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Competition and physician behaviour: Does the competitive environment affect the propensity to issue sickness certificates?*

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Abstract

Competition among physicians is widespread, but compelling empirical evidence on the impact on service provision is limited, mainly due to lack of exogenous variation in the degree of competition. In this paper we exploit that many GPs, in addition to own practice, work in local emergency centres, where the matching of patients to GPs is random. This allows us to observe the same GP in two different competitive environments; with competition (own practice) and without competition (emergency centre). Using rich administrative patient-level data from Norway for 2006-14, which allow us to estimate high-dimensional fixed-effect models to control for time-invariant patient and GP heterogeneity, we find that GPs with a fee-for-service (fixed salary) contract are 11 (8) percentage points more likely to certify sick leave at own practice than at the emergency centre. Thus, competition has a positive impact on GPs' sick listing that is reinforced by financial incentives.

Keywords: Physicians, Competition, Sickness certification

JEL Classification: I11; I18; L13

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1 Introduction

Competition among physicians is widespread. Almost every country has a market-based allocation of physician services, though the scope for competition may vary according to government regulations. In particular, the extent to which prices of physician services are set administratively or determined in the market differs across public and private health care systems. In this paper we study the effect of non-price competition among physicians on their service provision in a National Health Service (NHS), and how this relationship depends on the financial incentives provided by the physicians' remuneration schemes.

Despite the widespread presence of competition in physician markets, the empirical evidence on its impact on physicians' service provision is surprisingly scarce.[1] There are only a few papers, which we discuss below, that provide compelling evidence on the causal relationship between competition and physician behaviour. A main reason for this is that market structure is endogenous, which makes it hard to obtain plausible exogenous variation in the degree of competition. A standard regression analysis of market concentration on physicians' service provision, as used by most of the existing literature on physician markets, will yield biased estimates. While instrumental variable approaches could be employed to deal with the endogeneity problem, the lack of data in physician markets has made this difficult.[2]

In this paper we propose a novel approach to identify the impact of competition on physicians' service provision. More precisely, we take advantage of the fact that many General Practitioners (GPs), in addition to their regular office practice, work in local primary care emergency centres (PCECs). At the PCECs, the physician-patient matching is random, implying that the GPs face exogenous demand and thus no competition for patients. However, at the GPs' own practice, the matching is a result of patient choice and the GPs should realise that their treatment decisions will affect both the probability that the patient chooses to remain on the GPs' list in the future, and also, through reputation effects, the probability that new patients will choose to be listed with the GP. Since the data allows us to observe the same GP in different competitive environments, being exposed (in own practice) or not (in emergency centre) to competition, we are in principle able to isolate the effect on competition on GP behaviour in a way that allows

[1] See the review by Gaynor and Town (2011).

[2] For more details, see Gaynor and Town (2011).

us to make causal inferences.

A key issue, though, is to control for other factors (than competition) that may influence physician behaviour in the two competitive environments. To do so, we exploit rich administrative data with detailed patient-level information in Norway from 2006 to 2014. From these data, which basically cover the whole population in Norway, we select the ten most frequent acute diagnoses treated by GPs. As outcome variable, we use certification of (paid) sick leave, which is a highly frequent and standardised 'treatment choice' made by GPs for acute diagnoses. The detailed data allow us to estimate high-dimensional fixed-effect models using only within patient and GP variation. This implies that we control for all time-invariant unobserved (and observed) patient and GP heterogeneity. We also include diagnosis fixed-effects and control for time trend, as well as a wide set of potentially time-varying patient and GP characteristics.

Our key finding is that GPs are more likely to issue sick leave to patients that visit them at their own practice than at the emergency centre. We also find that GPs with an activity-based (fee-for-service and capitation) contract are more likely to offer sick leave than GPs with a fixed-salary contract. These results are economically significant. In our most preferred model, GPs with an activity-based contract are 11 percentage points more likely to offer a sick leave at their own practice than at the emergency centre, whereas the same figure for GPs on fixed-salary contracts are 8 percentage points. These finding are (in qualitative terms) highly robust across a large set of specifications and sensitivity tests. We therefore conclude that competition does influence physician behaviour, and that this effect is reinforced by financial incentives (i.e., activity-based remuneration of physician services).

To develop economic intuition for the results, we construct a dynamic model of GPs' choices of sick-listing practice styles when patients differ in illness severity and thus the need for a sick leave. In the model patients always (weakly) prefer a sick leave certificate irrespective of illness severity, as it is optional to make use of it. This implies that, under competition, GPs can increase future demand by adopting a more lenient sick-listing practice style. Assuming GPs are semi-altruistic and that deviating from medical sick-listing guidelines (i.e., being too lenient) is costly for the GP, we show that the effect of exposing GPs to competition crucially depends on the GPs' remuneration scheme. For GPs with an activity-based (fee-for-service or capitation) contract, competition always induces the GPs to be more lenient in terms of sick listing. For GPs with a fixed-salary contract, the effect of competition is *a priori* ambiguous. If GPs are mainly profit motivated, competition induces the GPs to adopt a stricter practice style in order to avoid (rather than attract) patients. However, the reverse is true if GPs are sufficiently altruistic and thus put a larger weight on patients' benefit from obtaining a sick leave relative to the costs of being too lenient.

The rest of the paper is organised as follows. In the next section we review the relevant literature. In Section 3 we present the Norwegian primary care market. In Section 4 we develop a dynamic model for GPs' sick listing practice and derive predictions for the empirical analysis. In Section 5 we present our data and provide some descriptive statistics. In Section 6 we explain our empirical strategy and in Section 7 the empirical results. In Section 8 we conduct several sensitivity tests. Section 9 concludes the paper.

2 Related literature

The economic literature on the market for physician services is extensive. A majority of work is on 'physician agency' that focuses on the role of asymmetric information in the relationship between patients and physicians and physician-induced demand.[3] There is also a large and related literature on physician incentives and payment schemes that studies the effects of fee changes on physicians' supply of medical services.[4] However, the literature on competition *per se* in physician markets is surprisingly sparse despite its widespread presence.[5]

There exists an early literature on the effects of competition on *pricing* of physician services. Most of this literature tends to use the number of physicians per capita within a geographic area as measure of competition, and exploit across-area variation to estimate the effect of competition on service prices.[6] More recent papers use instead measures of market concentration, such as the Herfindahl-Hirschman Index (HHI), to estimate the impact on service prices.[7] A key problem is that these measures of competition are endogenous and thus yield biased results. A

[3] See, for instance, the review by McGuire (2000) and the recent paper by Jacobson et al. (2013).

[4] See, for instance, the seminal work by Gruber and Owings (1996) and the more recent work by Devlin and Sarma (2008), Clemens and Gottlieb (2014) and Brekke et al. (2016).

[5] For a review, see Gaynor and Town (2011).

[6] See, for instance, the seminal work by Pauly and Satterthwaite (1981) who use data on 92 US metropolitan areas. They find that areas with more physicians per capita have lower prices.

[7] See, for instance, Schneider et al. (2008) who find that physician market concentration in California, measured by HHI, is associated with higher prices.

recent paper by Dunn and Shapiro (2014) deal with this problem by using predicted (rather than actual) fixed-travel-time HHI, as used by Kessler and McClellan (2000) for competition in hospital markets. Linking these concentration measures to health insurance claims in the US, they find that physicians in more concentrated markets charge higher service prices. Another paper is Gravelle et al. (2016) who study the impact of competition on consultation prices charged by GPs in Australia. The degree of competition is measured by distance between GPs, and they use within area (rather than across area) variation to identify the effects of competition on GPs' consultation prices. They argue that the areas are sufficiently small to account for the fact that GPs' locational decisions are endogenous. They find that GPs with more distant competitors charge higher prices and a smaller proportion of their patients make no out-of-pocket payment. Our paper differs from this strand of literature in that we focus on the impact on non-price competition variables (i.e., sick listing) and take a different approach to obtain exogenous variation in the degree of competition (i.e., within GP variation in competition and service provision).

The number of studies on the impact of competition on physicians' service provision is much more limited than the above-mentioned literature on physician pricing. A recent paper by Santos et al. (2016) provide evidence from the UK that patients respond to quality differences among GPs and are willing to travel further to higher quality practices. While this is not a direct test of the effects of competition, the study shows that GPs face higher demand if they improve their quality. There are a few papers that use 'shortage of patients' as competition measure, where shortage of patients is defined by whether the GP has open vacancies on their patient lists. The idea is simply that patients with closed list are competing less intense than those with open lists. For instance, Iversen and Lurås (2000) and Iversen (2004) show that Norwegian GPs who experience shortage of patients provide more services and thus obtain higher income per patient than their unconstrained colleagues (with full patient lists). A similar approach is taken by Iversen and Ma (2011) who find that more intense competition, measured either by whether the GPs' patient list is open or by the GPs' desired list size, leads to more diagnostic radiology referrals. Finally, Godager et al. (2015a) find that increased competition, measured either by the number of open primary physician practices or HHI, has negligible or small positive effects on referrals overall. Although it might seem plausible that GPs compete less aggressively in local markets with few open lists, the competition measure is clearly endogenous and thus likely to suffer from the same endogeneity problem as the use of market concentration measures, such as the HHI. Our paper differs from this strand of literature in that we do not consider the relationship between primary and secondary care and the gatekeeping role of GPs.[8] More importantly, we propose a different approach to identifying the effect of competition on GPs' service provision, i.e., within GP variation rather than across GP or local market variation.

