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A MULTILEVEL ANALYSIS ON DIABETES CARE PRACTICES IN PRIMARY CARE: THE IMPACT OF ECONOMIC INCENTIVES

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Abstract

In recognition of their generic potential to influence physician behaviour, financial incentives schemes have been increasingly introduced in primary care to try and improve allocative efficiency and quality of care. Such financial incentives usually take the form of bonuses paid over and above the physician's base income. Although many studies have confirmed that physicians respond to financial incentives, there is scarce empirical evidence on the degree of responsiveness and on how such incentive schemes influence quality of treatment. This problem reflects the lack of empirical data in relation to financial incentives but also the complexity of general practice systems in which many confounding factors are likely to influence physician behaviour. Given this background, we investigate the impact on care quality of having introduced economic incentives in Regional and Local Health Authority contracts for primary care in the Italian region Emilia Romagna. We concentrate on the treatment of patients affected by diabetes mellitus type 2, for which the assumption of responsibility and the delivery of specific treatments are linked to financial incentives. For this disease, we test the hypothesis that, other things equal, local health authorities that introduced financial incentives aimed to increase primary care assumption of type 2 diabetic patients were more likely to register a decrease in hospital admissions for hyperglycemic emergencies and in late hospitalizations. To this end, we examined the combined influence of physician, organisational and patient factors through the use of multilevel modelling. Data were obtained form a large dataset made available by the Regional Agency for Health Care of Emilia Romagna. This dataset covers patients and GPs of the whole region and allows, through the linking of several epidemiological and administrative data, to obtain for the first time detailed information on health consumption of the population, on the different components of GP remunerations, on morbidity levels of large groups of patients. Estimations are obtained for the year 2003.

Keywords

Primary care, practice profiling, financial incentives, diabetes mellitus, multilevel modelling.

JEL classification: I11, I18, C31

1. INTRODUCTION

In time of tight budget constraints major emphasis is attributed to the appropriateness of care process and primary care physicians are more and more involved in demand control strategies. In this context, it is necessary to improve our understanding of the determinants of General Practitioners (GPs) prescribing behaviour, in order to identify the factors that guide allocative decisions and to measure empirically the impact of the policy measures adopted at this scope.

Empirical data display large variations in the level of expenditure and treatment choices associated with single practices [Wennberg et al., 1982, 1987]. There are at least three reasons that have been proposed in order to explain this phenomenon. The first hypothesis is that different populations are characterised by different medical needs. If this hypothesis accounted for the largest share of observed variability, the major implication for health policymaking would be to design financing methods that minimise patient and treatment selection. A second explanation lies in physicians' prescribing habits, varying according to characteristics such as their specialisation, local clinical practice style, access to scientific information, etc [Folland and Stano, 1989; Grytten and Sorensen, 2003]. Finally, patterns of prescribing behaviour could be affected by the economic incentives under which physicians operate [Gaynor and Pauly, 1990; Gaynor and Gertler, 1995; Conrad et al., 2002; Sorensen and Grytten, 2003; Gaynor, Rebitzer and Taylor, 2004] and by the organisational and institutional system (associations, medical networks, primary care groups, presence of a specialist centre in the area) [Wester and Groenewegen, 1999]. One of the main limitations of this economic literature on primary care is the lack of an appropriate database for identifying and measuring the possible causes of prescribing variation and the effects of economic incentives, which would require information on an individual basis.

Given this background, we develop an empirical analysis of GPs behaviour, drawing from a large dataset made available by the Regional Agency for Health Care of Emilia Romagna. This dataset allows, through the linking of several epidemiological and administrative data, to obtain for the first time in Italy detailed information on health consumption of the population, on the different components of GP remunerations, on morbidity levels of large groups of patients. The database collects information starting from year 2002, and covers patients and GPs of the whole region.

In particular, the link between the two datasets (health consumption and GPs payment) allows to assess the effect of financial incentives on doctor's behaviour, once patient and GP characteristics are controlled for. From a methodological point of view, it is important to stress that the link between the different data bases will allow to apply risk adjustment procedures that are more accurate than those typically used in economic literature, generally based on age and sex.

