ECONOMIC INCENTIVES IN GENERAL PRACTICE: THE IMPACT OF PAY FOR PARTICIPATION PROGRAMS ON DIABETES CARE.

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Abstract

Financial incentives are increasingly adopted to improve allocative efficiency and quality in primary care. Although it has been recognised that incentive-based remuneration schemes can have an impact on GP behaviour, there is still weak empirical evidence on the extent to which such programs influence healthcare outcomes and on the degree of physicians' responsiveness to their introduction. This problem reflects the lack of adequate empirical data but also the complexity of general practice systems where many confounding and institutional factors are likely to influence physician behaviour. Given this background, we investigate the impact on quality of care of the introduction of pay-for-participation incentives in primary care contracts in the Italian region Emilia Romagna. We concentrate on patients affected by diabetes mellitus type 2, for which the assumption of responsibility and the adoption of clinical guidelines are specifically rewarded. We test the hypothesis that, other things equal, patients under the responsibility of GPs receiving a higher share of their income through these programs are less likely to experience hospitalisation for hyperglycaemic emergencies. 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 Services of Emilia Romagna. This dataset covers patients and GPs of the whole region and provides detailed information on healthcare 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, pay-for-participation incentives, diabetes mellitus, multilevel modelling.

JEL classification: I11, I18, C31

1. INTRODUCTION

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

Empirical data display large variations in expenditures and consumption patterns associated with single practices [Wennberg et al., 1982]. First, this may be due to different medical needs affecting different populations. A second explanation lies in physicians' prescribing habits, that may vary according to specialisation, local clinical practice style, access to scientific information, etc [Davis et al., 2000; Grytten and Sorensen, 2003]. Finally, prescribing behaviour can be affected by the economic incentives [Scott and Farrar, 2003, Iversen and Luras, 2006] and by the organisational and institutional features of the system under which physicians operate (associations, medical networks, primary care groups, presence of a specialist centre in the area) [Wester and Groenewegen, 1999]. Given this background, we develop an empirical analysis of GPs behaviour, drawing from a dataset that links several epidemiological and administrative databanks, and provides relatively rich information on healthcare consumption of the population, on the different components of GP remunerations and on the prevalence of morbidity for large groups of patients. Using information for the Italian region Emilia Romagna that covers year 2003, the paper analyses the impact of pay-for-participation incentives on health outcomes for diabetes mellitus type 2. At this scope, we evaluate the association between the onset of avoidable complications and geographically differentiated programs that increase capitation transfers to GPs for the assumption of responsibility of diabetic patients.

Diabetes mellitus is a chronic condition listed among those known as "ambulatory care-sensitive conditions" (ACSCs) [Billings et al. 1996; Yuen, 2004] for which adequate availability, accessibility and quality of primary medical care should be able to prevent hospitalisation. Hence, the rate of hospital admissions for hyperglycaemic emergencies can be used as an indicator of good clinical practice, since good quality of primary care is typically associated with low hospitalisation rates. [Booth and Fang, 2003]. We use hospitalization rates for hyperglycaemic emergencies to evaluate the influence of programs aimed at improving the quality of diabetes care and to examine the joint influence of patient, physician, organisational factors by means of a set of multilevel models, that include controls nested at different hierarchical levels.

Our main contribution to the existing literature consists of the analysis of the almost unexplored issue of the effectiveness of pay for participation programs in improving quality in primary care. An increasing number of studies has investigated the influence of economic incentives on GPs activity, but the large majority focuses on the impact of pay-for-performance mechanisms. Given the central role of primary care for the governance of demand, pay for participation schemes represent a viable alternative, advocated (and implemented) in the belief that, being less invasive of physicians' professional autonomy, in some cases, they may display relative advantages in inducing GPs to endorse the objectives of the healthcare planner and in fostering cooperation between primary care physicians and the other actors of the system.

Other valuable aspects relate to the scope of the analysis and to the detail of the available information. The study covers a rather large initial population (around 4 million citizens) out of which the subset of diabetic patients is identified thanks to comprehensive information on consumption of disease-specific care (pharmaceuticals, outpatient visits etc…). Furthermore, the availability of clinical information on hospital discharges allows to focus on the outcome care, which is the proper policy target for the programs considered here, instead of output indicators, more frequently available in the health economics literature. Finally, the possibility of linking a large administrative database to personal medical payment records allows to jointly control for individual characteristics at the patient and physician level and, therefore, to account for several dimensions of individual heterogeneity that substantially improves accuracy of measurement of the impact of financial incentives.

2. FINANCIAL INCENTIVES AND HEALTH CARE

The economic theory of incentives assumes that an agent gets utility from the wage he receives and disutility from the effort he exerts on behalf of the principal [Prendergast, 1999]. Thus, as argued by the literature on efficiency wages, higher wages and/or intensive monitoring are likely to increase workers' effort. The trade-off between supervision and wages has been widely discussed in labour economics, outlining that, as long as there is a conflict of interests and asymmetric information between employers and employees, wage incentives and supervision must be complementary and not substitute [Garcia-Prado, 2005]. The theoretical developments of the literature along these lines have therefore stressed the importance of establishing close links between monetary compensations and effective monitoring of performances.

