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# A Refutation of the Practice Style Hypothesis: the Case of Antibiotics Prescription by French General Practitioners for Acute Rhinopharyngitis

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Many researches in France or abroad have highlighted the medical practice variation (MPV) phenomenon, or even the inappropriateness of certain medical decisions. There is no consensus on the origin of this MPV between preference-centred versus opportunities and constraints approaches. This study principal purpose is to refute hypothesis which assume that physicians adopt for their patient a uniform practice style for each similar clinical decision beyond the time. More specifically, multilevel models are estimated: First to measure variability of antibiotics prescription by French general practitioners for acute rhinopharyngitis, a clinical decision making context with weak uncertainty, and to tests its significance; Second to prioritize its determinants, especially those relating to GP or its practice setting environment, by controlling visit or patient confounders. The study was based on the 2001 activity data, added by an ad hoc questionnaire, of a sample of 778 GPs arising from a panel of 1006 computerized French GPs.

We observe that a great part of the total variation was due to intra-physician variability (70%). Hence, in the French general practice context, we find empirical support for the rejection of the 'practice style', the 'enthusiasm' or the 'surgical signature' hypothesis. Thus, it is patients' characteristics that largely explain the prescription, even if physicians' characteristics (area of practice, level of activity, network participation, participation in ongoing medical training) and environmental factors (recent visit from pharmaceutical sales representatives) also exert considerable influence. The latter suggest that MPV are partly caused by differences in the type of dissemination or diffusion of information. Such findings may help us to develop and identify facilitators for promoting a better use of antibiotics in France and, more generally, for influencing GPs practice when it is of interest.

**Keywords:** Medical practice variation, Multilevel analysis, Upper respiratory tract infections, Rhinopharyngitis, Antibiotics, General practitioners, Panel, France.

**Classification JEL : I12, I18**

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## 1. Introduction

Many researches in France or abroad have highlighted a phenomenon of medical practice variation (MPV), even with equivalent clinical context, or even the inappropriateness of certain medical decisions. Examples of this phenomenon have been well described in the French context (CNAMTS, 1999; CNAMTS, 2002; CNAMTS, 2003; Pepin & Ricordeau, 2006) – which has been confronted with overuse (*i.e.* antibiotics…), underutilization (*i.e.* screening or follow-up of chronic disease like diabetes, hypertension) or misuse (*i.e.* prescription out of the official marketing authorization) – as in other health care systems (McGlynn, Asch, Adams, *et al.* 2003; Wennberg, 2004; Westert, Jabaaij & Schellevis, 2006; Chassin & Galvin, 1998).

MPV, in its normative meaning – the gap between practice and evidence based medicine – has been seen both as a sort of symptom and a source of inefficiency in health care delivery because some patients receive inappropriate delivery of treatment, even given equivalent clinical context and socio-demographic characteristics, where other receive appropriate care. In a system where funding is socialized, geographical or distribution related iniquities can also legitimately be taken into account (Bevan, 1990). The presence of inappropriate care can thus be a source of loss of well-being, both at the individual and social level: on one hand we finance inappropriate care, on the other hand we do not finance care which should be given (Leape, Park, Solomon *et al*., 1990; Phelps, 2000; Chassin, Brook, Park *et al.* 1986).

While the question of how to improve medical practices is on high position on the research and policy agenda in France (Haut Conseil pour l'Avenir de l'Assurance Maladie, 2004; Haut Conseil pour l'Avenir de l'Assurance Maladie, 2007), it is agreed that prior to adopt appropriate, we need to measure and identify sources of heterogeneity in medical practices (Wennberg, 2004). Several reviews or synthesised papers are now available on this topic (Casparie, 1996; Kerleau, 1998; de Jong, 2008a). Briefly, the lessons drawn by the literature on the origin of MPV vary between preference-centred hypothesis (differences in preferences or habits of physicians) *versus* opportunities and constraints one (differences in characteristics of social working environment); each one leading for different policy recommendation regarding measure which aimed at improving medical practice.

During the 70s and 80s, most of measures and explorations of MPV determinants has been based on studies called small-area variation (SAV), which analyse variation in occurrences of care events, or input utilisation between geographic areas (district, region, state, etc.) using aggregated data. Their main conclusion was that MPV could have been explained by differences in preferences or habits of physicians and in their patterns regarding treatments, which were themselves linked to age, gender, initial medical education, training or aversion for uncertainty for upholders of the 'practice style hypothesis' as J.E. Wennberg (Wennberg, Barnes & Zubkoff, 1982); or physicians' propensity to conform to with the local dominant practice for upholders of the "enthusiasm hypothesis" or the

”surgical signature” hypothesis (Chassin, 1993) (Wright, Hawker, Bombardier *et al.* 1999; Weinstein, Bronner, Morgan *et al.*, 2004). They both suggested that doctors developed specific and uniform practice for certain medical decision beyond the time and they particularly stress the need to implement the best guidelines in their day-to-day medical decision making process. But most of these studies were flown by the use of aggregated data and statistical and theorical limitations particular to SAV studies (Stano, 1991). Most of the latter have been overstep thanks to the better availability of individual data during the 90s (Phelps, 1995) enhances by the development of multilevel statistical methods. This is not only a way to take into account the hierarchical structure of the data at an individual level (visits, patients, physicians, hospitals, regions…) and then to avoid the statistical problems specific to this (dependency of observations…) but also to estimate the proportion of variation and its determinants at every level of clustering (Duncan, Jones & Moon, 1998).

There were many studies based on this type of methodology, in France (Rabilloud, Ecochard & Matillon, 1997; Mousquès, Renaud & Sermet, 2001; Pelletier-Fleury, Le, Hebbrecht & Boisnault, 2007) as in other countries (Scott & Shiell, 1997b; Scott & Shiell, 1997a; Davis, Gribben, Scott & Lay-Yee, 2000a; Davis, Gribben, Scott & Lay-Yee, 2000b; Davis, Gribben, Lay-Yee & Scott, 2002) (de Jong, Groenewegen & Westert, 2003; de Jong, Groenewegen & Westert, 2006; de Jong, Westert, Lagoe *et al.*, 2006). They brought the following conclusions: most of the variables characterizing the visits or the patients, and associated with the medical decision making, are significant (age, gender, diagnosis, degree/level of severity…). But they are also significant variations at physician or practice-area level given equivalent “clinical” context, thus taking account the level of professional uncertainty. These physicians' variations represent from 5% to 40% of total variation, depending on how large (*i.e.*, prescriptions as a whole) or focused (i.e., prescription restricted to acute otitis for example) the subject of the study is.

