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Daniel Monsees and Matthias Westphal*

# Disruptions in Primary Care: Can Resigning GPs Cause Persistently Negative Health Effects?


## Abstract

*We study the effects of general practitioners' (GPs') resignations on their patients' healthcare utilization, diagnoses, and mortality in an event-study setting. Using claims data from a large German statutory health insurance, we find that after physicians leave, their former patients persistently reduce their primary care utilization, only partially substituting it with specialist visits and hospital care. Because patients find a new GP already 1.1 quarters after the old resigns, on average, the persistent effects must be explained through the new GP. Indeed, we find that the new GP serves more patients but performs less diagnostic testing. While we do not find evidence for mortality, our results reveal a substantial decrease in diagnoses of chronic conditions (such as congestive heart failure and diabetes), suggesting that disruptions may have adverse consequences for the efficiency of the healthcare system. This indicates that continuity in primary care is pivotal and shows that the GP has an important role in healthcare delivery.*



*JEL-Codes: I11, I12, I18*

*Keywords: Healthcare utilization; healthcare expenditure; general practitioners; primary care*

*June 2024*


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# 1 Introduction

A close and long-lasting relationship between general practitioners (GPs)[1] and their patients is generally regarded as desirable and an essential factor in providing high-quality ambulatory care (Baker et al., 2020; Nyweide et al., 2013; Schuettig and Sundmacher, 2022; Saultz and Lochner, 2005). Patients may develop trust in their GPs over time while GPs gather specific and potentially important knowledge about their patients' underlying health – allowing them to make informed decisions about the best treatment options. The current demographic shift towards older populations in Western countries also affects the workforce in the healthcare sector. While in 2012, 9% of the practicing GPs in Germany were above the age of 65, this share rose to 20% in 2022 (Bundesärztekammer, 2023). These older physicians will soon resign, challenging the continuity of care for patients. This is particularly problematic in the German setting where no substitute for GPs services in primary care – like nurse practitioners – exists. However, if the new GPs have superior knowledge and treatment styles compared to their predecessors, changing GPs may benefit patients. Whether this is the case also depends on how quickly patients search for new doctors and how accessible primary care is in the healthcare system. Therefore, which forces prevail in the particular setting is an important empirical question we study in this paper.

Specifically, we evaluate the effects of a disruption of the patient-provider relationship on healthcare utilization, changes in the practice styles between the old and new GP, and mortality using detailed administrative claims data from a German statutory health insurance comprising almost 9 million insurees. We assess the health and healthcare utilization consequences for patients whose primary care provider resigns from his profession (e.g., due to retirement) in an event-study setting where we center calendar time on the exiting period of the leaving GP.

Similar approaches have been used to evaluate the effects of disrupting the patient-provider relationship in various healthcare systems. Most evidence comes from the US using either data on Medicare recipients aged 65 and older (for instance, Fadlon and van Parys, 2020; Kwok, 2019; Sabety et al., 2021; Zhang, 2022) or individuals in Medicaid who cannot afford regular health insurance (Staiger, 2022). Evidence outside the US is more scarce, comprising of Bischof and Kaiser (2021), Simonsen et al. (2021), and Zocher (2024), who study Switzerland, Denmark, and Austria, respectively. For the US, the literature documents significant reductions in primary care visits after a GP's exit. This reduction goes along with an increase in specialist visits. Since both these effects are persistent, this suggests a shift in healthcare utilization towards specialists. An increase in emergency department visits or hospitalizations is only found in the short term. For Switzerland, Bischof and

[1]Note that we refer to GPs also as physicians unless otherwise declared.

Kaiser (2021) report similar effects. They find a persistent decrease in GP visits and an increase in specialist visits. Although there is an increase in hospital visits, there does not seem to be an overall effect on mortality. Likewise, results for Austria suggest a significant increase in healthcare spending for inpatient and outpatient services of affected patients (Zocher, 2024). In Denmark, a higher level of regulation might be why the transition between physicians is much smoother (Simonsen et al., 2021). Although there is a decrease in GP visits and an increase in hospitalizations for chronic conditions, it is suggested that the latter results from a reassessment of patients' health by the absorbing GP or primary care provider, which means that patients may benefit from it.

We contribute to this recent literature by analyzing an interesting healthcare setting that may complement existing evidence, especially with respect to showing that disruptions can have adverse health consequences. We study GP exits within German social health insurance. Notably, three of its features distinguish our setting from the literature and may thereby explain this paper's pronounced and partially novel effects. First, the insurance plans of the social health insurance that we study do not exhibit any deductibles or copayments as is the case, e.g., in Bischof and Kaiser (2021). Deductibles can cause confounding effects as they censor healthcare utilization from below. Second, although we may not cover the disproportional high earners and civil servants from private health insurance, we otherwise study a general population that is almost unrestricted regarding age, employment, and socioeconomic characteristics. Finally, Germany has one of the highest physician densities, rendering the healthcare system highly accessible (Blümel et al., 2020).

Our findings suggest a significant and persistent reduction in the utilization of GP services, particularly driven by having regular contact with the GP (where we find a five percent reduction in the probability of visiting the GP in a given quarter). While we find evidence for substituting GP with specialist services, hospital services, especially adverse emergency hospitalizations, seem to be a more important substitute in the short run. In contrast, the persistence of preventable hospitalizations (that can be avoided by good ambulatory care) indicates an increased inefficiency in healthcare provision. As affected patients find a new GP 1.1 quarters after the exit of the former one, our persistent effects must be explained through the (relationship with the) new GPs and the frequency of primary care checkups. We find that new GPs serve more patients (reducing the average potential consulting time per patient) and are more likely part of a group practice. They also perform less diagnostic testing (regarding blood counts and protein tests) and prescribe more preventive drugs against cardiovascular diseases (ACE inhibitors) as a potential consequence of reduced time. Generally, practice style differences between old and new physicians cannot explain these effects, suggesting that new patients are treated differently than the new GP's average patient. Although we do not find higher patient mortality rates, we find evidence that GP disruption reduces healthcare quality. Following the old GP's exit, the new one detects fewer chronic diseases (such as congestive heart failure and diabetes). Most likely, these missed diagnoses directly result from fewer primary care checkups. Documenting these missed diagnoses is a novel finding in the literature.

Our paper proceeds as follows. In Section 2, we describe the institutional details of the German healthcare setting before we present the employed administrative data in Section 3. Section 4 details our event-study regression model and the necessary assumptions. We document our detailed results in Section 5. Finally, Section 6 concludes.

# 2 Institutional Setting and Theoretical Considerations

**Institutional Setting**

Health insurance is compulsory in Germany. This means that citizens have to be enrolled either in statutory health insurance (SHI; about 87% of the population) or – if they meet certain criteria that relate to earned income and employment – in private health insurance (PHI; about 10.8%, see Blümel et al., 2020).[2] While privately insured individuals have to pay for services upfront, which will be reimbursed by their insurance afterward, individuals in the SHI encounter almost no (out-of-pocket) fees for physician services. Individuals covered by the SHI may receive treatment from any physician contracted with the SHI (which is the case for more than 66% of the physicians). This liberal principle applies to general and specialist physicians who do not have any mandatory gatekeeping function as GPs. Together with the high physician density, this results in a high accessibility of healthcare services (Blümel et al., 2020), which should make it relatively easy for patients to switch from one physician to another and open the possibility of substituting GP with specialist services.

Germany has above-average outpatient contacts within the EU, with about 9.9 contacts per capita in 2018 (Blümel et al., 2020). German GPs mostly work in solo practices, albeit there is an increasing tendency for employment in group practices, especially medical care centers. This tendency also explains the decreasing total number of general practices (from 32.319 in 2012 to 27.430 in 2020, Kassenärztliche Bundesvereinigung (KBV), 2022b), while the total number of GPs is relatively stable (increasing from 54.172 in 2012 to 54.956 in 2020 Kassenärztliche Bundesvereinigung (KBV), 2022a). Still, the dominance of solo practices means that the exit of individual physicians likely results in the closure of practice and, thus, a significant disruption in the continuity of care for patients. Concerning the exits themselves, there is little to no regulation. GPs can revoke their license to practice until the

[2] The latter is open for permanent public employees and civil servants, self-employed, and individuals earning more than the opt-out threshold (€62,550 in 2020).

end of each quarter. There are no regulations concerning when GPs have to inform their patients.[3]

**Theoretical Considerations**

We present the most important theoretical mechanisms that could cause empirical repercussions of GP exits in one simple equation to guide the empirical analysis and structure the proceeding discussion of the results. This equation models individual healthcare utilization as

$$y = f\Big(H, \overbrace{p(e, H, G)}^{\text{Disruption}} \times \underbrace{h(S, T, I)}_{\text{Healthcare quality}}\Big). \tag{1}$$

In this equation, $y$ is a specific outcome variable, such as healthcare use or mortality. We model $y$ as being formed by the (healthcare demand) function $f()$. This function has (at least) two essential inputs: the stock of health, $H$, and the primary-care-induced effects on $y$ in the second argument, which consists of two margins.

First, the extensive margin, i.e., whether the individual has a GP in the first place – labeled as "disruption" in the equation. We model this margin as the probability of having a GP, $p()$. Importantly, every GP exit causes $p$ to drop from 100% to zero – the question is how long it remains at zero. This probability depends on the effort $e$ that an individual exerts to keep the old or search for a new GP, which remains unobserved but could act as an important latent mechanism. Additionally, it could depend on health $H$, as individuals with worse health have a higher demand for primary care. Lastly, it may depend on a vector of geographical attributes $G$, comprising, for instance, the GP density of the region. Hence, by general intuition, we expect individuals with worse health to exert more effort in finding a new GP, while the disruption should be more pronounced in areas with more inaccessible markets for primary care, like the countryside. Second, the disruption (forcing $p()$ to zero) causes individuals to switch their GP, such that the healthcare quality, the practice styles, or general characteristics of the new GP (and their practice) may differ. We model this by the healthcare quality function $h()$, which takes the vector of practice styles $S$ (e.g., the propensity to opt for a specific treatment, given the information about the patient and their condition). $T$ may represent trust between the patient and their GP, which may, to some degree, be formed by the length and quality of the relationship. Lastly, the vector $I$ may comprise all the doctors' information about the patient.

Importantly, the disruption and the healthcare quality channel are multiplicatively connected – if the patient does not visit the GP, their healthcare quality cannot affect patient

[3]According to an answer from an inquiry we have sent to the Federal Association of Statutory Health Insurance Physicians

outcomes. In the following analysis, we assess outcomes that address the disruption and the healthcare quality channel. Within the latter, we try to provide evidence of differences in the practice style of the GPs. Using sick notes as an outcome, we want to approach outcomes that could relate to the trust between the patient and their GP.

# 3 Data

We use administrative claims data from a large statutory health insurance covering about 10.6% of the German population (Grobe et al., 2022), with coverage rates that vary between 5.5% to 17.4% across the federal states (Augurzky et al., 2022). Although the data does not necessarily represent the German population, we cover nearly all contracted German physicians (GPs and specialists) registered in Germany. The data contains extensive information on the healthcare services patients use, including out-patient and in-patient services, as well as ambulatory and stationary hospital care. Importantly, we can identify the individual providers for each healthcare service. These are important features compared to other administrative health insurance data in Germany, which allow us to draw a comprehensive picture of the effects across all areas of healthcare. We use quarter-level data from the years 2010 to 2019.

**Identifying General Practitioners**
The data allows us to identify physicians, their practices, and their specializations. Although we do not directly observe when physicians close their practice, we can identify the last quarter in which a physician bills any service to the health insurance.[4] We define this as the quarter when the physician discontinues their service. We are mainly interested in general practitioners (GPs) exiting from the first quarter of 2012 to the last quarter of 2016. We refer to this group of GPs henceforth as *leaving physicians*, of whom we identify 7,376 in our dataset. Because patients are not bound to any provider in Germany, we do not directly observe each individual's main provider. However, we define the patients' main provider as the GP who provides the most healthcare services (billing the most fee schedule positions[5]) to patients for at least four consecutive quarters.

**Sample**
We only include patients exposed to exactly one GP exit in the study period (between 2010 and 2019) if that exit occurred between 2012 and 2016. For example, an individual experiencing one GP exit in 2014 is considered treated, while an individual experiencing

[4] There is the possibility that these GPs continue to serve privately insured patients, however, for SHI patients this still means a loss of the GP.

[5] Gebührenordnungspositionen in German.

an exit in 2018 is not included in the analysis, just like an individual experiencing two exits in 2014 and 2018. Additionally, we restrict the sample to patients who were continuously insured during the whole study period and are aged between 18 and 80 years at the beginning of the study period.[6] This leaves us with 15,340,080 patient quarter observations of 383,502 individuals.

**Outcomes**

Table 1 provides an overview of our main estimation sample and contrasts their characteristics with a sample of untreated individuals who do not experience any GP exit in the study period. For the estimation sample, we only include observations from the sixth quarter before the exit of the GP in the descriptive statistics, representing the levels before treatment or anticipation effects. For the untreated sample, we include all observations from the third quarter of 2010 to the second quarter of 2015, thus occurring simultaneously with the observations of the estimation sample. We base our analysis on the estimation sample and drop patients whose GP never quits. This is not only due to computational convenience but also because the observed and unobserved patient characteristics between exiting and remaining GPs may differ.

While we have extensive medical information on insured individuals, the socioeconomic information is limited. The average treated individual is born in 1958, 60% of the sample is female, and one-third of individuals live in rural counties.

For the disruption channel presented in Eq. (1), the main outcome variable is an indicator equal to one if an individual ever visited any GP during a quarter. In our estimation sample, 70% of patients see a GP on average in a given quarter. Similarly, we define an indicator for specialist services, with specialists being any physician who is not a GP, gynecologist, or pathologist, occurring for 52% of patients. *Emergency Visits* comprise all hospital visits that occurred without a referral from a physician, again as an indicator on the quarter level, with an average of 1.6% of patients. Other forms of hospital visits occur for 3% of patients. Likewise, 0.3% of individuals in the estimation sample are hospitalized with an ambulatory care-sensitive condition – as defined by Albrecht and Sander (2015) – in a given quarter. Next to this, we include costs for physician services – both GPs and specialists – per patient per quarter. The amount of money paid to a physician for treating a certain patient is based on a complex calculation involving multiple actors in the German healthcare system. Since it is impossible to calculate the exact amount with the data at hand, we calculate a proxy for the health insurance expenses based on the services provided by the physician, which we argue is sufficiently close. As a result, we observe

[6] Note that the reasons for not being continuously insured are either dying or switching insurance in the observational period. While this might decrease the generalizability of our estimation sample, it ensures that both do not drive our estimates. Generally, switching of insurance is rare, and there is no reason for it to be related to the exit of the GP.

average quarterly costs of €48 per patient for GP visits and €73 for specialist visits. We also include the number of ambulatory care visits per quarter for GPs and specialists, with an average of 1.8 and 1.6, respectively.

Additionally, to assess proxies of healthcare quality that could be affected by the transition from leaving to absorbing GP, we consider diagnoses based on the Charlson Comorbidity Index (Charlson et al., 1987). Here, we present an indicator if the respective diagnose was documented in the given quarter, irrespective of whether it was diagnosed for the first time.

Lastly, we include tests and prescriptions in our analysis. These should reveal how physicians diagnose diseases and how they decide to treat them. As before, the outcome variables are coded as one in the quarters where a given individual's respective outcome is observed. Blood counts contain various measures supporting the diagnosis of different diseases and are performed for 1.4% of individuals in a given quarter. Total protein is tested for 0.5% of patients in a given quarter and is part of the diagnosis of heart failure. For prescriptions, we focus on those related to heart conditions, as these are the most common in our sample (see above). Beta Blockers and ACE Inhibitors are used for treating high blood pressure, i.e., one of the earliest risk factors of cardiovascular disease (Strauss et al., 2023) with evidence that especially ACE Inhibitors are underused (Brooks et al., 2018). More than 10% of individuals receive a prescription for Beta Blockers, 7.7% receive prescriptions for ACE Inhibitors. 1% of patients receive antibiotics in a given quarter, a class of drugs generally thought of as being prescribed too often. Lastly, 12.2% of patients receive a sick note.

Mean differences between the estimation and the untreated sample are not negligible. For instance, the likelihood of visiting a GP is 13 percentage points higher in a given quarter. The remaining variables also indicate worse health outcomes of the estimation sample. However, as retirement is probably the leading cause for the GPs to resign, GPs in the estimation sample are likely much older than those in the comparison group. This age gap also translates to patients who are almost two years older. To statistically assess these differences, we provide standardized mean differences ($SMD = \frac{Mean_1 - Mean_0}{\sqrt{SD_1 + SD_0}}$, where the index 1 refers to the estimation sample and 0 to the untreated sample, $Mean$, and $SD$ refer to the sample mean and standard deviation, respectively) in the last column of Table 1. Almost all differences are below 10% of a standard derivation, and most are below 5%, suggesting that both samples are reasonably comparable. The only exceptions are the variables *Any GP Visit* and *Any Specialist Visit*, with differences of 19% and 12%, respectively, indicating that the treated sample has a higher utilization of ambulatory services in the extensive margin. Despite this similarity, we continue our analysis using only the estimation sample, i.e., individuals whose GPs discontinued providing healthcare services to their patients at some point.