Alongside, an increasing stream of theoretical literature has argued that workers might respond not only to external interventions such as supervision and wage-premia, but also to intrinsic motivation, such as the influence of norms or customs, professional ethics and peers review. Drawing upon the basic Akerlof's "social custom theory" [1980], this idea extends the standard theory by introducing concepts such as identity with the organisational goals, mission and implicit contracts [Benabou and Tirole, 2003].

Intrinsic motivations seem to influence effort especially in areas characterised by personal relationships between principals and agents that imply trust and loyalty, in professional groups or where a public service ethos, ethical and moral responsibilities exist [Dixit, 2002]. In this line, Frey (1993) discusses the importance of considering workers internal motivation in the design of monitoring regimes and incentive systems, challenging the belief that external interventions always lead to higher effort. According to Frey' Motivation Crowding Theory, the introduction of monetary rewards, where previously were none, can undermine intrinsic motivations and lead to lower productivity and participation [Scott and Farrar; 2003]. In other words, workers could reduce effort if they perceive external interventions as evidence of employer distrust [Frey and Jegen, 2001]. Contrary to the basic principal-agent model, in these cases, performance-related payments can be inefficient or sometimes even counterproductive.

Compensation schemes based on performance can also have unintended consequences in presence of "multitasking", in particular when effort levels for some tasks are more difficult to measure than for others [Holmstrom and Milgrom, 1991]. Multitasking implies that employers should be cautious in rewarding the achievement of specific targets, as long as they capture quality only to a limited extent or metrics are imperfect [Eggleston, 2005].

The design of incentive schemes that are effective in improving quality of care is a central policy issue for the health care sector [see Culyer and Newhouse (2000) for a general discussion; Gravelle and Masiero (2000) for an application to primary care]. Given this purpose, it must be taken into account that, in health care, where physicians have strong ethical interest in their patients' health, the whole process of healthcare delivery, including aspects such as quality, efficiency and equity, is deemed to depend largely on workers' motivations. While it has been recognised that remuneration can influence GP behaviour, there are also "counter-balancing arguments" in line with those previously discussed [Gosden et al., 2001]. In particular, ethical values may dilute the influence of economic incentives and in health care there might be relatively less need for strong external incentives [Mooney and Ryan, 1993]. Besides, in this context there are many examples of multitasking and physicians may game the system for their own gain. For these reasons, high powered incentives based on performance might not always represent the optimal solution in terms of overall welfare gains and could distort physicians' behaviour emphasising only the dimensions that are explicitly rewarded. This is particularly true for financial incentives aimed to influence providers' allocation of effort across the various tasks associated to medical care.

Despite the difficulties in obtaining robust indications about how financial incentives should be specifically designed to influence behaviour and health outcomes [Scott and Hall, 1995], the need to improve cost effectiveness and quality of care has led many private and public payers to adopt schemes based on physicians' performance measured through clinical and service quality indicators. For example, in 2003, the UK introduced a pay-for-performance contract for family practitioners that increases existing income according to performance with respect to 146 quality indicators [Smith and York, 2004].

Overall, the empirical literature on payments for quality in health care provides so far little evidence to support its effectiveness [Kristiansen and Mooney, 1993; Chaix-Couturier et al. 2000; Rosenthal and Frank, 2006]. For example, they have been found ineffective in improving the level of immunisation uptake [Lynch, 1994] and the delivery of preventive care [Town et al. 2005]. In the 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; and service provision turned out to be more related to patient demand and to 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 economic incentives were the major responsible of the observed changes, as opposed to changing professional attitudes and increased patient demand [Whynes and Baines, 1998]. Again in the 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 the growing enthusiasm for, and adoption of, pay for performance mechanisms, there is some scepticism about the effectiveness of this approach in stimulating quality improvement and there are risks of unintended consequences, such as redirecting physicians time and attention away from their main purpose of caring patients. In response to these concerns, payers are exploring also alternative incentive schemes for improving quality such as pay-for-participation programs. These mechanisms introduce compensations related simply to physicians' participation in collaborative activities and not to individual performances. 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.

This incentive scheme is now in its early stages of development and in surgical care, where the first applications have been implemented, is based on two elements. First, the availability of high-quality clinical data, including patient characteristics, processes of care and relevant outcomes. In most programs, performance data are not publicly reported. Second, at regular intervals physicians receive timely feedback on their performance relatively to that of their peers and during periodic meetings new interventions to achieve improvements are collectively discussed and implemented to all participants. More in general, the main distinguishing feature of this scheme in is that, unlike pay-for-performance initiatives, pay-for-participation programs neither link provider performance to financial reimbursement nor entail public reporting of provider level data. The (still very limited) empirical literature on the topic, based on the experience on surgical care, outlines that there are cases in which this kind of incentives may prove more effective in improving the quality of care. In particular, one of the potential advantages is physicians’ acceptation of this approach, together with significant improvement in providers’ adherence to evidence-based best practices [Birkmeier and Birkmeier, 2006]. Until now the use of pay-for-participation in national health system has been limited and the empirical evidence that this method works is almost absent, at least to our knowledge. Moreover, pay-for-participation methods that seem to work in specialties such as surgery may not be appropriate in primary care.

