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PHARMACOKINETICS AND PRESCRIPTION

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Influence of physician's education, drug information and medical-care settings on the quality of drugs prescribed

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Abstract *Objective*: To identify factors associated with low prescription quality in primary care.
Methods: We carried out a cross-sectional study on a sample of 405 primary care physicians in Galicia (Northwest Spain). The following independent variables were collected through a mail questionnaire survey: physician's education and speciality, physician's perception of the quality of available drug information sources, type of practice and number of patients. We constructed multiple regression models using as dependent variables four indicators of the quality of drugs prescribed.
Results: The response rate was 75.2%. The quality of drugs prescribed was found to be associated with regulated physician training ($P = 0.001$), perceived credibility of information sources ($P = 0.013$) and environmental characteristics of the practice (reform model and number of patients' cards).
Conclusion: Study results suggest that in order to improve the quality of drugs prescribed, physician education and training must be improved and the role of pharmaceutical companies in physician training should be limited, emphasising more objective sources of information, such as therapeutic guidelines. Our results also underline the need to complete the reform of our primary care system and promote better relationships among physicians and between physicians and patients.

Key words Primary care · Prescription quality · Cross-sectional study

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Introduction

Drug prescribing is the most common form of therapy and often has the greatest economic impact on all kinds of therapy in most countries. However, prescribing practices are often irrational and consequently dangerous [1]. Therefore, the factors associated with poor prescription practices are of great interest from social, economic and public-health perspectives.

There are numerous studies examining the influence of various factors on prescription quality, focusing on the practitioner [2, 3, 4, 5, 6]. These studies have identified factors such as physician's age [4], educational background [2, 5] and primary care (PC) patient load [6] as variables predictive of prescription quality.

After reviewing the literature, and based on explanatory models for health behaviour, we constructed a mixed theoretical model of the factors modifying prescription quality. The model (Fig. 1) includes factors inherent to the physician and related to his/her education, which would be explained using the behavioural theory of knowledge–attitudes–practices [7, 8]. The model also includes exogenous factors associated with the physician–environment interaction, the effect of which is explained by the satisfaction needs theory [9, 10].

In this model, inherent factors – formal education and information sources used by the physicians – would affect physician's knowledge of therapy, which in turn would generate attitudes toward drug prescription that would then manifest in prescription practices. However, the knowledge–attitudes–practices relationship is not univocal (certain knowledge does not always produce the same habits) [11]. This relationship can be modified by exogenous factors affecting prescription practices as explained by the satisfaction needs theory [9]. In the process of receiving information, physicians may develop mechanisms of "selective perception" that would shield them from information that they reject a priori. Even if the physician develops certain attitudes regarding prescription behaviour, these may not be directly put

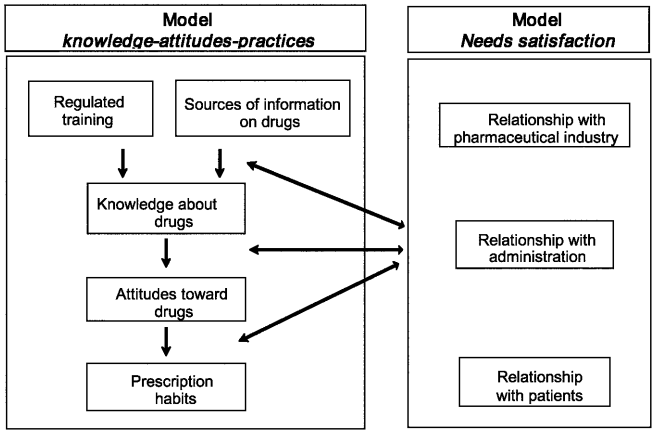

Fig. 1 Mixed theoretical model of the factors modifying prescription quality

into practice because of exogenous factors (such as relationships with patients [12], industry [13, 14, 15] and administration [16]). According to the needs satisfaction theory, the physician will feel the need to maintain a good relationship with his/her environment, and therefore will adapt to the demands (often competing demands) of those three entities mentioned.

The goal of this study was to evaluate the appropriateness of the mixed theoretical model to describe physicians' prescribing behaviour, with the specific objective of identifying the factors associated with the quality of drugs prescribed in PC, among the following categories: physicians' education, use of drug information sources, patient load and social and demographic factors of the practice.

Methods

Design, population and sample

We designed a cross-sectional study of the population of PC physicians in Galicia, Northwest Spain ($n = 1500$). The study's analysis unit is the physician. We selected a stratified random sample of 405 PC physicians. We divided the sampling frame in four geographic areas, and in each of those four areas we selected a random sample proportional to the population. We excluded physicians who had worked less than 6 months during 1993.

Setting

Galicia has 2.8 million inhabitants greatly spread out over the territory. Two million of the total population live in small villages. The territory is divided into 313 municipalities.