Most of these studies cast doubt over the “practice style”, the “enthusiasm” or the ”surgical signature“ hypothesis. They insist more on the primacy of the differences in the social (Goossens, Ferech, Vander *et al.*, 2005) and organisational context of the practice, than in differences in preference for certain procedures. For example, these studies stress the importance of: type of remuneration (capitation, salary, fee-for-service…), practice organisation mode (group vs. solo practice, participation in networks…) or level of medical supply available in the local area (medical density). Some of these authors were skeptical about policies that would be predominantly based on good practice enhancement, support by guidelines, without focusing enough on health care organisation or practice regulation (Westert & Groenewegen, 1999b; Westert & Groenewegen, 1999a; de Jong, 2008a). This lack of consensus on physicians' or context determinants of the MPV, especially in general practice, as well as the relative little work based on reliable statistical techniques, and the lack of French research on this topic, led us to try to bring some answers to this question, in the specific case of the prescription of antibiotics in acute rhinopharyngitis by GPs in France.

We chose this field for four main reasons. First, antibiotics prescription is a common practice, both in ambulatory and hospital care in France, and it is has been shown extensively that antibiotics consumption is much higher in France than in every other European country (Elseviers, Ferech, Stichele *et al.*, 2004; Goossens *et al.*, 2005). Second, at the time the study began, this situation had not evolved despite the implementation of a national plan in order to reduce antibiotics utilization, and annually renewed since then (Pepin & Ricordeau, 2006; Sommet, Sermet, Boelle, *et al.*, 2004; Goossens, Guillemot, Ferech *et al.* 2006). Third, there was, no doubt that, according to the medical profession, a high level of antibiotics was a key determinant in bacterial resistance development to antimicrobial agents. Forth, it was well established that antibiotics prescription in case acute rhinopharyngitis was only appropriate if bacterial complications, essentially acute medium ear infection and acute sinusitis, was suspected ( AFSSAPS, 1999). Rhinopharyngitis alone cannot be considered as a prodromic symptom neither of other upper respiratory tract infection (tonsillitis, laryngitis…) nor of a lower respiratory tract infection (pneumonia).

Thus the main purpose of this study is to know if the variations in antibiotics prescription in acute rhinopharyngitis are due to appropriate or inappropriate practice variations. We want to test whether the 'practice style', the ''enthusiasm" or the "surgical signature" hypothesis could match with our findings and explain such practice variations. More specifically, our objective is to measure the variability of use of antibiotics; then to identify the determinants of the visit and/or the patients coming for the visit; and finally to reveal any heterogeneity among physicians and to explain it through his social and organisational characteristics.

## 2. Data

The current study was based on the 2001 activity data from a panel of 1006 computerized French GPs (the "*Observatoire Epidémiologique Permanent Thalès"*) who where asked an ad hoc complementary questionnaire. The survey was conducted using a computerized questionnaire in June 2002 and 778 GPs answered the extra survey. This panel provided routine and complete visits (reason for the visit, for the prescription…) and patients characteristics (age, gender…), collected retrospectively from GPs' computerized patient files. The panel also provides GPs' characteristics and information about their practice. We filled in these by means of the *ad hoc* survey, in order to better understand GPs' relationship with their occupation and their working environment (medical continuing education, contact with pharmaceutical industry…).

We selected the visits performed at the physicians' office when rhinopharyngitis was the principal diagnosis or one of the reasons for which a drug prescription was delivered. Visits to patients' home were removed as they are known to be underreported in such computerized panel[c].

Data were naturally organised as a three levels cluster as every physician from the sample (778 GPs) follows several patients (185 383 patients) and each patient may have several visits during the year (254 620 visits). However, the recurrence of visits for a single patient was a rare phenomenon – in average, a patient had 1.37 visits for rhinopharyngitis in 2001 (maximum = 27) and 77% of the patients had only one visit for this diagnosis.

Then, the initial structure of the data was retained in the prospect of a hierarchical logistic model. As a random sample of 1 visit per patient was carried out, only the physician-visit clustering was taken into account. This identification/assimilation of visit and patients levels allowed us to: Retain simultaneously medical characteristics of the visit (complications, co-morbidities...), and socio-demographic and professional characteristics of the patient, without the risk to introduce ecological or atomistic fallacy; this could have be the case if we had chosen respectively to aggregate the first at the patient level or to break up the second at the visit level; Avoid a selection bias that would occur if we had only retained patients with one visit (77% of patients) or those with more than one (23% of patients).

Nevertheless, this simplification causes an information loss due to the repetition of visits for the same patient. We controlled this, *a minima,* by two types of indicators: When a visit follows within 10 days an initial visit for acute rhinopharyngitis, we chose to consider the latter as linked with the first one. In this way: one variable says if it was the case, another if the visit was the initial one or not, and a third whether it was initially treated by antibiotics or not; When a patient had already consulted this GP for acute rhinopharyngitis in 2001, the following medical decision is linked to the initial one(s). Thus one variable says if it is the case.

Finally, the sample includes 185 383 visits/patients, carried out by 778 GPs. The dependent variable in our analysis is a binary variable opposing the visits, depending on whether or not they generated antibiotics prescription. The dependent variable equals 1 if there is an antibiotics prescription for: the explicit diagnosis of rhinopharyngitis, as a reason for prescription indicated by the physician; or for another specific reason, directly associated with the rhinopharyngitis during the: one of its acknowledged bacterial complications (acute otitis media, sinusitis, conjunctivitis), or some specific co morbidities (upper respiratory tract infections, ear infections, lower respiratory tract infections).

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c One can notice that our selection of cases included all the care situations of acute rhinopharyngitis at the physicians' office, except when rhinopharyngitis was a secondary diagnosis and not treated by drugs, and thus not identified in the Thales panel. However, these situations appeared to be very unusual: from another French data source on private activity of physicians (IMS-Health France), this phenomenon represents only 0.8% of visits for acute rhinopharyngitis in GPs' practice in 2000.

The dependent variable equals 0 in any other situation. The explanatory variables could be routinely collected at practitioner (or practice) context level or at the visit/patient level. Physician's characteristics routinely collected through the panel concerned their socio-demographic and their practice setting profiles:

- Socio-demographic characteristics: age (in four classes) and gender (male or female);
- Practice setting characteristics: whether or not the GP was working in a group practice; what kind of financial agreement was contracted between the sickness fund and the GP (sector 1 vs. sector 2d); daily workload (number of visits in office and visits at home by day);
- Practice setting location characteristics, according to: a typology which splits France into light distinct areas, the level of urbanism (rural, suburbs, town center) and finally GPs density average by urban unity size (in three classes).

Through these variables, we aimed at testing the impact on MPV contextual determinant such as: temporal proximity to medical continuing education and the number of years of experiences (age); team-work (group *versus* solo practice); remuneration type (sector 1 *versus* sector 2); competition (medical density).