Following these premises, there are several questions that deserves further investigation at the empirical level, since incentive schemes that do not condition payments to the achievement of pre-defined individual targets present shortcomings that should not be overlooked. First, under these schemes, the incentive to dump more demanding patients may simply be shifted, increasing within groups of homogeneous patients even if it falls between groups. Physicians may be induced to avoid, in each group, those patients for whom the additional effort required exceeds the ad hoc transfers, with no guarantee that care will improve with respect to systems based on flat capitation. Moreover, we should improve our knowledge on the actual responsiveness of general practice to this kind of programs, since the lack of binding connections between individual results and financial transfers may strongly attenuate the influence on physicians 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 is 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 that is primarily treated in outpatient settings. Several studies [Diabetes Prevention Program Research Group, 2002; Beaulieu et al., 2007] have shown that intensive diabetes management can reduce the risk of onset and progression of long-term complications and ensure substantial cost containment in the long run. For these reasons, care is increasingly provided by primary care providers, whose regular clinical review is expected to assure good quality of treatment.

Replacing specialty with primary care, however, raises two delicate points. First, under a capitation system GPs have limited incentives to identify new cases of diabetes and to treat personally diabetic patients. Screening and identifying diabetic patients is time-consuming and GPs may be discouraged, as long as they receive the same fixed payment regardless of whether the patient is affected by a condition that requires special attention or not. This provides an incentive to refer patients identified as diabetics to the specialty clinic. As a result, the GP is less likely to view diabetes care as his responsibility and may exert insufficient levels of effort in following patients. To address this problem, health plans or provider organisations may introduce extra financial compensation to ensure adequate incentives for treating disease in a primary care setting. 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 (*pay-for-performance* schemes). A different approach increases capitation according programs that can have different features. A possibility is that the GP receives a financial bonus for the assumption of responsibility of each patient. Alternatively, compensations can be provided for GPs participation in audit meetings or for their adherence to evidence-based best practices. This latter scheme introduces a looser incentive structure with respect to the previous one, as long as it does not require an increase in the effort directly devoted to caring activities. To distinguish between these two different mechanisms, in this paper we include under the label "*pay-for-participation*" all financial transfers aimed at compensating GPs for the assumption of responsibility of patients, whereas we define "*pay-for-compliance*" all transfers associated to the mere participation in meetings and/or to the adherence to guidelines.

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 [Billing et al., 1996; Morris et al., 1997; Booth and Fang, 2003]. Diabetic patients with limited access to ambulatory care are likely to be hospitalised with higher rates of advanced disease and have less favourable health outcomes than those who have benefited from adequate primary care services. In particular, diabetic ketoacidosis and hyperosmolar nonketotic coma are acute and potentially life-threatening emergencies that require immediate hospitalization. Even if hyperglycaemic emergencies can be the first sign of diabetes, more frequently, they arise from poor adherence to 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 prevented, in most cases, through early recognition and by avoiding errors in patient management.

Although the Italian National Health System provides coverage for most physician and hospital services, other barriers to accessing care, such as patients socio-economic status and area 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.

Emilia Romagna is located in the north-east of the country and has a population of about 4 millions inhabitants. In the region, Local Health Authorities (LHAs) - subdivided into health districts encompassing at least 60,000 inhabitants- have had varying levels of involvement in monitoring diabetic services and, before the release of regional guidelines, there was no formal shared responsibility between primary and secondary care and patients could freely choose where to demand assistance. In 2003, the Regional Government released the "Clinical Guidelines for Management of Diabetes Mellitus". They reflected the growing shift in emphasis from hospital to community care for people with type 2 diabetes, recognising that these patients, on the whole, need not be hospitalised [Fitzsimons et al, 2002]. Consistently with this view, the regional guidelines introduce an integrated care model, where co-ordination between different levels of care is implemented to make diabetes services easily accessible. According to this model, primary care physicians play a pivotal role in making the initial diagnosis and in ensuring that patients receive effective care. The recommendation suggests that type 1 diabetic patients are treated by secondary care through a diabetes outpatient clinic (DOC), 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 DOC 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. Yet, the routine follow up has to be undertaken within primary care.

4. MULTILEVEL ANALYSIS

We use multilevel analysis to assess the joint influence on the outcome variable of a set of characteristics measured at different layers. Multilevel models are used to analyse data where observations are nested within groups [Scott and Shiell, 1997; Rice and Jones, 1997; Duncan et al., 1998; Kothari and Birch, 2004]. In our case, patients characteristics are nested within general practices and in turn GP characteristics are nested within districts. Since data clustered within the same hierarchical level are likely to be correlated, the use of standard regression techniques would produce too small standard errors and overestimate the statistical significance of explanatory variables. A multilevel model gets rid of the problem because it analyses separately variation occurring at each level.