In this context, our aim is to assess whether the introduction of financial incentives – varying across health authorities – had an impact on GPs behaviour. In particular, we consider the role of *ad hoc* payments that increase capitation transfers for specific groups of patients. In order to investigate the impact of introducing such economic incentives in regional and Local Health Authority contracts [Gaynor, Rebitzer, Taylor, 2004], we concentrate on the treatment of patients affected by diabetes mellitus type 2, for which the assumption of responsibility and the delivery of specific treatments are linked to financial incentives. In Emilia Romagna, a Diabetes project was set up to improve the clinical appropriateness of GPs behaviour. Local contracts assigns to GPs the home care responsibility of insulin dependent patients and type II non insulin dependent compensated diabetic patients, including specific economic incentives – differentiated across health authorities – for the assumption of responsibility of these patients.

Diabetes mellitus is associated with a number of short-term consequences that can lead to hospital admission. In particular, the rate of hospital admissions for hyperglycemic emergencies can be used as an indicator of good clinical practice, since its decrease is interpreted as an important signal of improvement in the appropriateness of treatment [Booth and Fang, 2003]. Actually, for diseases such as diabetes mellitus with diabetic coma, the hospitalization is avoidable with adequately accurate outpatient care. On the contrary, there could be potentially preventable late stage hospitalizations, i.e., patients with complications that may have been avoidable with earlier hospitalization or with more timely or aggressive outpatient care.

The main aim of this paper is to test the hypothesis that, other things equal, local health authorities that introduced financial incentives in order to increase the extent of assumption of type 2 diabetic patients by GPs were more likely to impact on two different measures of outcome: a decrease in hospital admissions for hyperglycemic emergencies and in late hospitalizations. To this end, we examined the joint influence of physician, organisational and patient factors estimating initially a three-level model with a random intercept and exploring subsequently a few patterns of model variation [Goldstein, 2003]. Multilevel models have seen a significant development in the past decade, also in health economics, as they provide an appropriate technique for the analysis of cross-sectional data with a hierarchical structure [Scott and Shiell, 1997; Rice and Jones, 1997].

The paper is organised as follows: section 2 reviews the literature on the impact of financial incentives on primary care. Section 3 describes the clinical and institutional characteristics of diabetes care and section 4 introduces the empirical methods employed. Section 5 presents the results while section 6 concludes.

2. PRIMARY CARE AND FINANCIAL INCENTIVES

The design of incentives for improving quality of care is a central policy issue for the health care sector [Culyer, Newhouse, 2000] and it has been shown that different payment schemes may significantly affect decision making within medical practices [Scott, 2002]. Capitation payment creates an incentive to provide fewer services than fee-for-service, because provision of additional care is not rewarded at the margin. In a fee-for-service system, services that are compensated relatively generously tend to be provided at higher rates than similar or substitutable services that are compensated less generously. For these reasons, the payment system for general practice should be "well balanced, preferably combining a salary or other form of fixed payment, a capitation fee, and fee-for-service" [WHO, 1998]. Within such a balanced system, there is room for targeted incentives to operate at the margin encouraging professional effort where quality (or quantity) gaps have been identified. In order to avoid under-provision of specific services, health systems have used a variety of strategies to influence practice styles of primary care physicians. Even if there is little information about how incentives can be specifically manipulated to influence behaviour and health outcomes [Scott and Hall, 1995], in recognition of their generic potential to influence doctor behaviour, financial incentives schemes have been increasingly adopted to improve allocative efficiency. Furthermore, as educational strategies such as guidelines and protocols alone have not proven completely successful [Grilli et al, 2000], economic incentives seem a more direct and potentially more effective approach to improve practice behaviour with respect to the quality of care.

In the United States, HMOs have been applying financial incentives to reduce costs by providing incentives to primary care doctors who limit their use of hospital services and rate of referrals to specialists [Grumbach et al, 1998]. Alternatively, Australia and UK have developed incentive schemes to address allocative inefficiency by encouraging the delivery of selected treatments and the GPs adherence to clinical guidelines. Such financial incentives usually take the form of bonuses paid over and above the physician's base income from fee-for-service payments, capitation, or salary. The proliferation of quality improvement initiatives has frequently resulted in paying bonuses for treating patients with conditions such as asthma and diabetes or for increasing immunisation, cervical cancer screening and cardiovascular disease prevention [Boyden and Carter, 2000].

While it has been recognised that remuneration can influence GP behaviour, there are also "counter-balancing arguments" [Gosden et al., 2001]. In particular, a strong system of ethics may dilute the economic incentive influence. Empirical evidence relating to the effect of financial incentives found that their impact also depends on clinical, demographic and organisational factors [Chaix-Couturier et al. 2000]. In particular, patient's medical condition and health status are considered the most important factors influencing physician decision making, while the effect of remuneration seems to be small [Kristiansen and Hjortdahl, 1992; Kristiansen and Mooney, 1993].