We made the assumption that physician with extra fees or practicing in area with huge medical density followed medical decision strategy aiming at maintaining or increasing their income. This can be done by increasing the intensity of the encounter (by self-promoting follow-up in cases of symptom persistence associated with a lower antibiotics prescription) or by increasing the daily productivity (by promoting visits which are less time consuming and then more frequently associated with antibiotics). The physicians' characteristics collected through the *ad hoc* survey were the following: intensity of peers contact: whether the GP belongs to a network of care takers or not, whether the GP was participating in a hospital staff or not, number of sessions of medical continuing education attempted by the GP during the previous year; intensity of pharmaceutical industry contact: number of pharmaceutical sales representatives received monthly by the GP (in three classes: from 0 to 9, from 10 to 19, 20 or more) and number of diners organized by pharmaceuticals for the GP (in three classes: 0, 1 or 2, 3 or more); perception of patient's demand: four items of the proneness of the physician to answer favorably at the patients requests for psychotropics or antibiotics prescription. In theses cases the assumptions were that an intensive relationship with peers was in favor of EBM and that frequent contacts with pharmaceutical industry marketing were in favor of a greater prescription.

Number of sessions of medical continuing education and volume of activity are incorporated in the model in their continuous form, all other variables being transformed into dummy variables.

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[d] GPs in "sector 1" are paid on a fee for services basis with tariffs under a ceiling whereas GPs in "sector 2" could bill extra discretionary fees not reimbursable by the sickness fund.

Table 1 gives the distribution of all these variables for the 778 GPs compared with the distribution in the overall population of French GPs (information from the French health Ministry). The bottom part of the table gives the distribution of the variables from the *ad hoc* survey.

**[Table 1 about here]**

Patient/visit's characteristics, which stand for case-mix variables that are potential confounders to be controlled, are:

- socio-professional indicators: age (in six classes), gender and professional position of the patient;
- diagnoses indicators, i.e. whether or not the patient had: a bacterial complication (acute otitis media or conjunctivitis or sinusitis), a risk factor of bacterial complication (serous otitis media), comorbidities suggesting that the acute rhinopharyngitis is a prodrome of a more severe disease (otorhinolaryngology or lower tract respiratory infection), an antecedent of acute otitis media.
- characteristics of the clinical context of the visit: the period of the year during which the visit proceeds (in order to capture a possible seasonal or epidemic context effect); when a visit follows by less than 10 days another visit for the same reason, whether or not the rhinopharyngitis is initially treated by antibiotics; whether or not the patient had already consulted this GP for acute rhinopharyngitis in 2001.

All these variables collected at the patient/visit level are integrated through dummy variables. The preliminary analyses were performed with SAS© 8.2.

## 3. Methods

As the standard logistic model is unsuitable for analysis of clustered data (dependence on the observations) and contextual effects proper to the physician medical decision (Rice & Jones, 1997; Duncan *et al.*, 1998) we used a hierarchical logistic model (HLM). This model allows us to include the average propensity of one GP to prescribe antibiotics and a random effect capturing the phenomenon of inter-practitioner variability, while in addition controlling visit or patient confounders (Raudenbush, Bryk, Cheong et al., 2001). Formally, the general specification of the HLM used in our work can be described as follows. Let us consider $\pi_{ij}$, the probability that the outcome of interest will occur at the $i$th visit by the $j$th GP. By using the logistic link function, the general form is:

$$\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_{0j} + \sum_{k} \beta_{kj} \cdot X_k + \varepsilon_{ij}$$

Level 1 equation (visit/patient)

$$\begin{cases} \beta_{0j} = \gamma_{00} + \sum_{h} \gamma_{0h} \cdot Z_h + u_{0j} \\ \beta_{kj} = \gamma_{k0} + \sum_{h} \gamma_{kh} \cdot Z_h + u_{kj}, \forall k \end{cases}$$

Level 2 equation (physician)

On this general form of the model, we use a modeling strategy in four stages, following the recommendations of modeling provided by Heck & Thomas (Heck & Thomas, 2002) and Bryk & Raudenbush (Raudenbush *et al.*, 2001). In a first step we estimate a simple null model (or model (1)) only with $\beta_{0j}$ – the conditional mean of realisation of the event « antibiotics prescription » – which can be split up in a constant term specific to the GP ($\gamma_{00}$) and an inter-physicians random effect ($u_{0j}$) plus the individual residual ($\varepsilon_{ij}$). This step is performed in order to verify whether inter-physicians medical practice variation indeed exist and to measure it as a part of total variation. In a second step, we identify the relevant visit or patient characteristics by integrating, in addition to the first step, visit and patient variables $X_k$ (age, gender, bacterial complication…). The associated parameters to these variables, considered fixed and common for all the GPs ($\gamma_{k0}$), were estimated and we only kept the significant ones (model (2)). Finally, we estimate the inter-physician heterogeneity evolution regarding the first step, and then the evolution of variance that could be explained by the introduction of visit and patient characteristics. In a third step, we add a complex variance structure by testing the presence of significant random effects $u_{kj}$ in the slope $\beta_{kj}$ of visit and patient variables: so doing, we assume that the visit or patient influence on antibiotics prescriptions varies from on GP to another. We now can estimate how large inter- and intra- physician variability are. We only keep into the model the slopes with a significant inter-GPs residual (model 3). Finally, the last step consists in integrating into the model resulting from preceding steps all characteristics of the physicians and of their practice $Z_h$ (age, gender, group or single practice, number of CME sessions…), in order to test the influence of these variables on random slopes $u_{kj}$ introduced in the previous step (model 3). Thus, we estimate in this final model all the residuals $u_{kj}$ (including $u_{0j}$) and all the constant parameters $\gamma_{k0}$ (visit or patient variables) and $\gamma_{kh}$ (physician variables). We only keep into the final model the significant physicians' predictors (model (4)).