Given our dichotomous dependent variable, we estimate a logit specification of the general multilevel model [Snijders and Bosker, 2002], starting with an empty model (Model 1), to understand the basic partitioning of the variability between different levels. Then, we estimate a two-level variance components model including patient and physician characteristics, allowing the intercept to vary randomly at level 2 (Model 2), and, finally, a three-level logit model with random intercept including also district characteristics (Model 3).

Our most general specification includes a hierarchical structure up to three levels of care:

$$\text{logit}(\pi_{ijk}) = \log\left(\frac{\pi_{ijk}}{1-\pi_{ijk}}\right) = \beta_0 + \beta_1 X_{ijk} + v_{0k} + u_{0jk} + \varepsilon_{ijk} \qquad (1)$$

where π_{ijk} corresponds to $\Pr(y_{ijk} = 1)$ and y_{ijk} is the realisation of a random variable Y_{ijk} that is typically assumed to follow a Bernoulli distribution. In our case, π_{ijk} represents the probability that a patient *i* falling under the responsibility of GP *j* in district *k* is hospitalised for an hyperglycaemic emergency.

The fixed part of our estimates is represented by $\beta_0 + \beta_1 X_{ijk}$. The random part is $v_{0k} + u_{0jk} + \varepsilon_{ijk}$,, where ε_{ijk} , u_{0jk} and v_{0k} are the random error terms at the level-1., level-2 and level-3 respectively. The component u_{0jk} measures the random variation of the intercept amongst GPs, while v_{0k} measures the random variation of the same intercept amongst districts. Distributional assumptions for the random part of the model are as follows (see, for instance, Iversen and Luras 2000):

$$\begin{aligned} &\text{E}(\varepsilon_{ijk}) = 0, \quad \text{var}(\varepsilon_{ijk}) = \sigma_\varepsilon^2, \quad \text{cov}(\varepsilon_{ijk}, u_{0jk}) = 0; \\ &E(u_{0jk}) = 0, \quad \text{var}(u_{0jk}) = \sigma_u^2, \quad \text{cov}(u_{0jk}, v_{0k}) = 0; \\ &E(v_{0k}) = 0, \quad \text{var}(v_{0k}) = \sigma_v^2. \end{aligned} \qquad (2)$$

In practice, we assume that, being at different levels, the random components (v_{0k}, u_{0jk},, ε_{ijk}) are uncorrelated with each other and they follow a Normal distribution [Rasbash et al., 2000]. As a result, the expression for the total conditional variance is simply the sum of the separate components:

$$\text{var}(y_{ijk} \mid X_{ijk}) = \sigma_\varepsilon^2 + \sigma_u^2 + \sigma_v^2$$

More important is the characterisation of the covariance between two patients *l* and *h* cared by the same physician in the same district:

$$\text{cov}(y_{ljk}, y_{hjk}) = E\left[(v_{0k} + u_{0jk} + \varepsilon_{ljk})(v_{0k} + u_{0jk} + \varepsilon_{hjk})\right] = \sigma_u^2 + \sigma_v^2 \tag{3}$$

while the covariance between two patients *l* and *h* cared by physicians *r* and *s*, belonging to the same district *k* is:

$$\text{cov}(y_{lrk}, y_{hsk}) = E\left[(v_{0k} + u_{0rk} + \varepsilon_{ljk})(v_{0k} + u_{0sk} + \varepsilon_{hjk})\right] = \sigma_v^2 \qquad .(4)$$

Consequently, the Var/Cov matrix is block diagonal:

$$\begin{bmatrix} \Omega_1 & 0 & \dots & 0 & \dots & 0 \\ 0 & \Omega_2 & & 0 & & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & & \Omega_k & & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & 0 & \dots & \Omega_K \end{bmatrix}$$

and the size of each square block Ω_k corresponds to the number of patients included in district *k*. Let [N_{1k}…, N_{jk},, ….N_{Jk}] be the number of patient followed by physician *[1…j…J]* in district *k*, respectively , then Ω_k has the following structure:

$$\Omega_k = \begin{bmatrix} A_{11}^{(N_1 \times N_1)} & B_{12}^{(N_1 \times N_2)} & \dots & B_{1j}^{(N_1 \times N_j)} & \dots & B_{1J}^{(N_1 \times N_J)} \\ B_{21}^{(N_2 \times N_1)} & A_{22}^{(N_2 \times N_2)} & & & & \\ \dots & & \dots & & & \\ B_{j1}^{(N_j \times N_1)} & & & A_{jj}^{(N_j \times N_j)} & & \\ \dots & & & & \dots & \\ B_{J1}^{(N_J \times N_1)} & & & B_{Jj}^{(N_J \times N_j)} & & A_{JJ}^{(N_J \times N_J)} \end{bmatrix}_k \tag{5}$$

