factors for cardiovascular morbidity and mortality; Scandinavian Simvastatin Survival Study Group (1994), DCCT (1993). Further, the prevalence of these conditions is high (especially among the elderly), and there is a general consensus that they are underdiagnosed in many populations. Among the adult US population, it is estimated that 13% had two of these conditions, and that 1 in 7 (15%) adults had one or more of these conditions undiagnosed (Fryar et al., 2010). Finally, substitution into other types of health care is measured as the use of emergency doctor services outside of regular office hours, practicing specialists, and hospital-related out-patient care.

Table 1 shows that the group exposed to practice closure resembles the comparison groups in terms of our observed characteristics but that they are slightly less educated and slightly younger than the overall population. In terms of health care usage, there are no economically significant differences between the three groups across any of the measures.

[8] Of the 1338 practices closing in the period 1998–2014, 50.15% close in December and 17.15% close in the last week of the year.
[9] Danish national prescription drug recommendation list: https://www.sst.dk/da/rationel-farmakoterapi/rekommandationsliste

TABLE 1

MEAN PATIENT CHARACTERISTICS OF COMPARISON AND TREATMENT GROUP 6 MONTHS PRIOR TO (SYNTHETIC) PRACTICE CLOSURE

Variable		Clinic closure:		Overall Population
		Comparison	Exposed	2004
Health capital:				
Predicted health index quartile (0/1)	1st Quartile	0.291	0.259	0.25
	2nd Quartile	0.244	0.247	0.25
	3rd Quartile	0.241	0.249	0.25
	4th Quartile	0.215	0.237	0.25
Use of chronic medication (0/1)		.314	.351	.334
Socio-economic status:				
Gross income (0/1)	1st Quartile	0.243	0.25	0.25
	2nd Quartile	0.247	0.248	0.25
	3rd Quartile	0.25	0.246	0.25
	4th Quartile	0.259	0.256	0.25
Male (0/1)		0.475	0.495	0.491
Education (0/1)	Some Primary	0.448	0.458	0.351
	Secondary	0.072	0.069	0.076
	Vocational	0.312	0.306	0.334
	Short tertiary	0.104	0.103	0.163
	Medium tertiary	0.012	0.012	0.014
	Long tertiary	0.052	0.052	0.061
Age (0/1)	<30	0.186	0.174	0.177
	30-65	0.596	0.611	0.623
	>65	0.218	0.215	0.2
Outcomes:				
Any PCP visit (0/1)		0.568	0.561	0.59
PCP reimbursement (DKK)		45.6	44.3	45.2
		(65.2)	(61.7)	(59.9)
Any pharmacy claim (0/1)		0.534	0.536	0.550
Drug initiation (0/1)	ACE inhibitors	0.003	0.003	0.003
	Statins	0.003	0.003	0.004
	Metformin	0.001	0.001	0.001
Any out-patient care (0/1)		0.085	0.084	0.082
Any use of practicing specialists (0/1)		0.135	0.135	0.126
Any use of emergency doctor service (0/1)		0.023	0.024	0.015
# Individuals		877,547	811,649	3,191,232

Notes: This table shows descriptive statistics for individuals who experience a practice closure and compares them with the corresponding characteristics of a matched comparison group consisting of individuals who experience a practice closure 3 years into the future. The comparison group is assigned a synthetic closing data in the year of the match. The averages are calculated over the three to six months prior to the (synthetic) closure. The predicted health index is the predicted expenditures on prescription drugs in the calendar year of the closure based on demographics, health care expenditures, and other medical service use in the previous calendar year (see online supplement C for details). The higher the index, the higher the predicted expenditures. The overall population means exclude individuals who experience a practice closure and are measured in the final quarter of 2004.

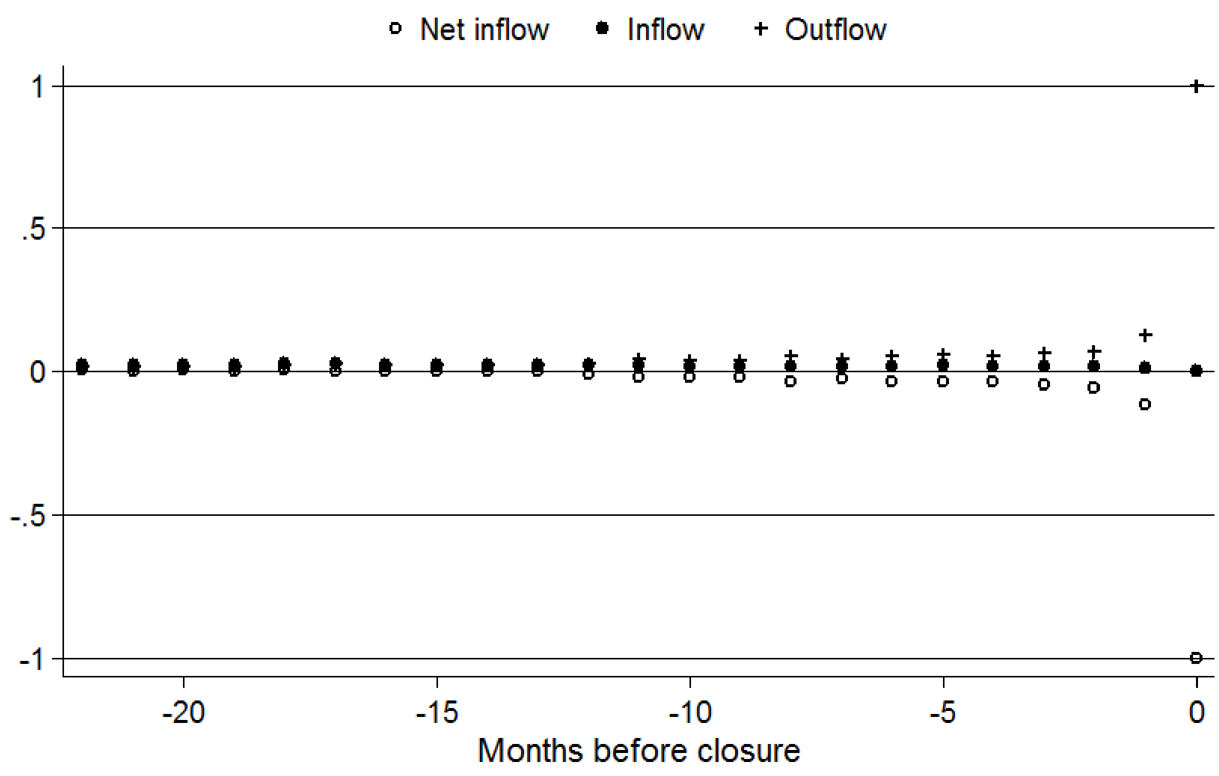
3.1 Patient behavior leading up to closure

To properly design our formal analyses, particularly in terms of defining an uncontaminated pre-period, it is important to gauge *when* patients react to the future closing. To this end, Figure 2 first plots the net patient flow leading up to practice closure. We observe that slightly more patients leave (i.e., interact with a new physician) than enter a practice as early as 10 months prior to the actual closure, but practice size is roughly constant up until six months before the closing. The vast majority of patients are not observed to visit a new physician in the months before practice closure. An alternative depiction of these dynamics is by showing the fraction shifting from one PCP to another in the period leading up to and after a closure (see online supplement Figure B2).

As seen in Figure 3, those who leave early are slightly more likely to be women; have lower income; worse predicted health score; and are more likely to purchase drugs for a chronic disease.