In any case, $\varepsilon_{ij}$ were considered as individual residuals randomly distributed. They vary between all visits and were distributed following the same logistic law as for the dependant variable. In the models (1) to (3) we consider that the random effect $u_{0j}$ is a normally distributed random variable, with: $u_{0j} \sim N(0, \sigma_0^2)$. In the model (4) we make the assumption that the random effects $u_{kj}$ were normally distributed, independently from $\varepsilon_{ij}$, with a complex variance structure:

$$u_{kj} \sim N(0,\Sigma) \text{ with } \Sigma = \begin{bmatrix} \sigma_0^2 & \sigma_{01} & \cdots & \sigma_{0K} \\ \sigma_{01} & \sigma_1^2 & \cdots & \sigma_{1K} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{0K} & \sigma_{1K} & \cdots & \sigma_K^2 \end{bmatrix}$$

This strategy of modeling allows, by comparing the various stages, to quantify the respective contributions of the variations between visit/patients and the variations between physicians according to the initial variance (inter- and intra- variations). Thus a precise report can be drawn up on the nature and the magnitude of the determinants of the antibiotics prescription. We will produce for each stage inter-physicians variance terms ($\sigma_0^2$ and the $\sigma_k^2$) as well as intra-class coefficients of correlation and median odds ratios to quantify the contribution of the variations between physicians to the full variance. Intra-class coefficient of correlation *ρ* is the statistical ratio mostly used in the hierarchical models because it is informative and easily understandable. *ρ* divides the proportion of variance of the level of the group (here, inter-physicians variations) to the total variance. However, if it is easy to assess with gaussian variables, several alternatives assessment methods coexist in the case of a binary variable (Snijders & Busker, 1999) (Goldstein, Brown and Rabash, 2002). We have chosen the simplest one and most frequently used (Davis and Al, 1999; Pickery and Loosveldt, 1999) which is based on the logistic specification of the model:

$$\rho_B = \frac{Var(u_0)}{Var(u_0) + \frac{\pi^2}{3}}$$

This formula has the advantage of simplicity and of flexibility, since it is an estimate conditional to the covariates without however utilizing the values of these covariates for the assessment; *a contrario* its validity is directly linked to the assumed validity of a continuous latent variable.

The median odds ratio (MOR), a less common measure, is more suitable for logistic hierarchical model. (Goldstein H., Browne W., Rasbash J. 2002).( MOR is the median of the distribution of the values of odds ratio between two randomly chosen visits within all visits realized by two different GPs. The calculation formula is:

$$MOR = \exp\left(\sqrt{(2 \times Var(u_0))} \times \Phi_{Norm}^{-1}\left(3/4\right)\right)$$

This ratio depends on patient/visit covariates values and will be difficult to produce in the case of complex variance structure as in the model (4). The hierarchical linear models were estimated with the support of the software HLM©, version 5 (Raudenbush *et al.*, 2001).

## 4. Results

One out of two visits (51.4%) results in an antibiotic prescription for acute rhinopharyngitis. When antibiotic prescription can be justify by bacterial complications (only for 4.27% visit), the prescription rate of antibiotics reaches 75%; without any bacterial complications the rate is 50.3% (see table 2).

**[Table 2 about here]**

Even if the antibiotic prescription appears to be the predominant pattern for acute rhinopharyngitis, the propensity to prescribe antibiotics differed considerably from one GP to another: on the one hand 30.1% of GPs prescribed antibiotics in less than 30% of visits; on the other hand 27.6% of GPs prescribed antibiotics in more than 70% of visits (see figure 1).

**[Figure 1 about here]**

This heterogeneity is confirmed by the estimation of the model (1) (see first and second column in table 3): the estimated variance of the inter-physicians random effect is significantly different from 0. From the mean of the intra-class coefficient ($\rho$= 0,272) we can say that the gap between GPs average practice represents one quarter of total variation of antibiotics prescription for acute rhinopharyngitis. From the calculation of the MOR (MOR=2.88) we can deduce a similar conclusion: with 50% probability, a GP, randomly picked, prescribes a least 2.88 more antibiotics than another GP randomly picked.

**[Table 3 about here]**

The model (2) shows that GP adapts his prescription pattern to patients' characteristics. Patients suffering from complicated acute rhinopharyngitis (with bacterial complication) are mostly concerned by antibiotics prescription. This is the most influent factor of antibiotics prescription (coefficient=1.25, MOR=3.49): in the case of two visits randomly chosen (one with bacterial complications, the other without) performed by two randomly picked GPs, the antibiotics prescription rate is 3.5 larger for the visit with bacterial complications. In the case of visits with ORL or respiratory comorbidities, which suggest that rhinopharyngitis is a prodromic symptom, the antibiotics prescription rate is higher too (MOR respectively equal to 3.25 and 4.85) whatever this can be justified by guidelines or not. On the opposite, other ORL comorbidities influence negatively antibiotics prescriptions (OR=0.59). Neither the presence of serous otitis media nor antecedent of acute otitis media, both risk factors of bacterial complication, influence significantly antibiotics prescription. Women with acute rhinopharyngitis are less treated by antibiotics than men (MOR=0.89). Comparatively to patients between 40-65 years old, patients of less than 16 years old, or more than 65 years old, are less treated by antibiotics (MOR respectively equal to 0.86 and 0.82) and those between 16-39 are more treated by antibiotics (MOR=1.13). Furthermore, the non-employed are less treated by antibiotics than all active workers

(MOR=0.91), but there is no difference between types of profession. Visits proceeding between January and April or between May and August are more likely to result in antibiotics prescription than others (MOR around 1.16). When a visit follows by less than 10 days a previous visit for the same reason, antibiotics prescription is conditionned by whether (OR=0.55) or not (OR=1.48) the rhinopharyngitis is initially treated by antibiotics. Finally, if patients had already consulted this GP for acute rhinopharyngitis in 2001 he had less probability to receive antibiotics prescription (OR=0.17).

By comparison to the model (1), the model (2) shows an increase of the intra-class correlation coefficient (with $\rho$=0,288, increase rate=5.84%) as of the median odds ratio (with MOR=3, increase rate=4.34%): the variance intra GP (between visit of one GP) is partly explained by visit or patient characteristics. The model (4) shows, first, that practically all the random effects in the slope of visit and patient variables were significant (with the exception of gender and occupation) and, second, that fixed effects remains significant. This confirms the assumption that the influence of visit or patient characteristics on antibiotics prescriptions varies from one GP to another.

**[Table 4 about here]**

In this model with a complex structure of variance the values of $\rho$ and MOR were dependant of values of covariates. They value $\rho$=0.30 and MOR=3.08 for a reference visit, chosen as follows: without any bacterial complication nor ORL comorbidities, not following by less than 10 days another visit for the same reason, proceeding between September and December 2001, for a patient between 40 and 54 years old. With 50% probability, a GP, randomly picked, prescribes a least 3.08 more frequently antibiotics than another GP randomly picked. For a visit with the same characteristics except that there is some ORL comorbidities and the patient age is between 16-39 years old, the MOR is higher and equals 4.03. On the opposite, for a visit following by less than 10 days a previous visit for acute rhinopharyngitis without any antibiotic prescription, with bacterial complication and for a patient more than 65 years old, the MOR is lower and equals 2.57.