with $A_{jj}^{(N_j \times N_j)} = \begin{bmatrix} \sigma_\varepsilon^2 + \sigma_u^2 + \sigma_v^2 & \sigma_u^2 + \sigma_v^2 & \dots & \sigma_u^2 + \sigma_v^2 \\ \sigma_u^2 + \sigma_v^2 & \sigma_\varepsilon^2 + \sigma_u^2 + \sigma_v^2 & & \\ \dots & & & \\ \sigma_u^2 + \sigma_v^2 & \dots & \dots & \sigma_\varepsilon^2 + \sigma_u^2 + \sigma_v^2 \end{bmatrix}$

$$\text{and } B_{jt}^{(N_j \times N_t)} = \begin{bmatrix} \sigma_v^2 & \dots & \dots & \sigma_v^2 \\ & & & \\ \sigma_v^2 & \dots & \dots & \sigma_v^2 \end{bmatrix}.$$

with *(N_j x N_t)* denoting the size of the sub-matrixes included in (5).

We use the estimated variance components obtained from the different specifications to calculate the intraclass correlation coefficients, interpreted as the fraction of total variability attributable to a particular level of care [Browne et al., 2005]. The intraclass correlation coefficient ICC is the proportion of variance (σ^2) that is accounted for by the group level. It is equal to the correlation between values of two randomly drawn micro-units in the same, randomly drawn, macro-unit:

$$\rho = ICC = \frac{\text{population variance between macro - units}}{\text{total variance}} \tag{6}$$

Larger values of ICC (0 < ICC <1) are indicative of greater potential for each particular level (GP, district) to influence the value of the dependent variable.

Multilevel analysis are performed with Mlwin 2.2.0 [Rashbash et al., 2000]. We produce estimates using the Iterative Generalized Least Squares (IGLS) algorithm with 1st order marginal quasi likelihood procedure (MQL 1) but results are robust also using a predictive quasi-likelihood (PQL) procedure. The significance of coefficients is evaluated with the Wald statistic while goodness of fit is assessed using deviance [Goldstein, 2003].

5. THE DATA

The study population consists of all the regional type 2 diabetic patients in year 2003, for which fully linked data is available. We identify the cohort members by integrating data from multiple sources.

Following WHO criteria, patients are 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. Specifically, we classify as diabetes patient anyone above 35 years who received 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 can be 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. We have decided to exclude one district from the overall analysis, provided that its hospital admissions rates for hyperglycaemic emergencies - in a single hospital - were over 10 times the regional average. Therefore, to avoid inappropriately inflating the data because of a likely coding mistake, we have opted for a trimmed database, excluding 2233 diabetic patients (1,34% of the total amount). The resulting dataset includes 164.574 patients, 2.938 GPs and 38 districts belonging to 13 LHAs.

As outcome measure we consider the diabetic hyperglycaemic emergency admissions associated with ketoacidosis and a hyperosmolar nonketotic coma for type 2 diabetic patients. Hospitalisations is identified from hospital records in which acute hyperglycaemia (ICD-9 codes 250.1 to 250.2) is documented as primary or most responsible diagnosis. The total number of adverse outcomes is 467, corresponding to the 0,3% of the 164.574 total number of diabetes patients.

Table 1 presents the explanatory variables. Patient demographics include age between 65 an 75 years, age over 75 years 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

The controls used at the GP level are gender, age and a dummy for type of practice, that distinguishes single-handed practice from the three level of partnership defined by the national contract for primary care: medicine in association; medicine in network; medicine in group. We also control for practice location with a dummy variable for deprived areas and two dummies related to the list size: one for a list size between 1100 and 1500 patients per GP and one for list a size with more than 1500 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 we consider. Consequently, we included only a general dummy for the presence of any postgraduate qualifications.

As stated in Section 3, we distinguish among two kind of incentives mechanisms: financial incentives for each diabetic patients assumption of responsibility (*Pay for participation*) and financial incentives for participation in improvement activities and for compliance with regional and local guidelines of care (*Pay for compliance*), since both sets of special payments are likely to produce different impacts on health outcome. These variables are measured as the share of GPs annual income deriving from these two revenue sources. Table 2 shows the distribution of the two schemes across local areas with money amounts expressed in Euro, while Figure 1 presents the distribution among the 38 regional districts in percentage terms on GPs annual income.

INSERT TABLE 2

INSERT FIGURE 1

As regards the third level, we include a set of income dummies measured at the district level and obtained from census data. We consider three categories (low, medium-high, high) with the 25th, 50th and 75th percentiles as cut-off points. As additional control to account for supply side characteristics, we include a dummy for the number of hospital beds in diabetes specialised wards.