Finally, we should mention a closely related study by Markussen and Røed (2016). They study, as we do, the GPs propensity to issue sickness certification to patients using Norwegian administrative data. Their study consists of three separate parts. First, they identify each GPs' degree of 'gatekeeper leniency' at each point in time by using worker (patient) fixed effects, which is identified by worker movements between GPs and between sick leave and work. Second, they examine the extent to which workers choose GPs that are more lenient by estimating a conditional logit model, where the choice set is identified by the observed GP choices among other workers in the same local area. Third, they examine whether GPs adjust their gatekeeper leniency in response to fluctuations in demand or in costs of losing patients. This is done using a fixed effect models where the effects are identified on the basis of changes in the local competitive environment or in the GP's remuneration structure. Their results show that patients tend to choose GPs that have a more lenient sick-listing practice and GPs tend to become more lenient in local markets with stronger competition. While this study reports similar results as we do, they use conventional measures of competition, such as the number or share of GPs with open lists (vacancies), the number of GPs per capita in an area, or the share of patients with a recent GP switch. Our contribution is to propose a different approach to identify the causal impact of competition by exploiting within GP variation in competition and sick listing.

3 Institutional background

In the Norwegian National Health Service (NHS), primary care provision is the responsibility of the municipalities, although funding and regulation are to a large extent made by the central government. Since the implementation of the Regular General Practitioner Scheme (*Fastlegere-*

[8] Besides the above-mentioned studies, there are several papers that adress the role of GPs as gatekeepers for specialist care; see, for instance, Dusheiko et al. (2006), Brekke et al. (2007), and Gonzalez (2010).

formen in Norwegian) in 2001, each inhabitant of Norway has the right to be listed with a GP.[9] Patients are free to choose their GP (if the GP has vacant patient slots), and can switch GP (without stating any particular reason) at most twice per year.[10] In contrast, the GPs are not allowed to select their patients. GPs are free to choose their patient list size in the interval between 500 and 2500 patients (average list size is around 1200 patients). About 95% of GPs are self-employed, private physicians contracting with municipalities, with the remaining GPs being directly employed by the municipalities. The payment system for self-employed GPs is a combination of a capitation fee (covered by the municipalities) and fee-for-service (covered partly by the public social security agency and partly by the patients), where the fee-for-service part constitutes around 70% of the GPs' total income. On the other hand, GPs employed by the municipality are paid a fixed salary.

Municipalities are also responsible for the emergency primary health care for their inhabitants (and visitors). These services are offered either at a GP's office or at PCECs, which often serve several municipalities. During evenings, nights and weekends, all emergency contacts are directed to these centres. In larger municipalities, PCECs also offer services at daytime. During ordinary opening hours, all GPs are obliged to accept and assess patients in need of emergency care in their own practice. In principle, when below the age of 60, GPs are also obliged to provide emergency care at PCECs, though it is possible to apply for exemption based on health or social reasons. In practice, more than 50% of the GPs work at PCECs.

Approximately half of the consultations taking place at PCECs are with a regular GP and the rest are covered by locums and junior doctors from hospitals. When working in an emergency centre during daytime or in the evenings, the vast majority of GPs are paid according to the same fee-for-service schedule as the one used for contracted GPs in their regular practice (Godager et al., 2015b). The PCECs are mainly visited by patients with infections, musculoskeletal problems, injuries and other physical disorder, though approximately 5% is related to mental health problems. Epidemiological research has found that, compared to many other countries, primary care emergency services are frequently used in Norway, and often in relation

[9] In the following, 'GP' refers to primary care doctors that are contracted or employed by the municipalities, i.e., GPs within the NHS.

[10] When choosing a GP, patients are not restricted to GPs located in their own municipalities. In practice, though, the share of patients listed with GPs outside their own municipalities is very low.

to conditions that could just as well have been treated by the patient's regular GP. The reason for this pattern appears to be relatively poor access to the GP during daytime (Sandvik et al., 2012). A key feature of the consultations taking place at the emergency centres is that patients are randomly matched with doctors, which we exploit as an identification strategy in our empirical analysis. The implications of this will be further discussed in Section 6, where we describe our empirical strategy.

An important function that GPs are entrusted with is gatekeeping to the Norwegian sickness benefit system, in which workers are entitled to a 100% replacement rate up to a maximum threshold (approximately €61,000 or $64,700) from the first day of sick leave and until one year for the same sickness spell. The first 16 days of sick leave are paid by the employer, while sickness benefit beyond the first 16 days is covered by the public social security agency. Self-certification can be used for the first three or eight days of an absence spell depending on employer. Beyond that period, eligibility for sickness benefit requires certification from a GP who must assess the ability to work (full or part time) and make a decision about sickness certification based on this evaluation. The Norwegian Health Directorate has issued sickness certification guidelines in order to help standardise the certification practice across GPs.[11] Sickness certificates can be issued both at a regular GP practice and at a PCEC and the procedures for issuing such certificates are identical in both cases.

4 A dynamic model of GP practice styles

In this section we develop a dynamic model of GPs' choices of sick-listing practice styles, where we make sure that the model is sufficiently rich to incorporate the key institutional details of the Norwegian primary care market. The model is used to make theoretical predictions about how competition is likely to affect sick-listing rates, and how this relationship is likely to depend on GP payment schemes.

Suppose that a total mass of 1 infinitely lived workers are uniformly distributed on a line segment $L = [0, 1]$. In every period t, each worker falls (temporarily) sick with illness severity s, which is assumed to be perfectly negatively correlated with work ability, and which is drawn

[11] These guidelines are available at https://helsedirektoratet.no/retningslinjer/sykmelderveileder.

(independently in each period) from a uniform distribution with support $[0,1]$. Each time a worker falls sick, he can visit a GP who, in addition to prescribing an appropriate treatment, might issue a sickness certificate. We assume that a GP can correctly observe patients' illness severity and will issue a sickness certificate if the severity is above a threshold level. More specifically, we assume that GP i issues a sickness certificate to every patient with severity $s \geq \widehat{s}_i := \sigma - \beta_i$, where $\sigma \in (0,1)$ is the threshold level for issuing sickness certificates according to official guidelines and $\beta_i = \sigma - \widehat{s}_i$ represents GP i's departure from these guidelines. Thus, β_i reflects GP i's chosen *practice style* for issuing sickness certificates, where a higher value of β_i implies a more lenient practice style.[12] Excluding travelling costs associated with a GP visit, the utility of a patient with severity s who attends a GP is $a(s)$ if he does not obtain a sickness certificate and $b(s)$ if he a obtains such a certificate, where $a'(s) < 0$, $b'(s) < 0$ and $b(s) > a(s)$ for all s. Thus, higher illness severity implies lower patient utility, but, for a given severity level, a patient always prefers to get a sickness certificate.[13]

Suppose there are two GPs in the market, one located at each endpoint of L. Including travelling costs, expected utility for a worker located at z and visiting GP i, located at z_i, is[14]

$$U^i(z) = \int_0^{\widehat{s}_i} a(s)\,ds + \int_{\widehat{s}_i}^1 b(s)\,ds - \tau\,|z - z_i|\,, \tag{1}$$

where $\tau > 0$ is the marginal travelling cost. With little loss of generality, we parameterise the sub-utility functions as follows: $a(s) = \eta - s$ and $b(s) = 1 - s$, where $\eta \in (0,1)$. Expected utility in (1) is then given by

$$U^i(z) = \frac{1}{2} - (1-\eta)\,\widehat{s}_i - \tau\,|z - z_i|\,. \tag{2}$$

We assume that the parameters σ, η and τ are such that $U^i(z) > 0$ for all z and β_i, which implies full market coverage; i.e., that every worker who falls sick always prefers to visit a GP.[15]

[12] A sickness certificate is valid for a certain period of time, which is decided by the GP. However, we abstract from this dimension of the certification decision and consider only the decision of whether or not to issue a sickness certificate.

[13] If a sick worker prefers to work, he can always refrain from using the sickness certificate. Thus, a worker who has already visited a GP can never be worse off by obtaining a sickness certificate.

[14] For simplicity, we assume that patient co-payments are zero. Positive patient copayments would not affect the analysis in any way, as long as these copayments are exogenous and equal for both GPs in the market.

[15] This requires $\tau < \frac{1}{2} - \sigma(1-\eta)$ and $\sigma < \frac{1}{2(1-\eta)}$.

Suppose that, at each point on the line, a share λ of workers can choose which GP to attend, whereas each of the remaining share $1-\lambda$ is randomly allocated to one of the GPs each time they fall sick. If all workers are able to correctly observe the practice style of each GP, the worker who is indifferent between GP i and GP j is located at

$$\widehat{x} = \frac{1}{2} + \frac{(1-\eta)\left(\beta_i - \beta_j\right)}{2\tau}. \tag{3}$$

This implies further that the *potential demand* for GP i from the segment of patients who make a choice of GP is given by $\lambda\widehat{x}$. However, since practice style is difficult to observe *ex ante*, it is unrealistic to assume that a GP who chooses a particular practice style will immediately realise his potential demand. We assume instead that patients' beliefs about the practice styles of the two GPs evolve sluggishly over time through repeated interactions and reputation. More specifically, we assume that, at each point in time, only a fraction $\gamma \in (0,1)$ of patients become aware of changes in GP practice styles. This implies that only a fraction γ of any potential change in demand is realised at each point in time. Let actual demand of GP i at time t be given by

$$Q_i(t) = \frac{1-\lambda}{2} + \lambda x(t) \tag{4}$$

whereas potential demand is given by

$$\widehat{Q}_i(t) = \frac{1-\lambda}{2} + \lambda \widehat{x}(t), \tag{5}$$

where $\widehat{x}$ is given by (3). Analytically, the law of motion of actual demand is given by

$$\frac{dQ_i(t)}{dt} := \dot{Q}_i(t) = \gamma\left(\widehat{Q}_i(t) - Q_i(t)\right), \tag{6}$$

which is equivalent to

$$\frac{dx(t)}{dt} := \dot{x}_i(t) = \gamma\left(\widehat{x}(t) - x(t)\right). \tag{7}$$

Suppose that the net income of GP i at time t is

$$\pi_i(t) = \theta w + (1-\theta)\,pQ_i(t) - cQ_i(t), \tag{8}$$

where the GP's gross income is a linear combination of fixed-salary income (w) and fee-for-service income (where p the consultation fee).[16] The GP's cost per patient consultation is assumed to be constant and equal to c. In order to make sure that the GP's participation constraint is satisfied for all $\theta \in [0,1]$, we assume that $c < p$. In addition to net income, we also assume that each GP has semi-altruistic preferences and therefore cares, to some extent, about patient utility. The aggregate utility of patients attending GP i at time t is given by

$$V_i(t) = \lambda \int_0^{x(t)} \left(\frac{1}{2} - (1-\eta)\,\widehat{s}_i(t) - \tau z \right) dz + \frac{(1-\lambda)}{2} \int_0^1 \left(\frac{1}{2} - (1-\eta)\,\widehat{s}_i(t) - \tau z \right) dz. \quad (9)$$

The payoff of GP i at time t is then assumed to be given by

$$\Omega_i(t) = \pi_i(t) + \alpha V_i(t) - \frac{k}{2}\left(\sigma - \widehat{s}_i(t)\right)^2, \quad (10)$$

where α measures the degree of altruism towards the patients, and where the last term reflects the GP's disutility of adopting a practice style that deviates from the official guidelines.