In the model (4), despite the introduction of GP characteristics, all the random effects in the slope of visit and patient variables remain significant. Variations between GPs can be explained by practice or GPs' socio-demographic characteristics. GPs' participation in a network, intensity of the continuing medical education and proximity to medical initial medical education (age), practicing in an area with strong density of GPs are associated with less antibiotics prescriptions. On the contrary, the number of recent visits from pharmaceutical sales representatives received by the GPs, as well as an high level of activity are associated with more antibiotics prescriptions. We also observe that some GPs' characteristics interact with visit or patient variables. One illustration is that GP with a small number of recent visits from pharmaceutical sales representatives prescribes fewer antibiotics for 16-39 years old patients. In the model (4), $\rho$ and MOR were lower than in the previous model (see table 4). For the first reference visit $\rho$ is equal to 1.317 and thus the relative reduction (from 1.388 to 1.317) equals 5%, the MOR is equal to 3 and thus the relative reduction equals 2.9%. For the second visit reference the diminution of the MOR is lower (from 4.03 to 3.97) and around 1.5% visit.

## 5. Discussion

The principal purpose of this study is to refute the 'practice style', the 'enthusiasm' or the 'surgical signature' hypothesis, which all assume that physicians adopt for their patient a uniform practice style for each similar clinical decision beyond the time. More specifically, multilevel models are estimated: First to measure variability of antibiotics prescription by French general practitioners for acute rhinopharyngitis, a clinical decision making context with weak uncertainty, and to tests its significance; Second to prioritize its determinants, especially those relating to GP or its practice setting environment, by controlling visit or patient confounders.

First, with regard both to the large level of antibiotic prescription for acute rhinopharyngitis, one out of two visits results in an antibiotic prescription, and to the clinical practice guidelines, it can be observed that such practice is common and globally inappropriate. Second, we put forward that there is a significant heterogeneity between GPs' antibiotics prescription patterns, which represent 28% of full variance based on the calculation of the intra-class coefficient of correlation. When we assumed that the influence of visit/patient characteristics on antibiotics prescriptions varies from on GP to another – regarding different scenarios related to the presence or not of certain visit/patient modalities –, we show that, with a 50% probability, one GP randomly chosen prescribes antibiotics for acute rhinopharyngitis 2 to 4.5 times more frequently than another randomly picked up GP. The between-GP variations here are consistent with the results of other studies in various medical field and using similar design and method: from 13 to 27% for upper respiratory tract infection according to clinical decision making analyse in a New Zeeland study (Davis *et al.*, 2002) ; from 18% to 43% for the treatment of sprain and acute otitis media in an Australian study (Scott & Shiell, 1997b) ; from 3% to 19% for the treatment of hypertension, lower back pain, insomnia, depression, cough, respiratory tract infection, diabetes mellitus in Dutch studies (de Jong, 2008b); from 20% to 33% for the cardiovascular prevention and for immunization in a French study (Pelletier-Fleury *et al.*, 2007). Finally, the largest part of the total variation was related to intra-physician variability (70%). Hence, there is clear evidence to support the rejection of the 'practice style', the 'enthusiasm' or the 'surgical signature' hypothesis in the French general practice context.

Even if our clinical or socio-demographic explanatory variables seem to exert a weak effect on variations between visits (5.8% of the full variance) the following points are also woth to consider. It appears that GPs in some specific clinical context are able to make the right medical decision (e.g.: for bacterial complication or ORL comorbidities directly linked with acute rhinopharyngitis), but this is not the case for all of them (other ORL and respiratory comorbidities, unfavourable epidemic context…) where their decision seems to be in inadequacy with clinical guidelines. In this latter case, we can assume either that GP wrongly appraise the clinical context: The comorbidities are considered as a sign of the greater intensity or severity of the disease, thus allowing them to justify wrongly (according to clinical guidelines) their therapeutic choice; Or that the GPs' decision to do not prescribe antibiotics is more difficult to argue with his patient and thus more difficult to implement. Both reasons may apply simultaneously: study results of the effect of patient variables such as occupational status, age, and even gender, on antibiotics prescription have suggested that for patient antibiotics prescription is wrongly linked with their preference for not interrupting their work.

Another set of results concern GPs or contextual variables. Regarding GP's variables which traditionally explain medical decision making, it is always observed that within a situation of agent relationship between GP and patient, the first have a discretionary power and is able to induce or influence demand in order to maintain, indeed or increase its remuneration (McGuire, 2008). Then, remuneration type and/or level of competition by modifying the workload - should impinge on medical decision making and its quality/performance (McGuire, 2008; Grignon, Paris, Polton *et al.,* 2002; Gosden, Forland, Kristiansen *et al.* 2001). As we mentioned before there is no opposition between fee for services and prospect payment in the French ambulatory health care system. Nevertheless, there is two fee for services sector: one with celled tariffs (sector 1) and one with extra fees (sector 2). It has been shown on French data that GPs who practice in sector 2 have a lower number of procedures, and pharmacy costs, per year and per patient, than those in sector 1 (Bejean, Peyron & Urbinelli, 2007). Furthermore, there is a clear evidence of supply inducement since it has been shown on longitudinal data that: an increase in medical density results, in sector 1, both in a decrease of activity (number of visits) and an increase of intensity of each encounter, whereas it results, in sector 2, in a decrease of tariffs and an increase of activity (Delattre & Dormont, 2003; Delattre & Dormont, 2005). Finally, the link between a high level of activity or workload and a high propensity to prescribe more drugs was also demonstrated (Paraponaris, Verger, Desquins *et al.* 2004; Bejean *et al.*, 2007).

In our study, GPs who practice in an area with strong medical density of GPs prescribe less antibiotics prescriptions than the others. GPs with extra fees could not be distinguished from those with celled tariffs. Moreover, GPs with a high level of visits prescribe more antibiotics than the others. We can argue, in this case, that when activity is high, whether as a consequence of deliberate choice (increased productivity) or not (workload), GPs use the "less time-consuming medical decision" which consist in prescribing antibiotics. It has been also frequently observed that: Group practice seems to be linked with better performance and less prescription than solo practice (Tollen, 2008); GPs working in a same group practice have more resemblance in attitudes and behaviours than GPs not working in the same partnership (de Jong *et al.*, 2003; de Jong, 2008b). In our study there is no effect of being in group practice. Finally, GPs between 35-44 years old prescribe less antibiotics than others, as it has been observed in other studies (Davis *et al.*, 2000a; Davis *et al.*, 2002; Bejean *et al.*, 2007). We can argue here that proximity to initial medical education is more in favour of a good practice.

A final set of results regards physician or contextual variables. We have seen that GPs' participation in a network and intensity of the continuing medical education are associated with less antibiotics prescriptions. On the contrary, the number of recent visits from pharmaceutical sales representatives received by the GPs is associated with more antibiotics prescriptions. Another French study gives evidence of this link for identification of suicidal ideation by GPs (Verger, Clavaud, Bidaud *et al.*, 2007). These results suggest that MPV may be influenced by differences in the type of dissemination or diffusion of information, as it is well demonstrated trough the studies published by the Cochrane Effective Practice and Organisation of Care Group (Grimshaw, Thomas, MacLennan *et al.* 2004). These results could help us to develop and identify facilitators for promoting a better use of antibiotic in France as increasing continuing medical education or educational outreach visits. Finally, altogether GP and contextual variables could explain 6% of the full variance.