FIGURE 2

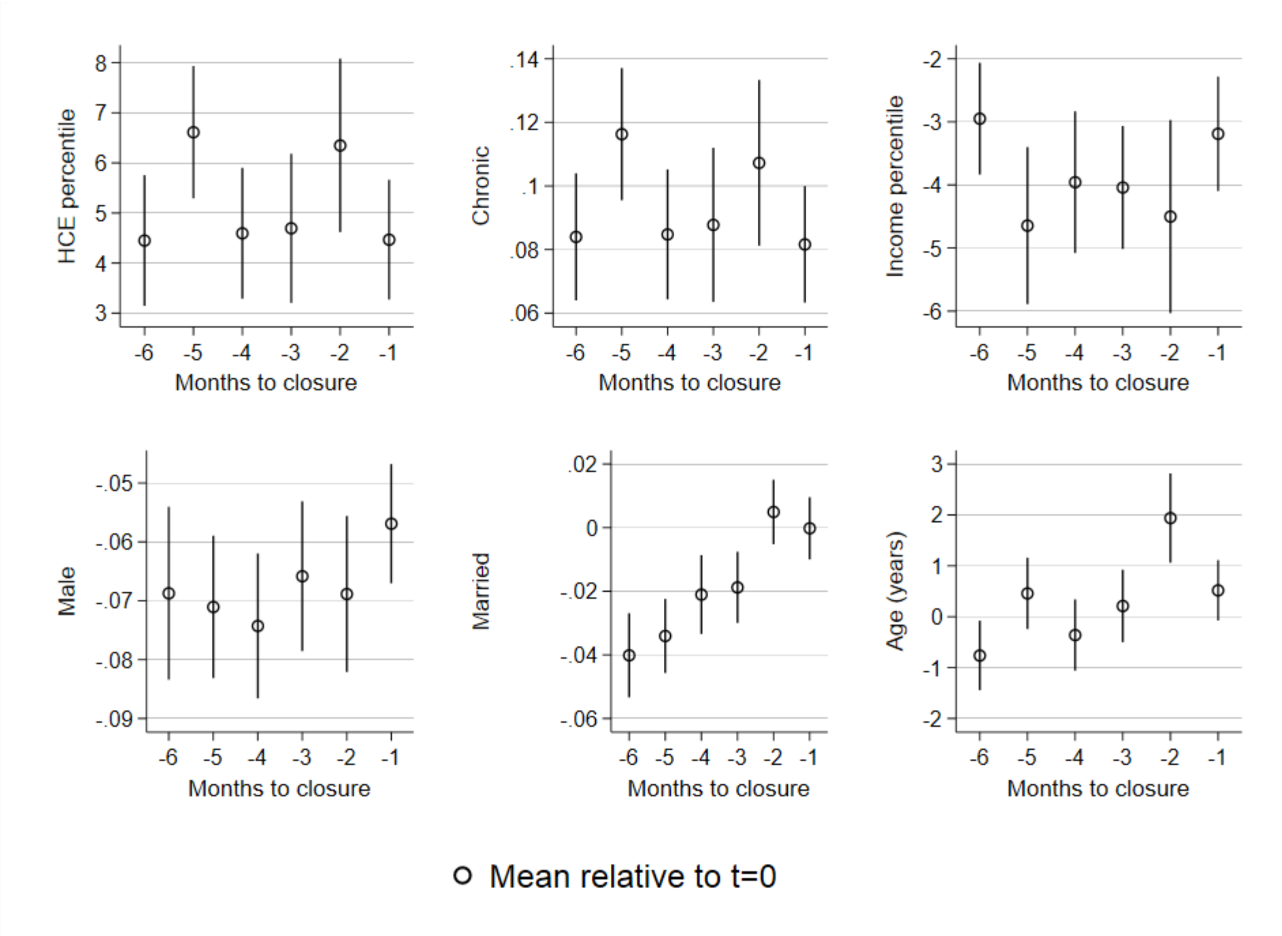
NET PATIENT FLOWS LEADING UP TO PRACTICE CLOSURE



Notes: This figure shows net inflow, inflow, and outflow relative to the previous month.

FIGURE 3

CHARACTERISTICS OF PATIENTS LEAVING THE PRACTICE IN MONTH RELATIVE TO CHARACTERISTICS OF PATIENTS WHO STAY UNTIL ACTUAL CLOSURE



Notes: This figure shows the mean characteristics of patients who leave a practice prior to closure relative to those who stay until the actual closure. Bars represent 95% CI. Predicted health care expenditure is the predicted spending of prescription drugs in the calendar year of the closure based on demographics, prescription-drug consumption, and other medical service use in the previous calendar year (see online supplement C for details).

3.2 The destination physician

We define the destination physician as the first physician with whom a patient interacts after leaving a closing practice, and we describe the characteristics of the destination physician to get a sense of what being assigned to a new PCP entails. As seen in Table 2 and further explored in Figure 4, while closing physicians are similar to those who close their practice in the near future, they are clearly older than the destination physicians. This is natural, as a closing is often associated with retirement.

As evidenced by the peak in the age distribution around age 50 for closing physicians (Panel B, Figure 4), however, retirement is not the sole driver of practice closures. We formally explore the role of physician retirement in our analyses below. Moreover, the vast majority of patients have a lengthy relationship with the closing physician (see panel C, Figure 4). Online supplement Figure B3 shows that a substantial share of patients leaves for the same new clinic. This is driven by cases where the destination practice is a completely new practice with no patients listed previously. Receiving practices that are already up and running typically only experience smaller increases in the size of their patient pools.

TABLE 2

CHARACTERISTICS OF PHYSICIANS BY CLOSURE STATUS

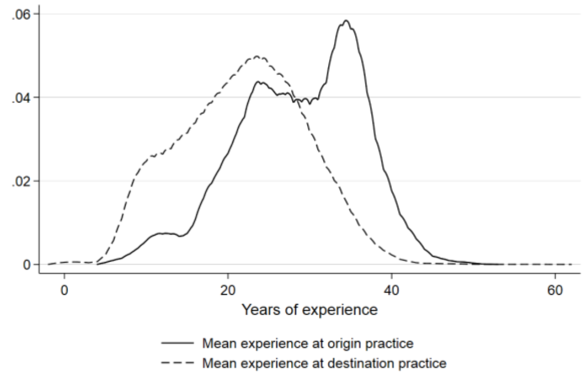
		Closing physician	Destination physician	Comparison physician
Male (0/1)		0.73	0.68	0.75
Married (0/1)		0.75	0.81	0.80
Immigrant (0/1)		0.10	0.06	0.04
Age	-40	0.08	0.07	0.03
	40-50	0.11	0.25	0.09
	50-60	0.23	0.45	0.35
	60+	0.58	0.22	0.53
Number of physicians in practice	1	0.78	0.55	0.78
	2	0.15	0.14	0.17
	3	0.04	0.10	0.03
	4+	0.03	0.07	0.01
Experience (years)		30.3	24.8	29.6
		(8.6)	(8.2)	(7.95)
Number of patients per physician, previous year		1,792	1,115	1,820
		(1.109)	(726)	(986)
Number of patients, subsequent year		0	1,166	1,793
		(0)	(765)	(1013)
Number of practices		770	2,826	915

Notes: This table shows descriptive statistics for physicians who choose to close their practices, the practices that patients from closing practices disseminate to, and a matched comparison group consisting of practices that close 3 years into the future. The characteristics for the closing and destination practices are measured in the year of the closure, while the comparison practice is measured 3 years later.