6. EMPIRICAL RESULTS

Table 3 presents different specifications of our ML model: the empty model (Model 1), the two levels logit model (Model 2) and the three levels logit model (Model 3). For each specification, we present the intraclass correlation coefficient (ICC) that illustrates the basic partitioning of the variability between different levels and the measures of goodness of fit.

INSERT TABLE 3

The empty model shows that the GP level accounts for the largest share of the variability. In particular, intra group correlation is equal to 9% at the GP and 3,3% at the district level. The result outlines the importance of differences in clinical practices among GPs and, to some extent, of different policies between districts. As expected, the introduction of explanatory variables for each hierarchical level reduces the residual variability within clusters. As for GPs, within group correlation of the unobserved component falls from

9% in the “empty” model, to 8.6% when patient related variables are included, and down to 2,4% when district area information is included.

Quite interestingly, it is only with the introduction of a third layer in the model (health districts) that ρ_{GP} falls significantly and the second stage variance, $\sigma^2(u_{0jik})$, drops from 0.309 to 0.084. The main indication seems to be that the area where the physician operate contributes to the variability between physicians more than the (observed) individual characteristics of the GP himself and of his group of patients. This is consistent with the result of a significant variability between districts reported in model 3 and we can conclude that the influence of the organisational arrangements defined at the local level is not negligible.

The intercept β_0 captures information related to the baseline case represented by a female patient , aged below 65, not insulin dependent, cared by a female physician that works in association in a urban area and whose list size is below the threshold of 1100. The baseline for the district characteristic is per capita income in the first quartile of the distribution.

As regards the main hypothesis to be tested, our results report a significant association between the health outcome and (one set of) economic incentives received by GPs for diabetes care. Both coefficients related to ad hoc transfers display the expected negative sign, indicating that, other things equal, the larger the share of diabetes-related payments with respect to GP total revenues, the lower the probability of the adverse event for the diabetic patients included in the list. Furthermore, the coefficient associated with "Pay for participation" programs is significant and robust across specifications. On the contrary, the coefficient for "Pay for compliance" is never significant.

Overall, our results support the idea that ad hoc financial transfers may contribute to improve the quality of care for targeted diseases, even when they are not based on the ex post verification of the achievement of specified targets, as for pay for performance programs. As long as, patients treated by physicians receiving a larger share of their income from specific diabetes programs do have a lower probability of experiencing an hyperglycaemic emergency, the strategy of complementing capitation with additional transfers according to the level of responsibility assumed by the physicians for this specific disease seems to have proved effective. At the same time, the potential improvements obtained through pay for participations schemes depend also on the particular way the incentives are designed. When the only requirement is compliance to guidelines and general protocols, the advantages in terms of more favourable outcomes are negligible, and economic incentives are effective only when GPs involvement requires additional efforts more directly addressed to his/her patients.

Among the other controls, patients' characteristics are the most important factors influencing the adverse outcome and all coefficients are fairly robust across specifications. Patients who are insulin dependent and who visits more frequently the local DOC have higher probability of emergency hospitalisation. Age has a non monotonous effect, with patients aged 75 or above displaying the highest probability of the adverse outcome. On the contrary, the group of patients between 65 and 75 years of age has a lower probability of emergency hospitalisation with respect both to younger and older patients.

As for physician characteristics, GPs age and postgraduate qualifications do not have any significant effect, while gender has a (poorly) significant impact and only in Model 3. Most of the controls included at the practice level (medicine in network, medicine in group, rural practice location) do not influence the observed outcome either. An interesting exception is list size with the significant and negative coefficient for both dummies, suggesting a sort of volume-outcome association in the management of diabetes in primary care. This result confirms those obtained in previous studies for different institutional settings [Millet et al., 2007], according to which larger practices seem to be able to provide better quality of diabetes care. Among the explanatory variables in the third level, only aggregate per capita income significantly contribute to capture part of the residual heterogeneity.

As for the policy implications, a final note of caution must be raised, since pay for participation programs may not be fully exogenous. In principle, one might argue that in the areas where GPs had independently developed a more direct involvement in diabetes management, this may have also translated into a larger propensity among GPs to agree on incentive mechanisms focused on diabetes care. As a consenquence, high shares of income following diabetes programs might be associated to higher quality of care simply because GPs with better expertise might have encouraged the implementation of such programs from the LHAs and districts they belong to.

Even if not much is known of the details of the bargaining process between LHAs, districts and GPs, anedoctal evidence suggests that the largest share of the bargaining power relies on public payer side, that sets its priorities mostly according to the views of the local managing board. Therefore, individual propensity of GPs is unlikely to have exerted ex ante a crucial influence in the allocation of the public budget at the district level across different potential alternative programs. If this is the case, endogeneity is probably not such a serious problem in practice.

Unfortunately, this hypothesis is not empirically testable given the cross sectional nature structure of our dataset, that does not allow to record how the probability incidence of the adverse outcome evolves over time with changes in the size of financial incentives. Fully linked data are not available at the individual level after 2003 and, as for the previous years, the incidence of hyperglycaemic emergency is so rare, to indicate that it was routinely not reported as primary diagnosis until 2003.