Table 1: Descriptive Statistics: Estimation vs. Untreated Sample

| | Estimation Sample (exposed to a leaving GP) | | Untreated Sample (not exposed to a leaving GP) | | |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | SMD |
| Patient characteristics: | | | | | |
| Birth Year | 1958.026 | 15.641 | 1959.846 | 15.719 | -0.082 |
| Female | 0.602 | 0.490 | 0.592 | 0.492 | 0.014 |
| Rural | 0.328 | 0.469 | 0.338 | 0.473 | -0.016 |
| Healthcare utilisation: | | | | | |
| Number of GP Visits | 1.788 | 2.249 | 1.517 | 2.287 | 0.085 |
| Any GP Visit | 0.702 | 0.457 | 0.573 | 0.495 | 0.191 |
| GP Costs [€] | 47.574 | 72.152 | 40.896 | 64.595 | 0.069 |
| Number of Specialist Visits | 1.637 | 2.840 | 1.384 | 2.690 | 0.065 |
| Any Specialist Visit | 0.520 | 0.500 | 0.436 | 0.496 | 0.119 |
| Specialist Costs [€] | 72.548 | 228.254 | 60.730 | 208.715 | 0.038 |
| Any Hospital Visit | 0.028 | 0.165 | 0.025 | 0.156 | 0.013 |
| Any Emergency Hospital Visit | 0.016 | 0.126 | 0.015 | 0.120 | 0.008 |
| Any Ambulatory Care Sensitive Condition | 0.003 | 0.053 | 0.003 | 0.052 | 0.001 |
| Diagnoses: | | | | | |
| Myocardial Infarction | 0.011 | 0.106 | 0.009 | 0.095 | 0.007 |
| Congestive Heart Failure | 0.025 | 0.157 | 0.021 | 0.142 | 0.011 |
| Peripheral Vascular Disease | 0.035 | 0.183 | 0.029 | 0.169 | 0.012 |
| Cerebrovascular Disease | 0.037 | 0.189 | 0.031 | 0.174 | 0.013 |
| Dementia | 0.006 | 0.076 | 0.004 | 0.067 | 0.005 |
| Chronic Pulmonary Disease | 0.102 | 0.302 | 0.085 | 0.278 | 0.028 |
| Rheumatoid Disease | 0.021 | 0.145 | 0.016 | 0.126 | 0.014 |
| Peptic Ulcer Disease | 0.005 | 0.073 | 0.004 | 0.063 | 0.005 |
| Mild Liver Disease | 0.051 | 0.219 | 0.043 | 0.203 | 0.015 |
| Diabetes Without Complications | 0.071 | 0.257 | 0.057 | 0.232 | 0.025 |
| Diabetes With Complications | 0.023 | 0.148 | 0.022 | 0.146 | 0.002 |
| Hemiplegia or Paraplegia | 0.008 | 0.088 | 0.006 | 0.078 | 0.005 |
| Renal Disease | 0.021 | 0.143 | 0.017 | 0.131 | 0.009 |
| Cancer (any Malignancy) | 0.044 | 0.206 | 0.034 | 0.182 | 0.021 |
| Moderate or Severe Liver Disease | 0.001 | 0.030 | 0.001 | 0.027 | 0.001 |
| Cancer (metastatic solid tumour) | 0.003 | 0.058 | 0.003 | 0.051 | 0.003 |
| AIDS | 0.001 | 0.024 | 0.001 | 0.028 | -0.001 |
| Tests and Prescriptions: | | | | | |
| Any Blood Count | 0.014 | 0.118 | 0.013 | 0.111 | 0.010 |
| Any Total Protein | 0.005 | 0.072 | 0.005 | 0.070 | 0.003 |
| Any Beta Blocker | 0.105 | 0.306 | 0.080 | 0.271 | 0.062 |
| Any ACE Inhibitor | 0.077 | 0.266 | 0.063 | 0.244 | 0.037 |
| Any Antibiotics | 0.011 | 0.103 | 0.009 | 0.093 | 0.014 |
| Any Sick Note | 0.122 | 0.328 | 0.116 | 0.320 | 0.015 |
| Observations: | 383,502 | | 99,282,654 | | |
| Individuals: | 383,502 | | 4,940,169 | | |

Note: The estimation sample consists of individuals who are continuously insured and who all experience a GP exit between 2012 and 2016, presented are observations 6 quarters before the exit of the GP. The untreated sample consists of individuals who are continuously insured and who experience no GP exit between 2010 and 2019, presented are observations from quarter 3 2010 to quarter 2 2015. *Rural* indicates individuals living in a county with less than 75% of the municipalities having a population density of more than 150 inhabitants per $km^2$ (BBSR, 2023). Diagnoses indicate whether an individual has ever received the given diagnosis, based on the Charlson comorbidity index (Charlson et al., 1987). Complete Blood Count as defined by EBM No.32122. Total Protein as defined by EBM No.32056. ACE Inhibitors include all prescriptions with ATC C09a and C09b. Beta Blockers include all prescriptions with ATC C07. Antibiotics include all prescriptions with ATC J01. SMD refers to the standardized mean differences and is calculated as follows: $SMD = \frac{Mean_1 - Mean_0}{\sqrt{SD_1 + SD_0}}$ (where the index 1 indicates the respective statistic for the estimation sample, while 0 refers to the untreated sample).

# 4 Empirical Strategy

To estimate the potential repercussions on patients that could be caused by leaving GPs, we apply a standard event study model of the following form:

$$Y_{it} = \alpha_i + \lambda_t + \beta^{BIN} \sum_{j \leq -9} e(j) + \sum_{\substack{j \geq -8; \\ j \neq -6}} \beta_j^{ES} e(j) + \epsilon_{it}, \quad (2)$$

where $Y_{it}$ is the respective outcome (such as measures on healthcare utilization) of individual $i$ in quarter $t$. We regress this outcome on $\alpha_i$ and $\lambda_t$, which are individual-specific and quarter effects, respectively. Additionally, we include indicators for the relative time since the exit of the original GP as our regressors of interest. We denote these regressors by $e(j) := \mathbb{1}[t - q_i = j]$. As before, $t$ is the usual calendar time, while $q_i$ denotes the quarter of exit of the GP of patient $i$. The coefficients $\beta_j^{ES}$ are the parameters of interest and capture the differences in the outcomes for the $j^{th}$ event time with respect to quarter $-6$, i.e., 1.5 years before the GP stops practicing. As is convenient in the literature, we bin the lowest event times (before $-8$) together (i.e., we include $\sum_{j \leq -9} e(j)$ as the sum of mutually exclusive dummies as a further dummy) but leave the highest ones (up to 31 quarters after the GP's exit) unrestricted. Our result section only discusses event-time coefficients from $-8$ to 12, where our panel is balanced (as we only consider GP exits from 2012 to 2016). Finally, $\epsilon_{it}$ represents the error term. Standard errors are clustered on the level of the exiting GP. We do not include further covariates apart from the essential time and individual fixed effects.

To interpret $\beta_j$ as causal effects for the periods $j > 0$, we need to assume that if the GP did not exit and continued practicing after $t = 0$, the outcomes of their patients would not have changed (apart from a *common trend* arising, for instance, due to aging). This is the common trend assumption of the two-way fixed effects literature (see, e.g., Callaway and Sant'Anna, 2021). Although this assumption is inherently untestable, one implication of this assumption is that if it holds, there should not be a trend in the outcomes before the quarter the GP leaves. Hence, $\beta_j$ must be zero for $j < a$. If $a < 0$, this means that treatment (the exit of the GP) can be anticipated, and individuals act accordingly (for instance, by switching GPs before the exit). In our setting, for all outcomes and throughout all specifications, we do not find evidence for a deviation from a common trend five quarters before the GP exit. As we set our reference period six quarters before the exit, we can identify causal effects with this treatment anticipation assumption (see Callaway and Sant'Anna, 2021) because we compare post-treatment outcomes with the reference period, which is not contaminated by anticipation effects.

Notice that our setting lacks a clean control group because we dropped the control sample of individuals with a GP that never exits. In such settings with two-way fixed effects, causal inference can be problematic as dynamic treatment effects could interfere with the implicit control group of already-treated individuals (see Sun and Abraham, 2021; De Chaisemartin and d'Haultfoeuille, 2020; Goodman-Bacon, 2021). To avoid such contamination between dynamic treatment effects and an implicit control group, we apply the estimators of Borusyak et al. (2023) and Sun and Abraham (2021). As an anticipation of the results, it shows that the results are pretty similar between these new and the conventional estimation methods, which is potentially due to a somewhat stable evolution of the treatment effects after five quarters past GP exit.

# 5 Results

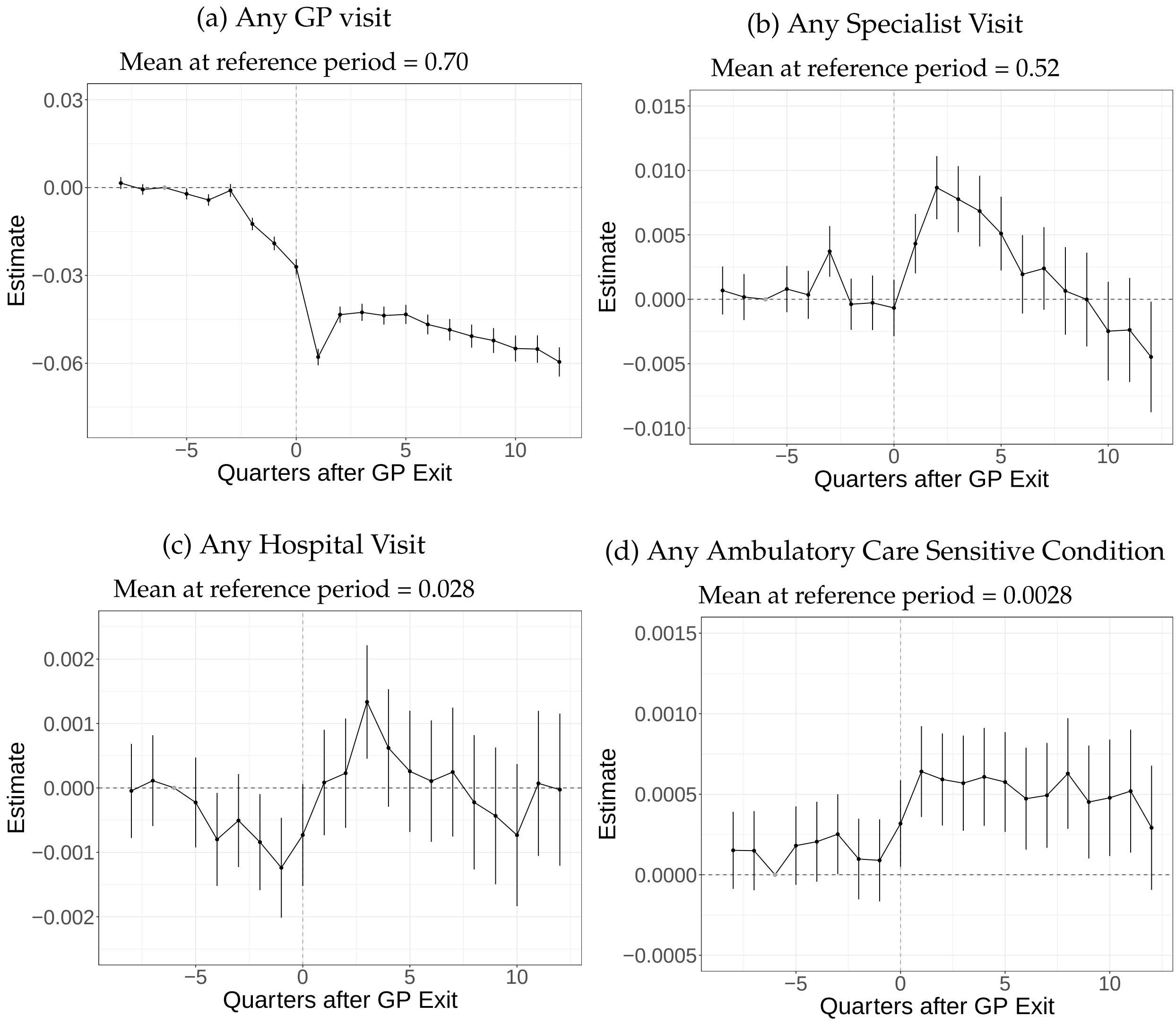
## 5.1 Main results

We now present the results for the event study estimations following our intuition that we built in Eq. (1). We start with ambulatory care, assessing GP and specialist visits on the intensive and extensive margins and total costs. Subsequently, we shift the focus to hospital care, particularly considering hospital cases that could have been prevented with a good provision of ambulatory care. Next, we focus on diagnoses of chronic conditions, tests, and prescriptions. Thereafter, we investigate how physician characteristics and practice styles potentially drive our results and conclude by presenting results on mortality.

**Ambulatory Care**

Starting with GP services, Panel 1a in Figure 1 presents the results for any GP visit in the corresponding quarter as an outcome. Specifically and for all outcome variables, we plot the point estimates for $\beta_j^{ES}$ along the corresponding time since the patients' GP exited, which we confine from $-8$ to 12 (i.e., two years before until three years after the exit). The vertical lines around the estimate indicate the 95% confidence intervals. These estimates exhibit at least three interesting and essential features. First, no clear pre-trends are visible up to three-quarters before the exit, including our reference quarter $-6$. Second, we see an anticipation phase two quarters before the exit until the GP drops out. Here, the probability of visiting a GP decreases by one additional percentage point every quarter. Individuals know that their traditional GP will exit and stop visiting them. Finally, the dynamic effects of the exit become visible. There is a direct reduction in the probability of consulting a GP by about six percentage points (pp) in the quarter after the GP exit. In the following quarter, this negative effect slightly attenuates to four pp below the pre-anticipation level before the effects persist on this level in the subsequent periods. We take this as evidence that the exit of the physician results in a permanent decrease in the probability of seeing a GP, which is – given the probability of seeing a GP of 70% in the reference period six quarters before the exit – of significant size. This relative decrease of 5% to 6% is considerably larger than the $-3\%$ found for Denmark (Simonsen et al., 2021) and more in line with results for the US from Staiger (2022) and Zhang (2022) with $-5.8\%$ and $-4.7\%$ respectively. We present the effects for the intensive margin (number of visits) and total costs of GP visits in Figure A1 (Panel a and c) in the Appendix (showing that the number of visits decreases persistently, whereas costs remain largely unaffected).

Figure 1: Event Study Results on Primary and Hospital Care Utilization




*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. The observation number is 15,340,080, with 383,502 unique patients and 7,376 different leaving physicians (GP). GP visits include all visits to GPs. Specialist visits include all visits to physicians without GPs, gynecologists, or pathologists. Hospital visits include all hospital stays, excluding births and emergency hospital visits. Ambulatory Care Sensitive Conditions include all hospitalizations related to ACSC, as defined by Albrecht and Sander (2015).

Concerning the effects on specialist services, we first consider the probability of seeing a specialist in Figure 1b. Here, no clear pre-trends are visible, including the quarters where we detect anticipatory effects for GP visits. We observe an increase in the probability of seeing a specialist by 0.75 pp in the second quarter after the exit. However, given the baseline value of 52%, the relative magnitude of this effect (1.4%) seems negligible. This small effect is followed by a steady decline, leading to null estimates ten quarters after the exit. Again, we present the effects on the intensive margin and on the costs of specialist visits in Figure A1 the Appendix (Panels b and d, showing a significant and persistent increase of about 3% and 4%, respectively).

In the literature, substitution effects depend on organizational structures. Simonsen et al. (2021) finds evidence of a reduction of specialist visits in Denmark (where GPs serve a gatekeeping function), whereas Zhang (2022) and Sabety et al. (2021) find evidence for the increased use of specialist services for the US medicare population of older individuals. For Switzerland (Bischof and Kaiser, 2021), a relative increase of 11% can be observed. Compared to this, our results show a small increase in the use of specialist services, which is still evidence for substituting GP services with specialist services.