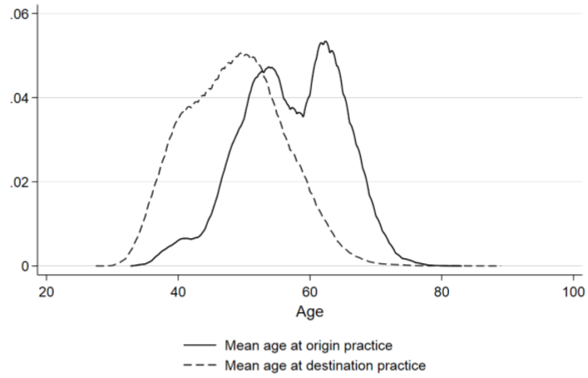
FIGURE 4

DISTRIBUTIONS, SELECTED PHYSICIAN CHARACTERISTICS

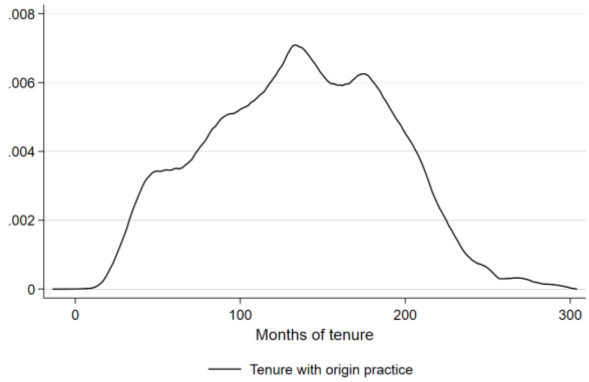
Panel A: Mean experience at origin and destination practice



Panel B: Mean age at origin and destination practice



Panel C: Tenure with original physician



Notes: This figure shows the distribution of physician characteristics for origin and destination physicians. Panel A shows experience, panel B shows age, and panel C shows tenure with origin physician at closure. The distributions are weighted by the number of patients at the practice at the time of its closing.

4. Detecting the consequences of practice closure for patient outcomes

The overarching goal of our paper is to estimate the consequences of practice closures for patient-level outcomes. Obviously, the key challenge inherent in such an analysis is to estimate outcomes in the absence of practice closure. One might worry that patients enrolled in practices that close comprise a different population compared to the population of patients enrolled in practices that continue to operate.

To address this concern, we implement a difference-in-differences strategy using individual-level panel data corresponding to a fixed-effects analysis. Our preferred strategy first compares one individual's outcomes *after* practice closure with that same individual's outcomes *prior* to practice closure. This first difference implicitly controls for time-invariant individual health. However, it is highly likely that underlying individual-level health changes with age, particularly for elderly patients. To account for this, we compare with a group of similar individuals enrolled in similar family practices *that continue to operate* for three more years beyond the point of comparison. The comparison group is subsequently assigned a random 'closure' date in the year of the treatment group based on the empirical distribution function of observed closing dates.

For computational and expositional reasons, we conduct our analysis on quarterly instead of monthly data. We choose quarter *t-2* and earlier as the pre-closure quarters in our formal analyses and drop *t-1* completely from the main formal analyses.[10] *t-2* is sufficiently close to the timing of practice closure to ensure that patient health is not markedly different. At the same time, it lies sufficiently early to minimize contamination due to patient anticipation of practice closure: As shown above, the vast majority of patients remain listed with a practice up to six months before a closing.[11]

Our analyses rely on following regression:

$$Y_{it} = \alpha_i + \beta_1 1(post)_i + \beta_2 closure_i \cdot 1(post)_i + \beta_3 closure_i + \varepsilon_{it} \qquad (1)$$

where Y is the outcome of interest, *closure* indicates that the patient belongs to the group exposed to practice closure, $1(post)$ indicates post-closure periods, ε is an error term, i indexes individuals, and t indexes time in quarters relative to the closure. β_2 is the parameter of interest. The background

[10] Remember from above that we observe individuals in our sample during a symmetric 4-year window around (synthetic) clinic closure.
[11] Below, we show that the conclusions are robust to choosing quarter *t-1* and *t-4* as pre-closure points.

variables are all measured prior to practice closure and therefore do not vary over time. The effect of these variables, along with *closure,* will therefore cancel out along with the individual-level fixed effect, α_i.

The key identifying assumption in our difference-in-differences set-up is that there can be no differential trends between the treatment and control groups in the absence of practice closure. Below, we investigate the validity of this assumption graphically by testing the robustness of our results to varying the choice of reference period and by performing placebo analyses prior to closures.[12]

5. Results

5.1 Effects of closure on individual level health outcomes

We start by analyzing the effects on primary care utilization. Figure 5 shows mean de-trended utilization outcomes by quarter for the group of patients affected by closure as well as the comparison group, before and after the actual shutdown.[13] Critically, outcomes for the affected and comparison groups move in parallel before the closure. Note that slight differences do appear in the months immediately prior to the closure, consistent with the systematic differences observed above between those who remain listed until the time of closure and those who leave earlier. This (anticipatory) reaction is the main reason for using *t-2* and earlier as pre-closure points in the formal analyses. In appendix Table A1, panel A, we present the corresponding formal difference-in-differences results. Columns 1–3 show the results for PCP utilization using a gradually richer specification. In line with the descriptive evidence from Figure 5, regardless of the specification, we detect no statistically or economically significant effects on indicators for PCP visits and pharmacy claims. One might have worried about supplier-induced demand among the many destination PCPs facing financial constraints after having opened up an entirely new practice; we find no evidence of this. Another worry might have been that destination PCPs were capacity-constrained and unable to deliver services on par with the closing physicians. This does not seem to be the case either; again at least on average.[14]

[12] Changing the choice of reference period is inherently also a placebo test; if this generates substantial differences in estimated effects, it implies that there are systematically different trends in pre-closure outcomes across treatment and comparison individuals that are not captured by our regression model.

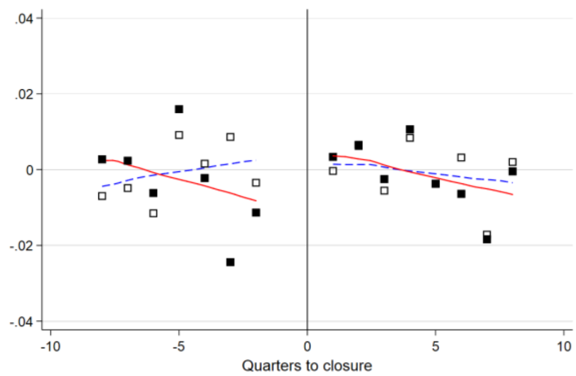
[13] We de-trend to purge away the upward-sloping trends reflecting the population age in our sample window.

[14] Analyses not included in the paper show that the existing patients at destination PCPs are unaffected by the influx of new patients; i.e., there appear to be no negative spillovers on the existing patient pool. This is unsurprising, since the increase relative to the stock of patients is often minor, as discussed above. Results available upon request.

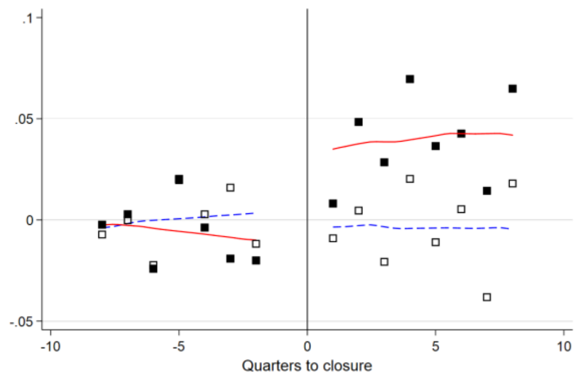
We do find evidence of destination physicians conducting procedures associated with statistically significantly higher government reimbursement, but the effect sizes are minuscule: we observe an increase in fee-for-service on the part of the physician corresponding to DKK 2 per quarter (€ .25).