Therefore, at this level of the analysis we can confidently outline a positive statistical association between ad hoc transfers to GPs and quality of care provided, while the full identification of a proper causal relationship, would require the availability longitudinal data.

6. CONCLUSIONS

In this paper we have assessed the impact of pay-for-participation incentives for GPs activity on health care outcomes. Our analysis is based on a regional dataset that provides 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 as adverse outcome hyperglycemic emergency admissions associated with ketoacidosis. Patients conditions emerge as the major driver of the probability of an adverse outcome. At the opposite, controls for practice characteristics display much lower significance levels. The comparison of intraclass correlation across different specifications confirms the importance of data clustering at the geographical level. With the introduction of districts in the model, the fraction of variability attributable to GPs falls substantially, outlining a relative homogeneity among practices subject to the influence of the same management disease programs typically defined at the LHAs and district level.

The most relevant policy issue addressed in the paper concerns the impact of financial incentives aimed to improve quality of diabetes care through pay for participation schemes. Our results indicate that higher shares of GP income received through these programs significantly reduce the probability of hyperglycaemic emergencies for their patients. This is true when programs are aimed at stimulating GP assumption of responsibility in disease management, but not when only adherence to clinical guidelines is required.

As for the possibility to derive more conclusive policy implications, substantial improvements could be obtained with the availability of longitudinal data that would provide a more clear-cut identification of causal relationships. Moreover, it would be interesting to extend the analysis to different sub-populations and types of disease by using a more comprehensive set of outcome indicators.

Acknowledgements

This paper is part of the research project "The role of economic incentives in primary care", funded by the Italian Ministry of Health and of the Strategic Research Project on "Health Economics: contracts, procurements and innovation", funded by the University of Bologna. We thank participants to AIES (Genoa), ECHE (Budapest) and SIEP (Pavia) Conferences, especially our discussant Paolo Pertile, for useful suggestions. We are also indebted to Francesco Taroni, Roberto Grilli, Gianluca Fiorentini for support and helpful comments on previous versions of the paper and to Elisa Iezzi for excellent research assistance. The Regional Healthcare Agency of Emilia Romagna (ASR-RER) kindly provided the databases used in this study. The opinions expressed here are the sole responsibility of the authors and do not represent the views of the ASR-RER. Usual disclaimers apply.

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APPENDIX

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

Explanatory variable	*Coding*	*Mean/%*	*Standard Deviation*	*Min*	*Max*
Patient level (n=164574)					
Patient gender	male=1	50,3			
Patient age	continuous	67,9	12,83	35	107
Patient age class	35 - 65 (ref)	37,9			
	65 - 75	30,0			
	> 75	32,1			
Insulin dependence	(if yes=1)	15,6			
Visit to DOC	continuous	0,92	1,70	0	9
Physician level (n=2.938)					
GP gender	Male=1	74,2			
GP age	continuous	50,8	5,54	35	71
GP age class	35 – 47 (ref)	21,0			
	47-53	52,3			
	> 53	26,7			
List size per GP	< 1100 (ref)	35,4			
	1100-1500	55,0			
	≥1500	9,6			
Practice type	single-handed (ref)	31,4			
	association	13,6			
	network	33,5			
	group	21,6			
Practice location rural	(if yes=1)	5,8			
Postgraduate qualification	(if yes=1)	5,1			
Pay for compliance	Continuos (% annual income)	0,4	1,04	0	7,74
Pay for participation	Continuous (% annual income)	0,2	0,72	0,03	6,97
District level (n=38)					
Income	< 25% (0)	17,7			
	25-75% (1)	42,7			
	>75% (2)	39,5			
Hospital beds in endocrinology	Continuos	15,7	9,9	2	28

Table 2. Economic incentives distribution. Local Health Authorities, amounts in Euro, year 2003.

		Pay for compliance (Adherence to local guidelines)					Pay for participation (assumption of responsibility)				
LHA	N°GP	% GPs	MIN	MAX	MEAN	STD	% GPs	MIN	MAX	MEAN	STD
1	220	0,91	626,62	4679,18	2652,9	2865,59	1,36	154,95	1208,51	712,72	529,51
2	297	0,67	671,37	1297,99	984,68	443,09	1,01	451,90	2386,09	1259,27	1005,90
3	361	8,59	33,56	5081,89	1094,48	1156,76	6,37	201,42	2618,44	1526,51	628,83
4	490	61,43	16,74	7452,54	1343,98	1246,11	2,86	185,92	5422,80	1476,07	1521,04
5	379	35,62	15,49	7445,26	2660,64	1714,99	46,70	30,987	8025,97	1118,22	1171,66
6	86	86,05	46,48	3501,87	1094,77	693,97	1,16	650,79	650,79	650,79	-
7	139	61,15	285,03	7065,42	2569,41	1287,71	17,99	247,92	2696,13	1062,78	792,42
8	85	32,94	123,96	4431,57	2348,56	1125,74	30,59	30,99	4822,41	827,61	970,84
9	236	0,00	0,00	0,00	0,00	0,00	0,42	1316,96	1316,96	1316,96	-
10	270	0,37	297,48	297,48	297,48	-	1,85	1226,58	4402,79	2805,01	1285,56
11	113	0,00	0,00	0,00	0,00	0,00	35,40	344,30	5056,54	2128,40	1209,18
12	130	5,38	198,32	2429,42	1165,13	761,12	63,08	65,22	5047,84	2410,61	993,76
13	165	27,88	148,74	5032,36	1226,03	1015,37	0,00	0,00	0,00	0,00	0,00
Tot.	2971	23,96	15,49	7452,54	1734,49	1433,27	13,46	30,99	8025,97	1516,25	1228,91