We explore hospital care to better understand if disruptions in primary care translate into worse quality of care. We start with results for general hospital visits, which are depicted in Figure 1c. These include all hospital visits that were referred by a physician. All in all, these results appear relatively noisy. However, the probability of staying in a hospital decreases by about 0.1 pp in the year before the exit. Three quarters after the exit, it increases temporarily by 0.1 pp. Comparing this to an individual's average hospital share in the reference quarter of about 3%, these short-term effects still represent a relative change of more than 3%. The decrease before the closure is most likely a result of the reduced GP visits, which prevent GPs from referring their patients in need to a hospital. Our results align with those of Zhang (2022), finding a 3% increase in the probability of hospitalizations, whereas Staiger (2022) does not find any effect for the general population. The reason for the increase in hospitalizations after the increase is unclear: is it a catch-up effect of missed hospitalization before the closure, or is it related to the new physicians' practice styles? To shed light on this aspect, we next assess hospitalizations with ambulatory care-sensitive conditions (Figure 1d), which could have been prevented with adequate ambulatory care. For instance, these conditions include hospitalizations for asthma and diabetes or hospitalizations for chronic ischemic heart diseases that do not include surgical operations (Albrecht and Sander, 2015). For this outcome, the effects are more pronounced: no pre-trends or anticipatory effects are visible, while the estimates exhibit a clear jump in effect in the quarter of the exit, the share of individuals hospitalized with an ambulatory care-sensitive condition increases by 0.05 to 0.06 pp. This effect is persistent, only reaching zero in the last depicted quarter. Given the baseline value of 0.3%, these estimates represent a relative increase of 16% to 20%. This indicator of care quality is only used by Zhang

(2022), finding no effect. The Appendix completes this picture by presenting results for emergency visits, where a similar picture emerges (Figure A1e).

In sum, our results indicate that the exit of the GP disrupts the accessibility of primary care. In response, individuals partly switch to physician specialists and – to a greater degree – to hospital services. Moreover, we find evidence that healthcare quality, in general, decreases, as evidenced by an increase in avoidable hospitalizations.

**Diagnoses**

We now investigate the impact of GP exits on diagnoses as defined by the Charlson Comorbidity Index (Charlson et al., 1987). We present results for the diagnoses of congestive heart failure, chronic pulmonary disease, and diabetes in Figure 2 and show results for all remaining diagnoses in the Appendix for completeness (Figures A2, A3, and A4). Contrary to the values depicted in Table 1, we use a dummy indicating the first quarter in which they are documented by any physician in the observational period. Because, by and large, these diagnoses indicate chronic diseases and only 2.5% of patients do not consult a new GP within three years after the old one exited, effects likely detect differences in the quality, opportunities, or rigor of the physicians to detect these diseases. As detecting these diseases is vital, these diagnoses can serve as a proxy for the overall healthcare quality.

The results for all these diagnoses exhibit a similar pattern: pretrends are absent before quarter three, with a slight dip before the exit. New diagnoses spike in the first quarter after the exits, after which they commonly decline irrespective of the specific disease. Congestive heart failure detection, for example, increases by 0.14 pp (Figure 2a), compared to a baseline of 0.3%, which translates to a relative increase of 46%. The most prevalent disease is Chronic Pulmonary Disease, with 10% of individuals diagnosed in the reference period (See Table 1). Although there is a decrease in detection before the exit, the detection rate rises to the pre-treatment level in the quarter after the exit, after which it declines continuously (Figure 2b). We observe a similar trend for diabetes diagnoses (Figure 2c), although the point estimate of an increase of 0.07 pp in the first quarter after the exit is statistically significant and given the baseline value of 0.6% of considerable size. The results for the other diagnoses follow a similar pattern (Figures A2, A3 and A4 in the Appendix). The spike in the quarter after the exit can be explained by the transition to a new GP, where the new GP records existing diagnoses. On the other hand, the long-term decrease in diagnoses suggests a decrease in the general healthcare quality. This is likely caused by the reduced doctor visits (as evident in Figure 1a), which reduce the probability of GP detecting new diseases. This is an important finding, which is undocumented in the literature so far.[7]

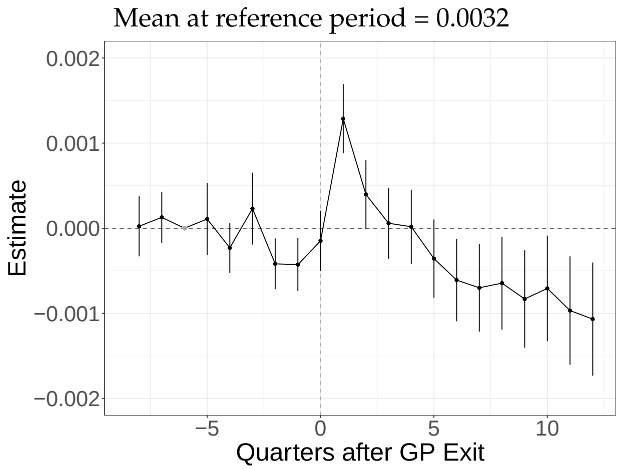
[7] Zhang (2022) reports an increase in diagnoses of chronic conditions (+12 percent).

### Tests and Prescriptions

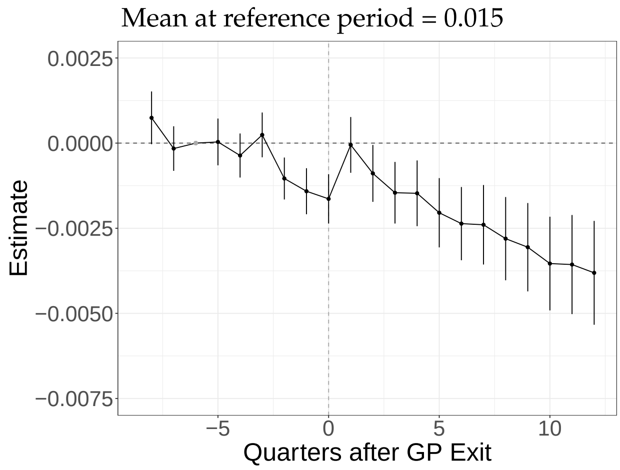
The extensive medical data also allows us to analyze the effects of switching physicians on testing and prescriptions, which can provide further insights into physician behavior. Figures 3a and 3b present results for blood tests in the form of a complete blood count and total protein tests, respectively. As can be seen, adverse effects of about −0.4 pp exist for complete blood counts and −0.15 pp for total protein tests, which are of significant size, compared to the baseline values of 1.4% and 0.5%, respectively. This is surprising as one would expect an increase in testing of the new physician if a reassessment of patients' health occurs. The lack of increased testing surrounding the exit further indicates that the increase in diagnoses results from physicians filing existing diagnoses when first seeing a patient. Moreover, because diagnoses decrease, we can exclude inefficient overtesting as

Figure 2: Event Study Results on Specific Diagnoses

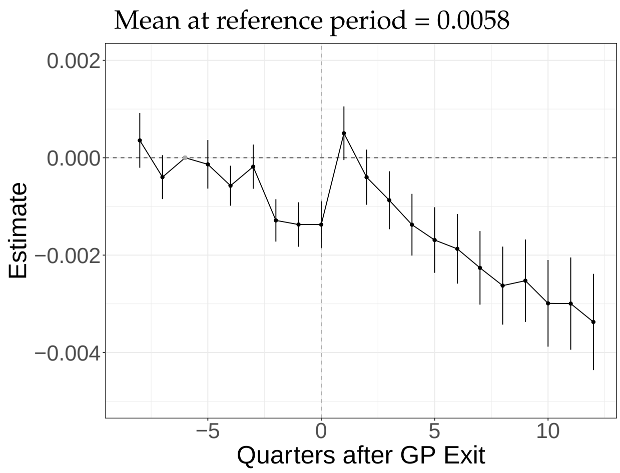
(a) New Congestive Heart Failure Diagnoses




(b) New Chronic Pulmonary Disease Diagnoses




(c) New Diabetes without Complications Diagnoses




*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. The observation number is 15,340,080, with 383,502 unique patients and 7,376 different leaving physicians. The outcome variable is equal to one in the first quarter in the observational period that the respective disease (as defined by the Chalson Comorbidity index Charlson et al., 1987) is diagnosed and 0 else.

an explanation and conclude that more chronic diseases remain undetected due to less testing.

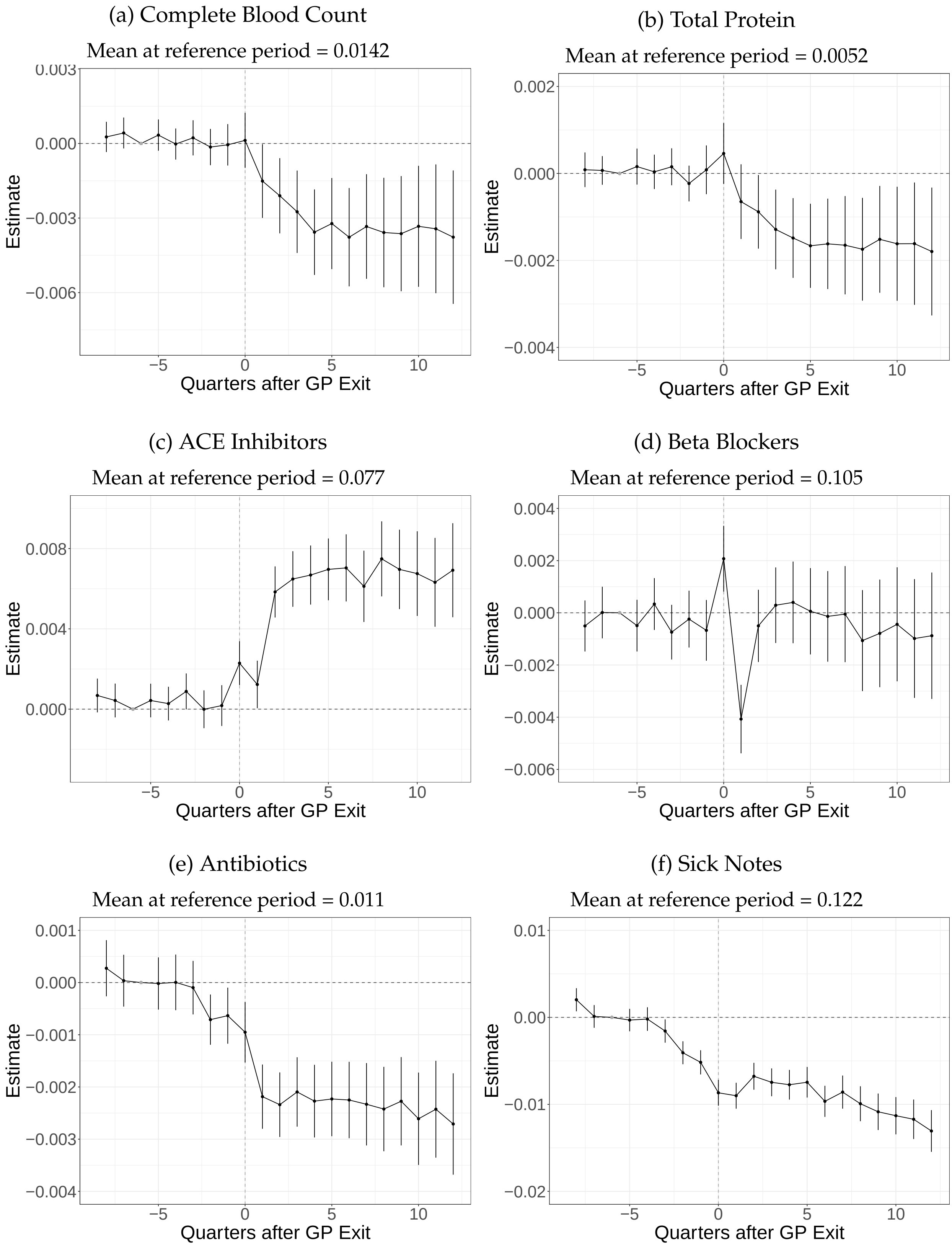
We also investigate whether the exit has effects on specific prescriptions. Figure 3c presents results for the prescription of ACE Inhibitors, while Figure 3d presents results for Beta Blockers. With ACE Inhibitor prescriptions, we observe increased prescriptions after the exit of 0.7 pp. Taking the baseline of 7.7% into account, this effect is meaningful. On the other hand, we observe no effects on the prescription of Beta Blockers in the long run. We investigate the effects on prescriptions of Antibiotics in Figure 3e. We observe a persistent decrease of about 0.25 pp compared to a baseline of 1%. In total, slight evidence favors the interpretation of absorbing GPs being more prone to prescribe according to recent medical knowledge than leaving GPs. On the other hand, prescribing ACE inhibitors may be a purely preventive measure that does not require specific knowledge about the patient's true health.

The final panel (f) of Figure 3 is on work absence certificates that the GP can issue – so far unconsidered in the literature. After three days of work absence, every employee in Germany needs such a sick note to be further released from work duties. Although, for most cases, the decision underlying these certificates is likely unambiguous, GPs may differ in their latent issuing threshold. Patients could also be deterred from going to their GP in the first place if collecting a certificate is uncertain. In this sense, this outcome may reflect the strength of the relationship ($T$ in Eq. 1). Indeed, the results in panel 3f demonstrate a small but distinct negative effect in sick notes. While in the reference period, 12.2% of patients receive a sick note in a quarter, this share drops by about one percentage point after the exit, translating to a relative decrease of 8%. This demonstrates again that healthcare accessibility decreases and suggests, in addition, that a long-lasting acquainted relationship with the GP may be valuable for the patients. One has to keep in mind, however, that (especially against the backdrop of our results) this pattern could also emerge due to the fact that patients feel healthier and do not request sick notes.

**Characteristics of New Practices**

As mentioned, we have limited information on the GPs – e.g., we lack information on the GPs' experience, age, and the distance that patients travel to the practice. Still, we try to gain insights into how the provider and practice characteristics change after a practice closure and assess the general treatment style GPs offer to their patients. Figure 4a shows the distribution of the time it takes patients to find a new GP. Almost 70% of patients see a GP in the quarter after their previous GP leaves. All in all, patients seem to find a new physician relatively quickly. This suggests that the causes of the reduced healthcare accessibility do not only lie on the demand side – patients do see a GP. GPs, however, do not seem to provide the same healthcare quality. Considering the number of patients

Figure 3: Event Study Results on Tests and Prescriptions

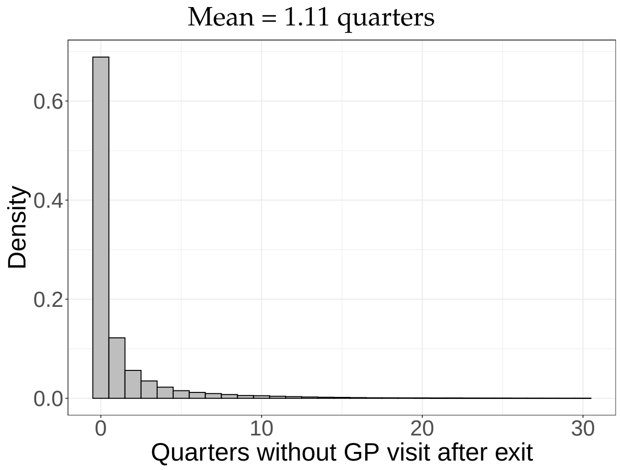



*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. The observation number is 15,340,080, with 383,502 unique patients and 7,376 different leaving physicians. Complete Blood Count as defined by EBM No.32122. Total Protein as defined by EBM No.32056. ACE Inhibitors include all prescriptions with ATC C09a and C09b. Beta Blockers include all prescriptions with ATC C07. Antibiotics include all prescriptions with ATC J01.

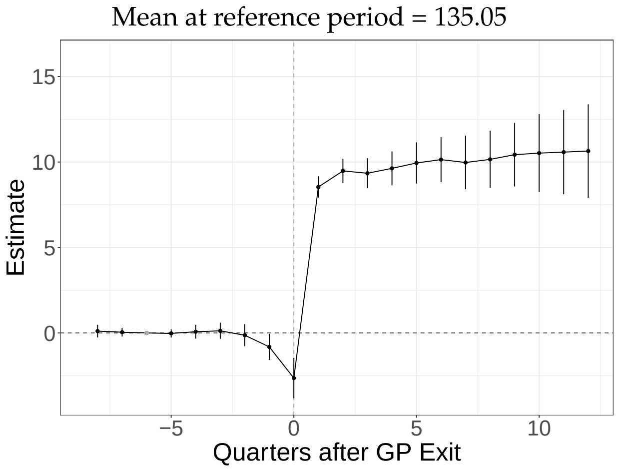
per GP (i.e., insurees in our claims data), Figure 4b reveals positive effects. The average number of patients of the new physicians in the sixth quarter before the exit is 135. After the exit, absorbing physicians treat about ten more patients, corresponding to an increase of 7.4%. Hence, the exit of the old GP causes patients to attend more crowded practices, where it is likely that the GP has less time for each patient. This also favors the view that patient-GP disruption may decrease healthcare quality. Figure 4c supports this view. It depicts the share of individuals being treated in single practices. In the reference period, 68%

Figure 4: Practice Characteristics

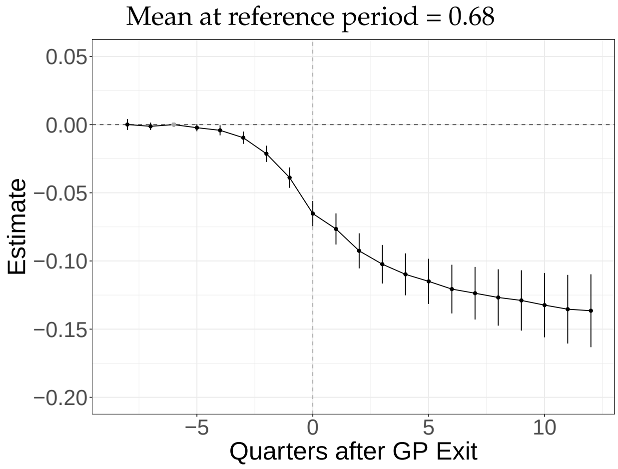
(a) Distribution of Quarters until Patients Consult a New GP




(b) Effect on the Number of Patients per GP




(c) Effect on the Share of Patients in Single Practices




*Notes:* Number of Observations in 4a: 383,502 Patients, in 4b: 1,089,466 Observations of 31,622 Physicians, in 4c: 15,340,080 Observations of 383,502 Patients.