We consider a dynamic game where the two GPs simultaneously (and independently) choose their practice styles (i.e., β_i and β_j) at each point in (continuous) time over an infinite time horizon. This is a 2-player differential game with practice style as the control variable and demand as the state variable. For analytical convenience, we choose the open-loop solution as our game-theoretic solution concept. Here it is assumed that each GP knows the initial state of the system but cannot observe the other GP's practice style, and thus potential demand, in subsequent periods. This implies that each GP computes his optimal plan (i.e., a sequence of practice styles over time) at the beginning of the game and then sticks to it forever. Thus, the optimal choice depends only on time, time-invariant parameters and initial conditions.[17]

Defining ρ as the rate of time preference, the dynamic optimisation problem of GP i is given

[16] As described in Section 3, the payment scheme for self-employed GPs in Norway is a combination of capitation and fee-for-service, and there is also a separate (but very low) fee for issuing a sickness certificate. In our theoretical model, the assumption that all workers fall sick once per period implies that the consultation fee p can be interpreted as including capitation payment. It is straightforward to extend the model by (i) introducing a distinction between capitation and fee-for-service payment (by assuming that each worker falls sick only with a certain probability in each period), and (ii) introducing a separate fee for issuing a sickness certificate. However, this would only complicate the exposition without qualitatively affecting any of the results, since all these fees would affect GP incentives in the same way (further details available upon request). Thus, for expositional purposes, we represent the fee-for-service payment scheme only by a single parameter, namely the consultation fee p.

[17] See Brekke et al. (2012) for a similar approach to quality competition more generally.

by

$$\max_{\beta_i(t)} \int_0^{+\infty} \Omega_i(t)\, e^{-\rho t} dt, \tag{11}$$

subject to the dynamic constraint[18]

$$\dot{x}(t) = \gamma\left(\widehat{x}(t) - x(t)\right) \tag{12}$$

and the initial condition

$$x(0) = x_0 > 0. \tag{13}$$

Let $\mu_i(t)$ denote the current-value co-state variable associated with the state equation (12). The current-value Hamiltonian is then given by[19]

$$H_i = \pi_i + \alpha V_i - \frac{k}{2}\beta_i^2 + \mu_i \gamma \left(\frac{1}{2} + \frac{(1-\eta)\left(\beta_i - \beta_j\right)}{2\tau} - x \right). \tag{14}$$

The optimal solution must satisfy the following three conditions:

$$\frac{\partial H_i}{\partial \beta_i} = \frac{(1-\eta)\left(\alpha\tau\left(1-\lambda+2\lambda x\right) + \mu_i\gamma\right)}{2\tau} - k\beta_i = 0, \tag{15}$$

$$\dot{\mu}_i = \rho\mu_i - \frac{\partial H_i}{\partial x} = (\rho+\gamma)\,\mu_i - \lambda\left(\left((1-\theta)\,p - c\right) + \alpha\left(\frac{1}{2} - \tau x - (1-\eta)\,\widehat{s}_i\right)\right), \tag{16}$$

$$\dot{x} = \frac{\partial H_i}{\partial \mu_i} = \gamma\left(\frac{1}{2} + \frac{(1-\eta)\left(\beta_i - \beta_j\right)}{2\tau} - x\right), \tag{17}$$

in addition to the transversality condition $\lim_{t\to+\infty} e^{-\rho t}\mu_i(t)\,x(t) = 0$. The second-order conditions are satisfied if the Hamiltonian is concave in its control and state variables, which requires $k > \frac{\alpha\lambda}{\tau}(1-\eta)^2$.

Time-differentiation of (15) yields

$$(1-\eta)\left(\alpha\lambda\dot{x} + \frac{\gamma}{2\tau}\dot{\mu}_i\right) - k\dot{\beta}_i = 0. \tag{18}$$

[18] Since total demand is fixed, both GPs face the same dynamic constraint; i.e., the demand dynamics for GP i automatically determine the demand for GP j.

[19] In order to save space, we henceforth drop the time indicator t.

Substituting in (18) for $\dot{\mu}_i$ from (16), $\dot{x}$ from (17) and using μ_i from (15), we arrive at

$$\dot{\beta}_i = \frac{1}{4k\tau}\left(\begin{array}{c}(1-\eta)\left(\alpha\left(\lambda\gamma\left(2\sigma\left(1-\eta\right)-1\right)+2\tau\left(\lambda\left(2\gamma+\rho\right)-\left(\gamma+\rho\right)\right)\right)-2\lambda\gamma\left(\left(1-\theta\right)p-c\right)\right)\\ +4k\tau\left(\gamma+\rho\right)\beta_i-2\alpha\lambda\gamma\left(1-\eta\right)^2\beta_j-2\alpha\lambda\tau\left(1-\eta\right)\left(3\gamma+2\rho\right)x\end{array}\right). \tag{19}$$

which, together with (17), describes the dynamics of the equilibrium.[20]

The symmetric steady-state GP practice style is found by setting $\dot{\beta}_i = 0$, $\beta_i = \beta_j$ and $x = \frac{1}{2}$, which yields

$$\beta^* = (1-\eta)\frac{\lambda\gamma\left(\left(1-\theta\right)p-c\right)+\alpha\left(\tau\left(\gamma+\rho\right)+\lambda\gamma\phi\right)}{2k\tau\left(\gamma+\rho\right)-\alpha\lambda\gamma\left(1-\eta\right)^2}, \tag{20}$$

where $\phi := \frac{1}{2} - (1-\eta)\sigma - \frac{\tau}{2} > 0$ (by the assumption of full market coverage). In the following, we restrict attention to the steady-state outcome and ask two related questions: (i) How does the degree of competition affect GP practice styles? (ii) How does the effect in (i) depend on the GP payment scheme?

Using the share of patients who choose GP as the measure of competition, the benchmark case of *no competition* is given by $\lambda = 0$. In this case, the steady-state GP practice style is given by[21]

$$\beta^*_{\lambda=0} = \frac{\alpha(1-\eta)}{2k}. \tag{21}$$

When GPs cannot affect demand through their choice of practice style, there exists only one incentive for GPs to adopt a practice style that deviates from the official guidelines, namely altruistic concern for patient utility at the *intensive* margin. A more lenient practice style ($\beta > 0$) implies that the expected utility of patients who are allocated to the GP increases, and a semi-altruistic GP derives some benefits from this. These marginal benefits are optimally traded off against the marginal disutility of deviating from the official guidelines. Thus, semi-altruistic GPs will choose a strictly positive value of β, whereas purely profit-oriented GPs will set $\beta = 0$. It is worth noting that, in the absence of competition, GP practice styles do not depend on the payment scheme for GPs.

[20] It is straightforward to verify that the second-order condition $k > \frac{\alpha\lambda}{\tau}(1-\eta)^2$ is also sufficient to ensure saddle-point stability of the open-loop solution.

[21] If $\lambda = 0$, there is no dynamic competition over time. Each GP will choose the steady-state value of β at $t = 0$ and stick to it forever.

The case of free patient choice, which implies *competition* between the GPs, is characterised by $\lambda = 1$. The effect of competition on GP practice styles in the steady state is then given by

$$\Delta\beta^* := \beta^*_{\lambda=1} - \beta^*_{\lambda=0} = \gamma(1-\eta)\frac{2k((1-\theta)p - c) + \alpha\left(\alpha(1-\eta)^2 + 2k\phi\right)}{2k\left(2k\tau(\gamma+\rho) - \alpha\gamma(1-\eta)^2\right)}. \tag{22}$$

The sign of this expression – which is *a priori* ambiguous – depends on the sign of the numerator, which consists of two terms. The first and second term capture the effect of competition on, respectively, the GPs' *financial* and *altruistic* incentives for the choice of practice style.

We can isolate the *financial incentives* by considering the case of purely profit-oriented GPs (i.e., $\alpha = 0$). In this case, we see that the sign of $\Delta\beta^*$ depends crucially on the GP payment scheme. The effect of competition on the GPs' propensity to issue sickness certificates is negative ($\Delta\beta^* < 0$) under fixed-salary contracts ($\theta = 1$) and positive ($\Delta\beta^* > 0$) under fee-for-service contracts ($\theta = 0$). More generally, competition leads to a more lenient GP practice style if the financial incentives for attracting more patients are sufficiently high-powered (i.e., if θ is sufficiently low). If these incentives do not exist, which is the case under fixed-salary contracts, a purely profit-oriented GP will choose a practice style in the steady state that is stricter than the official guidelines (i.e., $\beta^* < 0$) in an attempt to reduce demand and thereby save consultation costs.[22]

The effect of GP *altruism* is captured by the second term in the numerator of (22) and contributes unambiguously positive. The reason is that competition allows for patient utility effects of GP practice styles at the *extensive* margin. By adopting a more lenient practice style, a GP can attract more patients and thereby increase the total utility of the patients treated. Under fee-for-service payment ($\theta = 0$), this effect will reinforce the positive relationship between competition and the propensity to issue sickness certificates. Under fixed-salary contracts ($\theta = 1$), GP altruism introduces a counteracting effect. If the altruistic gain of increased patient utility at the extensive margin is higher than the marginal consultation cost, competition leads to a more lenient GP practice style ($\Delta\beta^* > 0$) also for GPs on fixed-salary contracts.