Besides, although financial incentives have been extensively used in primary care, there has been little research on how such incentive schemes influence quality of treatment [Adams et al. 1998; Boyden and Carter, 2000] and patient welfare. For example, these have been reported to have been ineffective in improving the level of immunisation uptake [Lynch, 1995; Kouides et al. 1998], the delivery of preventive care [Town et al. 2005] or effective cervical care screening [Boyden and Carter, 2000]. In UK, changes in per-item fees for maternity care and cervical cytology over the period 1966–1989 appear to have had little effect on the numbers of treatments; rather service provision was related to patient demand and the availability of GPs

[Hughes and Yule, 1992]. However, target payments for cervical cytology introduced in 1990 appear to have had a major impact, although it remains unclear whether the economic incentive effect was responsible, as opposed to changing professional attitudes and increased patient demand [Whynes and Baines, 1998]. Always in UK, the existence of fees for obstetric care did not prevent a sizeable reduction in the proportion of GPs willing to provide a full obstetric service between the 1960s and the 1980s [Whynes and Baines, 1998]. Furthermore, there is evidence suggesting that the quality of activities fostered by incentives may not be high [Iliffe and Munro, 1993].

Despite these limited results, at least three research questions have to be seriously investigated. First, incentive schemes based on indicators which are not necessarily indicative of health outcomes, for example a simple prepayment, could be easily criticised. With such a scheme, the physician receive a monthly or annually payment per each patient's assumption of responsibility. Without adjustment for case mix, there is a financial incentive to select the healthiest patients who need the least care and to avoid patients who are very sick (*cream skimming*). Furthermore, these payments may result in perverse incentives to increase list size with no guarantee that care will improve. Second, how large an incentive does it take to change physicians behaviour? The lack of significant relationship between financial incentives and the provision of a certain treatment could often depend on too small rewards, not able to motivate physician to change their care routines. Third, although many studies have confirmed that physicians respond to financial incentives, there is scarce empirical evidence on the degree of responsiveness [Boyden and Carter, 2000]. Thus, studies have not been able to isolate the specific effect of incentives, or how the can be specifically designed to reach a pre-determined effect. This problem reflects the lack of empirical data in relation to financial incentives but also the complexity of general practice systems in which many confounding factors - such as inter- and intra-country differences in remuneration systems, practice organisation and physician's non financial professional and personal incentives, patient health status, socio-economic, cultural and demographic characteristics - are likely to influence physician behaviour.

3. DIABETES CARE

Diabetes mellitus is a major cause of morbidity and mortality in OECD countries. In Italy, approximately 2 million people are diabetic, and the prevalence has been estimated at around 3%, with 90% of cases affected by diabetes type 2 (non-insulin dependent) and 10% by type 1 (insulin dependent). Approximately 12% of the population over 65 years of age is affected by diabetes type 2.

In recent years, efforts to measure and improve the quality of care have expanded to include care for chronic medical conditions, such as diabetes mellitus, that are primarily treated in outpatient settings. Once diabetes has been diagnosed, the patient's risk of developing microvascular and macrovascular complications over time can be significantly reduced by early identification and treatment of risk factors. In particular, long term complications can be reduced by early and effective treatment of hyperglycemia, hypertension and diabetic eye disease. For these reasons, care is increasingly provided by primary care providers, whose regular clinical review assures good quality of treatment.

Replacing specialty care with primary care, however, requires to analyse deeply two points. First, in a context where GPs are paid according to a capitation, there is limited financial incentive to identify new cases of diabetes and to treat personally diabetic patients. Screening and identifying diabetic patients is time-consuming, and the primary care physician receives the same fixed payment per person regardless of whether the patient is affected by a condition that requires special attention or not. This provides an incentive for GPs to refer patients who are identified as diabetics to the specialty clinic. Similarly, because of capitation, the physician's follow-up visits with these patients requires effort for the physician that is not compensated through capitation. As a result, the primary care physician is less likely to view diabetes care as his responsibility and may exert little effort in following patients. To address such problems, primary and specialty care should be closely co-ordinated. Health plans or provider organisations often introduce extra financial compensation to ensure primary care physicians adequate incentives for treating the disease. For example, physicians may be entitled to a monetary bonus if they meet certain targets for diabetes treatment, such as standards for cost-effective prescribing, or they receive an increased capitation quota for each diabetic patient taken under their responsibility. In this context, financial incentives, either bonuses or penalties, can be also attached to performance indicators to provide additional encouragement for the physician to achieve the desired goals.