**Practice Style of New Physicians**

We now try to shed light on changes in the general practice style of the GPs (vector $S$ from

Eq. 1), which is independent of the specific patient. Hence, we have to disentangle the patient-specific from the GP-specific outcome. For this purpose, we follow the spirit of Simonsen et al. (2021) and first estimate outcome-specific auxiliary regressions, where we regress each prescription and test in Figure 3 on patient, quarter, and physician dummies using data from 2010 and 2011, i.e., the pre-treatment periods.[8] With patient-fixed effects, the physician dummies are identified by patients who switch doctors and thereby achieve the goal of separating the two factors. We then take the estimates of the physician-fixed effects as a proxy for the treatment style of the corresponding physician and assign them to each patient-quarter observation in our sample. Finally, we use these estimated physician-fixed effects as an outcome in the event study and present the results in Figure 5.

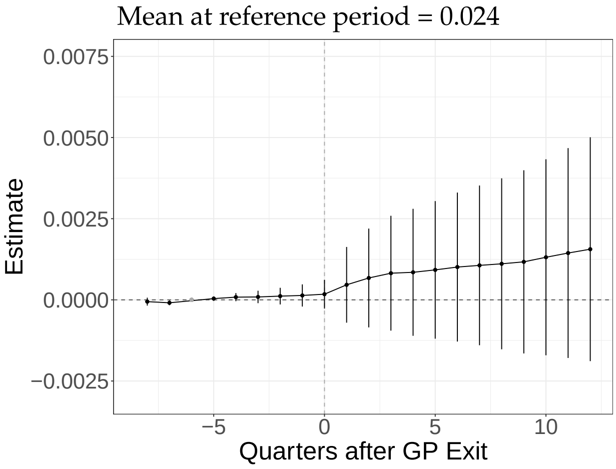
We start by presenting the results of the physician's effects on testing behavior. We find statistically significant effects neither for complete blood counts (Figure 5a) nor for total protein tests (Figure 5b), indicating that new GPs have the same tendencies for testing as the leaving physicians. Together with the opposed individual findings from Figures 3a and 3b, it demonstrates that decreased testing of disrupted patients is patient- or disruption-specific, not attributable to the GP per se. One explanation is that GPs test less because patients continue to visit them less often. This conclusion can also be drawn from the prescription behavior of Beta Blockers or antibiotics (Figures 5d and 5e, respectively). By contrast, new physicians seem to be more inclined to prescribe ACE inhibitors (Figure 5c), which can partly explain the results in Figure 3c. We also assess differences in the GPs' propensity to issue sick notes (Figure 5f). In contrast to the effects on the specific patients (Figure 3f), the new physicians are generally more likely to give out sick notes. As the GP does not cause this effect alone, this favors the interpretation that the lack of acquaintance with the GP may cause the patient-level effects.

We conclude our main results by presenting evidence on mortality, the ultimate health outcome. To analyze mortality, we adjust our sample to include individuals older than 80 in 2010 (as mortality becomes more prevalent) and, naturally, individuals who died by the end of 2019, the end of our observational period. We only include those individuals who were treated by the same leaving physicians as our main sample for four quarters either at the time of their death (if they died before the exit of the GP) or at the time of the exit of the GP (if they died after the exit). We define an indicator set to one in the quarter an individual dies and zero in all other quarters (both before and after death). We then apply our event-study model. Figure 6 presents the results of this analysis. There is a slight decrease in mortality directly after the exit of 0.03 pp (translating to a relative decrease of 7.5%). However, these effects are only evident for two quarters and are only marginally significant. Therefore, we refrain from interpreting these estimates as meaningful effects on mortality. In any case, we do not detect a short-term increase in mortality due to a

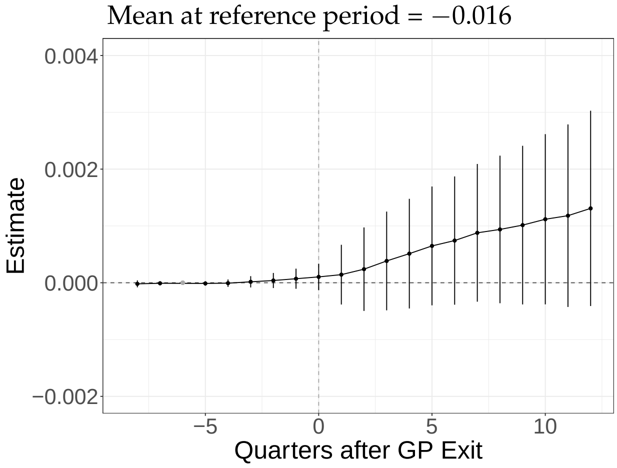
[8] The exact regression specification is $y_{ijt} = \delta_i + \gamma_j + \pi_t + \varepsilon_{ijt}$, where $y$ is the respective outcome of patient $i$, who is treated by physician $j$ in quarter $t$. We then use $\widehat{\gamma}_j$ as the outcome for the event studies.

Figure 5: Event Study Results on Physician Characteristics

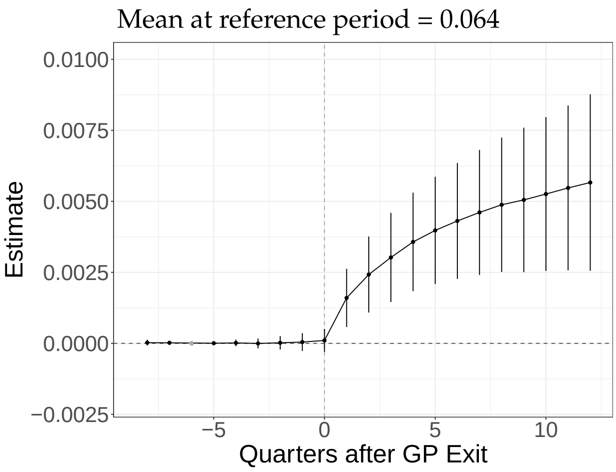
(a) Physician Effects of Complete Blood Counts



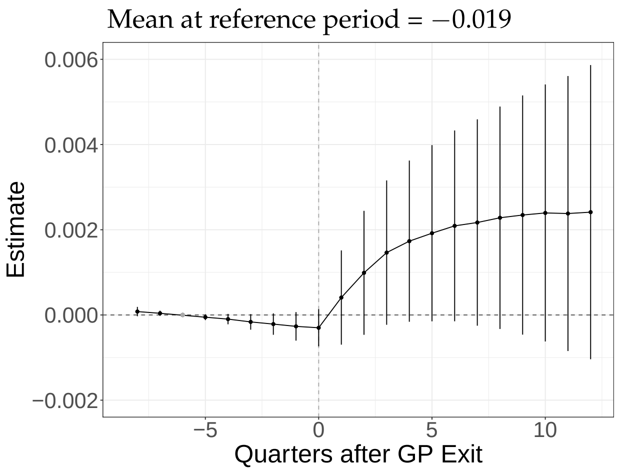

(b) Physician Effects of Total Protein Tests



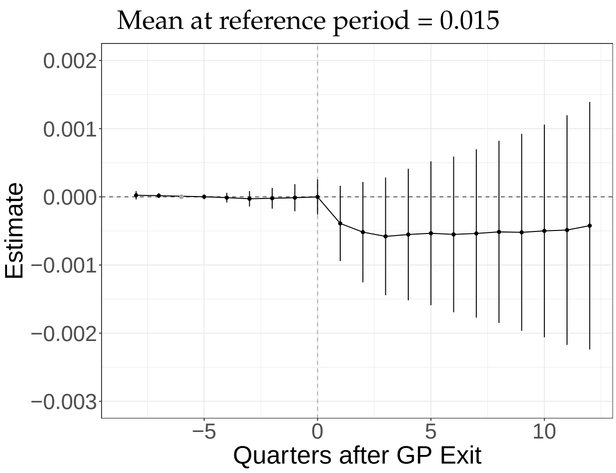

(c) Physician Effects of ACE Inhibitor Prescriptions



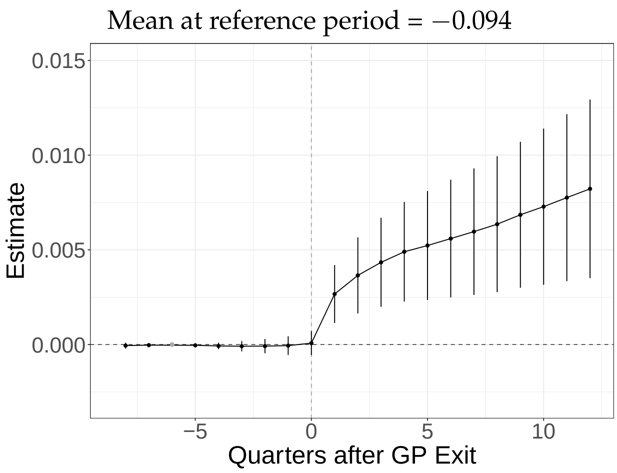

(d) Physician effects of Beta Blocker prescriptions




(e) Physician Effects of Antibiotic Prescriptions



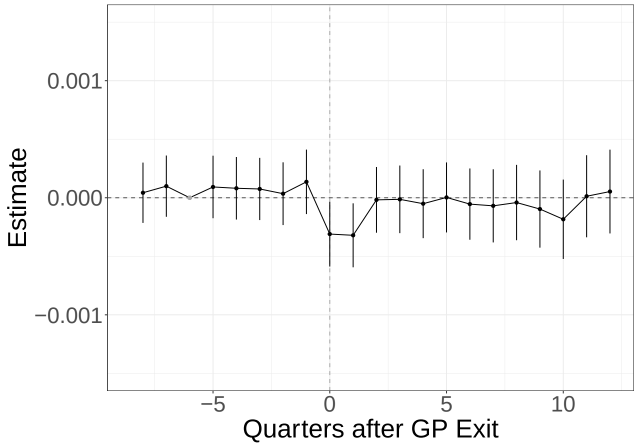

(f) Physician Effects of Sick Notes




*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. The observation number is 15,340,080, with 383,502 unique patients and 7,376 different leaving physicians.

corresponding spike in ambulatory care-sensitive conditions. However, we do not find surging mortality effects in the long run either. Hence, the undetected chronic diseases do not (not) yet translate into mortality effects.

Figure 6: Event Study Results on Mortality




*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. Mean at reference period = 0.004. The observation number is 18,593,392, with 418,582 unique patients and 7,376 different leaving physicians.

## 5.2 Effect heterogeneities and robustness checks

We now explore the heterogeneity of our results. To keep these results traceable, we abstain from showing event-study plots and estimate more aggregate results, distinguishing our estimates between four phases. These phases capture the important properties of all the presented results: The pretrends (in quarters −8 and −7), the anticipation phase (at most from quarters −5 to −1), the first year (quarters 0 to 3), the medium run (quarters 4 to 12) and the long run (quarters 13 and upwards) for which it should be kept in mind that the sample is not balanced. Specifically, we estimate the following regression:

$$\begin{aligned} Y_{it} \;=\; & \alpha_i + \lambda_t + \beta^{BIN} \sum_{j \leq -9} e(j) + \beta_j^{PRE} \sum_{j=-8}^{-7} e(j) + \beta_j^{ANTI} \sum_{j=-5}^{-1} e(j) + \\ & \beta_j^{1st} \sum_{j=0}^{3} e(j) + \beta_j^{MT} \sum_{j=4}^{12} e(j) + \beta_j^{post} \sum_{j \geq 13} e(j) + \epsilon_{it}. \end{aligned}$$

Hence, this regression only differs from Eq. (2) because the coefficients are restricted within the five groups. In particular, we split the sample by gender, age (with a median split), between rural and urban counties, and patient comorbidities (determined by any diagnosis of the Charlson Comorbidity Index in any of the eight quarters before the GP exit), as well as whether patients were treated by a physician in single practice or group practice. Table 2 reports estimates of this regression on healthcare utilization without pretrends (as they are negligible), the anticipation phase, and long-term effects (note that coefficients are scaled by 100). The complete results for all outcomes are presented in the Supplementary Materials.

Generally, there do not seem to be any substantial gender differences or differences between individuals living in urban or rural areas. In contrast, age appears to be an essential factor, with older individuals having higher levels of healthcare utilization after the exit. This could be due to a higher healthcare elasticity of younger relative to older individuals, which could arise as the implicit price for healthcare utilization increases because of the exit (in the form of decreased accessibility). This is also supported by a split by comorbidities, as comorbid individuals have a lower healthcare elasticity. Considering the differences between leaving GPs who work in a group practice versus those working in a single practice, there do not appear to be differences in GP utilization, while patients of single practice physicians seek the care of specialists and hospitals more often after the exit.

**Robustness**

We test for several types of robustness. In Figure A5 in the Appendix, we provide results for different model specifications using our main outcome variable of any GP visit in a given quarter. Figure A5a is the main specification as used before. Using fixed effects for the leaving physician (instead of individual fixed effects) has no meaningful influence on the estimates (Figure A5b). In Figure A5c, we also include all individuals older than 80 in 2010 (and surviving until 2019) in the estimation. Although this age group is quite selective, its inclusion does not seem to drive the results in any direction. In the main specification, we use only those individuals who are continuously insured from 2010 to 2019, we drop this restriction in Figure A5d, only conditioning on observing individuals from Event Times $-8$ to 12. We thereby include individuals who die or leave the insurance during the observational period. Again, this has no meaningful effect on the estimates. In Figure A5e, we include individuals whose GP exits in the last quarter of 2019 as a control group. Descriptive statistics for this sample can be found in Table A1 in the Appendix. We set event time $-6$ as the reference period for the whole group. We do not use this specification as our main specification because using the *not yet treated* as a control group might bias the estimates as this may be selective regarding unobserved trends (violating the common trend assumption). However, as can be seen, this control group has no meaningful impact on estimates. We also include individuals switching their GP up to three quarters before their GP resigns (Figure A5f), which again has no impact on the estimates. All in all, we conclude from this that the restrictions we used to define our main estimation sample did not affect the results meaningfully.

Figure A6 checks whether our results suffer from the potentially adverse consequences in two-way fixed effects models (which may use already treated units as an implicit

Table 2: Effects by specific sub-groups (coefficients multiplied by 100)

| | Any GP visit | | Any specialist visit | | Any hospital visit | | |
|---|---|---|---|---|---|---|---|
| | First Year | Med. run | First Year | Med. run | First Year | Med. run | Observations |
| Complete Sample | −3.234*** (0.114) | −2.958*** (0.132) | 0.884*** (0.097) | 0.881*** (0.117) | 0.059* (0.034) | 0.073* (0.038) | 15,340,080 |
| Gender: | | | | | | | |
| – Female | −2.966*** (0.127) | −2.750*** (0.150) | 0.884*** (0.121) | 0.783*** (0.144) | 0.079* (0.044) | 0.055 (0.050) | 9,231,320 |
| – Male | −3.653*** (0.156) | −3.294*** (0.182) | 0.871*** (0.141) | 1.005*** (0.170) | 0.028 (0.051) | 0.097* (0.058) | 6,108,760 |
| Individuals: | | | | | | | |
| – Older | −2.026*** (0.132) | −1.944*** (0.155) | 1.381*** (0.130) | 1.417*** (0.155) | 0.138** (0.055) | 0.121* (0.063) | 7,794,800 |
| – Younger | −4.500*** (0.152) | −4.067*** (0.180) | 0.372*** (0.133) | 0.320** (0.160) | −0.017 (0.038) | 0.0313 (0.042) | 7,545,280 |
| Area: | | | | | | | |
| – Rural | −3.234*** (0.190) | −2.991*** (0.211) | 1.159*** (0.174) | 1.085*** (0.203) | 0.022 (0.061) | 0.038 (0.070) | 4,797,560 |
| – Urban | −3.256*** (0.141) | −3.018*** (0.167) | 0.760*** (0.118) | 0.741*** (0.145) | 0.0740* (0.042) | 0.087* (0.047) | 9,839,000 |
| Comorbidities: | | | | | | | |
| – with | −3.036*** (0.136) | −3.671*** (0.155) | 0.900*** (0.129) | 0.126 (0.153) | −0.027 (0.056) | −0.136** (0.063) | 7,874,760 |
| – without | −3.406*** (0.150) | −2.149*** (0.177) | 0.888*** (0.133) | 1.711*** (0.160) | 0.152*** (0.036) | 0.296*** (0.041) | 7,465,320 |
| Practice: | | | | | | | |
| – Single | −3.352*** (0.144) | −2.812*** (0.166) | 0.966*** (0.121) | 1.154*** (0.145) | 0.131*** (0.043) | 0.155*** (0.049) | 9,699,160 |
| – Group | −3.019*** (0.175) | −3.152*** (0.213) | 0.751*** (0.157) | 0.438** (0.192) | −0.061 (0.055) | −0.065 (0.062) | 5,640,920 |

*Notes:* Standard Errors in Parentheses. emphFirst Year = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice.

control group). For event study estimators, Sun and Abraham (2021), among others, draw attention to this important source of bias. We present estimates for our baseline model as described above (for computational purposes, we first aggregated the data on the quarter GP level) for the imputation estimator following Borusyak et al. (2023), and for the approach described by Sun and Abraham (2021).[9] In Figure A6a, we use our main specification without including a control group, while Figure A6b includes the same control group as Figure A5e. Although there are some minor differences between the estimates of the treatment effects, we argue that the more sophisticated estimators still virtually lead to the same interpretations as our baseline model.