[22] Since total demand is fixed, each GP always has the same demand in the symmetric steady-state equilibrium, regardless of the competitive environment. However, when patients are free to choose their preferred GP, each GP has a unilateral incentive to increase (decrease) demand if the marginal net benefit of doing so is positive (negative).

Finally, notice that the *magnitude* of the competition effect on GP practice styles depends on the size of the *potential* demand response to a more lenient practice style (measured by $(1-\eta)$) and by how fast *actual* demand adjusts to such a change in practice style (measured by γ).

The above described results are summarised as follows:

Proposition 1 *(i) Under fee-for-service contracts, competition always leads to a more lenient GP practice style. (ii) Under fixed-salary contracts, competition leads to a more lenient (stricter) GP practice style if the degree of altruism is sufficiently strong (weak). (iii) When facing competition, a GP on fee-for-service contract is always more lenient than a GP on fixed-salary contract.*

5 Data and descriptive statistics

Data on GPs and their patients are derived from the Norwegian Health Economics Administration (HELFO), which is responsible for the Norwegian primary care patient list scheme.[23] For each patient contact (consultation), whether at the GP's regular office or at an emergency centre, the GP sends an invoice to HELFO. The register includes information on patients' age and gender, date and time of contact, diagnosis according to the ICPC-2-diagnosis code and codes from a detailed tariff scheme for type of contact (including a tariff for issuing sickness certificates). The register incudes the same type of information regardless of where the consultation takes place (at the GP's own practice or in an emergency centre). HELFO also holds a register of the regular GPs, including their age, gender, medical specialist status and the personal identifiers of the patients on the list. From HELFO we have obtained data from 2006-2014.

Data from HELFO do not include information on individual characteristics like education and income. This information is derived from the FD-Trygd database, which links administrative information from the National Insurance Administration, Statistics Norway and the Directorate of Labour. The database covers all Norwegians from 1992 onwards. Besides detailed information on work activity, income and social security (sick leave, disability, retirement pension, etc.), the database also includes extensive background information such as education, marital status and number of children.

[23] HELFO is a subordinate institution directly linked to the Norwegian Directorate of Health.

5.1 Sample

We restrict attention to the 10 most frequent diagnoses among employed patients attending PCECs in the period 2007-2014. These are listed in Table 1, which also contains information on the total number of visits at emergency centres per diagnosis.

[Table 1 here]

From HELFO we have extracted information on all consultations, whether at a regular GP practice or at an emergency centre, where the patient was diagnosed with one of these 10 diagnoses. This amounts to a total of 5,887,319 visits over the period 2007-2014. Since we focus on GPs' sick-listing practice we only include patients who were employed at the time of consultation, which reduces the total number of visits by approximately 25 percent. Furthermore, we exclude from the sample visits to physicians not registered as a regular GP[24] and visits to another regular GP than the one the patient is listed with.[25] These two categories constitute roughly 25 and 30 percent, respectively, of all visits.[26] A potential remaining problem is related to visits which result in emergency hospital admissions. In these cases, the sickness certificate might be issued at the hospital. In order to exclude such cases we link our data on primary care visits to data from the Norwegian Patient Register (NPR), which contains (weekly) information on all admissions to secondary care in Norway. Based on this information, we have excluded visits from patients who are registered with a hospital stay in the same week as the primary care consultation.

[Table 2 here]

We also exclude consultations at PCECs that take place during the night (which constitute less than 3 percent of all consultations). This exclusion is an attempt to reduce unobservable patient and GP heterogeneity across consultation types. On the patient side, consultations at emergency centres during the night is likely to involve more high-severity patients, while on

[24] These include locums, interns, junior doctors from hospitals working in emergency centres, etc.

[25] A patient might be seen by another GP than the one she is listed with if the patient's regular GP is unavailable for some reason. This is particularly frequent in GP group practices.

[26] Notice that these two categories are not mutually exclusive. The intersection consists of all consultations outside emergency centres where the pasient visits a GP different from the one she is listed with, and this GP is not registered as a regular GP.

the GP side, excluding night-time consultations will exclude most of the PCEC consultations where GPs are paid a fixed salary, ensuring a more homogeneous remuneration scheme (fee-for-service) for the remaining PCEC consultations in the sample.[27] Finally, we have dropped a small number of patients with missing observations on some explanatory variables. Table 2 contains information on the relative size of each of the excluded consultation categories for each of the ten diagnoses considered.[28] Our final sample contains almost 2.5 million consultations.

5.2 Variables

In line with our empirical strategy (to be further explained in the next section), we classify all consultations in our final sample into three different categories: (i) consultations where the patient visits her own regular GP and this GP is self-employed and paid by capitation and fee-for-service, (ii) consultations where the patient visits her own regular GP and this GP is employed on a fixed-salary contract, and (iii) consultations which takes place at a municipal emergency centre. These categories constitute approximately 85%, 4% and 11%, respectively, of the total number of consultations. For each consultation we also know whether a sickness certificate has been issued and whether the consultation is a prolonged one.[29]

[Figures 1a and 1b here]

Figure 1a shows the frequency of each diagnosis in each category of primary care consultations. For many diagnoses, their frequency is quite similar across consultation categories. Within this set of diagnoses, we see that *upper respiratory infection* is the most common diagnosis at GP offices and almost equally frequent at emergency centres. On the other hand, *laceration/cut* is much more common at emergency centres. These patient sample differences will be taken care of in the empirical analysis where we control for diagnosis. Notice, however, that the descriptive statistics on the rate of sick listing across the three categories of consultations, as depicted in Figure 1b, show a very consistent pattern. For every single diagnosis, the

[27] It should be noted that, according to our theory model, the renumeration scheme has no impact on GP behaviour in a situation with exogenous demand, as is the case for emergency centre consultations. We have also estimated our empirical models on a sample where we include night-time PCEC consultations and the results (which are available upon request) are practically identical.

[28] Notice that, since these categories are not mutually exclusive, the number of visits in the final sample cannot be directly calculated from the total number of visits by using the shares of excluded visits given in Table 2.

[29] The standard time for a consultation is 20 minutes, but the consultation can be prolonged by the physician.

sick-listing rate is highest in consultations with a regular GP on fee-for-service payment and lowest in consultations at emergency centres.

We also include a relatively large set of GP and patient characteristics as control variables. All variables are listed and defined in Table A.1 in the Appendix. In Table 3 we report the mean values of all variables (summed over all diagnoses) for each of the three consultation categories. Patients at the emergency center had a lower number of visits to a GP or an emergency centre the previous year, but they are also somewhat younger than the average patient at the GP office. For most of the other variables, the descriptive statistics show relatively small and non-systematic differences across consultation categories. As expected, since regular GPs above the age of 60 are automatically exempted from the obligation to work at emergency centres, the average GP age is somewhat lower for consultations taking place there.

[Table 3 here]

6 Empirical strategy

The (twofold) aim of our empirical analysis is (i) to estimate the causal relationship between the degree of competition a GP is exposed to and his propensity to issue sickness certificates to his patients, and (ii) to assess how this relationship depends on the GP payment scheme (fixed salary versus fee-for-service). Our theoretical analysis predicts that more competition will lead to a higher sick-listing rate if GP payment is based on fee-for-service, whereas the effect of competition on the sick-listing rate of fixed-salary GPs is *a priori* ambiguous and, if positive, smaller than the effect on the sick-listing rate of fee-for-service GPs.

The key challenge for empirical identification is to create an exogenous measure of competition intensity. Our strategy here is to exploit the fact that the consultation-specific matching of patients to physicians is based on patient choice at regular GP practices, whereas it is completely random at emergency centres. This difference in 'matching technology' has clear implications for the nature of the competitive environment the GPs find themselves in when they work in their own practice or in an emergency centre. When patient-physician matching is random, as is the case in an emergency centre, the GP cannot influence his future demand, which is exogenous. This implies that the GP is not exposed to any competition for patients and is equivalent to the case of $\lambda = 0$ in the theory model. On the other hand, when working in his own practice, where physician-patient matching is a result of patient choice, the GP should realise that his treatment decisions (or 'practice style') will affect both the probability that the patient chooses to remain on the GP's list in the future, and also, through reputation effects, the probability that new patients will choose to be listed with the GP. This implies that the GP is exposed to competition for patients and is equivalent to the case of $\lambda = 1$ in the theory model. Since the data allows us to observe the same GP in different competitive environments, being exposed (in own practice) or not (in emergency centre) to competition, we are in principle able to isolate the effect on competition on GP behaviour in a way that allows us to make causal inferences.

In order to estimate the effect of competition on physician behaviour, we employ the following high-dimensional fixed effect model where we control for all time-invariant characteristics of patients and physicians using the Stata module *reghdfe* (Correia, 2014):

$$y_{ijt} = \xi * Type_{ijt} + \kappa * X_{ijt} + \psi_i + \delta_j + \omega_t + \varepsilon_{ijt}, \tag{23}$$

where the dependent variable y_{ijt} is equal to 1 if GP j issues a sickness certificate to patient i at time t, and equal to zero otherwise. According to (23), we have the following distinct sources of variation in the dependent variable:

1. Type of consultation ($Type_{ijt}$) according to the three previously defined categories.
2. Observed time-varying exogenous characteristics of patients and physicians (X_{ijt}).
3. Time-invariant patient heterogeneity (ψ_i).
4. Time-invariant physician heterogeneity (δ_j).
5. Period-specific effects (dummy variables for year, month, day of week and hour) common to all patients and physicians (ω_t).
6. Unexplained random variation (ε_{ijt}).