Second, diabetes mellitus is associated with a number of short-term consequences that can lead to hospital admission. Clinical studies show that many hospital admissions for acute complications of diabetes can be prevented if appropriate outpatient care is provided [Weissman et al, 1992; Morris et al., 1997; Booth and Fang, 2003]. In particular, diabetic ketoacidosis and hyperosmolar nonketotic coma are acute and potentially life-threatening emergencies that require immediate hospitalization and are both characterised by severe elevations in blood glucose levels (hyperglycemia). Even if hyperglycemic emergencies can be the first sign of diabetes, in diabetic patients these episodes may be sign of poor adherence with diabetes medications. As people who have poorly controlled diabetes mellitus are at greater risk for developing these complications, hospitalisation for acute hyperglycemic episodes can be in many cases avoided through early recognition and by avoiding errors in patient management.

Although the Italian National Health System provides coverage for most physician and hospital services [France, Taroni and Donatini, 2005], other barriers to accessing care, such as patients socio-economic status and region of residence, together with physicians adherence to clinical guidelines and existing economic and organisational arrangements may have an impact on the development of acute complications of diabetes mellitus.

In the Italian region Emilia Romagna - located in the north-east of the country and with a population of about 4 millions inhabitants - primary care for diabetes is provided by General Practitioners (GPs) and in diabetes outpatient clinics (DOCs). Before the regional guidelines released in 2003, there was no formal shared responsibility between primary and secondary care and patients could freely choose the way for accessing the health care system according to their preferences. Historically, Local Health Authorities (LHAs) have had varying levels of involvement in monitoring diabetic services. Nevertheless, since 1998 some LHAs have been autonomously developing local guidelines aimed to increase the GP's assumption of responsibility for type 2 diabetic patients, introducing bonus payments to encourage such behaviour. In 2003 the Region released the Clinical Guideline for Management of Diabetes Mellitus, which incorporated information from several existing evidence-based international and national guidelines. Internationally, there has been recently a shift in emphasis from hospital to community care for people with type 2 diabetes, as a result of limited hospital resources, increasing number of patients and the recognition that people with type 2 diabetes, on the whole, need not be hospitalised [Fitzsimons et al, 2002]. Consistently with this view, the regional guidelines introduce an integrated care model for diabetes, where co-ordination between different levels of care is implemented to make diabetes services easily accessible. In this scheme, primary care physicians play a pivotal role in ensuring that people with diabetes receive effective care and in making the initial diagnosis. The recommendation suggests that type 1 diabetic patients are treated by secondary care through a diabetes specialty clinic, whereas housebound type 1 and type 2 diabetic patients have to be treated in primary care. Primary care physicians should refer their type 2 diabetic patients to the local diabetes specialty clinic on average once a year, for a formal comprehensive assessment and recommendations, or in any moment when the specialist advice is required regarding the management of metabolic control, cardiovascular risk factors or diabetic complications. In any case, the routine follow up of these patients has to be undertaken within primary care.

4. METHODS

The population of our study consists of all the regional type 2 diabetic patients in year 2003. We identify the cohort members by integrating data from multiple sources.

Patients were classified as having type 1 diabetes if they were between 0 and 35 years of age at the time of diagnosis and are currently taking insulin; patients were classified as having type 2 diabetes if they were aged 35 or more at the time of diagnosis or if they are not currently treated with insulin. These definitions follow the WHO criteria. Specifically, diabetes patients were identified as anyone above 35 years who had at least one prescription for diabetes medications (oral agents or insulin) during the year 2002. As some diabetes patients who are being managed through a diet and exercise alone are missed with this strategy, we also include individuals who had at least one outpatient visit to a diabetic centre during the 2002 or an hospital admission with a diabetic diagnostic code in the previous two years. The resulting dataset includes 168.843 patients, 3.252 GPs and 13 LHAs.