**Summary of the Results**

Relating our results to Eq. (1), we find that the exit of a physician causes a significant disruption in healthcare utilization. Even though the probability of having a GP ($p$) is decreased due to the disruption, patients find a new physician quite fast (on average after 1.1 quarters). Nonetheless, patients do not return to their old level of healthcare utilization: GP visits are persistently reduced, whereas specialist and hospital visits increase. The adverse effects on chronic diseases provide evidence for a negative effect on unobserved healthcare quality. Lower patient testing and less frequent ambulatory care visits can explain these missed diagnoses. As we do not find substantial differences in practice styles $S$, specific factors of the patient-GP matching must drive these results. Most likely, the decreased primary care utilization on the demand side drives these effects (rather than the GP quality on the supply side). As new GPs treat more patients than the old GPs, patients or GPs must have difficulties establishing a good relationship with the new patients. This may also be reflected in the persistently negative effects on sick notes, which more acquainted GPs may issue more confidently.

# 6 Conclusion

We study the impact of a disruption in the patient-physician relationship induced by GPs leaving the profession (for whatever reason). As we have argued, this induces a potential trade-off. On the one hand, depending on the healthcare system, primary care accessibility is reduced, as all patients need to search for a new GP. On the other hand, finding a new GP may have beneficial consequences regarding healthcare quality: they are likely younger and therefore more informed about more up-to-date medical guidelines.

Our results show that the closure of a GP practice has a significant and long-lasting negative impact on the probability of seeing a GP, while the effects on the number of visits and costs for GP services are less pronounced. There is evidence for substituting GP services with specialist and hospital services, especially in the short run. Results for hospitalizations with ambulatory care-sensitive conditions reveal a substantial and

[9] Since estimating these models is computationally more challenging, we aggregate the data on the level of the leaving physician and use the number of physician patients in a given quarter as the respective weight. This estimation lets us replicate our main results perfectly.

persistent negative impact of practice closures on patients, which do not translate into increased mortality. However, we observe an important decrease in diagnoses of chronic conditions, suggesting that disruptions may have adverse consequences for the efficiency of the healthcare system. These negative consequences may ultimately be caused by fewer primary care visits, which in turn cause reduced diagnostic testing. Primary care may be reduced as the stock of patients of the new GPs is larger, preventing GPs from building good professional relationships with their patients.

Our results align more with those for the US (Sabety et al., 2021; Staiger, 2022; Zhang, 2022) than for Denmark, where forced changes of physicians are much more organized (Simonsen et al., 2021). Although the healthcare systems of Switzerland and Germany are comparable, our results differ from Bischof and Kaiser (2021), who find an even more pronounced drop in GP visits. This, however, may result from the small remaining differences in the healthcare system, particularly concerning insurance plans that limit provider choice and deductibles that may disincentivize seeking medical advice unless absolutely necessary. The healthcare systems of Austria and Germany seem to be more comparable. In line with Zocher (2024), we find a decrease in the probability of seeing a GP after the visit. However, we do not observe an increase in physician fees. Our results stand out from the literature since we are the first to document the negative consequences of GP exits for the healthcare market, as measured by missed diagnoses of chronic diseases.

Hence, our results reveal important insights into the importance of a good informal and long-lasting relationship with the GP, particularly in light of the upcoming demographic transition of GPs in Germany. Because many GPs will resign in the upcoming years, it is important to help patients and the GPs build such an informal relationship. Incentivizing GPs to offer additional consultation hours may be one short-term solution. In the long run, expanding the GP workforce to help GPs increase the time per patient may be another.

Overall, our results paint a picture of the GP as the main coordinator of patient health care in Germany. Even though GP's in Germany do not serve as gatekeepers formally, they still fill this role informally. The GP's exit disrupts all forms of healthcare usage, and the limited access to primary care after the exit results in worse healthcare for patients overall.

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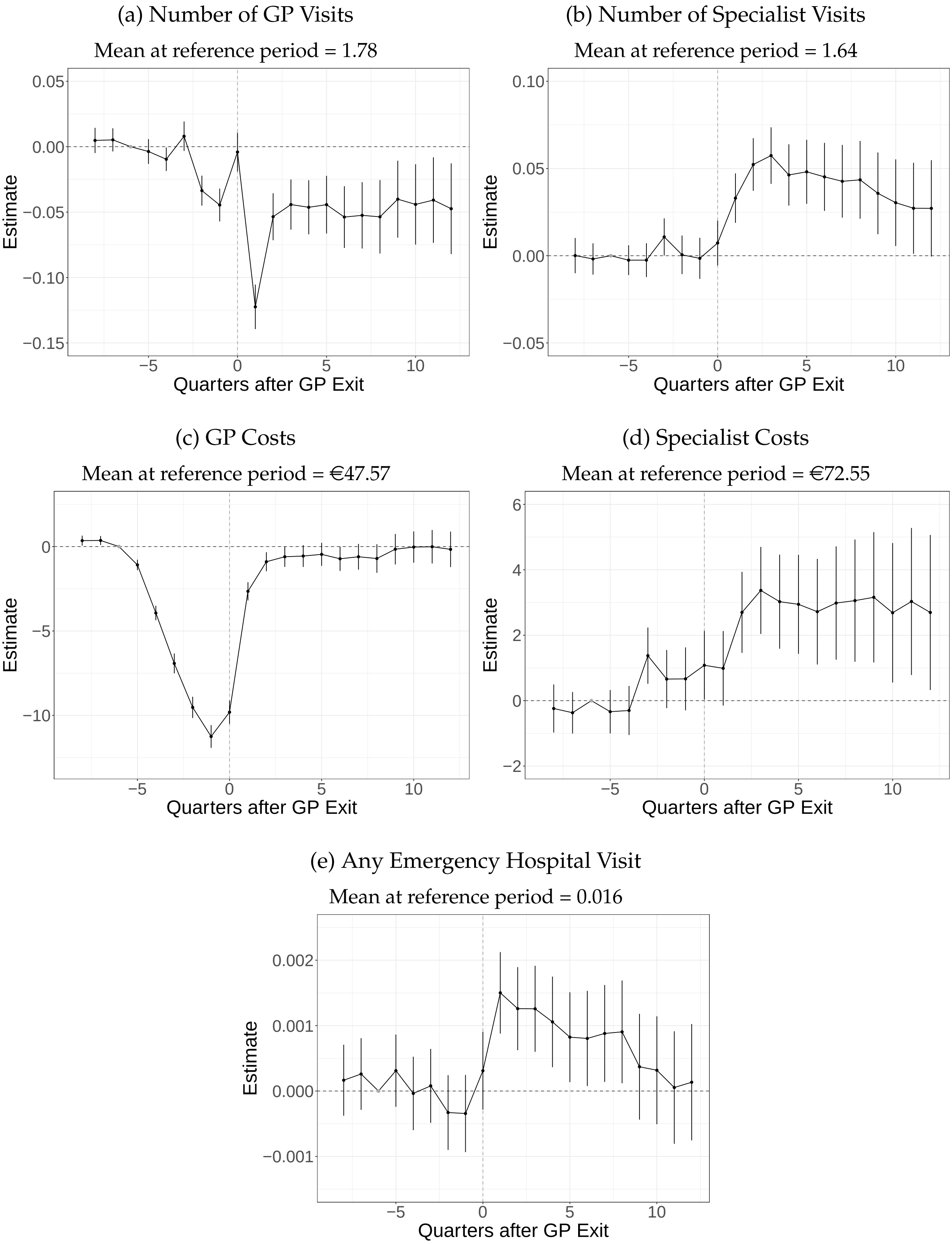
# Appendix

## Additional Figures

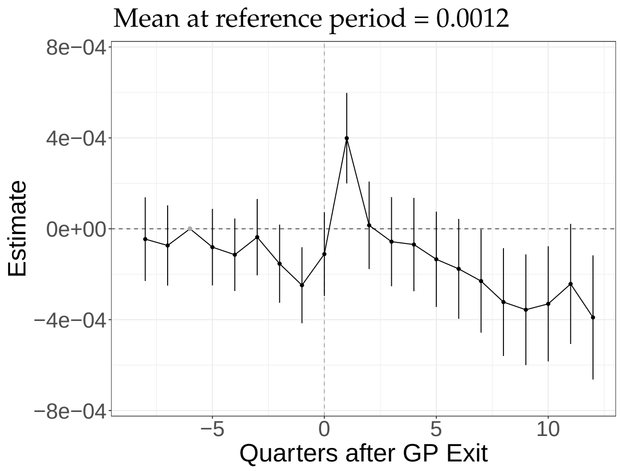
Figure A1: Additional Results on Primary and Hospital Care Utilization



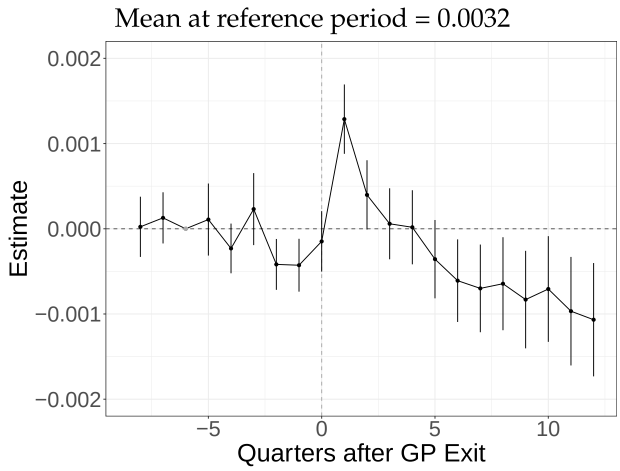

*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. The observation number is 15,340,080, with 383,502 unique patients and 7,376 different leaving physicians (GP). GP visits include all visits to GPs. Specialist visits include all visits to physicians without GPs, gynecologists, or pathologists. The number of visits is the number of unique days services were billed to the health insurance. Costs are based on the *fee schedule* (EBM) points. Emergency Hospital Visits include all hospital stays without a referral from a physician.

## Figure A2: Additional Results on Specific Diagnoses

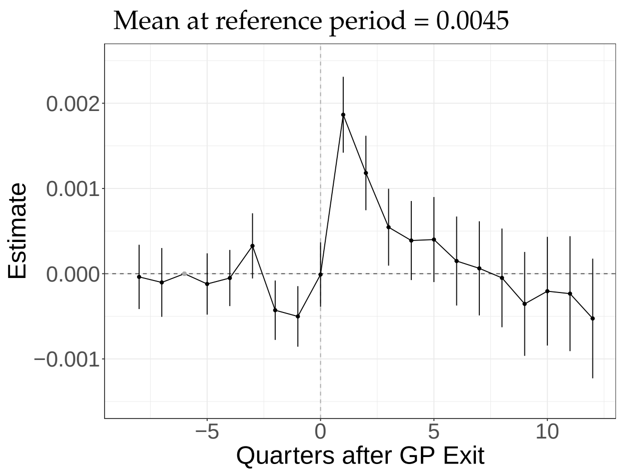
(a) New Myocardial Infarction Diagnoses



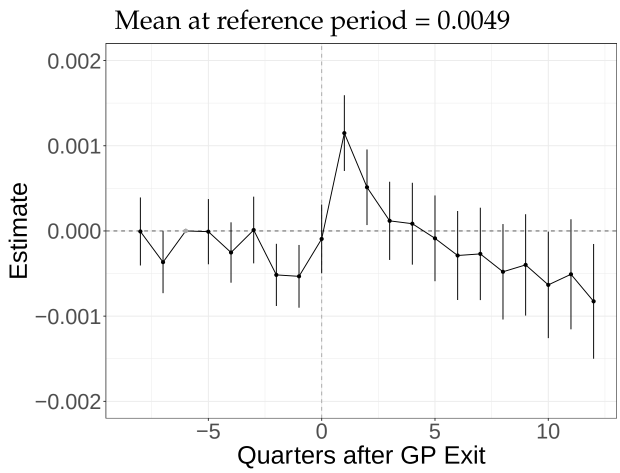

(b) New Congestive Heart Failure Diagnoses



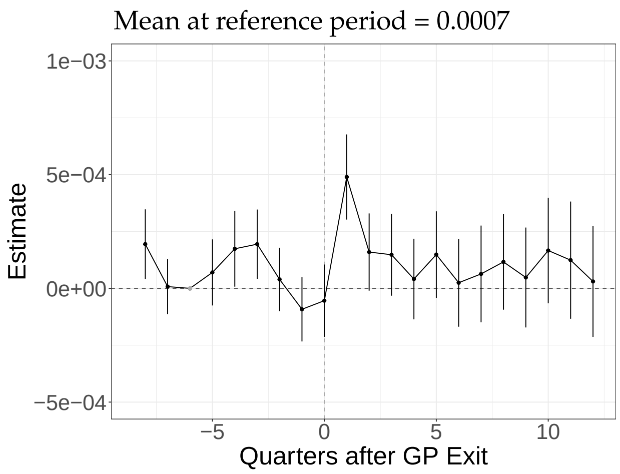

(c) New Peripheral Vascular Disease Diagnoses



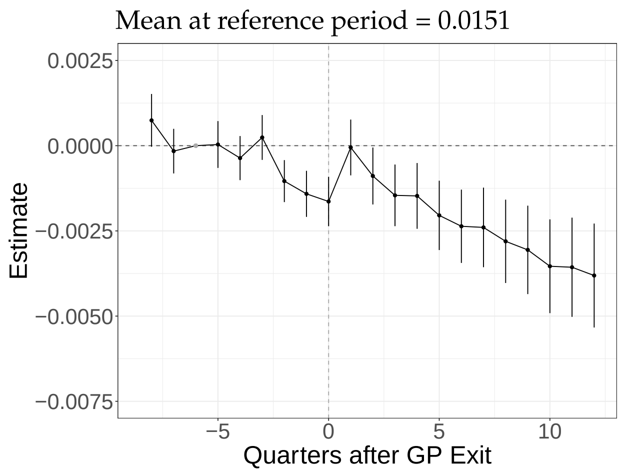

(d) New Cerebrovascular Disease Diagnoses




(e) New Dementia Diagnoses




(f) New Chronic Pulmonary Disease Diagnoses

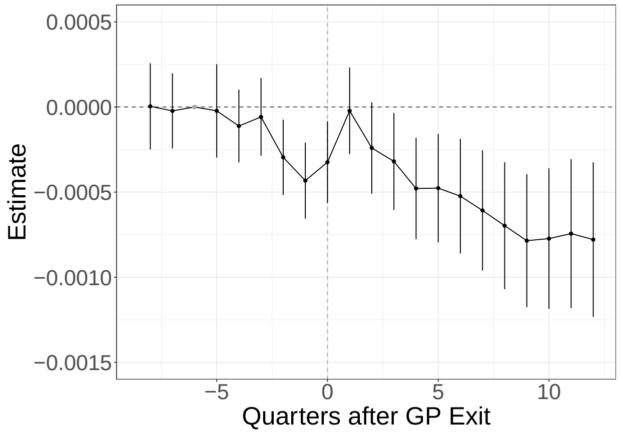



*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. The observation number is 15,340,080, with 383,502 unique patients and 7,376 different leaving physicians. The outcome variable is equal to one in the first quarter in the observational period that the respective disease (as defined by the Chalson Comorbidity index Charlson et al., 1987) is diagnosed and 0 else.