FIGURE 5: PRACTICE CLOSURE AND PRIMARY CARE UTILIZATION

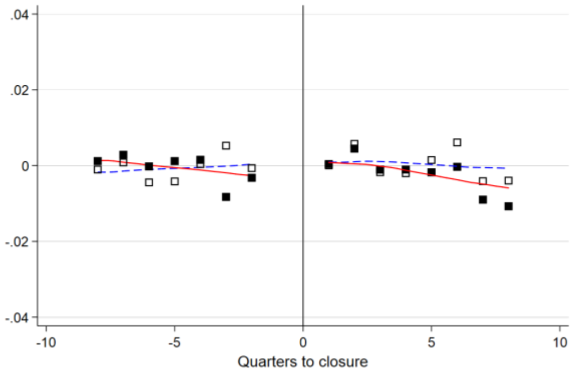
Panel A: Any PCP visit



Panel B: Total government reimbursement associated with PCP visit



Panel C: Any pharmacy claim

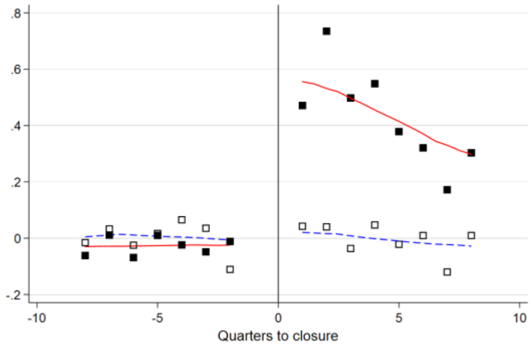


Notes: This figure shows the mean utilization primary care of a treated group (solid; red if read in color) and a comparison group (hollow; blue if read in color) relative to the time of (synthetic) closure. Each point is the quarterly average demeaned relative to the quarters $q \in (-8, -4)$. Lines are calculated using local linear regressions. Outcomes are a dummy variable for any consultation (panel A), total government reimbursement associated with PCP visit (panel B), and a dummy variable for any pharmacy claim (panel C).

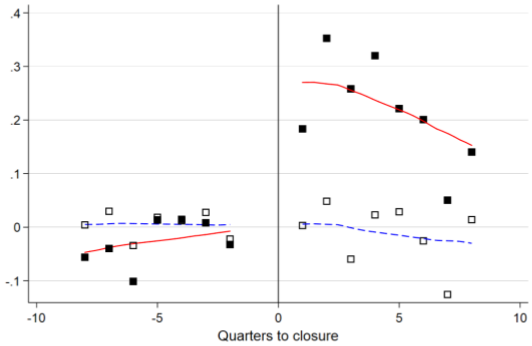
Figure 6 and appendix Table A1, panel B, continues to explore the impact on the detection of illness. As mentioned above, we consider the initiation rates of three of the most important drugs targeting chronic ailments: hypertension (ACE inhibitors), hyperlipidemia (statins), and diabetes (metformin). These results stand in sharp contrast to the results of PCP utilization: shifting from a closing PCP leads to considerable *upticks* in start-ups with drugs targeting severe diseases that are treatable yet highly underdiagnosed in the overall population. Relative to the pre-closure sample mean, treatment initiations with ACE inhibitors increase by approximately 50%, statins by 20%, and metformin by 25%. Remarkably, these effects on start-ups persist throughout our data window.

FIGURE 6: PRACTICE CLOSURE AND INITIATION WITH CHRONIC MEDICATIONS

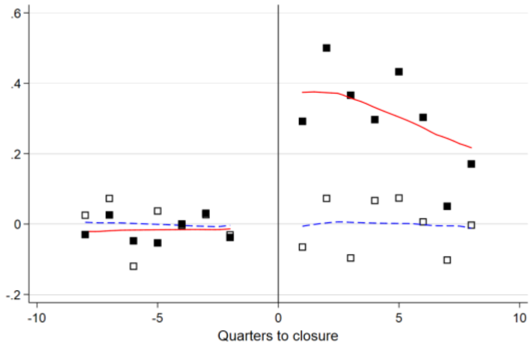
Panel A: Initiation with ACE inhibitor



Panel B: Initiation with Statin



Panel C: Initiation with Metformin

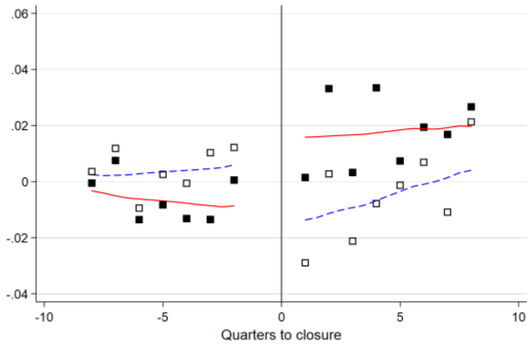


Notes: This figure shows the mean utilization primary care of a treated group (solid; red if read in color) and a comparison group (hollow; blue if read in color) relative to the time of (synthetic) closure. Each point is the quarterly average demeaned relative to the quarters $q \in (-8, -4)$. Lines are calculated using local linear regressions. Outcomes are dummy variables indicating initiation with ACE inhibitors (panel A), Statins (panel B), and Metformin (panel C).

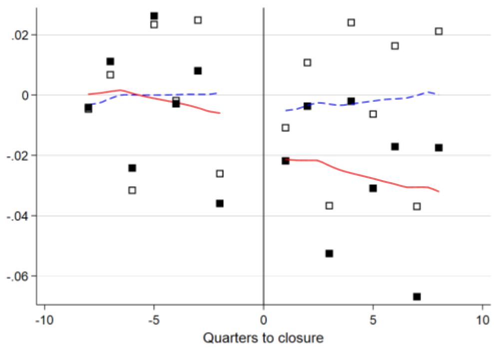
Finally, Figure 7 and appendix Table A1, panel C, show the results for the use of additional (and typically more expensive) modes of care. We observe numerically small increases in hospital outpatient care of around 3% relative to the pre-closure sample mean but a corresponding drop of 3% in the use of practicing specialists. Though we do not want to read too much into these small effects at this stage, they could be in line with an interpretation whereby the destination physicians are more likely to follow the official government guidelines that recommend the use of outpatient care at hospitals over private specialists to secure a higher degree of continuity of care and access to modern facilities and treatments. Finally, emergency services take-up increases by as much as 5–10% relative to the pre-closure sample mean. This might be interpreted as a response to the disruption of the interpersonal continuity in the patient–physician relationship.

FIGURE 7: PRACTICE CLOSURE AND SECONDARY AND OUTPATIENT CARE

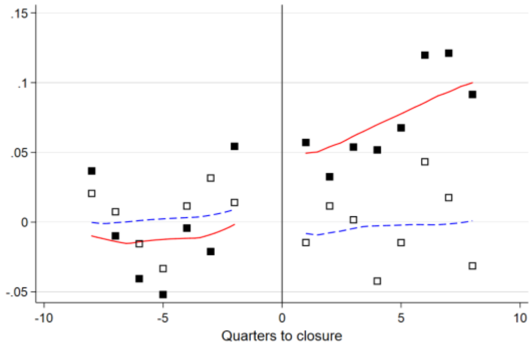
Panel A: Any outpatient care



Panel B: Any practicing specialist



Panel C: Any use of emergency doctor services



Notes: This figure shows the mean utilization primary care of a treated group (solid; red if read in color) and a comparison group (hollow; blue if read in color) relative to the time of (synthetic) closure. Each point is the quarterly average demeaned relative to the quarters $q \in (-8, -4)$. Lines are calculated using local linear regressions. Outcomes are dummy variables indicating any outpatient interaction (panel A), any specialist care (panel B), and any use of emergency care (panel C).

To sum up, we find little evidence of changes in primary care utilization, large effects on the initiation of chronic medication, and some evidence of changes in referral patterns, possibly reflecting a more modern approach among destination physicians. To learn more about the degree to which the uptick in the initiation rates of chronic medication reflect improved detection rates among the receiving physicians, appendix Table A2 shows the results of inpatient care associated with the most common, debilitating diseases: cardiovascular disease, diabetes, and cancer. Although rare events (between .1 and .5% of the population are hospitalized in each quarter because of these diseases), we are still able to detect large and highly statistically significant increases in inpatient care. The effects on the incidence of hospitalization associated with cardiovascular disease and diabetes amount to around 9% relative to the mean, while the effects on cancer are as large as 30% compared to the mean. As none of these ailments are in any way likely to be caused by the immediate change in provider, we ascribe these effects to the improved detection skills of the destination physician.[15]

A deeper understanding of our findings obviously requires us to delve into the roles of practice features and patient background. And even more fundamentally, we must also clarify whether effects

[15] All main findings are robust to changing the pre-closure period from *t-2* to earlier points in time and excluding the time interval between this reference point and actual closure. Similarly, we find no 'effects' of practice closure in placebo analyses that consider outcomes measured *prior* to the actual closing. As expected with more than 11 million observations, some estimates are statistically significant, but all are diminutive. Results presented in online supplement Tables B1–B2.

arise because of provider practice style or merely because of the disruption itself. The next section explores these issues further.