We consider two outcomes. The first one consists of diabetic hyperglycemic emergency admissions associated with ketoacidosis and a hyperosmolar nonketotic coma for type 2 diabetic patients (MODEL A). Hospitalisations is identified from hospital records in which acute hyperglycaemia (ICD-9 codes 250.1 to 250.2) is documented as a primary or most responsible diagnosis. The second outcome measure is the rate of late admissions (MODEL B). This measure has been recently developed through a methodology using ICD coded hospital discharge abstract data by the Regional Health Care Agency of Emilia Romagna and the Jefferson Medical College of Philadelphia to identify potentially inappropriate hospital admissions. This methodology, using a combination of the DRG definitions, the Disease Staging classification and a clinical review, has been applied to 67 DRGs identified by the Italian Ministry of Health and the Emilia Romagna Region as suspected of including cases of inappropriate hospitalisation. In particular, clinicians developed criteria for assessing the timeliness and appropriateness of admission based on the patients medical problems, principal diagnosis and stage of severity, the presence of specific co-morbid diseases and their severity stage, and, for surgical admissions, on the procedure performed. This process aims to develop guidelines for classifying admissions as inappropriate, appropriate, or late, where late admissions refers to patients who developed complications that may have been avoided with earlier hospitalization or with more timely or aggressive outpatient care. Our outcome measure is strictly referred to type 2 diabetic patients.

Table 1 displays the explanatory variables. Patient demographics include age and gender. Other patient characteristics are insulin dependence and number of visits to a diabetic outpatient clinic (DOC) during the year 2003. Both variables are expected to capture severity of illness.

INSERT TABLE 1

Controls at the physician level are GPs gender, age and a dummy for type of practice, distinguishing single-handed practice from the three level of partnership provided by the national labour contract for primary care: medicine in association; medicine in network; medicine in group. We also control for practice location with a dummy variable for straitened areas, list size per GP and financial incentives received for assumption of responsibility for each diabetic patients. Following the literature [Levetan et al., 1999], we initially included also physician specialisation, but the small number of GPs completing an endocrinology fellowship did not permit to take into account the effect produced by a physician speciality which is specific for the disease considered here. Consequently, we opted for including only a more general dummy for the presence of any postgraduate qualifications.

As regards the third level, multilevel analysis permits to investigate effects of the LHA, even if the specific characteristics at local area level are either non-measurable or non-observable. Anyway, we include two explanatory variables at local area level that account for problems that some of them may face in managing relationships between primary and hospital care (e.g. limited number of day-hospital beds or organisational deficiencies leading to substitute primary with hospital care even when the former is clinically more appropriate). For this purpose we first consider the proportion of inappropriate hospital admissions on the total amount of hospitalisations. These admissions have been classified according to the regional classification methodology for hospital appropriateness described above and refers to patients that did not require acute hospital care. They include, for instance, patients with a chronic disease that can be managed in an ambulatory setting (e.g., type 2 diabetes mellitus, Stage 1, without complications) or symptoms or signs that are non-specific (e.g., headache, hepatomegaly) and can be evaluated and treated in outpatient care. Second, we introduce the proportion of late admissions on the overall population computed according the methodology described above, after excluding the cohort of diabetic patients.

We use multilevel analysis (MLe) to assess the joint influence of all characteristics on the outcome variable [Goldstein, 2003]. Multilevel models or hierarchical linear models are used to analyse data where observations are nested or clustered in groups with particular characteristics [Scott and Shiell, 1997; Rice and Jones, 1997]. In our case, data on outcomes standardised for patients characteristics are nested within general practices and in turn GP characteristics are nested within LHAs. Since data related to the same hierarchical level are likely to be correlated, the use of standard regression techniques would produce small standard errors and overestimate the statistical significance of explanatory variables [Goldstein, 2003; Scott and Shiell, 1997]. A multilevel model gets rid of the problem because it analyses separately variation occurring at each level.

The final version of the model we estimated is a three-level logit model with a random intercept (also called *variance components model*), where the intercept is allowed to vary randomly at level 2 and at level 3:

$$\text{logit}(\pi_{ijk}) = \beta_0 + \beta_1 x_{ijk} + v_{0k} + u_{0jk} + \varepsilon_{ijk} \qquad (1)$$

where π_{ijk} is the probability that a type 2 diabetic patient i falling under the responsibility of GP j in the local area k was hospitalised for an hyperglycemic emergency (Model A) or for a late admission (Model B). The fixed part of the model is $\beta_0 + \beta_1 x_{ijk}$, where β_0 is the intercept for the model as a whole and $\beta_i x_{ijk}$ is the vector of coefficients. The random part of the model is $v_{0k} + u_{0jk} + \varepsilon_{ijk}$, where ε_{ijk} is the usual level-1 random error term, u_{0jk} is the level-2 random error term and v_{0k} is the level-3 random error term. The coefficient of u_{0jk} measures the random variation of the intercept, β_0, amongst GPs and the coefficient of v_{0k} measures the random variation of the same intercept amongst local areas. We assume that, being at different levels, the random quantities of the models (v_{0k}, u_{0jk}, ε_{ijk}) are uncorrelated and we further make the standard assumption that they follow a Normal distribution.