## Figure A3: Additional Results on Specific Diagnoses - cont.

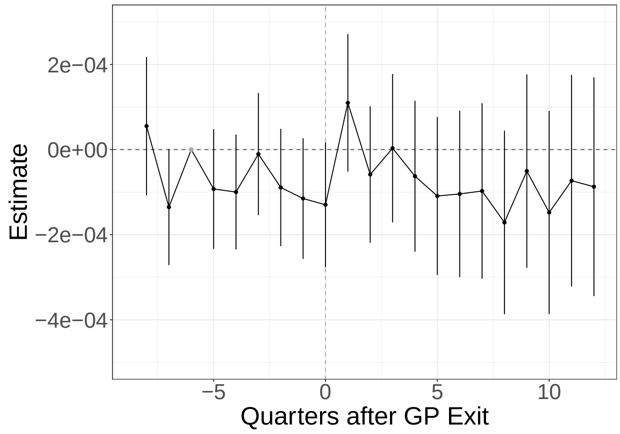
(a) New Rheumatoid Disease Diagnoses

Mean at reference period = 0.0021



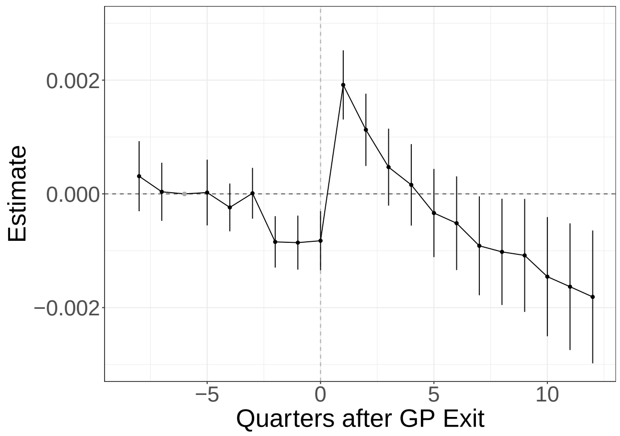

(b) New Peptic Ulcer Disease Diagnoses

Mean at reference period = 0.0009



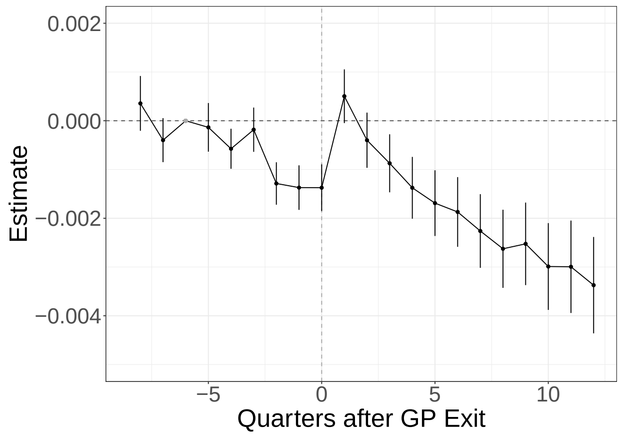

(c) New Mild Liver Disease Diagnoses

Mean at reference period = 0.0056



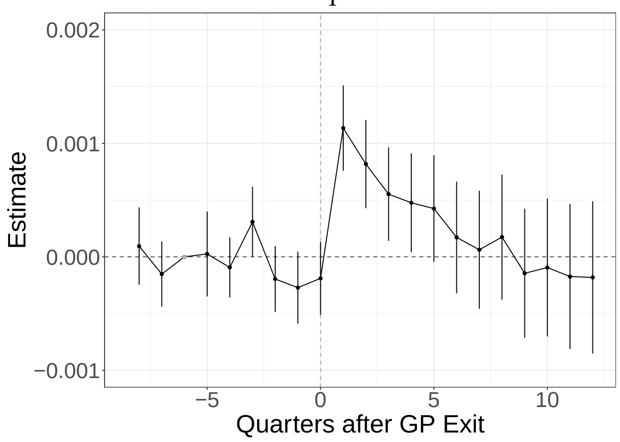

(d) New Diabetes without Complications Diagnoses

Mean at reference period = 0.0058



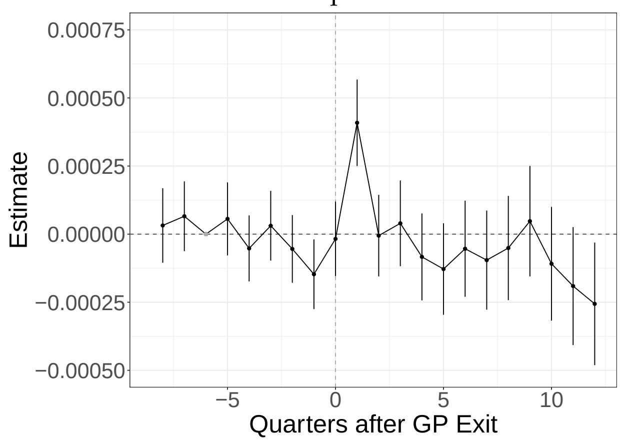

(e) New Diabetes with Complications Diagnoses

Mean at reference period = 0.0025




(f) New Hemiplegia or Paraplegia Diagnoses

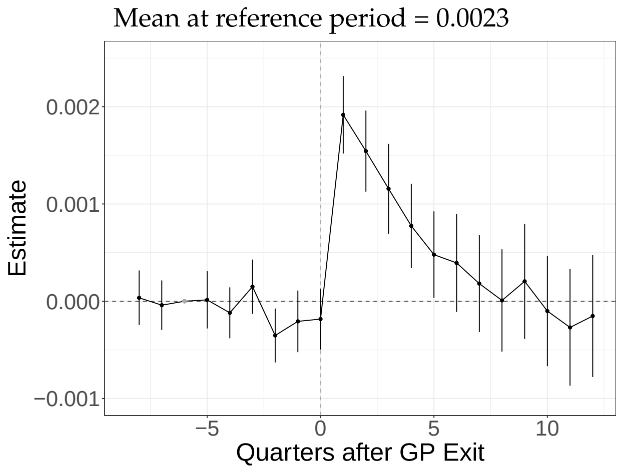
Mean at reference period = 0.0008



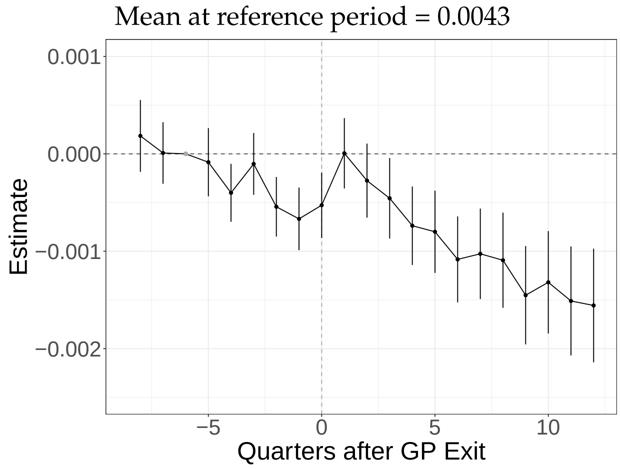

*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. The observation number is 15,340,080, with 383,502 unique patients and 7,376 different leaving physicians. The outcome variable is equal to one in the first quarter in the observational period that the respective disease (as defined by the Chalson Comorbidity index Charlson et al., 1987) is diagnosed and 0 else.

Figure A4: Additional Results on Specific Diagnoses - cont.

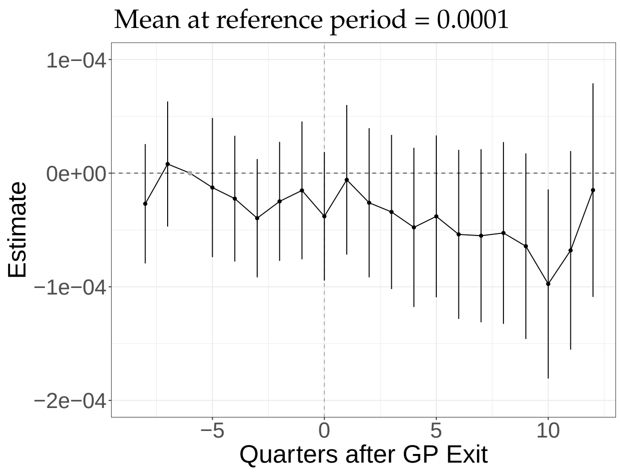
(a) New Renal Disease Diagnoses



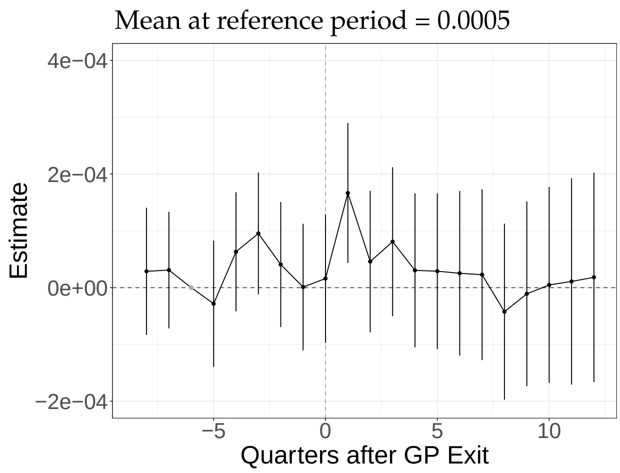

(b) New Cancer (any Malignancy) Diagnoses



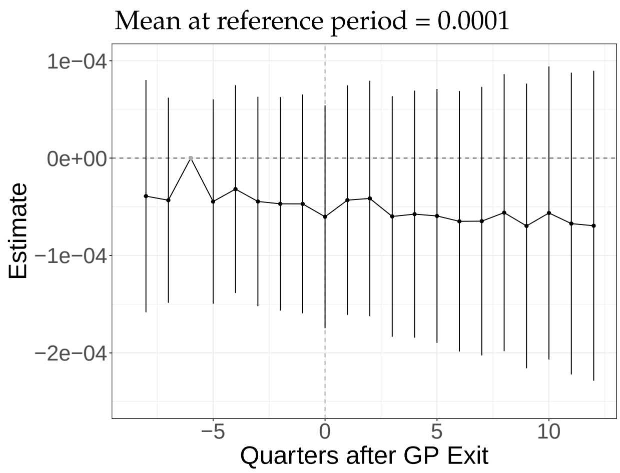

(c) New Moderate or Severe Liver Disease Diagnoses




(d) New Cancer (metastatic solid tumour) Diagnoses



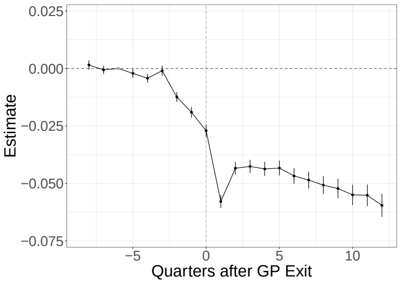

(e) New AIDS Diagnoses




*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. The observation number is 15,340,080, with 383,502 unique patients and 7,376 different leaving physicians. The outcome variable is equal to one in the first quarter in the observational period that the respective disease (as defined by the Chalson Comorbidity index Charlson et al., 1987) is diagnosed and 0 else.

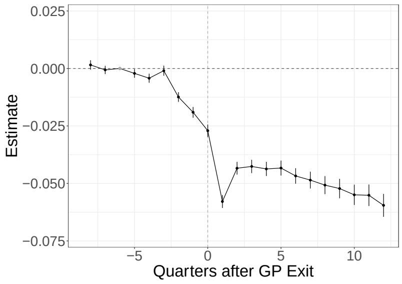
Figure A5: Event Study Results on Any GP Visit, robustness tests

(a) Any GP visit, Main Specification (With Individual and Quarter Fixed Effects)



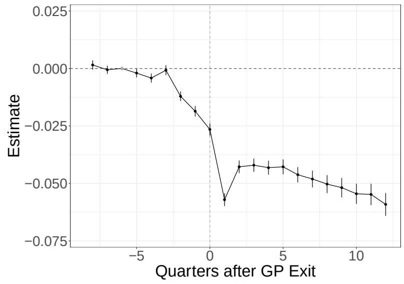

Observations 15,340,040

(b) With Group Fixed Effects and Quarter Fixed Effects



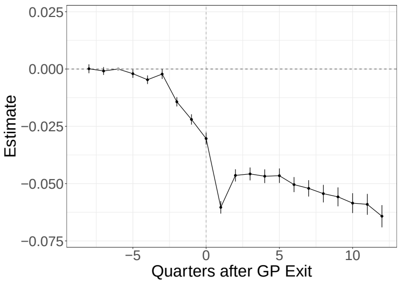

Observations 15,340,040

(c) Including Individuals older than 80 in 2010 patient quarter observations



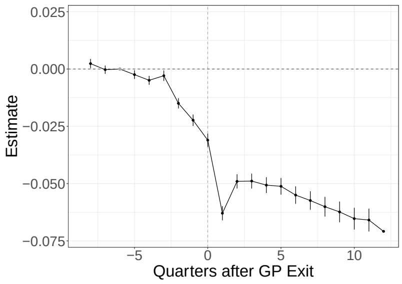

Observations: 15,735,680

(d) Including individuals with discontinuous insurance status



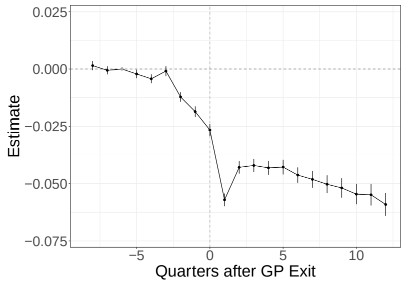

Observations: 17,324,063

(e) Including control group with exit in 2019Q4




Observations: 17,207,200

(f) Including individuals switching GP up to 3 quarters before the exit of the old GP

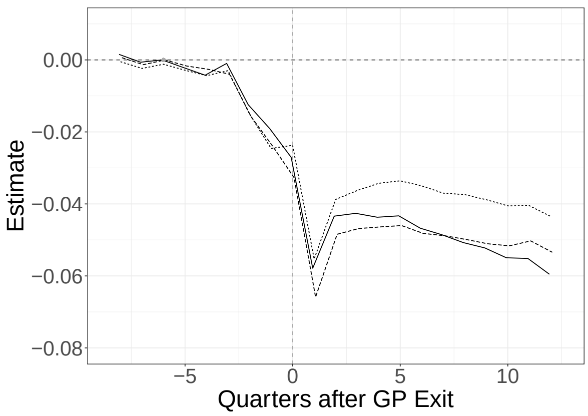



Observations 15,606,500

*Notes:* The graph depicts the event-study estimates (the $\beta_j^{ES}$ from Eq. (2)). Vertical lines indicate 95% confidence intervals. Observations are on the patient-quarter level

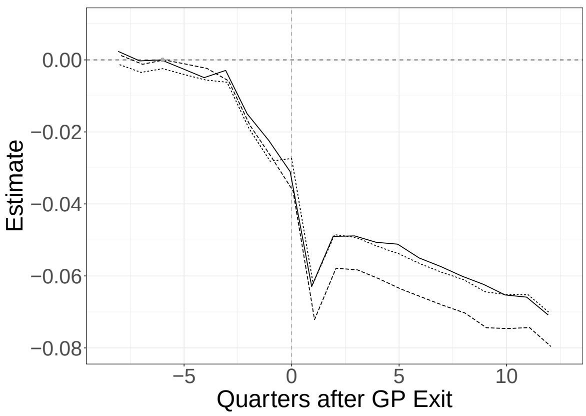
Figure A6: Event Study Results on Any GP Visit, robustness tests

(a) Without Control Group




Observations: 295,040

(b) With Control Group




Observations: 323,440

Baseline Imputation Sun and Abraham

*Notes: Baseline*: Estimation as described above. *Imputation*: Estimation using the Imputation estimator following Borusyak et al. (2023). *Sun and Abraham*: Estimation following Sun and Abraham (2021). For computational purposes, we aggregated the observations first to the GP-quarter level.