Some limitations should be taking into account in our study. First, GPs included in the study may not be representative of the GP's profession as they belong to the same network. They are much more computerised, more located in Paris area and older than the others. Second, our selection of cases included all the care situations of acute rhinopharyngitis at the physicians' office, except when rhinopharyngitis was a secondary diagnosis and not treated by drugs, and thus not identified in the panel. But, as we said before, these situations are known to be rare. Third, only visits to the doctor's office were taken into account and then the visits to patients' home being removed, as they are known to be under-reported in the panel. Last, the only level of clustering we took into account was the physician-visit one: by doing so, we are not able to get the longitudinal perspective of repeated visits for a same patient. But, *a minima*, we controlled this phenomenon with a dummy for patient return.

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**Table 1 – Descriptive statistics**

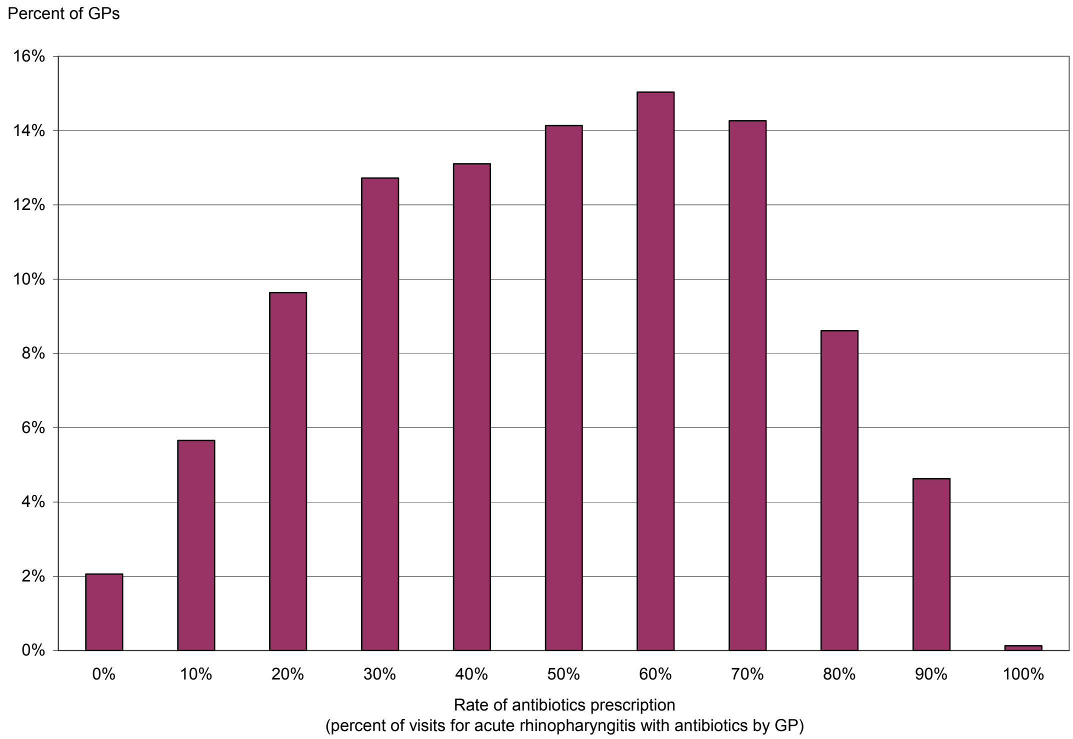
| | Sample from a panel of computerized French GPs | | National Sickness Fund database | |
|---|---|---|---|---|
| | **Frequency** | **Percent** | **Frequency** | **Percent** |
| **Gender** | | | | |
| Male | 701 | 90,1% | 42 066 | 77,5 % |
| Female | 77 | 9,9 % | 12 206 | 22,5 % |
| **Age** | | | | |
| <35 years old | 12 | 1,5 % | 2 988 | 5,5 % |
| 35-44 years old | 190 | 24,4 % | 19 793 | 36,5 % |
| 45-54 years old | 466 | 59,9 % | 25 469 | 46,9 % |
| >=55 years old | 109 | 14,0 % | 6 022 | 11,1 % |
| **Practice** | | | | |
| Group | 381 | 49,0 % | 22 593 | 41,6 % |
| Solo | 397 | 51,0 % | 31 679 | 58,4 % |
| **GP-Sickness Fund Contract** | | | | |
| Fee for services with tariffs under a ceiling | 617 | 79,3 % | 48 486 | 89,3 % |
| Fee for services plus extra discretionary fees not reimbursable by the sickness fund | 161 | 20,7 % | 5 786 | 10,7 % |
| **Location** | | | | |
| Paris area | 305 | 39,2 % | 8 449 | 15,6 % |
| Paris region | 107 | 13,8 % | 8 784 | 16,2 % |
| North | 39 | 5,0 % | 3 857 | 7,1 % |
| East | 36 | 4,6 % | 4 837 | 8,9 % |
| West | 72 | 9,2 % | 6 972 | 12,8 % |
| South-West | 52 | 6,7 % | 6 613 | 12,2 % |
| Center-East | 66 | 8,5 % | 6 392 | 11,8 % |
| South-East | 101 | 13,0 % | 8 368 | 15,4 % |
| **GPs density average by urban unity size** | | | No data available | |
| Below 75 GPs by 100.000 inhabitants | 63 | 8,1% | | |
| Between 75-135 GPs by 100.000 inhabitants | 386 | 49,6% | | |
| More than 135 GPs by 100.000 inhabitants | 329 | 42,3% | | |
| **Level of urbanism** | | | | |
| Rural | 63 | 8,1 % | | |
| Suburb | 321 | 41,3 % | | |
| Town center | 394 | 50,6 % | | |
| **Participation to hospital staff :** Yes | 223 | 28,7 % | | |
| **Participation to network of care :** Yes | 174 | 22,4 % | | |
| **Number of pharmaceutical sales representatives received per month** | | | | |
| From 0 to 9 | 172 | 22,1 % | | |
| From 10 to 19 | 248 | 31,9 % | | |
| More than 19 | 358 | 46,0 % | | |
| **Number of diners, organized by pharmaceuticals attempted by the GP during the previous year** | | | | |
| 0 or 1 | 421 | 54,1 % | | |
| 2 or 3 | 259 | 33,3 % | | |
| More than 3 | 98 | 12,6 % | | |
| **Proneness of the GP to answer favourably at the patients requests for antibiotics drugs** | | | | |
| Exceptionally or never | 316 | 40,6 % | | |
| Occasionally | 383 | 49,2 % | | |
| Always or regularly | 79 | 10,2 % | | |
| **Proneness of the GP to answer favourably at the patients requests for psychotropics drugs** | | | | |
| Exceptionally or never | 323 | 41,5 % | | |
| Occasionally | 359 | 46,1 % | | |
| Always or regularly | 96 | 12,3 % | | |
| | **Moyenne** | **Ecart-type** | | |
| **Number of sessions of medical continuing education attempted by the GP during the previous year** | 6,48 | 7,0 | No data available | |
| **Number of visits (at office and at patient's home) by day** | 22,5 | 10,3 | | |
| **Total** | **778** | **100,0 %** | **54 272** | **100,0 %** |