6. Explicating effects on patient outcomes

6.1 Practice features

As explained in Section 2.2, government agencies bear the responsibility for assigning patients who experience a practice closure to new, nearby physicians – and in reality, as explained above and in line with our findings on PCP utilization, patients do not go uncovered in our period of investigation. Still, as discussed above, patients may experience some changes in the quality of care, for example via changes in distance to care and the patient load with the new provider. This section empirically explores these margins. In practice, we model the distance to PCP and practice size as outcomes in our difference-in-differences setup.

To learn about the effects on distance to PCP, we augment our main data with auxiliary data containing information about the distance between individuals' residence and the (up to) 50 closest PCPs within a 20 km radius. Our data allows us to identify changes in distance for 261,166 of the 530,594 individuals experiencing a practice closure from 2005 to 2010. Online supplement Table B3 shows how this sample (henceforth the distance sample) compares to the original estimation sample in terms of observable characteristics, and online supplement Table B4 replicates our main findings on the distance sample.

Table 3 shows the formal results of changes in the distance to physician based on the distance sample and practice size based on the full sample. Although statistically significant, we find no economically important increases in distance arising from practice closure. On average, patients travel .5 km longer. We observe no statistically significant effects on patients per physician; the estimate lies around 20 patients, which should be compared to a mean of just above 1,000 patients.

TABLE 3: DIFFERENCE-IN-DIFFERENCES RESULTS

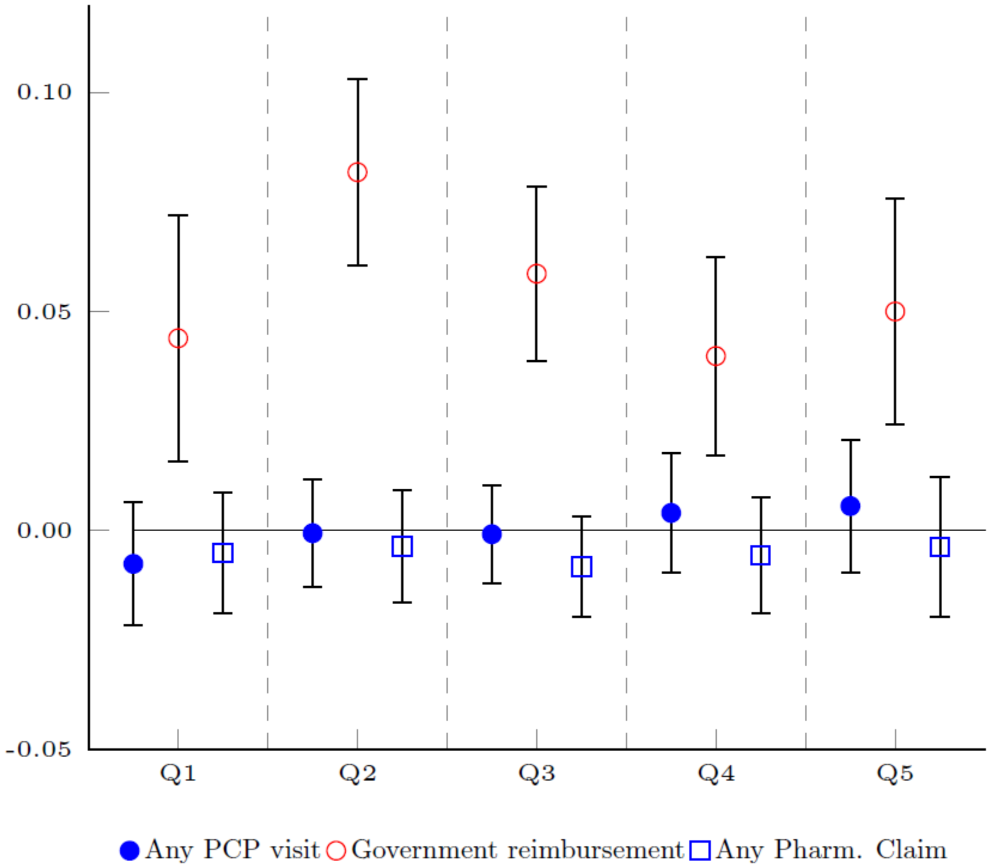
	(1) Distance to physician	(2) Distance to physician	(3) Distance to physician	(4) Patients per physician	(5) Patients per physician	(6) Patients per physician
Closure	3.46***	3.46***		-63.06***	-64.63***	
	(0.08)	(0.08)		(9.25)	(9.29)	
Closure X Post	0.47***	0.47***	0.47***	19.71	20.06	17.26
	(0.13)	(0.13)	(0.06)	(18.63)	(18.63)	(11.50)
# Observations	18,262,557	18,262,557	18,262,556	24,844,530	24,844,530	24,844,530
R-squared	0.449	0.451	0.913	0.003	0.005	0.274
Mean outcome	3.4	3.4	3.4	1,083	1,083	1,083
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Individual background chars	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes

Notes: This table shows individual-level difference-in-differences results for distance to physician measured in km (columns 1–3 using the distance-sample) and patients per physician (columns 4–6 using the full estimation sample). Standard errors are clustered on the physician level. ***p < 0.01, **p < 0.05, *p < 0.10.

While neither distance nor patients per physician appear to pose barriers to maintaining access, the availability of physicians can still be constrained if nearby physicians are closed for take-up. If a patient experiences a practice closure in an area with fewer existing practices, it might be relatively more difficult for the government authorities to assign patients to physicians.

To investigate this dimension, we use the distance data to calculate the fraction of physicians in each patient choice set who are closed for patient intake. We approximate a practice as being closed for intake if the patients-to-physician ratio is larger than 1,600 (see Section 2.2). We define *patient density* as the ratio of practices in the choice set that is closed for the intake of new patients. If the effect on primary care utilization varies across this dimension, it would indicate that some areas have access problems. We estimate the effects of practice closures for each quintile in the share of practices closed for intake distribution (see Figure 8), finding no evidence that effects on PCP utilization – the probability of having a visit, the extent of government reimbursement, and the number of pharmacy claims – decrease with patient density.

FIGURE 8: EFFECTS OF PRACTICE CLOSURE ON PRIMARY CARE UTILIZATION BY QUINTILES OF PATIENT DENSITY



Notes: This figure shows how a practice closure affects the probability of any PCP visit (solid blue circles), total government reimbursement associated with PCP visit (hollow red circles), and having any prescription claim (open square) by quintile of share of practices in a patient choice set that is closed for intake.

We interpret this latter finding as evidence that practice closures are not associated with differential access to care afterwards. Our finding of large increases in the take-up of drugs targeting major chronic diseases plausibly stems from different sources. For example, the detection of these chronic conditions is potentially related to differences in provider characteristics and practice styles between closing physicians and the comparison group. Physicians generally doing routine check-ups and, hence, detecting these conditions upon seeing a new patient can be interpreted as a positive effect of care discontinuity or *disruption*. While some information may be lost in the transfer from one PCP to the next, the negative consequences are still less than the gains from meeting a new provider.