# Additional Tables

Table A1: Descriptive Statistics: Treated vs. Control Sample

| | Treated (treated by a leaving GP) | | Control (treated by a GP leaving in 2019Q4) | | |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | SMD |
| Patient characteristics: | | | | | |
| Birth Year | 1958.026 | 15.641 | 1959.554 | 15.676 | -0.069 |
| Female | 0.602 | 0.490 | 0.589 | 0.492 | 0.018 |
| Rural | 0.328 | 0.469 | 0.301 | 0.458 | 0.041 |
| Healthcare utilisation: | | | | | |
| Number of GP Visits | 1.788 | 2.249 | 1.941 | 2.573 | -0.044 |
| Any GP Visit | 0.702 | 0.457 | 0.694 | 0.461 | 0.013 |
| GP Costs [€] | 47.574 | 72.152 | 56.928 | 73.216 | -0.091 |
| Number of Specialist Visits | 1.637 | 2.840 | 1.694 | 2.867 | -0.014 |
| Any Specialist Visit | 0.520 | 0.500 | 0.536 | 0.499 | -0.023 |
| Specialist Costs [€] | 72.548 | 228.254 | 90.938 | 302.507 | -0.048 |
| Any Hospital Visit | 0.028 | 0.165 | 0.029 | 0.169 | -0.007 |
| Any Emergency Hospital Visit | 0.016 | 0.126 | 0.021 | 0.145 | -0.028 |
| Any Ambulatory Care Sensitive Condition | 0.003 | 0.053 | 0.004 | 0.066 | -0.018 |
| Diagnoses: | | | | | |
| Myocardial Infarction | 0.011 | 0.106 | 0.019 | 0.137 | -0.020 |
| Congestive Heart Failure | 0.025 | 0.157 | 0.041 | 0.199 | -0.034 |
| Peripheral Vascular Disease | 0.035 | 0.183 | 0.058 | 0.234 | -0.046 |
| Cerebrovascular Disease | 0.037 | 0.189 | 0.063 | 0.243 | -0.049 |
| Dementia | 0.006 | 0.076 | 0.017 | 0.128 | -0.030 |
| Chronic Pulmonary Disease | 0.102 | 0.302 | 0.116 | 0.320 | -0.021 |
| Rheumatoid Disease | 0.021 | 0.145 | 0.029 | 0.167 | -0.016 |
| Peptic Ulcer Disease | 0.005 | 0.073 | 0.005 | 0.073 | 0.0003 |
| Mild Liver Disease | 0.051 | 0.219 | 0.063 | 0.243 | -0.023 |
| Diabetes Without Complications | 0.071 | 0.257 | 0.077 | 0.267 | -0.010 |
| Diabetes With Complications | 0.023 | 0.148 | 0.039 | 0.193 | -0.035 |
| Hemiplegia or Paraplegia | 0.008 | 0.088 | 0.014 | 0.116 | -0.017 |
| Renal Disease | 0.021 | 0.143 | 0.050 | 0.218 | -0.060 |
| Cancer (any Malignancy) | 0.044 | 0.206 | 0.059 | 0.236 | -0.028 |
| Moderate or Severe Liver Disease | 0.001 | 0.030 | 0.001 | 0.035 | -0.002 |
| Cancer (metastatic solid tumour) | 0.003 | 0.058 | 0.008 | 0.089 | -0.015 |
| AIDS | 0.001 | 0.024 | 0.001 | 0.027 | -0.001 |
| Tests and Prescriptions: | | | | | |
| Any Blood Count | 0.014 | 0.118 | 0.018 | 0.132 | -0.020 |
| Any Total Protein | 0.005 | 0.072 | 0.007 | 0.086 | -0.020 |
| Any Beta Blocker | 0.105 | 0.306 | 0.141 | 0.348 | -0.078 |
| Any ACE Inhibitor | 0.077 | 0.266 | 0.091 | 0.287 | -0.036 |
| Any Antibiotics | 0.011 | 0.103 | 0.006 | 0.079 | 0.035 |
| Any Sick Note | 0.122 | 0.328 | 0.098 | 0.297 | 0.055 |
| Observations: | 383,502 | | 46,678 | | |
| Patients: | 383,502 | | 46,678 | | |

Note: The estimation sample consists of individuals who are continuously insured and who all experience a GP exit between 2012 and 2017. The control sample consists of continuously insured individuals who experience a GP exit in the fourth quarter of 2019. Presented are observations 6 quarters before the exit of the GP. *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75% (BBSR, 2023). Diagnoses indicate whether an individual has received the given diagnosis, based on the Charlson comorbidity index (Charlson et al., 1987). Complete Blood Count as defined by EBM No.32122. Total Protein as defined by EBM No.32056. ACE Inhibitors include all prescriptions with ATC C09a and C09b. Beta Blockers include all prescriptions with ATC C07. Antibiotics include all prescriptions with ATC J01. SMD refers to the standardized mean differences and is calculated as follows: $SMD = \frac{Mean_1 - Mean_0}{\sqrt{SD_1 + SD_0}}$ (where the index 1 indicates the respective statistic for the estimation sample, while 0 refers to the control sample).

# Disruptions in Primary Care: Can Resigning GPs Cause Persistently Negative Health Effects?

## — For Online Publication: Supplementary Materials —


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Table S1: Results: Any GP Visits (coefficients multiplied by 100)

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Complete Sample | −0.1351 | −0.3803*** | −3.2338*** | −2.9579*** | −4.0625*** | 15,340,080 |
| | (0.0842) | (0.0843) | (0.1142) | (0.1321) | (0.1875) | |
| Female | −0.0644 | −0.3409*** | −2.9655*** | −2.7497*** | −3.8851*** | 9,231,320 |
| | (0.0976) | (0.0942) | (0.1271) | (0.1496) | (0.2102) | |
| Male | −0.2348* | −0.4444*** | −3.6526*** | −3.2936*** | −4.3611*** | 6,108,760 |
| | (0.1248) | (0.1230) | (0.1558) | (0.1819) | (0.2471) | |
| Older Individuals | −0.0305 | 0.0050 | −2.0263*** | −1.9438*** | −3.2316*** | 7,794,800 |
| | (0.0982) | (0.0976) | (0.1320) | (0.1548) | (0.2257) | |
| Younger Individuals | −0.2277* | −0.7806*** | −4.5003*** | −4.0670*** | −5.0256*** | 7,545,280 |
| | (0.1225) | (0.1191) | (0.1522) | (0.1795) | (0.2378) | |
| Rural | 0.0595 | −0.3545** | −3.2336*** | −2.9912*** | −4.1037*** | 4,797,560 |
| | (0.1451) | (0.1503) | (0.1898) | (0.2110) | (0.3141) | |
| Urban | −0.2001* | −0.4198*** | −3.2561*** | −3.0176*** | −4.1499*** | 9,839,000 |
| | (0.1050) | (0.1030) | (0.1413) | (0.1668) | (0.2318) | |
| Comorbidities | −0.1298 | 0.0426 | −3.0358*** | −3.6705*** | −5.5322*** | 7,874,760 |
| | (0.0975) | (0.0987) | (0.1359) | (0.1552) | (0.2274) | |
| No Comorbidities | −0.1359 | −0.8119*** | −3.4058*** | −2.1478*** | −2.4482*** | 7,465,320 |
| | (0.1234) | (0.1172) | (0.1496) | (0.1773) | (0.2332) | |
| Single Practice | −0.0617 | −0.5845*** | −3.3523*** | −2.8115*** | −3.4574*** | 9,699,160 |
| | (0.1050) | (0.1050) | (0.1436) | (0.1661) | (0.2247) | |
| Group Practice | −0.2598* | −0.0246 | −3.0188*** | −3.1522*** | −4.9847*** | 5,640,920 |
| | (0.1350) | (0.1399) | (0.1752) | (0.2128) | (0.3179) | |

*Notes:* Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice. .

Table S2: Results: Number of GP Visits

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Complete Sample | 0.0042 | −0.0149*** | −0.0515*** | −0.0388*** | −0.0520*** | 15,340,080 |
| | (0.0040) | (0.0043) | (0.0068) | (0.0091) | (0.0126) | |
| Female | 0.0025 | −0.0166*** | −0.0443*** | −0.0373*** | −0.0503*** | 9,231,320 |
| | (0.0046) | (0.0048) | (0.0074) | (0.0101) | (0.0137) | |
| Male | 0.0068 | −0.0125** | −0.0627*** | −0.0418*** | −0.0555*** | 6,108,760 |
| | (0.0053) | (0.0058) | (0.0083) | (0.0108) | (0.0151) | |
| Older Individuals | 0.0113** | −0.0089 | −0.0175* | −0.0170 | −0.0362** | 7,794,800 |
| | (0.0057) | (0.0060) | (0.0092) | (0.0124) | (0.0168) | |
| Younger Individuals | −0.0036 | −0.0197*** | −0.0837*** | −0.0597*** | −0.0728*** | 7,545,280 |
| | (0.0045) | (0.0045) | (0.0070) | (0.0091) | (0.0130) | |
| Rural | −0.0019 | −0.0250*** | −0.0686*** | −0.0632*** | −0.0916*** | 4,797,560 |
| | (0.0068) | (0.0074) | (0.0112) | (0.0145) | (0.0196) | |
| Urban | 0.0065 | −0.0121** | −0.0451*** | −0.0300*** | −0.0373** | 9,839,000 |
| | (0.0050) | (0.0054) | (0.0084) | (0.0115) | (0.0158) | |
| Comorbidities | 0.0051 | $2e-04$ | −0.0650*** | −0.0861*** | −0.1263*** | 7,874,760 |
| | (0.0058) | (0.0063) | (0.0099) | (0.0129) | (0.0177) | |
| No Comorbidities | 0.0032 | −0.0303*** | −0.0357*** | 0.0142* | 0.0320*** | 7,465,320 |
| | (0.0041) | (0.0040) | (0.0059) | (0.0080) | (0.0109) | |
| Single Practice | 0.0072 | −0.0286*** | −0.0475*** | −0.0267** | −0.0294** | 9,699,160 |
| | (0.0049) | (0.0051) | (0.0082) | (0.0110) | (0.0148) | |
| Group Practice | −0.0018 | 0.0088 | −0.0581*** | −0.0581*** | −0.0881*** | 5,640,920 |
| | (0.0063) | (0.0069) | (0.0105) | (0.0141) | (0.0199) | |

*Notes:* Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice.

Table S3: Results: Total GP Costs

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Complete Sample | 0.3334*** | −6.4550*** | −3.3373*** | −0.2760 | −0.0739 | 15,340,080 |
| | (0.1271) | (0.2233) | (0.2501) | (0.2939) | (0.3809) | |
| Female | 0.2894** | −6.6129*** | −3.1411*** | −0.1382 | −0.0856 | 9,231,320 |
| | (0.1463) | (0.2350) | (0.2594) | (0.3245) | (0.4162) | |
| Male | 0.4040** | −6.2187*** | −3.6378*** | −0.4885 | −0.0642 | 6,108,760 |
| | (0.1801) | (0.2679) | (0.3314) | (0.3453) | (0.4617) | |
| Older Individuals | 0.5480*** | −8.1722*** | −3.1031*** | 0.7634* | 0.8463 | 7,794,800 |
| | (0.1784) | (0.3150) | (0.3564) | (0.4179) | (0.5533) | |
| Younger Individuals | 0.0558 | −4.5484*** | −3.2812*** | −0.9933*** | −0.9620*** | 7,545,280 |
| | (0.1428) | (0.1787) | (0.2138) | (0.2650) | (0.3397) | |
| Rural | 0.1728 | −7.3361*** | −3.9747*** | −0.7013 | −0.4287 | 4,797,560 |
| | (0.2241) | (0.3979) | (0.4590) | (0.4976) | (0.6215) | |
| Urban | 0.4571*** | −5.9018*** | −2.9037*** | 0.0846 | 0.2048 | 9,839,000 |
| | (0.1447) | (0.2598) | (0.2915) | (0.3529) | (0.4659) | |
| Comorbidities | 0.3504* | −7.9216*** | −4.1052*** | −0.9743** | −1.3595** | 7,874,760 |
| | (0.1922) | (0.3254) | (0.3941) | (0.4505) | (0.5783) | |
| No Comorbidities | 0.3235*** | −4.9071*** | −2.5194*** | 0.5068** | 1.4429*** | 7,465,320 |
| | (0.1176) | (0.1667) | (0.1788) | (0.2230) | (0.2953) | |
| Single Practice | 0.5487*** | −7.9578*** | −3.5082*** | 0.4810 | 1.2583*** | 9,699,160 |
| | (0.1400) | (0.2727) | (0.2852) | (0.3471) | (0.4651) | |
| Group Practice | −0.0889 | −3.7870*** | −2.8802*** | −1.3060*** | −2.0617*** | 5,640,920 |
| | (0.2297) | (0.2891) | (0.3873) | (0.4607) | (0.6025) | |

*Notes:* Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice.

Table S4: Results: Any Specialist Visit (coefficients multiplied by 100)

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Complete Sample | −0.0226 | 0.2309*** | 0.8842*** | 0.8809*** | 0.2015 | 15,340,080 |
| | (0.0809) | (0.0781) | (0.0972) | (0.1171) | (0.1611) | |
| Female | −0.0882 | 0.1680* | 0.8841*** | 0.7833*** | 0.0600 | 9,231,320 |
| | (0.1061) | (0.1003) | (0.1207) | (0.1443) | (0.1947) | |
| Male | 0.0792 | 0.3212*** | 0.8708*** | 1.0046*** | 0.3814* | 6,108,760 |
| | (0.1212) | (0.1136) | (0.1410) | (0.1696) | (0.2289) | |
| Older Individuals | −0.1435 | 0.2992*** | 1.3810*** | 1.4174*** | 0.5342** | 7,794,800 |
| | (0.1091) | (0.1055) | (0.1295) | (0.1545) | (0.2152) | |
| Younger Individuals | 0.1027 | 0.1610 | 0.3716*** | 0.3204** | −0.1729 | 7,545,280 |
| | (0.1156) | (0.1090) | (0.1326) | (0.1595) | (0.2114) | |
| Rural | 0.1958 | 0.3808*** | 1.1587*** | 1.0845*** | 0.4899* | 4,797,560 |
| | (0.1448) | (0.1439) | (0.1742) | (0.2033) | (0.2821) | |
| Urban | −0.1708* | 0.1307 | 0.7595*** | 0.7410***$-3e-04$ | | 9,839,000 |
| | (0.0996) | (0.0942) | (0.1184) | (0.1447) | (0.1991) | |
| Comorbidities | −0.1830* | 0.3849*** | 0.9004*** | 0.1255 | −1.2400*** | 7,874,760 |
| | (0.1085) | (0.1041) | (0.1291) | (0.1529) | (0.2129) | |
| No Comorbidities | 0.1464 | 0.0772 | 0.8877*** | 1.7106*** | 1.7543*** | 7,465,320 |
| | (0.1167) | (0.1107) | (0.1328) | (0.1595) | (0.2087) | |
| Single Practice | 0.0644 | 0.1673* | 0.9657*** | 1.1544*** | 0.6793*** | 9,699,160 |
| | (0.1020) | (0.0983) | (0.1212) | (0.1449) | (0.1916) | |
| Group Practice | −0.1839 | 0.3406*** | 0.7511*** | 0.4383** | −0.5837** | 5,640,920 |
| | (0.1316) | (0.1274) | (0.1571) | (0.1921) | (0.2721) | |

*Notes:* Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice.

Table S5: Results: Number of Specialist Visits

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Complete Sample | −0.0023 | 0.0042 | 0.0459*** | 0.0563*** | 0.0376*** | 15,340,080 |
| | (0.0043) | (0.0041) | (0.0059) | (0.0076) | (0.0103) | |
| Female | −0.0026 | 0.0049 | 0.0520*** | 0.0610*** | 0.0356*** | 9,231,320 |
| | (0.0055) | (0.0055) | (0.0075) | (0.0096) | (0.0128) | |
| Male | −0.0019 | 0.0029 | 0.0359*** | 0.0479*** | 0.0385*** | 6,108,760 |
| | (0.0062) | (0.0058) | (0.0083) | (0.0109) | (0.0148) | |
| Older Individuals | −0.0036 | 0.0075 | 0.0752*** | 0.0859*** | 0.0553*** | 7,794,800 |
| | (0.0063) | (0.0063) | (0.0085) | (0.0107) | (0.0144) | |
| Younger Individuals | −0.0011 | $8e-04$ | 0.0160** | 0.0259*** | 0.0180 | 7,545,280 |
| | (0.0055) | (0.0050) | (0.0073) | (0.0096) | (0.0133) | |
| Rural | 0.0000 | 0.0032 | 0.0493*** | 0.0601*** | 0.0448*** | 4,797,560 |
| | (0.0071) | (0.0070) | (0.0098) | (0.0122) | (0.0168) | |
| Urban | −0.0056 | 0.0021 | 0.0432*** | 0.0520*** | 0.0308** | 9,839,000 |
| | (0.0053) | (0.0053) | (0.0076) | (0.0098) | (0.0133) | |
| Comorbidities | −0.0031 | 0.0158** | 0.0529*** | 0.0289** | −0.0204 | 7,874,760 |
| | (0.0066) | (0.0065) | (0.0092) | (0.0118) | (0.0160) | |
| No Comorbidities | −0.0016 | −0.0076 | 0.0395*** | 0.0870*** | 0.1010*** | 7,465,320 |
| | (0.0048) | (0.0047) | (0.0064) | (0.0080) | (0.0109) | |
| Single Practice | −0.0009 | −0.0030 | 0.0429*** | 0.0591*** | 0.0419*** | 9,699,160 |
| | (0.0051) | (0.0051) | (0.0071) | (0.0089) | (0.0120) | |
| Group Practice | −0.0053 | 0.0170** | 0.0516*** | 0.0528*** | 0.0315* | 5,640,920 |
| | (0.0073) | (0.0070) | (0.0099) | (0.0128) | (0.0176) | |

*Notes:* Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice.