Figure 1. Economic incentives in % annual income. Districts, year 2003.

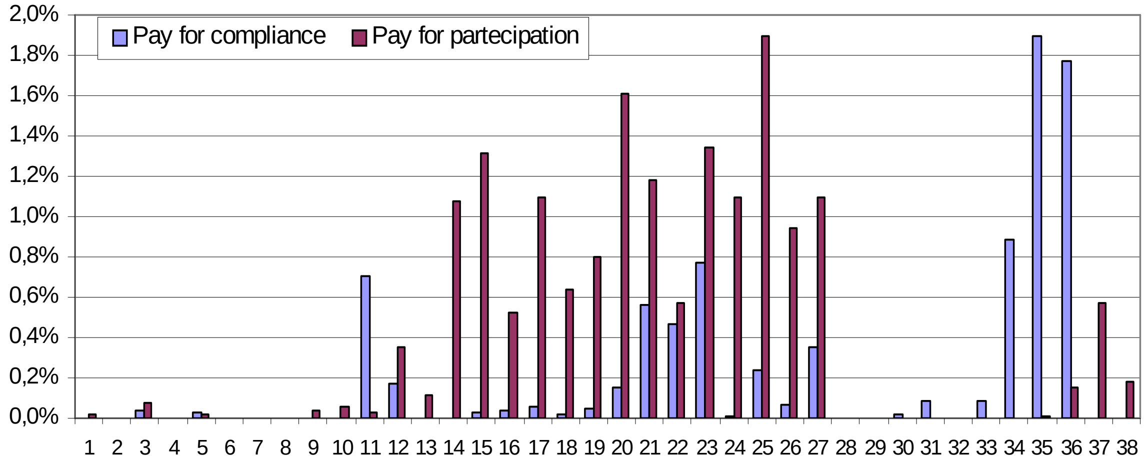

Table 3. GP and patient factors predicting an hospital admission for hyperglycemic emergencies, year 2003.

	Empty model - Model 1			**Model 2**			**Model 3**		
Explanatory variables	Coefficient	SE	p >	Coefficient	SE	p >	Coefficient	SE	p >
FIXED EFFECTS									
Constant	-5.884	(0.078)	***	-6.492	(0.188)	***	-6.831	(0.250)	***
Patient level									
Patient gender				-0.159	(0.095)	*	-0.169	(0.094)	*
Patient age 65-75				-0.324	(0.126)	***	-0.328	(0.125)	***
Patient age >75				0.325	(0.107)	***	0.332	(0.106)	***
Insulin dependence				1.913	(0.101)	***	1.877	(0.101)	***
Visit to DOC				0.103	(0.021)	***	0.124	(0.021)	***
Physician level									
GP gender				0.196	(0.124)		0.213	(0.122)	*
GP age 47-53				-0.138	(0.128		-0.153	(0.124)	
GP age >53				-0.061	(0.151)		-0.004	(0,139)	
List per GP 1100-1500				-0.262	(0.110)	**	-0.258	(0.108)	**
List per GP > 1500				-0.419	(0,178)	**	-0.395	(0.176)	**
Association				-0.141	(0.164)		-0.142	(0.169)	
Network				0.055	(0.121)		-0.014	(0.124)	
Group				0.157	(0.136)		0.196	(0.139)	
Practice location rural				-0.166	(0.213)		0.040	(0.236)	
Postgrad. qualification				-0.213	(0.240)		-0.266	(0.240)	
Pay for compliance				-0.062	(0.042)		-0.034	(0.051)	
Pay for participation				-0.222	(0.085)	***	-0.210	(0.089)	**
District area level									
Income 25%-75%							0.150	(0.201)	
Income ≥75%							0.771	(0.223)	***
Beds in endocrinology							-0.233	(0.193)	
RANDOM EFFECTS									
Level 2 - σ^2 (u_{0jk})	0.339	0.175	*	0.309	0.165	*	0.084	(0.153)	
Level 3 - σ^2 (v_{0k})	0.122	0.051	**				0.079	(0.037)	**
ρ GP	0.090			0.086			0.024		
ρ districts	0.033						0.023		
Deviance [-2ln(L)]	-498614			-5843333			-590556		

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