The Primary Care System (PCS) functions under two structures: the traditional model, based on the setting of a physician working alone, and the reformed model, which is more in accordance with the guidelines set forth in Alma-Ata [17, 18]. The latter revolves around the structure of the health centre, integrating the roles of doctors, nurses, social workers and other health personnel. More than 70% of all prescriptions are generated through the PCS, and over 90% of all prescriptions are processed through the PCS, since PCS physicians also process prescriptions from specialists. Under the PCS, physicians do not administer the medications, but only prescribe them. Medications are dispensed in the pharmacy by pharmacists, who rarely substitute medications in the prescription.

Health care for the population is free of charge and universal. Economically inactive persons (children, students, disabled, etc.) have access to the system through the identification card of the person of whom they are dependants. There are two types of identification cards: those for actively working persons and those for retirees. Actively working persons and their dependants pay 40% of drug charges, whereas retirees and their dependants receive all drugs for free.

Physicians both with and without speciality work in the PCS. Those with speciality, once they have finished University training, are trained in a regulated program for a minimum of 3 years in one of the centres of the National Health Service. Specialities include community and family medicine among others.

Data collection procedures

The main independent variables were collected through a self-administered mail questionnaire. This was mailed to the sample physicians with a letter describing the objectives of the study and the importance of their participation, and a pre-paid addressed envelope for returning the questionnaire. The first questionnaire was mailed out in October, 1992. It was re-sent to non-respondents a maximum of four times. We excluded from the study those physicians for whom the postal service returned the questionnaire.

The questionnaire was designed to be short and easy to complete, since the studied factors have shown to influence response rates [19]. The questionnaire form presented 60 items in one single page. The first part collected personal and education data, such as age, gender, year of graduation, speciality and pharmacology training. In the second part, physicians were asked about different drug information sources (advertisements, visits by company marketers and medical journals and conferences). They were asked specifically about the quality of these sources and the degree of influence that they perceived each of them had on their selection of prescription drugs. In the last part, physicians were asked about the characteristics of their practice: type of practice, number of identification cards, number of patients seen per day and patients' accessibility to the particular doctor. All of these variables are thought to modify prescription behaviour. Other variables that may modify prescription behaviour, such as unemployment rate and population distribution, were obtained from secondary sources.

Dependent variables were obtained for 1993 from the database of the accounting archives of the National Health Service, which includes all prescriptions served in all the pharmacies in Galicia. These data bases are prepared by the professional pharmacists colleges and they are very detailed, given that they are used so that the National Health Service can pay the pharmacists.

Definition of variables

Independent variables

Physicians were asked whether they had a graduate speciality and whether it was in family and community medicine. Both variables are dichotomous (1 = yes, 0 = no). Physicians were also queried about which health care model they followed in their practice. The model followed was classified and coded as: 0 = traditional model, 1 = reform model.

Physicians were asked whether they used medical journals (1 = yes, 0 = no). The quality of drug information obtained from visits from pharmaceutical representatives, medical journals and conferences, and the influence of this information on drug selection was measured using a 4-point Likert-like scale, featuring the categories "none", "low", "medium" and "high". Using the same scale, we measured physicians' opinions about the quality and influence of the formulary for PC in 1992 as an information source on drug choice.

A number of social and service variables were included to adjust for their expected influence on the quality and quantity of drug prescription. These were: the number of identification cards, the service demand (measured as number of patients seen per hour) and the service accessibility (measured as the median travel time the patient requires to reach the health centre).

In addition, two socio-economic variables were measured: the percentage of residents born in a particular municipality (an indicator of a rural setting, since higher percentages are found among rural municipalities) and unemployment rate. These variables were collected for each municipality and are therefore ecological in nature.

Dependent variables

We defined three variables to measure the quality of the drug prescribed [1]. One variable is the percentage of drugs prescribed of intrinsic value not elevated (IVNE). According to Laporte et al. [20], a drug is classified as IVNE if there are no controlled clinical trials demonstrating its efficacy [2]. A second variable is the percentage of drugs prescribed of degree of therapeutic use not elevated (DTUNE) in PC. This indicator classified the drugs with elevated intrinsic value according to the suitability of their use in PC settings [21, 3]. The final variable is the percentage of prescribed drugs not included in the 1992 formulary for PC. This formulary was developed in the Spanish National Health Service and includes a selection of the most suitable drugs for use in PHC [22]. A previous edition of this formulary, published in 1987, was widely distributed amongst PC doctors in Spain [23]. These three dependent variables were combined using factorial analysis in a new ''global indicator'' variable, which describes the overall quality of prescription.