Our hierarchical modelling takes place in stages. The modelling strategy consisted firstly of fitting a simple two-level variance components model including patients' and physicians' characteristics and allowing the intercept to vary randomly at level 2 (Model 1). Secondly, we estimate the three level logit model stated in (1), testing for random variation across local areas by allowing the intercept to vary randomly at level 3 (Model 2). In the multilevel approach, the groups in the sample are treated as a random sample from a population of groups. However, when the number of groups is small, group effects can be captured using fixed effects, i.e. including dummy variables for groups as explanatory variables. For this reason, as the small number of LHAs in the region (13), we also estimate a two level random intercept model, inserting local areas as fixed effects in order to compare performance across local authorities (Model 3).

With MLe estimation, the significance of coefficients is assessed using the Wald statistic. As a measure of goodness of fit, we used the Pearson χ^2 test.

Descriptive analysis were performed with SAS 8.02 and multilevel analysis were performed with Mlwin 2.02 [Snijders and Bosker, 2002].

5. EMPIRICAL RESULTS

In Table 2 and Table 3 we present different specifications for the two outcomes considered. As regards the main hypothesis we wanted to test, our results suggest that, the economic incentives for treating diabetes have produced very little influence on outcomes so far.

INSERT TABLE 2

Patient's characteristics are the most important factors influencing both outcomes considered. In all specifications, patients aged more than 75 years and patients who were using insulin and patients with an increasing number of visits to the local DOC had a higher probability of both adverse outcomes. It is interesting to note that patient age has a different impact according to the outcome examined. In particular when we look at late admissions, patients aged 75 or above have a significantly higher probability of incurring in the adverse outcome. On the contrary, we observe a non-monotonic effect once hyperglycaemic emergencies are considered, with the group of patients between 65 and 75 years of age having a lower probability of incurring in the adverse outcome with respect both to younger and older patients.

As regards physician characteristics also included in the first specification, GPs gender, age, postgraduate qualifications do not display any significant effect. Only the practice type "medicine in association" has a significant impact after adjusting for patient characteristics. Besides it, none of the other determinants at the practice level contributed to explaining the differences in both the outcomes observed (medicine in network, medicine in group, practice location rural, list size per GP). Apparently, patients treated by physicians receiving a lager share of their income according to specific diabetes programs (economic incentives) do have a lower probability of experiencing an hyperglycaemic emergencies, although the result is only slightly significant (90%). In this case, when we consider hyperglycaemic emergencies, the most parsimonious specification (Model A.1) presents a large variance in the residuals at the second stage [$\sigma^2(u_{0jk}) = 1.880$].

Moving from model A.1 to specifications that controls for local area effects, the coefficient of “medicine in association” decreases substantially in absolute terms and looses significance. On the contrary, the variable "List per GP" increases its explanatory power. With the introduction of regressors related to the third level of the analysis (Local health authorities, LHA) economic incentives, which were marginally significant in model A.1, become non-significant in more general specifications..

By introducing local areas indicators, the intercept was found to vary al level 2 and level 3, showing that there were significant differences across GPs (second level) and across LHAs (third level). In fact, the second stage variance, $\sigma^2(u_{0jk})$, decreases significantly moving from 1.800 to 0.961. Unfortunately, the two explanatory variables included at this level perform poorly in explaining local areas variations.

In the last version of the model (A.3), LHAs are included as fixed effects. The result confirms the existence of a large variability across local areas, which at the present state of the analysis is not captured by controls for physicians and LHA characteristics, which has to be found in other factors that at the present state of the analysis have not been explicitly identified and which might be not entirely measurable.

Most of the indications outlined above hold for model B as well. The main difference is a generalised lower variance between different levels of the analysis. The results suggests that, other things equal, the rate of late hospitalisations varies less than the previous outcome according to the type of physician involved and of the LHA to which the physician belongs.

As far as controls are concerned, the coefficients for “medicine in association” and “list per GP” are more robust across specifications than in the previous case. Economic incentives are only significant only the two-level model with fixed, but the result is not robust to different specifications. Despite displaying always the expected negative sign, the poor significance level of the coefficient indicates that in our data economic incentives do not play a crucial role in influencing the outcome of GPs behaviour. Our estimates and in particular the significance of the variance indicators, suggests that different factors both at GP and at the LHA level affect the outcomes considered here to a much larger extent than additional ad-hoc payments for taking care of patients with diabetes.