**Table 2 – Adequacy of antibiotics prescription for acute rhinopharyngitis to guidelines**

| Antibiotic prescription for acute rhinopharyngitis [1] | Antibiotic prescription justified by some bacterial complications | Antibiotic prescription justified by upper respiratory tract infections, ear infections or lower respiratory tract infections | Antibiotic prescription not relevant | Total |
|---|---|---|---|---|
| No | 825<br>0,9%<br>23,7% | 1 107<br>1,2%<br>24,9% | 88 153<br>97,9%<br>49,7% | **90 085**<br>100%<br>48,6% |
| Yes | 2 656<br>2,8%<br>76,3% | 3 331<br>3,5%<br>75,1% | 89 311<br>93,7%<br>50,3% | **95 298**<br>100%<br>51,4% |
| **Total** | **3 481**<br>1,9%<br>100% | **4 438**<br>2,4%<br>100% | **177 464**<br>95,7%<br>100% | **185 383**<br>100%<br>100% |

[1] **Specifically for rhinopharyngitis or for another specific reason, directly associated with the rhinopharyngitis during the visit**

**Figure 1 – Percent of GPs regarding their rate of antibiotics prescription for acute rhinopharyngitis**



### Table 3 – Hierarchical Logistic Models (1), (2) and (3)

| | Model (1) | | Model (2) | | Model (3) | |
|---|---|---|---|---|---|---|
| | Coefficient | (standard deviation) | Coefficient | (standard deviation) | Coefficient | (standard deviation) |
| **Intercept** | -0,049 | (0,032) | -0,043 | (0,033) | -0,045 | (0,033) |
| **GP's explanatory variables (fixed effects)** | | | | | | |
| GPs aged 35 to 44 years old | | | | | **-0,173** | (0,075) |
| Participation to a network of care | | | | | **-0,167** | (0,080) |
| Nb. of medical continuing education sessions attempted by the GP during the previous year | | | | | **-0,015** | (0,005) |
| Less than 10 pharmaceutical sales representatives received per month | | | | | **-0,187** | (0,081) |
| More than 135 GPs per 100.000 inhabitants within the urban unity | | | | | **-0,231** | (0,068) |
| Number of visits (at office and at patient's home) by day | | | | | **0,011** | (0,003) |
| **Patient-visit and GP explanatory variables (fixed effects)** | | | | | | |
| Age *(reference 40-64 years old)* | | | | | | |
| <16 years old: intercept | | | **-0,151** | (0,024) | **-0,156** | (0,025) |
| 16-39 years old | | | **0,123** | (0,014) | **0,126** | (0,014) |
| >=65 years old | | | **-0,196** | (0,025) | **-0,199** | (0,025) |
| Female | | | **-0,121** | (0,009) | **-0,124** | (0,009) |
| Patient with no occupation | | | **-0,095** | (0,017) | **-0,098** | (0,017) |
| Patient with bacterial complication (acute otitis media, conjunctivitis or sinusitis) | | | **1,250** | (0,065) | **1,268** | (0,068) |
| Patient with comorbidities (otorhinolaryngology or lower tract respiratory infection) justifying an antibiotics prescription | | | **1,181** | (0,074) | **1,175** | (0,080) |
| Patient with comorbidities (otorhinolaryngology or lower tract respiratory infection) not justifying an antibiotics prescription | | | **1,578** | (0,084) | **1,604** | (0,087) |
| Patient with other otorhinolaryngology or lower tract respiratory infection | | | **-0,527** | (0,046) | **-0,535** | (0,046) |
| Period of the year during which the visit proceeds (*ref. from September to December*) | | | | | | |
| From January to April | | | **0,158** | (0,017) | **0,162** | (0,017) |
| From May to August | | | **0,148** | (0,018) | **0,152** | (0,018) |
| Rhinopharyngitis initially treated by antibiotics less than 10 days before | | | **-0,586** | (0,073) | **-0,613** | (0,075) |
| Rhinopharyngitis initially treated without antibiotic prescription less than 10 days before | | | **0,387** | (0,066) | **0,392** | (0,067) |
| Patient with previous visits for acute rhinopharyngitis during the year | | | **-0,168** | (0,017) | **-0,172** | (0,017) |
| **Variance of inter-physicians random effect** | **1,228** | | **1,329** | | **1,252** | |
| **Intra-class coefficient of correlation *ρ*** | **$\rho_1$ = 27,2%** | | **$\rho_2$ = 28,8%** | | **Depending on patient/visit covariates hold. See Result section for details.** | |
| **Median Odd Ratio (MOR)** | **$MOR_1$ = 2,88** | | **$MOR_2$ = 3,00** | | | |