Statistical analysis

Questionnaire-collected variables have a proportion of missing values (8.7% for the variables introduced into the models). Various studies have shown that some imputation techniques, such as conditional-mean imputation or complete-subject analysis, can be biased under reasonable circumstances and that multiple imputation is recommended in these cases [24]. Multiple imputation was carried out using the SOLAS program [25].

We tested our hypotheses using multiple regression techniques. A multiple regression model was elaborated for each dependent variable (IVNE, DTUNE, PC). Full models were created according to the theoretical model. From the full model, variables that did not appear to be cofounders or have an effect on the dependent variable were eliminated. Once we defined the models in this way, we evaluated possible effect modification between variables. We also evaluated possible non-linear effects of continuous variables using generalised additive models [26].

Results

Of the 405 physicians in our sample, 94 were excluded (78 because they had worked less than 6 months and 16 for various other reasons). Of the 311 remaining, 234 responded to our questionnaire. We found no statistically significant differences in quality of prescription between the whole of the sample and those who responded to the questionnaire. Table 1 shows the characteristics of the participants.

Of all prescriptions, 30.0% [95% confidence interval (CI): 29.4, 30.6] are IVNE, 72.7% (95% CI: 72.2, 73.3) are DTUNE, and 64.7% (95% CI: 64.0, 65.3) are not in the 1992 formulary for PC. The ''global indicator'' contains 64% of the variability of the three indicators. The percentage of contribution of each indicator to the global indicator is as follows: IVNE 74.8%, DTUNE 84.5% and PC 88.9%.

Table 1 Description of subjects studied for the main independent variables. *NHS* National Health Service; *95%CI* 95% confidence interval

	95% CI
Mean of years with degree	14.7 (13.6, 15.8)
Proportion of males (%)	71 (66.9, 77.0)
Proportion of speciality obtained though residency in NHS (%)	12.1 (8.1, 16.6)
Proportion of family and community medicine specialist (%)	23.2 (17.6, 28.5)
Proportion of physicians in reform model (%)	40.2 (33.8, 46.5)
Mean of number patients' cards by physician	1116 (1041.3, 1190.4)
Proportion of retirees' cards by physician (%)	44 (41.6, 46.7)

Table 2 shows multivariate models for percentage of prescriptions of IVNE and for percentage of prescriptions not included in the PC formulary. Table 3 shows the results of the multivariate models generated based on percentage of prescriptions of DTUNE and on the ''global indicator'' variable. Both tables show the association between specialising in family and community medicine through a residency in the National Health Service (NHS) and higher prescription quality.

Use of medical journals and the PC formulary is associated with a lower percentage of prescriptions of drugs not included in the PC formulary. However, using information obtained from pharmaceutical representatives is associated with a higher percentage of prescriptions of drugs not included in the PC formulary and with a higher ''global indicator'' variable. Lastly, practising under the reform model and having a smaller number of patient cards are associated with a lower percentage of IVNE prescriptions.

Discussion

Our results suggest that the proposed theoretical model could be right. In it, prescription behaviour can be explained using two models that combine specific factors of behaviour acquisition and change. The model of knowledge–attitudes–practices explains the factors inherent to the physician (in particular those regarding his or her training), and the model of satisfaction needs explains the interaction of the physician and his or her environment.

According to the knowledge–attitudes–practices model in our study, trained physicians prescribe a lower percentage of low-quality drugs. In addition we found a synergistic effect between PC training (i.e. family and community medicine) and further regulated training (i.e. receiving speciality through regulated practice through

Table 2 The influence of physician's education, quality of drug information and medical care setting on the percentage of prescriptions of intrinsic value not elevated and percentage of prescriptions not included in the formulary for Primary Health Care (PHC) of 1992. *Coef* regression coefficients; *95%CI* confidence intervals; *P* statistical significance; *NHS* National Health Service

	Percentage of drugs of intrinsic value not elevated			Percentage of drugs not included in the formulary for PHC		
	Coef[a]	95% CI[a]	*P*	Coef[a]	95% CI[a]	*P*
Number of years with medical degree	0.034	(−0.038, 0.107)	0.351	0.018	(−0.060, 0.097)	0.648
No residency in NHS						
No family and community medicine specialist	Reference category			Reference category		
Family and community medicine specialist	0.627	(−1.095, 2.34)	0.473	0.451	(−1.420, 2.323)	0.635
Residency in NHS						
No family and community medicine specialist	−0.547	(−3.880, 2.786)	0.746	−1.420	(−2.189, 5.029)	0.438
Family and community medicine specialist	−6.488	(−10.56, -2.414)	0.001	−7.454	(−11.90, −3.011)	0.001
Influence of visiting marketers' information[b]	0.660	(−0.039, 1.359)	0.064			
Influence of medical journal information[b]				−0.926	(−1.746, -0.106)	0.027
Quality of visiting marketers' information[b]				1.021	(0.257, 1.784)	0.009
Quality of formulary for PHC[b]				−1.11	(0.301, 1.821)	0.043
Reform model[c]	−1.363	(−2.575, −0.151)	0.027	−1.285	(−2.605, 0.034)	0.056
Number of patients' cards	0.001	(0.000, 0.002)	0.030	0.0005	(−0.001, 0.002)	0.345
Unemployment rate in municipality	−0.527	(−0.686, −0.368)	0.001			
Birth rate in municipality	0.030	(−0.011, 0.071)	0.147	0.048	(−0.004, 0.092)	0.031