6. CONCLUSIONS

In this paper we have tried to assess the impact of economic incentives for GPs activity on patients outcomes. Our analysis is based on a regional dataset that provides very detailed information on patient conditions, GPs remuneration schemes and organisational arrangements. In particular, we have focused on the sub-population of patients affected by diabetes type-2 and we have considered two adverse outcomes such as hyperglycemic emergency admissions associated with ketoacidosis and the rate of late admissions. At this stage of the analysis, we highlight no significant association of the extent of economic incentives earned by GPs with their patients outcomes. At the opposite, patients conditions emerge as the major driver of the probability of an adverse outcome.

As for our methodological contribution, these results suggest that accurately controlling for patients conditions is a necessary step to avoid serious flaws because of omitted variables bias. This cast doubts on the reliability of analysis dealing with health related outcomes unless they include a comprehensive set of controls for initial health conditions. Since it is still frequent to observe in the economic literature cases where health information is very poor, when not limited exclusively to self assessed health status, age and gender, major efforts in enriching the studies with accurate clinical information should be strongly encouraged.

As for the possibility to derive more conclusive policy implications, further developments of our study require to disentangle the components of GPs remuneration schemes according to their different nature, in order to verify if more specific indicators will provide a more refined picture of the role of incentives on patient outcomes. Finally, we leave to future studies the extension of the methodology to different sub-populations, in order to check whether results are consistent across treatments or if GPs role proves relatively more effective for particular diseases.

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APPENDIX

Table 1. Explanatory variable definitions. Patient and general practitioner characteristics , year 2003.

Explanatory variable	*Coding*	*Mean/ Proportion*	*Standard Deviation*	*Min*	*Max*
Patient level (n=168.843)					
Patient gender	male=1	50,3			
Patient age	continuous	67,9	12,84	35	107
Patient age class	35 - 65 (ref)	38,0			
	65 - 75	30,0			
	> 75	32,0			
Insulin dependence	(if yes=1)	15,6			
Visit to DOC	continuous	0,93	1,70	0	9
Physician level (n=3.252)					
GP gender	Male=1	74,0			
GP age	continuous	50,8	5,79	32	71
GP age class	32 – 50 (ref)	44,6			
	> 50	55,4			
List size per GP	continuous	0,03	0.009	0.01	0.05
	≤ median (ref)	48,5			
	> median (if yes = 1)	51,5			
Practice type	single-handed (ref)	31,5			
	association	13,4			
	network	33,6			
	group	21,5			
Practice location rural	(if yes=1)	5,8			
Postgraduate qualification	(if yes=1)	5,1			
Economic incentives	Continuous (% annual income)	0,6	1,30	0	10,3
Local Area level (n=13)					
Inappropriate admissions	Continuous (% total admissions)	5,8	2,7	0,9	11,5
Late admissions	Continuous (% total admissions)	0,4	0,4	0	1,1

Table 2. Physician and patient factors predicting an hospital admission for hyperglycemic emergencies (Model A), year 2003.