Our explanatory variable of main interest is type of consultation. In the analysis we use visits to emergency centres as the baseline category, which implies that the estimated parameter vector ξ measures the effect of exposure to competition on physicians' propensity to issue sickness certificates, with separate parameter estimates depending on whether physicians have fixed salaries or fee-for-service payments in the environment where they are exposed to competition. GPs working at emergency centres may well differ systematically from GPs who do not on unobservable characteristics. However, GP fixed effects capture differences between GPs regarding their motivation for working at emergency centers, their attitudes towards the gatekeeper role and to the usefulness of sickness absence in a therapeutic context, their degree of altruism, and so on. Patient fixed effects, in turn, capture factors such as genetic predispositions, initial health status including chronic disease, attitudes towards illness and work, and degree of risk aversion regarding change of Regular GP.

A remaining potential estimation problem, though, is that patients visiting an emergency centre might differ from patients visiting a regular GP. Even in a regression model where we include patient, GP and time fixed effects, and where we also control for a large set of time-varying patient and physician characteristics, the dependent variable is likely to be correlated with the error term due to unobserved patient characteristics. However, the interpretation of the estimation results is greatly enhanced by the fact that, although it is hard to know the size of the patient selection bias, the *direction* of the bias appears to be clear. Controlled for observable patient characteristics, there is no reason to believe that regular GP consultations involve sicker patient, on average, than consultations at emergency centres. On the contrary, any potential remaining difference in the average severity levels between the two consultation types must surely be caused by sicker patients being treated at emergency centres. Although we cannot directly observe patient severity, this conjecture is backed by the observation that, for every diagnosis considered, the share of patients who are sent to hospital after a primary care consultation is considerably higher for emergency centre consultations than for regular GP consultations.[30] We will get back to this issue when discussing our empirical results in the next section.

Eq. (23) is our preferred model, but we also report results from estimations of OLS models with time-fixed and diagnoses-fixed effects, as well as models adding GP or patient fixed effects.

[30] These figures are calculated using the data and procedure previously described in Section 5 and are reported in Table A.2. in the Appendix.

When estimating GP and/or patient fixed effects specifications, we follow Correia (2015) and drop singleton observations (i.e., GPs or patients for whom there is only one observation) in order to ensure proper inference and improve computational efficiency in our fixed-effect regressions.

7 Results and discussion

Our main regression results are presented in Table 4, which displays results from the estimation of four different versions of (23). As a benchmark for comparison, estimates based on pooled ordinary least squares (OLS) are reported in Column 1 of Table 4. If we compare OLS results with raw data sickness certification rates (Table 3), the differences in sick-listing propensity across consultation categories are much less when we control for observable GP and patient characteristics as well as time fixed effects. In particular, controlling for diagnosis is important, as could be expected from the descriptive statistics (Figures 1a and 1b).

Columns 2 and 3 in Table 4 show the estimates from models with physician fixed effects and patient fixed effects, respectively. In the model with physician fixed effects, identification of the competition effect is based on observations of the same physician both in his own practice and at an emergency centre. On the other hand, in the model with patient fixed effects, identification is based on observations of the same patient visiting her regular GP and visiting an emergency centre. Finally, in Column 4 we report estimates from our preferred empirical model with two-way (physician and patient) fixed effects, as specified in (23).

[Table 4 here]

For our independent variables of interest, the point estimates are qualitatively similar in all four models. When a physician works in a more competitive environment (i.e., in his own practice instead of at an emergency centre), the physician's propensity to issue sickness certificates is significantly higher. Furthermore, this effect is significantly stronger if the physician has financial incentives to compete for patients (i.e., if the physician's income in his own practice is based on capitation and fee-for-service rather than a fixed salary). These effects are estimated with a great deal of precision. In our most preferred model, exposure to competition increases the probability of sick listing by more than 8 percentage points if the GP is on a fixed-salary contract, and by more than 11 percentage points if the GP is on a fee-for-service contract.[31] The estimated coefficients for the other covariates are all relatively small in magnitude.

The estimated effect of competition on the sick-listing practice of fee-for-service GPs, who have financial incentives to attract patients, serves as a strong confirmation of the prediction from our theoretical model. That the effect is stronger for these GPs than for fixed-salary GPs is also in accordance with the theoretical analysis. However, our theory predicts that the sign of the competition effect is *a priori* ambiguous for fixed-salary GPs, with a positive (negative) effect if the degree of altruism is sufficiently strong (weak). The empirical finding of a relatively strong and positive effect also for this group of GPs suggests, in light of the theory, that the degree of GP altruism is relatively high.

The results for the two types of GPs might also be partly explained by a selection effect that is not fully accounted for in our empirical models. When the Regular General Practitioner Scheme was introduced in 2001, the GPs who were already on a fixed-salary contract were given the right to keep their position as employed GPs earning a fixed salary. Thus, the type of GP (fee-for-service vs. fixed salary) is to some extent a result of the GPs' own choice and we cannot rule out the possibility that the two types of GPs differ along some unobservable dimension. One possible self-selection criterion, which seems intuitively plausible, is that the more profit-oriented GPs opted for a self-employment contract (capitation and fee-for-service) whereas the more altruistic ones opted to remain on a fixed-salary contract. Such a selection effect, which implies that fixed-salary GPs are, on average, more altruistic than fee-for-service GPs, might explain why we find relatively strong and positive effects of competition also for the fixed-salary GPs.

There are also two other potential biases that might affect our results. First, as mentioned in Section 6, our results might be influenced by patient selection bias due to unobserved systematic differences between patients who visit an emergency centre and patients who visit their regular GP. However, as previously argued, such a bias – if it still remains after controlling for both time-varying and time-invariant heterogeneity – must surely be in the direction of sicker patients attending emergency centres, which implies that, absent the competition effect, the rate of sick

[31] Using an F-test, we confirm that the effects of competition on physicians' sick-listing practice are siginificantly different (in all four models) for the two types of GPs (fixed salary vs. fee-for-service).

listing should be higher at emergency centres than at regular GP practices. The fact that we find significantly *lower* sick-listing rates at emergency centres suggests that we are, if anything, *underestimating* the positive effect of competition on physicians' propensity to issue sickness certificates. Thus, in light of this potential patient selection bias, the point estimates reported in Table 4 could be seen as lower-bound estimates of the true effect of competition.

Second, another difference between consultations at emergency centres and consultations at regular GPs, which might potentially affect our results, is that the degree of familiarity between physician and patient is (at least on average) higher in a regular GP consultation. This might have two different effects on the physician's decision of whether or not to issue a sickness certificate. First, higher familiarity is likely to improve diagnosis accuracy; i.e., the better the GP knows the patient, the more likely he is to observe the true severity level of the patient. However, there is no particular reason to believe that this will create a bias in our analysis. For any given GP practice style (i.e., sick-listing threshold), the inability to diagnose accurately can create two types of mistakes: the GP issues sickness certificates to patients who should not have been sick listed, and patients who should have been sick listed does not obtain a sickness certificate. Improved diagnosis accuracy will reduce both types of mistakes and there is no *a priori* reason to believe that the net effect is systematically different from zero. However, higher familiarity between physician and patient might also make the physician more prone to give the patient a sickness certificate in borderline cases. A GP might simply find it more difficult to deny a patient he knows well a sickness certificate. In the context of our theoretical model, this effect could be interpreted as the GP acting more altruistic towards patients when there is higher familiarity between physician and patient, as would be the case in the context of patient choice ($\lambda = 1$).

All else equal, the 'familiarity effect' might create a bias in the direction of lower sick-listing rates at emergency centres, counteracting the aforementioned patient selection bias. Notice, however, that the potential bias due to familiarity between physician and patient is in principle the same for both types of GPs (fixed salary and fee-for-service). The fact that we find a significantly stronger response to competition for fee-for-service GPs than for fixed-salary GPs suggests, in light of our theoretical model, that our results cannot be fully explained by such a bias. In the next section we will also report results from a sensitivity analysis where we specify our empirical model in a way that eliminates the familiarity bias.

8 Sensitivity analysis

In this section we perform some sensitivity tests to our main results presented in the previous section. The results are presented in Table 5, where Columns 1-4 show point estimates from the two-way fixed effects model with different sample selection criteria and Column 5 shows the estimated effects of competition in a differently specified model, with a fixed effect for each physician-patient pair. For space-saving purposes, we only report the estimated coefficients for our two independent variables of interest.

We introduce (separately) four different sample selection criteria. First, we exclude all consultations outside the regular GPs' opening hours. It might seem likely that patients who attend emergency centres outside the opening hours of their regular GPs do so because they are too sick to wait until they can see their regular GP the following day. On the other hand, at least a share of the patients who visit an emergency centre during the opening hours of their regular GPs have probably chosen the emergency centre after first contacting their GP and being told that he was not available within a reasonable amount of time. Thus, by excluding not only night-time consultations (as we do in the main sample), but also all other consultations outside regular GP opening hours, we might further reduce the potential patient selection bias. The point estimates from regressions on this restricted sample are reported in Column 1 in Table 5 and are very similar to the ones estimated using the full sample.

Second, we exclude consultations with patients living in the municipality of Oslo. The reason is that, compared with the remaining Norwegian municipalities, the provision of emergency health care services is organised differently in Oslo, with a larger share of physicians working exclusively at emergency centres. However, the estimates reported in the Column 2 of Table 5 reveals that this has practically no impact on the estimated effects of competition on GP sick-listing rates.