6.2 Patient characteristics

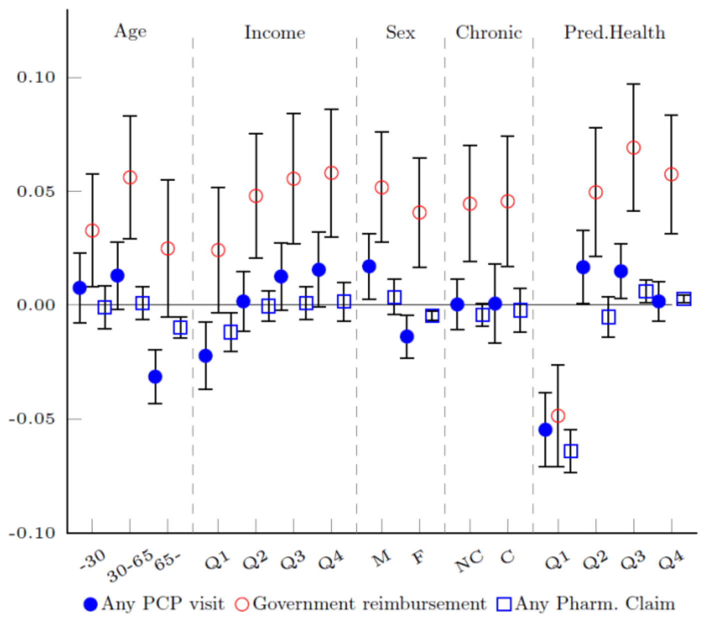
We next assess the degree to which the effects of practice closure vary across individuals. Though we see little change in utilization, for example, there could be variation across patient groups – and there is certainly political focus on disadvantaged groups and inequality in health. Moreover, evidence from the medical literature shows that, in particular, patients with chronic diseases value relationship continuity with their physicians (Guthrie et al., 2008); this is likely because continuous monitoring and assistance in complying with treatment regiments are crucial to this population. Accordingly, they may be disproportionally affected by closures.

To investigate heterogeneity in the effects of being exposed to a practice closure across background characteristics, we extend our baseline model to include interactions between these characteristics and the indicator for practice closure.

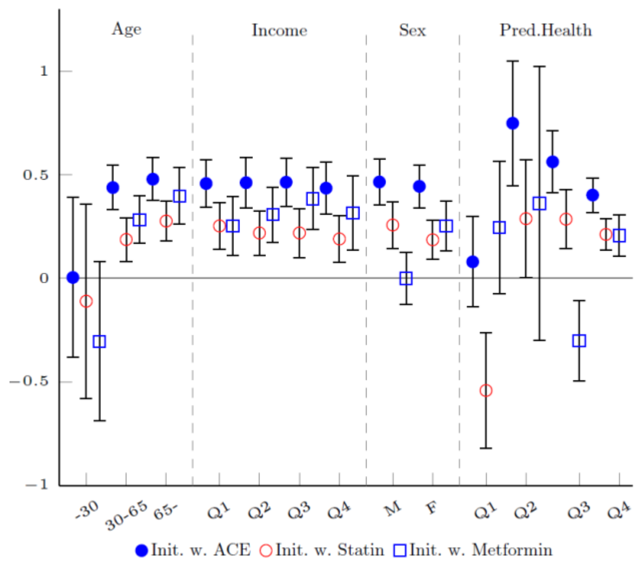
The results are presented in Figure 8. Panel A shows the results for primary care utilization, panel B chronic medication initiation, and panel C secondary care utilization. To ease the comparability across subgroups, each panel presents the estimated effect for a subgroup relative to the within-group mean outcome prior to (synthetic) closure. While the sign of the effects tends to align across subgroups, the most striking finding is that those in better health (1^{st} quartile of health score) in fact experience reductions in primary care utilization, lower initiations, and lower secondary care utilization, pointing to more targeted service provision from destination physicians. Moreover, except for the use of practicing specialists, the effects on secondary care utilization increase monotonously in health quartiles.

FIGURE 9: HETEROGENOUS TREATMENT EFFECTS

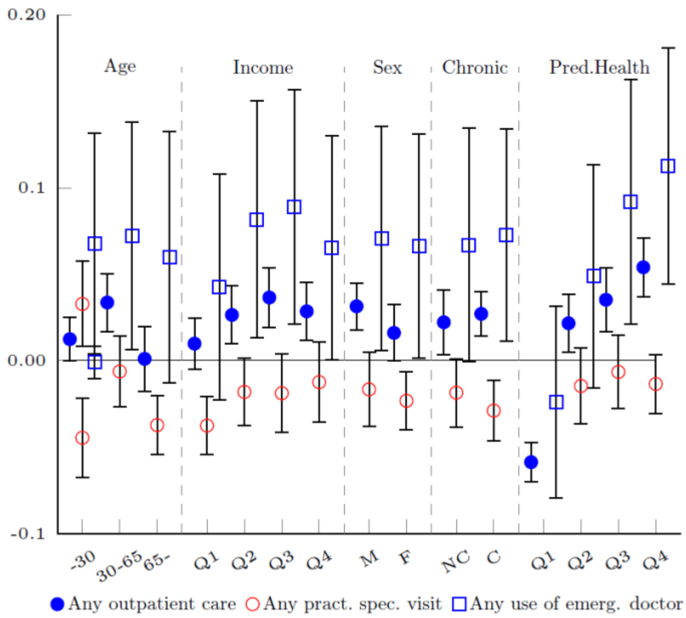
Panel A: Primary care utilization



Panel B: Initiation with chronic medications



Panel C: Secondary and outpatient care utilization



Notes: This figure shows the average quarterly effects over the first 2 years following subgroup closures. The graph reports the effects relative to the within-group outcome mean two quarters before the practice closes. Panel A shows the results of primary care, panel B shows the results for medication initiation, and panel C shows the results for secondary utilization. Standard errors are clustered at the physician level. The corresponding 95%-confidence bounds are shown as bars.

6.3 Physician practice styles and disruption effects

Our results thus far indicate that practice closures may differentially affect patients with varying background characteristics. In contrast, the distance to the practice and its size do not appear to affect our overall findings. Of course, this does not rule out that physician characteristics matter. Figure 4 above, for example, provides initial evidence that, on average, the destination physicians are considerably younger and less experienced than the origin physicians. As these characteristics have been shown to correlate with practice style (see Currie et al., 2016; Epstein & Nicholson, 2009; Koulayev et al., 2017), a natural question addresses the degree to which the increases in treatment for chronic disease reflect changes in physician composition (or practice style) versus a pure disruption effect. On one hand, if the observed difference between the comparison and treatment groups are solely due to the change in provider, then the estimated effect would equal the difference in practice styles. On the other hand, if the observed difference on average has nothing to do with the physician, the change in physician practice style would not influence the estimates. This will offer important insight, as the relative weights of these dimensions are crucial for fully understanding the impacts of practice closures on patient outcomes.

As a first indication that practice styles do indeed matter, we explore whether experiencing a retirement-driven closure differs from other types of closures: individuals moving from a retired physician almost inevitably receive a younger, less experienced (and more often female) physician relative to their original physician than would be the case for individuals experiencing a practice closure due to other reasons.[16] Individuals experiencing closures classified as retirements, for example, face a much larger reduction in physician age (16 years reduction vs. 3.5 years) and a larger increase in the occurrence of female physicians (14 vs. 0.4 percentage points).

We find that while the differences in effects are miniscule for the primary care utilization and secondary care,[17] the effects on initiation with chronic medication are significantly lower (by a factor 3) for the sample of individuals who experience a closure due to non-retirement. Results are shown in online supplement Tables B5 (retirees) and B6 (non-retirees). These findings confirm that individuals exposed to larger changes in observed physician characteristics that are associated with practice style experience relatively larger effects. We interpret this as preliminary evidence that distinct practice styles matter for outcomes and that the documented changes in health care utilization are not driven solely by disruption.