	Model A.1			Model A.2			Model A.3		
Explanatory variables	ß	Standard Deviation	p >	ß	Standard Deviation	p >	ß	Standard Deviation	p >
FIXED EFFECTS									
Constant	-6.222	(0.163)	***	-6.141	(1.343)	***	-5.900	(0.223)	***
Patient level									
Patient gender	-0.087	(0.086)		-0.098	(0.085)		-0.098	(0.087)	
Patient age 65-75	-0.352	(0.112)	***	-0.364	(0.110)	***	-0.364	(0.113)	***
Patient age >75	0.182	(0.098)	*	0.180	(0.097)	*	0.185	(0.099)	*
Insulin dependence	1.610	(0.092)	***	1.529	(0.091)	***	1.539	(0.093)	***
Visit to DOC	0.176	(0.019)	***	0.214	(0.018)	***	0.214	(0.020)	***
Physician level									
GP gender	0.061	(0.122)		0.086	(0.115)		0.116	(0.119)	
GP age >50	-0.023	(0.103)		-0.052	(0.096)		-0.069	(0.099)	
List per GP	-0.139	(0.104)		-0.211	(0.097)	**	-0.215	(0.100)	**
Association	-0.402	(0.176)	**	-0.275	(0.167)	*	-0.255	(0.173)	
Network	-0.081	(0.123)		-0.093	(0.121)		-0.068	(0.125)	
Group	-0.025	(0.142)		0.108	(0.138)		0.124	(0.142)	
Practice location rural	-0.053	(0.210)		-0.276	(0.203)		-0.226	(0.202)	
Postgraduate qualification	-0.102	(0.231)		-0.159	(0.223)		-0.162	(0.224)	
Economic incentives	-0.070	(0.041)	*	-0.050	(0.050)		-0.069	(0.046)	
Local area level									
Inappropriate admissions				-0.273	(0.159)	*			
Late admissions				3.518	(2.596)				
FIXED EFFECTS (LHA 1 ref)									
LHA 2							-0.390	(0.214)	*
LHA 3							0.534	(0.192)	***
LHA 4							-0.775	(0.214)	***
LHA 5							-0.551	(0.265)	**
LHA 6							0.052	(0.347)	
LHA 7							0.037	(0.283)	
LHA 8							-0.095	(0.233)	
LHA 9							-0.628	(0.233)	***
LHA 10							-1.529	(0.287)	***
LHA 11							-1.281	(0.367)	***
LHA 12							-1.726	(0.454)	***
LHA 13							-0.956	(0.294)	***
RANDOM EFFECTS									
Level 2 - σ^2 (u_{0jk})	1.800	0.182	***	0.961	(0.152)	***	0.885	(0.150)	***
Level 3 - σ^2 (v_{0k})				0.238	(0.109)	**			

*** p-value < 0.01 ** p-value < 0.05 * p-value < 0.10

Table 3. Physician and patient factors predicting late hospital admissions (Model B), year 2003.

	Model B.1			Model B.2			Model B.3		
Explanatory variables	ß	Standard Deviation	p >	ß	Standard Deviation	p >	ß	Standard Deviation	p >
FIXED EFFECTS									
Constant	-6.765	(0.173)	***	-7.691	(0.943)	***	-6.978	(0.266)	***
Patient level									
Patient gender	-0.140	(0.094)		-0.148	(0.094)		-0.151	(0.094)	
Patient age 65-75	0.048	(0.125)		0.042	(0.124)		0.041	(0.125)	
Patient age >75	0.614	(0.110)	***	0.612	(0.109)	***	0.617	(0.110)	***
Insulin dependence	1.886	(0.100)	***	1.857	(0.100)	***	1.852	(0.101)	***
Visit to DOC	0.107	(0.021)	***	0.116	(0.021)	***	0.122	(0.022)	***
Physician level									
GP gender	0.132	(0.121)		0.153	(0.120)		0.170	(0.122)	
GP age >50	-0.012	(0.099)		-0.037	(0.098)		-0.049	(0.099)	
List per GP	-0.207	(0.100)	**	-0.206	(0.099)	**	-0.202	(0.100)	**
Association	-0.399	(0.179)	**	-0.335	(0.180)	*	-0.320	(0.181)	*
Network	0.032	(0.119)		0.053	(0.123)		0.094	(0.127)	
Group	0.094	(0.136)		0.160	(0.139)		0.174	(0.143)	
Practice location rural	-0.049	(0.202)		-0.112	(0.201)		-0.087	(0.206)	
Postgraduate qualification	-0.272	(0.249)		-0.299	(0.248)		-0.306	(0.248)	
Economic incentives	-0.030	(0.037)		-0.060	(0.047)		-0.091	(0.046)	**
Local area level									
Inappropriate admissions				-0.063	(0.111)				
Late admissions				2.898	(1.810)				
FIXED EFFECTS (LHA 1 ref)									
LHA 2							0.355	(0.241)	
LHA 3							0.412	(0.240)	*
LHA 4							0.186	(0.240)	
LHA 5							0.263	(0.288)	
LHA 6							0.714	(0.359)	**
LHA 7							0.652	(0.310)	**
LHA 8							0.607	(0.262)	**
LHA 9							0.152	(0.258)	
LHA 10							-0.644	(0.301)	**
LHA 11							-0.688	(0.397)	*
LHA 12							-0.560	(0.403)	
LHA 13							-0.074	(0.307)	
RANDOM EFFECTS									
Level 2 - σ^2 (u_{0jk})	0.444	(0.165)	***	0.279	(0.157)	*	0.307	(0.157)	**
Level 3 - σ^2 (v_{0k})				0.095	(0.051)	*			

*** p-value < 0.01 ** p-value < 0.05 * p-value < 0.10