Third, we also exclude patients who were already on sick leave when visiting a physician (either the regular GP or at an emergency centre). Since sickness certificates are issued with a certain time limit, which can often be quite restricted, a certain share of the total patient mass, in particular those with a more long-term disease, might visit a GP simply to have their sickness certificate renewed. Given that, for a given sickness episode, the probability of having a sickness certificate renewed is, on average, higher than the probability of obtaining the first sickness certificate, and given that renewals of sickness certificates mainly take place at a regular GP practice, this could create a bias in the direction of higher sick listing by regular GPs, implying that our competition effects might be overestimated. The point estimates shown in Column 3 of Table 5 suggest that such an effect might be present. By excluding consultations involving patients who were already on sick leave, the estimated coefficients are somewhat reduced in magnitude. Still, though, the effects of exposure to competition are relatively large, very precisely estimated, and significantly larger for fee-for-service GPs than for fixed-salary GPs.

Fourth, we exclude consultations where the same patient visits a regular GP within three days of visiting an emergency centre. This is done to avoid potential cases where a physician at an emergency centre asks the patient to visit her regular GP in order to get a sickness certificate. Such cases might potentially arise if the sickness certification decision is a borderline one, where the emergency centre physician is more comfortable leaving this decision to the patient's own GP.[32] However, as shown in Column 4, imposing this sample restriction has only a negligible effect on the estimated coefficients.

[Table 5 here]

As discussed in the previous section, our results might be biased due to higher familiarity between physician and patient in regular GP consultations. One way to eliminate this bias is to estimate a different version of (23), where we include, instead of separate GP and patient fixed-effects, a fixed effect for each physician-patient pair; a 'match fixed effect'. In this version of the model, identification is based on observations of the same physician with the same patient in both competitive environments. The results, reported in Column 5 of Table 5, show that the effects of competition are qualitatively the same, although considerably smaller in magnitude.[33] Notice, however, that this way of removing the 'familiarity bias' introduces another potential bias. A

[32] Given the acute nature of the diagnoses considered, a window of three days should be enough to exclude such cases, if they exist.

[33] While the effect is still highly statistically significant for GPs on fee-for-service contracts, the relatively small number of observations where fixed-salary GPs see the same patients both in their own practice and at an emergency centre implies that the effect of competition on the sick-listing rates of these types of GPs is less precisely estimated.

physician might reasonably expect that his behaviour towards one of his own listed patients will affect his GP practice demand, even if the consultation takes place at an emergency centre. Thus, although physicians face completely exogenous demand when working at emergency centres, it might be reasonable to assume that, if they happen to see their own listed patients at the emergency centre, they will behave differently towards these patients. But this potential bias works in the same direction as the patient selection bias, which is potentially present also in this alternative model. The fact that we still obtain a significantly positive effect of competition on sick-listing rates (for fee-for-service GPs) suggests that the 'familiarity bias', if it exists, is smaller than the patient selection bias, and that the true effects of competition are considerably larger in magnitude then the estimates presented in the last column of Table 5.

Finally, we have also estimated (23) separately for each of the ten diagnoses given in Table 1. The results, reported in Table A.3 in the Appendix, show that the effect of competition on sick-listing rates is significantly positive for most of the diagnoses, particularly for GPs on fee-for-service contracts, although the results across diagnoses are not perfectly consistent. But this is fairly expected, given the considerably reduced number of observations on which each estimation is based.

9 Concluding remarks

In this paper we study the impact of competition among physicians on their service provision, and how this relationship depends on financial incentives. Despite the fact that almost every country has a market-based allocation of physician services, compelling empirical evidence on the effects of competition is sparse. A key challenge is to obtain exogenous variation in the degree of competition in physician markets. In this paper we address this challenge by exploiting the fact that many GPs, in addition to their regular practice, work in primary care emergency centres. This allows us to observe the same GP in two different competitive environments: (i) with competition (regular practice) and (ii) without competition (emergency centre). Thus, our empirical strategy is to exploit within-GP variation in the degree of competition, using the GP's service provision at the emergency centre as a benchmark to identify the effect of competition.

From rich administrative data with detailed patient level information in Norway over nine years (2006 to 2016), we select a sample of the ten most frequent acute diagnoses treated by GPs. As outcome variable we use the GPs' propensity to certify (paid) sick leave to patients, which is a highly frequent and standardised 'treatment' for acute diagnoses. Our main empirical finding is that GPs are more likely to issue sickness certificates to patients that visit them at their regular practice than at the emergency centre. The strength of this effect depends on the GPs' financial incentives. GPs that have a volume-based (i.e., combination of fee-for-service and capitation) contract are 11 percentage points more likely to offer a sick leave to their patients in their regular practice than at the emergency centre. For GPs with fixed-salary contracts, the same figure is 8 percentage points. We therefore conclude that exposing GPs to competition has a strong, positive impact on their propensity to sick list patients, which is reinforced by high-powered volume-based financial incentives. These results accord with the predictions from a dynamic model of semi-altruistic physicians whose evolution of demand over time depends on their chosen practice styles (i.e., their leniency towards issuing sickness certificates).

Although our empirical strategy allows us to identify exogenous variation in the degree of physician competition, a remaining challenge is to control for other factors (than competition) that may affect the GPs' service provision in the two competitive environments. The detail and richness of our data allow us to estimate a high-dimensional fixed effect model controlling for all (observed and unobserved) time-invariant patient, GP and diagnosis heterogeneity, in addition to a wide set of observable patient and GP characteristics. In order to deal with potential estimation biases stemming from any remaining (time-variant) heterogeneity, we first establish the likely direction of the most obvious bias, namely that patient severity is likely to be higher at emergency centre than at GP practices, all else equal. This suggests that we *underestimate* the true effects of competition and therefore serves as a validation of the qualitative nature of our results. As a further validation, we carefully re-estimate our empirical model varying the sample selection criteria (and also the model specification) in order to account for any conceivable remaining biases caused by unobserved heterogeneity. Reassuringly, our main results hold up well when being exposed to such a falsification exercise.

The welfare effects and thus policy implications of our findings are not clear-cut. On the one hand, exposing GPs to (more) competition leads to more sick listing, which results in higher expenditures for the employer and the social insurance scheme. In addition, sickness absence has a direct negative impact on labour market productivity, all else equal. On the other hand, sick leave improves patients utility by allowing them to not show up at work when ill and in most cases improving their recovery from illness. This may also have an indirect positive effect on labour market productivity given that their health condition is improved. While competition induces the GPs to become more lenient, we cannot say whether they are too lenient from a social welfare perspective. One could possibly argue that the treatment at emergency centres, where a GP's sick listing is not distorted by competition, defines a 'gold standard' given that GPs in this case act as perfect gatekeepers, balancing patient utility and societal expenditures. However, absence of competition may also involve adverse treatment effects, for instance due to low diagnosing efforts by GPs.

The above discussion illustrates a more general insight, namely that non-price competition can be excessive and lead to overutilisation of resources, from a social welfare perspective, when the costs of these resources are not fully internalised in the market. In the case of sick listing, the costs are not (fully) borne by either the physician or the patient. In general, the potential for competition-driven overutilisation of resources exists for any non-price dimension along which physicians compete. Our empirical results indicate that the effect of competition on physician behaviour is of sizeable magnitude. Furthermore, we show that that these effects are significantly interlinked with the financial incentives inherent in different physician payment schemes. These results suggest that policies towards competition and patient choice in primary care markets should be seen in conjuction with the design of the physician payment schemes, and that the appropriate policy response to adverse competition effects might be to redesign payment schemes rather than to restrict patient choice.

A complete welfare analysis of the effect of physician competition requires a careful estimation on the effects on expenditures and patient utility (including health outcomes and labour market productivity). Unfortunately, our data do not allow for this, so we leave this issue for future research.

Appendix

List of variables

The variables used in the estimation of (23) are listed and defined in Table A.1.

[Table A.1 here]

Share of consultations where patients are hospitalised

Table A.2 shows, for each diagnosis and for each consultation type, the share of consultations involving patients who are registered with a hospital stay in the same week as the primary care consultation.

[Table A.2 here]

Regression results per diagnosis

Table A.3 presents the results from separate estimations of (23) for each of the ten diagnoses listed in Table 1. For space-saving purposes, only the independent variables of interest are included in the table.

[Table A.3 here]

References

[1] Brekke, K.R., Nuscheler, R., Straume, O.R., 2007. Gatekeeping in health care. Journal of Health Economics, 26, 149-170.

[2] Brekke, K.R., Cellini, R., Siciliani, L., Straume, O.R., 2012. Competition and quality in regulated markets with sluggish demand. Journal of Economics & Management Strategy, 21, 131-178.

[3] Brekke, K.R., Holmås, T.H., Monstad, K., Straume, O.R., 2016. Do treatment decisions depend on physicians' financial incentives? Mimeo.

[4] Clemens, J., Gottlieb, J.D., 2014. Do physicians' financial incentives affect medical treatment and patient health? American Economic Review, 104, 1320–1349.

[5] Correia, S., 2014. REGHDFE: Stata module to perform linear or instrumental-variable regression absorbing any number of high-dimensional fixed effects. Statistical Software Components S457874, Boston College Department of Economics.

[6] Correia, S., 2015. Singletons, cluster-robust standard errors and fixed effects: A bad mix. Duke University, mimeo.

[7] Devlin, R.A., Sarma, S., 2008. Do physician remuneration schemes matter? The case of Canadian family physicians. Journal of Health Economics, 27, 1168–1181.

[8] Dusheiko, M., Gravelle, H., Jacobs, R., Smith, P., 2006. The effect of financial incentives on gatekeeping doctors: evidence from a natural experiment. Journal of Health Economics, 25(3), 449-78.

[9] Dunn, A., Shapiro, A.H., 2014. Do physicians possess market power? Journal of Law and Economics, 57, 159-193.

[10] Gaynor, M., Town, R., 2011. Competition in Health Care Markets. Chapter 9 in Pauly, M., McGuire, T., Barros, P.P., (eds.), Handbook of Health Economics, Vol. 2, pp. 439–637. Elsevier, Amsterdam.

[11] Godager, G., Iversen, T., Ma, C.A., 2015a. Competition, gatekeeping, and health care access. Journal of Health Economics, 39, 159–170.