Equipped with this insight, we proceed to shed light on the relative importance of physician practice styles more generally. First, we estimate practice styles via physician fixed effects from an auxiliary regression relying on data prior to practice closures. To do this, we follow a recent literature using patient mobility to infer practice style from a *two-way fixed-effects model* (Abowd et al., 1999; Finkelstein et al., 2016, 2018; Markussen and Røed, 2017). We estimate this model for the group

[16] As the reason for closure is not available from the data, we impute (Hastie et al., 2001) an age threshold from the ages of the closing physician and classify physicians older than this threshold as retirees, while younger physicians are classified as closing due to other reasons. Details on the imputation can be found in online supplement D. We identify a threshold of 60.3 years, as illustrated in online supplement Figure B4. In online supplement Figures B5 and B6 we show that the types of practice closure do not differ in terms of patient anticipation – patients do not leave retiring physicians at an increasing rate pre-closure, and those that do leave, do not differ in terms of observables characteristics.

[17] Online supplement Table B5 shows the results for the retirees, and online supplement Table B6 the results for the non-retirees.

exposed to practice closure before they experience the closure ($q < -1$) and our comparison group. The two-way fixed-effects model is, then

$$y_{it} = \alpha_i + \gamma_{j(i,t)} + \sum_{\tau \in (-2,2)} \delta_t q(i,\tau) + \tau_t + \varepsilon_{it}, \quad (3)$$

where y_{it} denotes the outcome of interest, $q(i,\tau)$ is a dummy for quarter relative to the separation, and $\gamma_{j(i,t)}$ measures practice fixed effects (practice style). As in Finkelstein et al. (2016), the inclusion of $q(i,\tau)$ allows outcomes at the end of an existing relationship with a physician and at the beginning of a new relationship to be different from outcomes in stable periods. We do this to facilitate the possibility that patients differ in their health care utilization around physician switches, as the reason for the switch (e.g., residential relocation) might affect the outcome.

Since α_i, the patient fixed effect, and $\gamma_{j(i,t)}$, the practice fixed effect, can be arbitrarily correlated in our estimation setup, we consequently allow for certain patient types to select into certain practices; or sorting between patients and practices. Following Finkelstein et al. (2016), we assume away selection into a practice based on unobserved but time-varying patient characteristics, ε_{it}. Contemporaneous health shocks, for instance, cannot lead patients to seek out physicians with certain practice styles. Formally, $E\left[\gamma_{j(i,t)}\varepsilon_{it}\middle|\alpha_i\right] = 0$. For a detailed discussion, see Abowd et al. (1999) or Abowd et al. (2002).

We proxy the practice style of the first assigned destination practice via a standard leave-one-out strategy to accommodate the possibility of patients sorting into destination practices in connection with practice closures. We do so by predicting the practice fixed effect with a weighted average of destination practice fixed effects for the subset of all the *other* patients from the *same* closing practice who leave in the period immediately prior to the closure. Formally, let D_o denote the set of destination practices that patients from the origin practice *o* switches to in last period we observe *o*. We weigh the destination practices by the fraction of movers from origin practice *o* to each destination practice *d*, θ_{od}.[18] That is, let

$$\bar{\gamma}_{j(i,t)} = \sum\nolimits_{d \in D_o} \gamma_d \frac{\theta_{od}}{\sum_{d \in D_o} \theta_{od}}$$

[18] As there is variation in how many destination practices each closure produces, we show that the general case, where we weigh every destination practice, produces similar results to choose the modal destination practices or the weighted average of the up to three, five, and ten destination practices. Results available upon request.

be the average physician practice style of physicians who receive patients from the closing practice o. We then define the *predicted* practice fixed effect by

$$\gamma^*_{j(i,t)} = \begin{cases} \bar{\gamma}_{j(i,t)} & if\ closure_i = 1, post_{i,t} = 1, F_{j(i,t)} = 1 \\ \gamma_{j(i,t)} & else \end{cases}$$

where $close_i$ is an indicator for being in the treatment group, $post_{i,t}$ is an indicator for having experienced a practice closure, and $F_{j(i,t)}$ is an indicator if the physician is the first visited after a practice closure.

After obtaining $\gamma^*{}_{j(i,t)}$, we finally decompose the differences between the treated and comparison groups before and after the (synthetic) closure of the practice in the spirit of Finkelstein et al. (2016). Under (3), we can decompose the change in outcome into a share explained by changes in physician practice style and a share that is not.[19] We interpret the latter residual as the share of the effect that is due to the disruption and therefore assume that, for example, any individual behavioral changes unrelated to practice affiliation are part of the disruption effect.

TABLE 4: DECOMPOSITION OF EFFECTS ACROSS OUTCOMES

	Primary care utilization			Initiation with chronic medications			Secondary and outpatient care		
Outcome	Any visit	Gov. reimb.	Any pharm. claim	ACE inhib.	Statins	Metformin	Any outpat. Care	Any prac. spec.	Any emerg. care
Total effect variation	1	1	1	1	1	1	1	1	1
Share physician	0.51	0.74	0.47	0.07	0.21	0.36	0.61	0.48	0.04
Share disruption	0.49	0.26	0.53	0.93	0.79	0.64	0.39	0.52	0.96
Total effect (relative to mean)	0%	5%	0%	48%	24%	31%	3%	-1%	7%
Rel. effect phys	6%	7%	2%	3%	5%	11%	2%	11%	0%
Rel. effect disruption	-6%	-3%	-3%	44%	19%	20%	1%	-12%	7%

Notes: This table shows the decompositions for each outcome. The top three rows show how much of the variation in the change in outcome is due to changes in physician practice style and what is due to disruption. The bottom three rows show the total effect relative to the mean, how much is due to physicians, and what is due to disruptions.

Table 4 presents our decomposition results. The main takeaway is that disruption effects are present, and they are not unambiguously harmful to patient outcomes. Importantly, we do find a negative

[19] As unconditional and conditional estimated effect sizes in Table A1 are very similar, we decompose the detrended but otherwise unconditional outcome.

disruption effect in primary care utilization. Gains in practice style offset the negative disruption effects, however, meaning that the total impact on PCP utilization of the practice closure is modest at most. The total effect on the probability of seeing a PCP, for example, is 0.2 percentage points or 0.4% relative to the mean (compared to Table A1). However, the estimated disruption effect constitutes a 6% reduction relative to the mean that is offset by a 6% *increase* attributable to the physicians' practice style. The results are more or less similar for the other primary care outcomes; disruption reduces utilization, which to varying extents is offset by (more aggressive) physician practice styles.

Turning to the initiation of chronic medication, the lesson is slightly different. While the physician still has a positive effect, the disruption effect is also positive and is much stronger than that of the physician. The total effect of closure on statin initiations, for example, is a 24% increase relative to the mean. Here, the disruption effect constitutes 19 percentage points of this increase and the change in physician practice style accounts for the remaining 5 percentage points. This suggests that the large increases in drug treatment initiations are by no means solely driven by differential physician practice styles but pertain to an effect of seeing a new provider.

For the remaining utilization measures, the size and sign of the disruption effect varies across outcomes. Regarding outpatient care, the effects are similar in direction and magnitude, while the disruption effects dominate completely for emergency care visits. Finally, the effects on specialist visits that stem from increases in physician effects are large (11% relative to the mean) but offset by a large negative disruption effect of -12% relative to the mean.

The findings in this section reveal two important insights: firstly, practice styles among the destination physicians uniformly increase care utilization and the detection of chronic illness. Secondly, and contrary to many common beliefs, disruption is not *per se* negative from the patient's perspective; in and of itself, disruption reduces primary care provision and referrals to practicing specialists, but it also clearly supports the initiation of medications targeting chronic disease.

7. Conclusion

We study how discontinuity in primary care provision affects health care utilization in Denmark. We do so by utilizing how, over time, primary care practices close and patients subsequently require new providers. Using a difference-in-differences setup, we compare utilization patterns among those who experience a practice closure to those who only experience a practice closure later.