Table S6: Results: Total Specialist Costs

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Complete Sample | −0.2845 | 0.3699 | 1.9123*** | 2.7115*** | 1.6677* | 15,340,080 |
| | (0.3057) | (0.3329) | (0.4908) | (0.6491) | (0.9143) | |
| Female | −0.1900 | 0.4085 | 2.2997*** | 3.1762*** | 1.7565* | 9,231,320 |
| | (0.3987) | (0.4222) | (0.5990) | (0.7707) | (1.0669) | |
| Male | −0.4239 | 0.2962 | 1.2896 | 1.9441* | 1.4304 | 6,108,760 |
| | (0.4690) | (0.5256) | (0.7860) | (1.0914) | (1.4676) | |
| Older Individuals | −0.4363 | 0.7284 | 3.9233*** | 4.5896*** | 2.6046* | 7,794,800 |
| | (0.5021) | (0.5263) | (0.7362) | (0.9704) | (1.3602) | |
| Younger Individuals | −0.1822 | 0.0523 | −0.0514 | 0.8845 | 0.5165 | 7,545,280 |
| | (0.3402) | (0.3775) | (0.5704) | (0.7813) | (1.0708) | |
| Rural | −0.5578 | −0.1081 | 1.4964* | 2.8356** | 1.8346 | 4,797,560 |
| | (0.5137) | (0.5613) | (0.8086) | (1.1139) | (1.7386) | |
| Urban | −0.2532 | 0.4782 | 2.0244*** | 2.5456*** | 1.5223 | 9,839,000 |
| | (0.3961) | (0.4261) | (0.6297) | (0.8226) | (1.0966) | |
| Comorbidities | −0.0887 | 1.5345*** | 2.4470*** | 1.0653 | −1.6852 | 7,874,760 |
| | (0.5138) | (0.5763) | (0.8323) | (1.0989) | (1.5509) | |
| No Comorbidities | −0.4919* | −0.8416*** | 1.4031*** | 4.5675*** | 5.4905*** | 7,465,320 |
| | (0.2990) | (0.3090) | (0.4467) | (0.5835) | (0.7929) | |
| Single Practice | −0.5482 | −0.0726 | 1.3972** | 2.5095*** | 1.3891 | 9,699,160 |
| | (0.3786) | (0.3985) | (0.5873) | (0.7972) | (1.1171) | |
| Group Practice | 0.1560 | 1.1370** | 2.8406*** | 3.1366*** | 2.2852 | 5,640,920 |
| | (0.5141) | (0.5722) | (0.8240) | (1.0486) | (1.4579) | |

*Notes:* Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice.

Table S7: Results: Any Hospital Visit (coefficients multiplied by 100)

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Complete Sample | −0.0032 | −0.0582** | 0.0589* | 0.0729* | −0.0020 | 15,340,080 |
| | (0.0318) | (0.0291) | (0.0340) | (0.0383) | (0.0485) | |
| Female | 0.0072 | −0.0684* | 0.0787* | 0.0553 | −0.0261 | 9,231,320 |
| | (0.0413) | (0.0377) | (0.0438) | (0.0496) | (0.0623) | |
| Male | −0.0188 | −0.0433 | 0.0275 | 0.0969* | 0.0300 | 6,108,760 |
| | (0.0494) | (0.0451) | (0.0514) | (0.0583) | (0.0745) | |
| Older Individuals | −0.0169 | −0.0839* | 0.1377** | 0.1205* | 0.0002 | 7,794,800 |
| | (0.0514) | (0.0468) | (0.0547) | (0.0625) | (0.0785) | |
| Younger Individuals | 0.0085 | −0.0302 | −0.0174 | 0.0313 | −0.0056 | 7,545,280 |
| | (0.0357) | (0.0328) | (0.0375) | (0.0416) | (0.0534) | |
| Rural | −0.0490 | −0.0957* | 0.0223 | 0.0382 | 0.0125 | 4,797,560 |
| | (0.0576) | (0.0523) | (0.0611) | (0.0695) | (0.0866) | |
| Urban | 0.0362 | −0.0406 | 0.0736* | 0.0868* | −0.0190 | 9,839,000 |
| | (0.0395) | (0.0363) | (0.0416) | (0.0470) | (0.0600) | |
| Comorbidities | −0.0310 | −0.0738 | −0.0266 | −0.1355** | −0.2934*** | 7,874,760 |
| | (0.0531) | (0.0483) | (0.0559) | (0.0631) | (0.0792) | |
| No Comorbidities | 0.0255 | −0.0405 | 0.1515*** | 0.2963*** | 0.3105*** | 7,465,320 |
| | (0.0338) | (0.0311) | (0.0358) | (0.0408) | (0.0529) | |
| Single Practice | 0.0066 | −0.0299 | 0.1309*** | 0.1550*** | 0.1008* | 9,699,160 |
| | (0.0401) | (0.0361) | (0.0429) | (0.0487) | (0.0608) | |
| Group Practice | −0.0227 | −0.1046** | −0.0605 | −0.0650 | −0.1762** | 5,640,920 |
| | (0.0521) | (0.0492) | (0.0551) | (0.0618) | (0.0801) | |

*Notes:* Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice.

Table S8: Results: Any Emergency Visit (coefficients multiplied by 100)

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Complete Sample | 0.0215 | −0.0059 | 0.1089*** | 0.0601** | 0.0327 | 15,340,080 |
| | (0.0241) | (0.0224) | (0.0253) | (0.0291) | (0.0380) | |
| Female | 0.0044 | −0.0172 | 0.1099*** | 0.0775** | 0.0333 | 9,231,320 |
| | (0.0307) | (0.0282) | (0.0322) | (0.0370) | (0.0485) | |
| Male | 0.0475 | 0.0111 | 0.1069*** | 0.0323 | 0.0294 | 6,108,760 |
| | (0.0389) | (0.0364) | (0.0410) | (0.0465) | (0.0610) | |
| Older Individuals | 0.0314 | 0.0295 | 0.2013*** | 0.1519*** | 0.1001 | 7,794,800 |
| | (0.0387) | (0.0359) | (0.0408) | (0.0466) | (0.0613) | |
| Younger Individuals | 0.0062 | −0.0337 | 0.0341 | −0.0036 | −0.0271 | 7,545,280 |
| | (0.0295) | (0.0272) | (0.0298) | (0.0335) | (0.0429) | |
| Rural | 0.0661 | 0.0176 | 0.1550*** | 0.1117** | 0.1210* | 4,797,560 |
| | (0.0448) | (0.0415) | (0.0454) | (0.0529) | (0.0689) | |
| Urban | 0.0059 | −0.0224 | 0.0849*** | 0.0333 | −0.0162 | 9,839,000 |
| | (0.0294) | (0.0276) | (0.0316) | (0.0357) | (0.0470) | |
| Comorbidities | 0.0147 | 0.0294 | 0.0956** | −0.0367 | −0.0939 | 7,874,760 |
| | (0.0399) | (0.0372) | (0.0415) | (0.0474) | (0.0617) | |
| No Comorbidities | 0.0283 | −0.0427* | 0.1237*** | 0.1650*** | 0.1780*** | 7,465,320 |
| | (0.0272) | (0.0244) | (0.0279) | (0.0317) | (0.0411) | |
| Single Practice | 0.0525* | 0.0182 | 0.1536*** | 0.1098*** | 0.0940** | 9,699,160 |
| | (0.0294) | (0.0273) | (0.0308) | (0.0360) | (0.0475) | |
| Group Practice | −0.0327 | −0.0477 | 0.0333 | −0.0226 | −0.0717 | 5,640,920 |
| | (0.0419) | (0.0389) | (0.0440) | (0.0483) | (0.0630) | |

*Notes:* Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice.

Table S9: Results: Any Hospitalization with Ambulatory Care Sensitive Condition (coefficients multiplied by 100)

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Complete Sample | 0.0157 | 0.0153 | 0.0497*** | 0.0437*** | 0.0336** | 15,340,080 |
| | (0.0108) | (0.0098) | (0.0113) | (0.0127) | (0.0167) | |
| Female | 0.0131 | 0.0117 | 0.0461*** | 0.0372** | 0.0238 | 9,231,320 |
| | (0.0139) | (0.0126) | (0.0145) | (0.0165) | (0.0213) | |
| Male | 0.0195 | 0.0207 | 0.0550*** | 0.0532*** | 0.0476* | 6,108,760 |
| | (0.0165) | (0.0151) | (0.0173) | (0.0196) | (0.0263) | |
| Older Individuals | 0.0244 | 0.0304* | 0.0974*** | 0.0917*** | 0.0583** | 7,794,800 |
| | (0.0187) | (0.0170) | (0.0197) | (0.0223) | (0.0295) | |
| Younger Individuals | 0.0049 | 0.0017 | 0.0053 | 0.0017 | 0.0094 | 7,545,280 |
| | (0.0099) | (0.0092) | (0.0101) | (0.0113) | (0.0145) | |
| Rural | 0.0265 | 0.0061 | 0.0613*** | 0.0496** | 0.0499 | 4,797,560 |
| | (0.0197) | (0.0177) | (0.0212) | (0.0241) | (0.0308) | |
| Urban | 0.0088 | 0.0157 | 0.0434*** | 0.0418*** | 0.0283 | 9,839,000 |
| | (0.0133) | (0.0122) | (0.0138) | (0.0155) | (0.0207) | |
| Comorbidities | 0.0027 | 0.0207 | 0.0564*** | 0.0345 | 0.0166 | 7,874,760 |
| | (0.0193) | (0.0176) | (0.0201) | (0.0223) | (0.0291) | |
| No Comorbidities | 0.0291*** | 0.0097 | 0.0426*** | 0.0538*** | 0.0551*** | 7,465,320 |
| | (0.0084) | (0.0074) | (0.0090) | (0.0107) | (0.0145) | |
| Single Practice | 0.0186 | 0.0235** | 0.0605*** | 0.0550*** | 0.0535** | 9,699,160 |
| | (0.0132) | (0.0119) | (0.0141) | (0.0158) | (0.0208) | |
| Group Practice | 0.0105 | 0.0011 | 0.0306 | 0.0231 | −0.0016 | 5,640,920 |
| | (0.0186) | (0.0170) | (0.0188) | (0.0213) | (0.0282) | |

Note: Standard Errors in Parentheses. Ambulatory Care Sensitive Conditions include all hospitalizations related to ACSC, as defined by Albrecht and Sander (2015). *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 and greater; *Complete Sample* = All Observations, *Female* = Only females, *Male* = Only males, *Older Individuals* = Individuals born before or in the median birth year of 1957, *Younger Individuals* = Individuals born after the median birth year of 1957, *Rural* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is less than 75%, *Urban* = Individuals living in a county, where the share of inhabitants that live in municipalities with more than 150 Inhabitants per $km^2$ is more than 75%, *Comorbidities* = Individuals, that received at least one diagnosis of the Charlson Comorbidity Index by a Physician in the eight quarters before the exit of their GP, *Single Practice* = Leaving physician practiced in a single practice, *Group Practice* = Leaving physician practiced in a group practice.

Table S10: Results: New Diagnoses (coefficients multiplied by 100)

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| MI | −0.0077 | −0.0091 | 0.0156** | −0.0060 | −0.0116 | 14,956,578 |
| | (0.0079) | (0.0069) | (0.0076) | (0.0081) | (0.0102) | |
| CHF | 0.0016 | −0.0018 | 0.0737*** | 0.0033 | −0.0309 | 14,956,578 |
| | (0.0141) | (0.0132) | (0.0144) | (0.0163) | (0.0223) | |
| PDV | −0.0136 | −0.0015 | 0.1260*** | 0.0698*** | 0.0407* | 14,956,578 |
| | (0.0168) | (0.0142) | (0.0158) | (0.0179) | (0.0241) | |
| CEVD | −0.0245 | −0.0144 | 0.0722*** | 0.0224 | −0.0081 | 14,956,578 |
| | (0.0173) | (0.0156) | (0.0174) | (0.0191) | (0.0241) | |
| Dementia | 0.0099* | 0.0079 | 0.0190*** | 0.0088 | −0.0097 | 14,956,578 |
| | (0.0058) | (0.0056) | (0.0066) | (0.0074) | (0.0097) | |
| CPD | 0.0105 | −0.0142 | −0.0053 | −0.0856** | −0.1815*** | 14,956,578 |
| | (0.0311) | (0.0264) | (0.0298) | (0.0350) | (0.0485) | |
| RehumD | −0.0045 | −0.0112 | −0.0037 | −0.0271** | −0.0420*** | 14,956,578 |
| | (0.0105) | (0.0094) | (0.0098) | (0.0112) | (0.0150) | |
| PUD | −0.0041 | −0.0083 | −0.0023 | −0.0108 | −0.0172* | 14,956,578 |
| | (0.0065) | (0.0056) | (0.0061) | (0.0069) | (0.0089) | |
| MLD | 0.0046 | −0.0117 | 0.1358*** | 0.0438* | −0.0364 | 14,956,578 |
| | (0.0240) | (0.0193) | (0.0215) | (0.0255) | (0.0360) | |
| Diab | −0.0186 | −0.0383** | 0.0318 | −0.0687*** | −0.1337*** | 14,956,578 |
| | (0.0223) | (0.0188) | (0.0202) | (0.0235) | (0.0315) | |
| DiabWC | −0.0066 | 0.0030 | 0.0773*** | 0.0478*** | 0.0221 | 14,956,578 |
| | (0.0136) | (0.0122) | (0.0133) | (0.0161) | (0.0219) | |
| HP | 0.0042 | −0.0015 | 0.0153*** | −0.0013 | −0.0067 | 14,956,578 |
| | (0.0058) | (0.0051) | (0.0057) | (0.0063) | (0.0083) | |
| RenD | −0.0042 | −0.0016 | 0.1331*** | 0.0628*** | 0.0284 | 14,956,578 |
| | (0.0121) | (0.0115) | (0.0146) | (0.0164) | (0.0225) | |
| Canc | 0.0029 | −0.0224* | 0.0040 | −0.0460*** | −0.0741*** | 14,956,578 |
| | (0.0152) | (0.0132) | (0.0145) | (0.0158) | (0.0204) | |
| MSLD | −0.0011 | −0.0020 | −0.0017 | −0.0037 | −0.0033 | 14,956,578 |
| | (0.0025) | (0.0023) | (0.0026) | (0.0029) | (0.0035) | |
| Meta Canc | 0.0027 | 0.0041 | 0.0094** | 0.0046 | 0.0017 | 14,956,578 |
| | (0.0046) | (0.0042) | (0.0047) | (0.0054) | (0.0073) | |
| AIDS | −0.0042 | −0.0042 | −0.0048 | −0.0056 | −0.0064 | 14,956,578 |
| | (0.0057) | (0.0052) | (0.0053) | (0.0056) | (0.0062) | |

Note: Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; All estimations based on the complete sample of treated individuals. The outcome variable is equal to one in the first quarter in the observational period that respective disease (as defined by the Chalson Comorbidity index (Charlson et al., 1987)) is diagnosed and 0 else.

Table S11: Results: Tests (coefficients multiplied by 100)

| | Pretrend | Anticipation | First Year | Medium Term | Long Term | Observations |
|---|---|---|---|---|---|---|
| Blood Counts | 0.0310 | 0.0137 | $-0.1371^{**}$ | $-0.3148^{***}$ | $-0.3299^{***}$ | 15,34,080 |
| | (0.0271) | (0.0287) | (0.0597) | (0.0830) | (0.0995) | |
| Total Protein | 0.0083 | 0.0023 | $-0.0628^{*}$ | $-0.1729^{***}$ | $-0.1555^{***}$ | 15,340,080 |
| | (0.0161) | (0.0177) | (0.0355) | (0.0458) | (0.0527) | |
| Beta Blockers | $-0.0187$ | $-0.0489$ | $-0.0881$ | $-0.1125$ | $-0.2125^{**}$ | 15,340,080 |
| | (0.0431) | (0.0418) | (0.0545) | (0.0717) | (0.0963) | |
| ACE Inhibitors | 0.0548 | 0.0386 | $0.4024^{***}$ | $0.6941^{***}$ | $0.6514^{***}$ | 15,340,080 |
| | (0.0369) | (0.0357) | (0.0493) | (0.0657) | (0.0891) | |
| Antibiotics | 0.0098 | $-0.0172$ | $-0.1574^{***}$ | $-0.1761^{***}$ | $-0.1905^{***}$ | 15,340,080 |
| | (0.0232) | (0.0203) | (0.0250) | (0.0288) | (0.0369) | |

Note: Standard Errors in Parentheses. *Pretrend* = Event Times -8 to -7, *Anticipation* = Event Times -5 to -1, *First Year* = Event Times 0 to 3, *Medium Term* = Event Times 4 to 12, *Medium Term* = Event Times 13 and greater; All estimations based on the complete sample of treated individuals. Complete Blood Count as defined by EBM No.32122. Total Protein as defined by EBM No.32056. ACE Inhibitors include all prescriptions with ATC C09a and C09b. Beta Blockers include all prescriptions with ATC C07. Antibiotics include all prescriptions with ATC J01.