[12] Godager, G., Iversen, T., Morken, T., Hunskår, S., 2015b. Fixed salary for doctors in emergency primary healt care in Norway. Report No. 4-2015. Bergen: National Centre for Emergency Primary Health Care, Uni Research Health.

[13] Gonzalez, P., 2010. Gatekeeping versus direct-access when patient information matters. Health Economics, 19(6), 730-54.

[14] Gravelle, H., Scott, A., Sivey, P., Yong, J., 2016. Competition, prices and quality in the market for physician consultations. Journal of Industrial Economics, 64, 135-169.

[15] Gruber, J., Owings, M., 1996. Physician financial incentives and cesarean section delivery. RAND Journal of Economics, 27, 99–123.

[16] Iversen, T., 2004. The effects of patient shortage on general practitioners' future income and list of patients. Journal of Health Economics, 23, 673-694.

[17] Iversen, T., Lurås, H., 2000. Economic motives and professional norms: the case of general medical practice. Journal of Economic Behavior & Organization, 43, 447-470.

[18] Iversen, T., Ma, C.A., 2011. Market conditions and general practitioners' referrals. International Journal of Health Care Finance and Economics, 11, 245–265.

[19] Jacobson, M., Chang, T.Y., Newhouse, J.P., Earle, C.C., 2013. Physician agency and competition: evidence from a major change to Medicare chemotherapy reimbursement policy. NBER Working Paper 19247, National Bureau of Economic Research.

[20] Kessler, D., McClellan, M., 2000. Is hospital competition socially wasteful? Quarterly Journal of Economics, 115, 577–615.

[21] Markussen, S., Røed, K., 2016. The market for paid sick leave. IZA Discussion Paper No. 9825.

[22] McGuire, T.G., 2000. Physician agency. Chapter 9 in Culyer, A.J., Newhouse, J.P. (ed.), Handbook of Health Economics, Vol. 1, pp. 461-536, Elsevier, Amsterdam.

[23] Sandvik, H., Hunskår, S., Diaz, E., 2012. Use of emergency medical services by patients encompassed by the Regular GP scheme. Tidsskrift for den Norske laegeforening: tidsskrift for praktisk medicin, ny raekke, 132 (20), 2272–2276.

[24] Santos, R., Gravelle, H., Propper, C., 2016. Does quality affect patients' choice of doctor? Evidence from England. Economic Journal, forthcoming.

[25] Schneider, J., Li, P., Klepser, D., Peterson, A., Brown. T., Scheffler, R., 2008. The effect of physician and health plan market concentration on prices in commercial health insurance markets. International Journal of Health Care Financing and Economics, 8(1), 13–26.

Tables

Table 1. The ten most frequent diagnoses at municipal emergency centres 2007-2014 (employed patients only).

ICPC-2	Diagosis	Number of visits
A11	Chest pain NOS[1]	61,255
D01	Abdominal pain/cramps general	134,012
L81	Injury musculoskeletal NOS	71,390
R05	Cough	56,930
R74	Upper respiratory infection acute	174,812
R75	Sinusitis acute/chronic	87,081
R76	Tonsillitis acute	56,763
R78	Acute bronchitis/bronchiolitis	57,819
S18	Laceration/cut	153,081
U71	Cystitis/urinary infection other	182,994

[1] NOS: not otherwise specified

Table 2. Visits excluded from the sample (as percentage of all visits to primary care physicians).

	All visits[1]	Patient not working	Physician not regular GP	Patient sent to hospital[2]	Patient visiting other GP[3]	Visits at night (11:00-08:00)	Final sample
Chest pain	283,344	32.01	31.91	21.21	21.74	8.50	96,157
Abdominal pain/cramps	821,894	31.53	25.99	13.77	23.44	5.53	320,653
Injury musculoskeletal	342,044	22.99	22.39	19.38	22.95	3.23	143,958
Cough	665,311	26.90	23.83	0.009	34.47	0.96	284,985
Upper respiratory infection	1,235,964	18.12	25.43	0.008	35.02	1.02	565,675
Sinusitis acute/chronic	673,543	19.10	21.68	0.007	30.99	0.79	330,268
Tonsillitis acute	187,603	18.12	28.15	0.035	30.08	1.19	80,850
Acute bronchitis/bronchiolitis	551,711	26.35	18.76	0.010	28.19	1.12	259,047
Laceration/cut	314,272	27.31	39.83	0.061	22.54	11.40	93,293
Cystitis/urinary infection, other	811,633	30.26	29.09	0.019	31.32	2.85	290,761
All diagnoses	5,887,319	24.98	25.77	0.051	29.57	2.95	2,465,647

[1] Patients enlisted to a GP (99.6 % of the Norwegian population). [2] Emergency admission to hospital the same week as the visit to primary care physician. [3] Visit to a GP other than the one the patient is enlisted to.

Table 3. Descriptive statistics per consultation type (all diagnoses)

	Regular GP (fee-for-service)	Regular GP (fixed salary)	Emergency centre
Consultation characteristics			
Sickness certificate	0.353	0.264	0.139
Visits last year	2.487 (2.390)	2.406 (2.404)	2.147 (2.353)
Prolonged consultation	0.199	0.230	0.190
Patient characteristics			
Male	0.377	0.362	0.389
Age	41.564 (12.533)	41.239 (13.062)	38.260 (12.464)
Low education	0.215	0.220	0.217
Medium education	0.440	0.463	0.451
High education	0.345	0.317	0.332
Labour income	39.688 (24.378)	35.673 (20.462)	38.186 (24.875)
Married	0.462	0.448	0.416
Unmarried	0.390	0.423	0.461
Divorced	0.148	0.130	0.123
Children 0-5	0.206	0.193	0.246
Children 6-17	0.219	0.218	0.216
GP characteristics			
Male	0.695	0.613	0.768
Age	50.095 (9.770)	44.826 (11.232)	43.404 (9.051)
Specialist	0.679	0.445	0.489
2008	0.135	0.137	0.152
2009	0.130	0.127	0.139
2010	0.137	0.136	0.141
2011	0.152	0.152	0.143
2012	0.155	0.159	0.149
2013	0.143	0.159	0.138
2014	0.148	0.131	0.138
Observations	2,120,323	101,289	244,035
Patients	950,706	62,057	207,042
GPs	4,972	1,055	3,740

Table 4. Effect of competition on GP sick listing

	OLS	Fixed effect GP	Fixed effect Patient	Fixed effect GP and patient
	(1)	(2)	(3)	(4)
Regular GP (fee-for-service)	0.1319***	0.1384***	0.1118***	0.1114***
	(0.0057)	(0.0040)	(0.0044)	(0.0041)
Regular GP (fixed salary)	0.0624***	0.1085***	0.0798***	0.0826***
	(0.0072)	(0.0054)	(0.0056)	(0.0061)
Prolonged consultation	-0.0009	-0.0067***	0.0035	0.0025
	(0.0020)	(0.0014)	(0.0016)	(0.0017)
Visits last year	0.0104***	0.0092***	-0.0017***	-0.0017***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Male	-0.0142***	-0.0141***		
	(0.0012)	(0.0010)		
Age	-0.0020***	-0.0016***		
	(0.0001)	(0.0000)		
Medium education	-0.0478***	-0.0375***		
	(0.0012)	(0.0010)		
High education	-0.0749***	-0.0708***		
	(0.0014)	(0.0012)		
Labour income	0.0001**	-0.0001*	0.0022***	0.0022***
	(0.0000)	(0.0000)	(0.0004)	(0.0004)
Unmarried	0.0158***	0.0155***	0.0066	0.0058
	(0.0012)	(0.0010)	(0.0038)	(0.0038)
Divorced	0.0372***	0.0321***	0.0151***	0.0148***
	(0.0012)	(0.0011)	(0.0040)	(0.0040)
Children 0-5	-0.0258***	-0.0253***	-0.0282***	-0.0271***
	(0.0013)	(0.0011)	(0.0025)	(0.0025)
Children 6-17	-0.0061***	-0.0030**	-0.0109***	-0.0100***
	(0.0011)	(0.0010)	(0.0023)	(0.0023)
GP age	0.0001		0.0003***	
	(0.0002)		(0.0001)	
GP male	-0.0195***		-0.0168***	
	(0.0032)		(0.0022)	
GP specialist	0.0068	-0.0028	0.0018	-0.0008
	(0.0038)	(0.0025)	(0.0023)	(0.0032)
Observations	2,465,647	2,465,627	1,924,448	1,924,427
Singleton observations	0	20	541,119	541,220
Patients	1,092,740	1,092,727	551,541	551,535
GPs	5,682	5,662	5,655	5,640
Time fixed effects[1]	Yes	Yes	Yes	Yes
Diagnoses fixed effects	Yes	Yes	Yes	Yes
Prob > F[2]	0.000	0.000	0.000	0.000
R^2 adjusted	0.119	0.154	0.317	0.322
R^2 within	-	0.107	0.067	0.060

[1] Dummy variables for year, month, week and hour. [2] F-test: Reg. GP (fee-for-service) = Reg. GP (fixed salary)

***, **, *: significant at 0.1, 1 and 5 percent level.

Table 5. Effect of competition on GP sick listing: Sensitivity analyses.