We find large, positive impact on the take-up of prescription medications that target the three major chronic conditions hypertension, hyperlipidemia, and diabetes. It is well-established that these conditions are significant risk-factors for cardiovascular morbidity and mortality and that they are generally underdiagnosed (see, e.g., Fryar et al., 2010). We show, however, that the take-up of drugs targeting these chronic conditions is not driven by differential treatment styles across physicians; instead, it stems from a common disruption effect associated with seeing a new physician. We also find that the dissolution of patient–physician relationships induced by the practice closures have only modest effects on primary-care utilization as well as on the use of other specialists. The disruption of the patient–provider relationship – the break in interpersonal continuity – does however lead to increased use of emergency services.

Overall, our findings are important for policymakers because they indicate that practice closures are not necessarily to the patient's disadvantage. Because it implicitly introduces a second opinion, a change in provider may even lead to the detection and treatment of chronic disease and ultimately to improved patient well-being. Obviously, our results are only valid in a context where the patient is not left entirely without access to primary care.

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Appendix A: Additional tables and figures

TABLE A1: DIFFERENCE-IN-DIFFERENCES RESULTS,

EFFECTS OF CLOSURE ON QUARTERLY OUTCOMES

Panel A	(1) Any PCP visit	(2) Any PCP visit	(3) Any PCP visit	(4) Government reimbursement to PCP (DKK)	(5) Government reimbursement to PCP (DKK)	(6) Government reimbursement to PCP (DKK)	(7) Any pharmacy claim	(8) Any pharmacy claim	(9) Any pharmacy claim
Closure (x100)	0.160	0.0138		47.4	13.6		0.948***	0.424***	
	(0.232)	(0.185)		(42.5)	(40.2)		(0.220)	(0.137)	
Closure X Post (x100)	0.0977	0.0386	0.181	209.3***	204.9***	212.9***	-0.126	0.206	0.063
	(0.393)	(0.288)	(0.125)	(58.8)	(53.8)	(19.3)	(0.376)	(0.182)	(0.069)
# Observations	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768
R-squared	0.001	0.157	0.352	0.003	0.084	0.289	0.001	0.311	0.529
Mean outcome (x100)	56	56	56	4405	4405	4405	53	53	53
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual background chars	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes	No	No	Yes

Panel B	(1) ACE	(2) ACE	(3) ACE	(4) Statins	(5) Statins	(6) Statins	(7) Metformin	(8) Metformin	(9) Metformin
Closure (x100)	0.0149*	0.00		0.0212**	0.000		0.000***	0.000***	
	(0.00)	(0.00)		(0.00)	(0.000)		(0.000)	(0.000)	
Closure X Post (x100)	0.122***	0.122***	0.124***	0.0825***	0.0824***	0.0831***	0.0261***	0.0259***	0.0266***
	(0.0136)	(0.0130)	(0.0103)	(0.0165)	(0.0155)	(0.0114)	(0.000)	(0.000)	(0.000)
# Observations	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768
R-squared	0.000	0.003	0.064	0.000	0.004	0.063	0.000	0.001	0.066
Mean outcome (x100)	.260	.260	.260	.327	.327	.327	.084	.084	.084
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual background chars	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes	No	No	Yes

Panel C	(1) Any outpatient care	(2) Any outpatient care	(3) Any outpatient care	(4) Any prac. specialist	(5) Any prac. specialist	(6) Any prac. specialist	(7) Any emergency care	(8) Any emergency care	(9) Any emergency care
Closure (x100)	0.147***	0.115**		0.570***	0.350***		0.177**	0.201**	
	(0.0604)	(0.0516)		(0.134)	(0.131)		(0.0845)	(0.0814)	
Closure X Post (x100)	0.255**	0.245**	0.293***	-0.304	-0.312	-0.300***	0.174	0.162	0.183***
	(0.127)	(0.117)	(0.0889)	(0.252)	(0.238)	(0.0569)	(0.147)	(0.145)	(0.0646)
# Observations	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768
R-squared	0.001	0.014	0.143	0.002	0.020	0.268	0.001	0.006	0.174
Mean outcome(x100)	8.3	8.3	8.3	8.6	8.6	8.6	2.3	2.3	2.3
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual background chars	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes	No	No	Yes

Notes: This table shows the difference-in-differences results for primary care utilization (panel A), initiation with chronic medication (panel B), and secondary care use (Panel C). For each outcome, we run models sequentially adding quarter and region dummies. Standard errors are clustered on the physician level. ***p < 0.01, **p < 0.05, *p < 0.10.

TABLE A2: DIFFERENCE-IN-DIFFERENCES RESULTS, EFFECTS OF CLOSURE ON QUARTERLY OUTCOMES

Panel A	(1) Any CVD Hosp	(2) Any CVD Hosp	(3) Any CVD Hosp	(4) CVD Hosp >5 days	(5) CVD Hosp >5 days	(6) CVD Hosp >5 days	(7) CVD Hosp >10 days	(8) CVD Hosp >10 days	(9) CVD Hosp >10 days
Closure (x100)	0.0515***	0.0239***		0.0285***	0.0170***		0.0135***	0.008***	
	(0.006)	(0.005)		(0.003)	(0.003)		(0.002)	(0.002)	
Closure X Post (x100)	0.030**	0.0311***	0.040***	0.0002	0.001	0.005	0.0005	0.0001	0.002
	(0.011)	(0.009)	(0.007)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)	(0.002)
# Observations	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768
R-squared	0.000	0.008	0.117	0.000	0.004	0.091	0.000	0.002	0.081
Mean outcome (x100)	.451	.451	.451	.16	.16	.16	.066	.066	.066
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual background chars	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes	No	No	Yes

Panel B	(1) Any Diab Hosp	(2) Any Diab Hosp	(3) Any Diab Hosp	(4) Diab Hosp >5 days	(5) Diab Hosp >5 days	(6) Diab Hosp >5 days	(7) Diab Hosp >10 days	(8) Diab Hosp >10 days	(9) Diab Hosp >10 days
Closure (x100)	0.007**	0.004		5.41e-05**	0.004		0.003*	0.003	
	(0.003)	(0.003)		(0.002)	(0.002)		(0.002)	(0.002)	
Closure X Post (x100)	0.007	0.007	0.008**	0.001	0.001	0.002	0.002	0.002	0.001
	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)
# Observations	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768
R-squared	0.000	0.003	0.114	0.000	0.002	0.090	0.000	0.001	0.078
Mean outcome (x100)	.105	.105	.105	.06	.06	.06	.029	.029	.029
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual background chars	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes	No	No	Yes

Panel C	(1) Any Cancer Hosp	(2) Any Cancer Hosp	(3) Any Cancer Hosp	(4) Cancer Hosp >5 days	(5) Cancer Hosp >5 days	(6) Cancer Hosp >5 days	(7) Cancer Hosp >10 days	(8) Cancer Hosp >10 days	(9) Cancer Hosp >10 days
Closure (x100)	0.044***	0.033***		0.024***	0.019***		0.013***	0.010***	
	(0.004)	(0.005)		(0.002)	(0.002)		(0.002)	(0.002)	
Closure X Post (x100)	0.048***	0.049***	0.060***	0.021***	0.021***	0.027***	0.010***	0.011***	0.014***
	(0.007)	(0.007)	(0.006)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)
# Observations	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768	25,302,769	25,302,769	25,302,768
R-squared	0.000	0.002	0.138	0.000	0.001	0.102	0.000	0.000	0.088
Mean outcome (x100)	.199	.199	.199	.098	.098	.098	.055	.055	.055
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual background chars	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Individual FE	No	No	Yes	No	No	Yes	No	No	Yes

Notes: This table shows the difference-in-differences results for inpatient admissions with cardiovascular diseases (panel A), inpatient admissions with diabetes related diseases (panel B), and inpatient admissions with cancer (Panel C). For each outcome, we run models sequentially adding quarter and region dummies. Standard errors are clustered on the physician level. ***p < 0.01, **p < 0.05, *p < 0.10.