## Table 4 – Hierarchical Logistic Model (4)

| | Coefficient | (standard deviation ) |
|---|---|---|
| **Intercept** | -0,045 | (0,033) |
| **GP's explanatory variables within the intercept (fixed effects)** | | |
| GPs aged 35 to 44 years old | -0,173 | (0,075) |
| Participation to a network of care | -0,167 | (0,080) |
| Nb. of medical continuing education sessions attempted by the GP during the previous year | -0,015 | (0,005) |
| Less than 10 pharmaceutical sales representatives received per month | -0,187 | (0,081) |
| More than 135 GP per 100.000 inhabitants within the urban unity size | -0,231 | (0,068) |
| Number of visits (at office and at patient's home) by day | 0,011 | (0,003) |
| **Patient-visit and GP explanatory variables within the slopes (fixed and random effects)** | | |
| Age *(reference 40-64 years old)* | | |
| <16 years old: intercept | -0,152 | (0,023) |
| <16 years old: variance of inter-physicians random effect | 0,224 | |
| 16-39 years old : intercept | 0,117 | (0,014) |
| 16-39 years old : participation to hospital staff | 0,084 | (0,027) |
| 16-39 years old : less than 10 pharmaceutical sales representatives received monthly | -0,056 | (0,028) |
| 16-39 years old : variance of inter physicians random effect | 0,085 | |
| >=65 years old: intercept | -0,183 | (0,023) |
| >=65 years old: participation to network of care | 0,129 | (0,053) |
| >=65 years old: variance of inter physicians random effect | 0,103 | |
| Female | -0,119 | (0,009) |
| Patient with no occupation | -0,085 | (0,016) |
| Patient with bacterial complication (acute otitis media, conjunctivitis or sinusitis) | | |
| Intercept | 1,061 | (0,043) |
| Variance of inter physicians random effect | 0,765 | |
| Patient with comorbidities (otorhinolaryngology or lower tract respiratory infection) justifying an antibiotics prescription | | |
| Intercept | 0,978 | (0,040) |
| Variance of inter physicians random effect | 0,612 | |
| Patient with comorbidities (otorhinolaryngology or lower tract respiratory infection) not justifying an antibiotics prescription | | |
| Intercept | 1,288 | (0,046) |
| GPS between 35-44 years old | 0,223 | (0,105) |
| Variance of inter physicans random effect | 0,862 | |
| Patient with other otorhinolaryngology or lower tract respiratory infection | | |
| Intercept | -0,533 | (0,039) |
| >135 GPs per 100.000 inhabitants within the urban unity | 0,168 | (0,077) |
| Variance of inter physicians random effect | 0,259 | |
| Period of the year during which the visit proceeds (*ref. from September to December*) | | |
| From January to April: intercept | 0,160 | (0,015) |
| From January to April: variance of inter physicians random effect | 0,156 | |
| From May to August: intercept | 0,152 | (0,016) |
| From May to August: variance of inter physicians random effect | 0,133 | |
| Rhinopharyngitis initially treated by antibiotics less than 10 days before | | |
| Intercept | -0,320 | (0,063) |
| Nb. of medical continuing education sessions attempted by the GP during the previous year | 0,021 | (0,009) |
| variance of inter physicians old random effect | 0,742 | |
| Rhinopharyngitis initially treated without antibiotic prescription less than 10 days before | | |
| intercept | 0,276 | (0,059) |
| Participation to network of care | 0,376 | (0,137) |
| Variance of inter physicians random effect | 0,794 | |
| Patient with previous visits for acute rhinopharyngitis during the year | | |
| Intercept | -0,146 | (0,015) |
| GPs female | 0,104 | (0,050) |
| Participation to a network of care | 0,066 | (0,036) |
| Less than 10 pharmaceutical sales representatives received per month | 0,079 | (0,037) |
| Variance of inter physicians random effect | 0,093 | |
| **Variance of inter-physicians random effect** | **1,252** | |
| **Intra-class coefficient of correlation ρ** | **See Results sections for details** | |
| **Median Odd Ratio (MOR)** | | |

## A Refutation of the Practice Style Hypothesis: the Case of Antibiotics Prescription by French General Practitioners for Acute Rhinopharyngitis

Julien Mousquès (Irdes), Thomas Renaud (Irdes) and Olivier Scemama (Has)

Many researches in France or abroad have highlighted the medical practice variation (MPV) phenomenon, or even the inappropriateness of certain medical decisions. There is no consensus on the origin of this MPV between preference-centred versus opportunities and constraints approaches. This study principal purpose is to refute hypothesis which assume that physicians adopt for their patient a uniform practice style for each similar clinical decision beyond the time. More specifically, multilevel models are estimated: First to measure variability of antibiotics prescription by French general practitioners for acute rhinopharyngitis, a clinical decision making context with weak uncertainty, and to tests its significance; Second to prioritize its determinants, especially those relating to GP or its practice setting environment, by controlling visit or patient confounders. The study was based on the 2001 activity data, added by an ad hoc questionnaire, of a sample of 778 GPs arising from a panel of 1006 computerized French GPs.

A great part of the total variation was due to intra-physician variability (70%). Hence, in the French general practice context, we find empirical support for the rejection of the 'practice style', the 'enthusiasm' or the 'surgical signature' hypothesis. Thus, it is patients' characteristics that largely explain the prescription, even if physicians' characteristics (area of practice, level of activity, network participation, participation in ongoing medical training) and environmental factors (recent visit from pharmaceutical sales representatives) also exert considerable influence. The latter suggest that MPV are partly caused by differences in the type of dissemination or diffusion of information. Such findings may help us to develop and identify facilitators for promoting a better use of antibiotics in France and, more generally, for influencing GPs practice when it is of interest.

## Une réfutation de l'hypothèse de style de pratique : le cas de la prescription d'antibiotiques pour la rhinopharyngite aiguë par les médecins généralistes français

Julien Mousquès (Irdes), Thomas Renaud (Irdes) and Olivier Scemama (Has)

Nombre de recherches en France ou à l'étranger ont mis en évidence des phénomènes de variabilité des pratiques médicale (VPM), voire d'inadéquation de certaines décisions médicales. Il n'y a pas de consensus sur l'origine de la VPM et les hypothèses mises en avant privilégient tantôt le concept de préférences des médecins tantôt les opportunités et les contraintes auxquels ils ont à faire face. L'objectif principal de cette étude est de réfuter l'hypothèse selon laquelle les médecins adoptent, au cours du temps, pour chaque décision clinique et à patient équivalent, un comportement thérapeutique uniforme, un style de pratique. Plus spécifiquement, des modèles à multiniveaux sont estimés : premièrement, pour mesurer la variabilité de la prescription d'antibiotiques par les médecins généralistes français dans la rhinopharyngite aiguë, un contexte clinique de prise de décision à incertitude faible, et tester sa significativité ; deuxièmement, pour hiérarchiser les déterminants de la variabilité, particulièrement ceux relatifs aux généralistes ou à leur exercice, tout en contrôlant des facteurs de confusion propre au contexte de la consultation ou aux caractéristiques du patient. L'étude se fonde sur les données d'activité 2001 d'un échantillon de 778 généralistes issus d'un panel de 1 006 généralistes français informatisés, associées à des données d'une enquête *ad hoc*.

Une grande partie de la variance totale relevant d'une variabilité intra-médecin (70 %), dans le contexte français, nous rejetons l'hypothèse reposant sur le style de pratique des médecins généralistes. Ce sont surtout les caractéristiques des patients ou de la consultation qui expliquent la décision de prescrire ou non des antibiotiques dans la rhinopharyngite aiguë, même si les caractéristiques des médecins (secteur conventionnel d'exercice, niveau d'activité, participation à des réseaux, participation à de la formation médicale continue) et de leur exercice (visite récente par des représentants de ventes de l'industrie pharmaceutique) exercent également une influence importante. La VPM serait en partie causée par des différences dans la nature ou dans les formes de diffusion des informations médicales. De tels résultats peuvent nous aider à identifier des leviers pour favoriser une meilleure utilisation des antibiotiques en France et, plus généralement, pour améliorer les pratiques des médecins généralistes.

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