	Excluding consultations outside GPs' opening hours (1)	Excluding patients living in Oslo (2)	Excluding patients already on sick leave (3)	Excluding emergency care visits with a subsequent GP visit (4)	Fixed effect GP-patient match (5)
Regular GP (fee-for-service)	0.0976***	0.1146***	0.0872***	0.1072***	0.0383***
	(0.0060)	(0.0044)	(0.0042)	(0.0042)	(0.0086)
Regular GP (fixed salary)	0.0787***	0.0865***	0.0600***	0.0788***	0.0185
	(0.0085)	(0.0063)	(0.0060)	(0.0061)	(0.0105)
Observations	1,721,627	1,638,769	1,684,065	1,911,406	1,610,288
Dropped singleton observations	508,212	478,233	543,963	542,351	855,359
Patients	499,820	472,609	511,441	555,142	466,523
GPs	5,587	5,115	5,633	5640	5,510
Time fixed effects[1]	yes	yes	yes	yes	yes
GP fixed effects	yes	yes	yes	yes	no
Patient fixed effects	yes	yes	yes	yes	no
GP-patient fixed effect	no	no	no	no	yes
Diagnoses fixed effect	yes	yes	yes	yes	yes
Prob > F^2	0.005	0.000	0.000	0.000	0.007
R^2 adjusted	0.323	0.315	0.321	0.322	0.333
R^2 within	0.056	0.058	0.068	0.060	0.053

[1] Dummy variables for year, month, week and hour. [2] F-test: Reg. GP (fee-for-service) = Reg. GP (fixed salary).
***, **, *: significant at 0.1, 1 and 5 percent level.

Table A.1. Variable definitions

Consultation characteristics	
Regular GP (fee-for-service)	1 if visit to regular GP on fee-for-service contract
Regular GP (fixed salary)	1 if visit to regular GP on fixed-salary contract
Emergency centre	1 if visit at a municipal emergency center
Sickness certificate	1 if the physician issues a sickness certificate during consultation
Prolonged consultation	1 if the consultation is prolonged (beyond 20 minutes)
GP characteristics	
Male	1 if the GP is male
Age	Age of GP
Specialist	1 if the GP is specialist in general practice
Patient characteristics	
Male	1 if the patient is male
Age	Patient's age
Low education	1 if compulsory schooling
Medium education	1 if upper secondary education
High education	1 if higher education
Labour income	Patient's labour income (in 10,000 NOK)
Married	1 if the patient is married
Unmarried	1 if the patient is unmarried
Divorced	1 if the patient is divorced/widow/widower
Children 0-5	1 if the patient has children 0-5 years old
Children 6-17	1 if the patient has children 6-17 years old
Visits last year	Number of visits to GP or emergency centre last year

Table A.2. Percentage of patients sent to hospital, by type of consultation.

	Emergency centre		Regular GP (fee-for-service)		Regular GP (fixed salary)	
	All visits	% sent to hospital	All visits	% sent to hospital	All visits	% sent to hospital
Chest pain	82,759	42.7	131,256	9.3	10,370	15.0
Abdominal pain/cramps	157,568	40.3	446,074	6.1	32,360	8.6
Injury musculoskeletal	70,410	45.8	181,800	9.9	15,279	14.9
Cough	60,613	2.2	356,202	0.4	27,159	0.9
Upper respiratory infection	164,516	1.8	615,969	0.6	39,650	0.7
Sinusitis acute/chronic	86,683	1.2	361,911	0.5	23,741	0.6
Tonsillitis acute	47,957	6.2	79,490	2.3	5,716	3.1
Acute bronchitis/bronchiolitis	64,819	2.4	319,535	0.8	16,924	1.0
Laceration/cut	156,914	7.1	80,427	4.8	10,328	5.5
Cystitis/urinary infection, other	193,909	3.3	342,537	1.4	31,303	1.4
All diagnoses	1,086,148	14.6	2,915,201	2.7	212,830	4.1

Table A.3. Effect of competition on GP sick listing, by diagnoses.

Diagnoses:	**A11**	**D01**	**L81**	**R05**	**R74**
Regular GP (fee-for-service)	0.0751	0.0938***	0.0641	0.0671**	0.1416***
	(0.0587)	(0.0168)	(0.0398)	(0.0201)	(0.0140)
Regular GP (fixed salary)	0.0757	0.0670**	0.0639	0.0706*	0.1189***
	(0.0899)	(0.0265)	(0.0556)	(0.0315)	(0.0216)
Observations	42,914	200,211	86,810	134,091	303,594
Dropped singleton observations	53,243	120,441	57,148	150,894	262,081
Patients	15,536	66,112	24,875	51,335	110,641
GPs	3,672	5,113	4,151	4,767	5,014
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Prob>F	0.994	0.241	0.996	0.619	0.193
R^2 adjusted	0.403	0.378	0.352	0.317	0.326
R^2 within	0.007	0.008	0.012	0.015	0.025
Diagnoses:	**R75**	**R76**	**R78**	**S18**	**U71**
Regular GP (fee-for-service)	0.0973***	0.0752	0.0746***	0.0957***	0.0437***
	(0.0128)	(0.0448)	(0.0231)	(0.0287)	(0.0061)
Regular GP (fixed salary)	0.0542*	-0.0142	0.1191***	0.1231	0.0352***
	(0.0221)	(0.1082)	(0.0375)	(0.0644)	(0.0106)
Observations	188,849	28,994	138,361	31,157	172,826
Dropped singleton observations	141,419	51,856	120,686	62,136	117,935
Patients	64,291	11,876	50,028	11,341	59,085
GPs	5,004	2,731	4,341	3,350	5,136
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Prob> F	0.029	0.398	0.166	0.661	0.383
R^2 adjusted	0.308	0.202	0.303	0.253	0.210
R^2 within	0.023	0.024	0.025	0.016	0.013

***, **, *: significant at 0.1, 1 and 5 percent level.

Figures

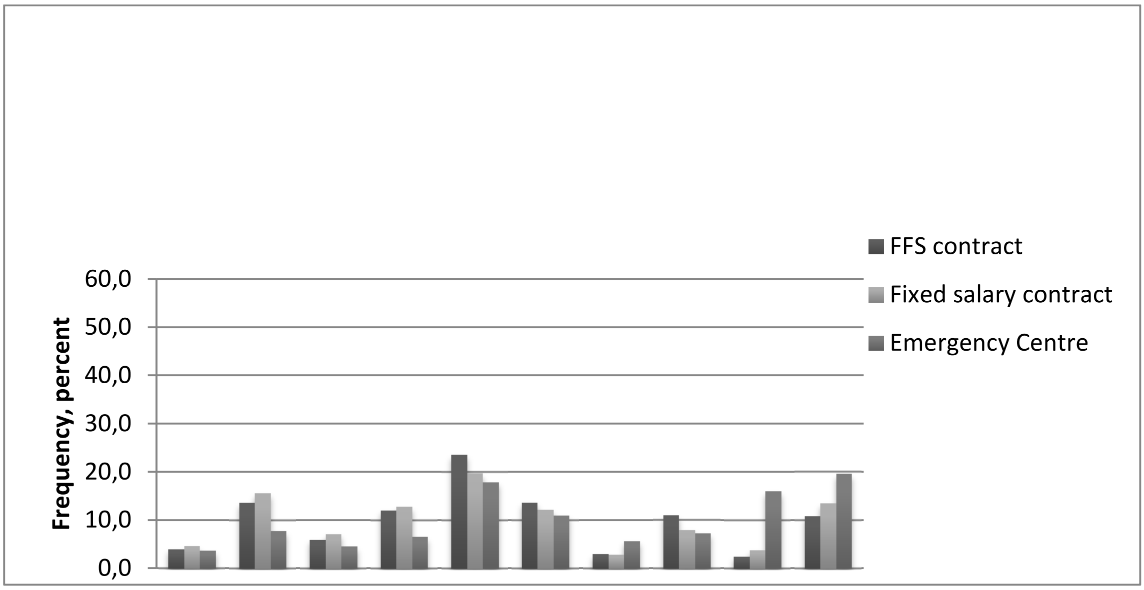

Figure 1a. Frequency of each diagnosis in each consultation category.

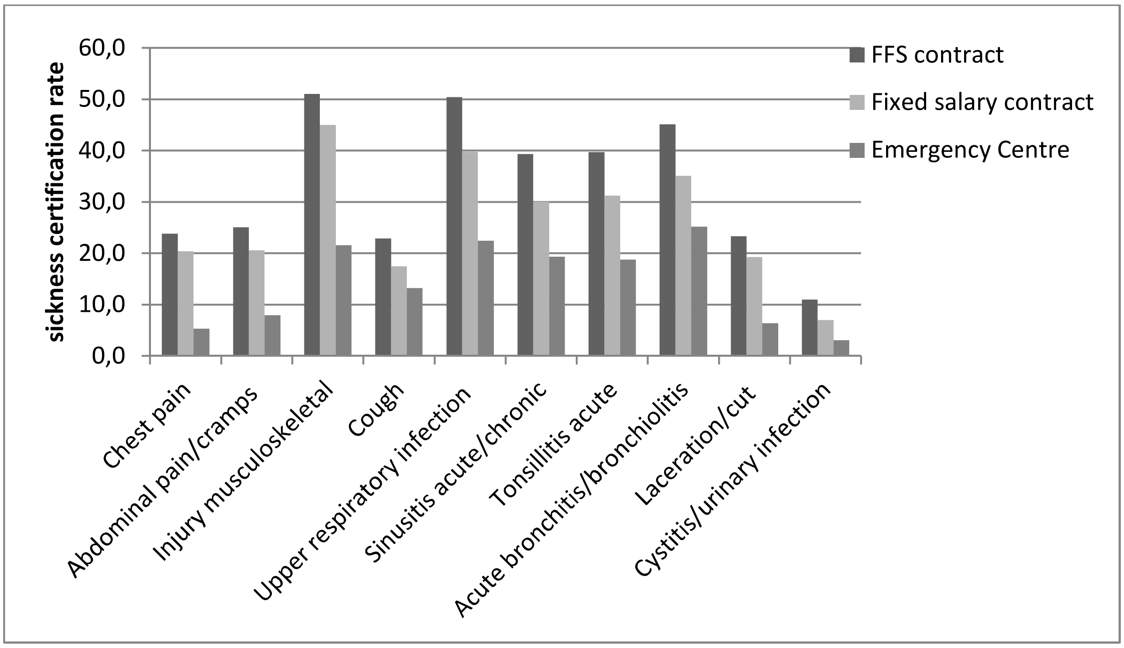

Figure 1b. Sickness certification rates for each diagnosis in each consultation category.

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