[a] Adjusted for the other independent variables included in this table. The variables with coefficients that do not figure in the table are not included in the model
[b] Measurements on Likert-like scale (0 = none, 4 = high)
[c] Yes = 1, no = 0

Table 3 The influence of physician's education, quality of drug information and medical care setting on percentage of prescriptions of degree of therapeutic use not elevated, and on the global indicator. *Coef* regression coefficients; *95%CI* confidence intervals; *P* statistical significance; *NHS* National Health Service

	Percentage of drugs of degree of therapeutic use not elevated			Global indicator		
	Coef[a]	95%CI[a]	*P*	Coef[a]	95%CI[a]	*P*
Number of years with medical degree	−0.012	(−0.083, 0.058)	0.732	0.003	(−0.011, 0.017)	0.682
No residency in NHS						
No family and community medicine specialist	Reference category			Reference category		
Family and community medicine specialist	0.779	(−0.910, 2.469)	0.364	0.172	(−0.172, 0.515)	0.325
Residency in NHS						
No family and community medicine specialist	2.102	(−1.140, 5.344)	0.202	0.278	(−0.388, 0.944)	0.412
Family and community medicine specialist	−7.334	(−11.31, -3.357)	0.001	−1.823	(−2.641, -1.005)	0.001
Quality of visiting marketers' information[b]	0.608	(−0.078, 1.295)	0.082	0.178	(0.037, 0.319)	0.013
Reform model[c]	−0.520	(−1.700, 0.659)	0.385	−0.239	(−0.484, 0.010)	0.055
Number of patients' cards	0.0006	(0.000, 0.002)	0.161	0.0002	(0.000, 0.004)	0.030
Unemployment rate in municipality	0.220	(0.065, 0.375)	0.005	0.005	(0.000, 0.010)	0.054
Birthrate in municipality	0.049	(−0.078, 1.295)	0.014	0.012	(0.004, 0.020)	0.001

[a] Adjusted for the other independent variables included in this table
[b] Measurements on Likert-like scale (0 = none, 4 = high)
[c] Yes = 1, no = 0

the NHS). Even though other studies detected the association between both greater degrees of specialisation [27, 28, 29] and a lower percentage of low-quality drugs prescribed, this was the first study in which a synergistic effect between both factors was found.

Advances in drug therapy research progress rapidly, and continuing medical education is probably as important as initial medical training. The quality of drug information sources is also associated with prescription quality in our study. Specifically, the quality of prescribed drugs increases as the physician places more confidence in independent sources of information (such as medical journals and prescription guides) and decreases as the physician relies more on sources of information from the pharmaceutical industry (visits from pharmaceutical representatives). These results are consistent with those of other authors who postulate that advertisement campaigns from pharmaceutical

industries are the cause of poor prescription practices [30, 31].

According to some authors [32], the pharmaceutical industry fills in the gaps left by the health care education and training system. Following this reasoning, independent drug information sources supplied by the public health system (e.g. prescription guides) would alleviate the effect of industry marketing. This is verified in our study, as shown by the association between a lower quality of prescription drugs and a negative attitude towards prescription guidelines. These findings are in agreement with those of several other studies [33, 34, 35].

Other independent information sources regarding drug prescription available to physicians include medical journals. However, several studies report that their influence is not related to quality of prescription [36, 37, 38], probably because the quantity of information is so great that it becomes difficult to keep up with it. Prescription guides and newsletters published by experts can fill in the gap between the information needed by the PC practitioner and the vast quantity of information available in medical journals. In our study, however, greater confidence in medical journals is associated with fewer prescriptions for drugs not covered by prescription guides.

According to the proposed theoretical model, knowledge of prescription practices does not translate directly into prescription habits because external factors can modify significantly the linearity of the relationship of knowledge–attitudes–practices [11]. The relationship of the physician with the pharmaceutical industry [13], the health care administration [16] and the population served [12] are important modifiers of prescription.

Therefore, the influence of the pharmaceutical industry on prescription cannot be explained through the content of the information that it makes available to practitioners. This relationship must be examined through the satisfaction needs model, which takes into consideration the practitioner's need to be in harmony with his/her practice environment. Several authors think that the pharmaceutical industry takes advantage of the alienation of practitioners within the PC setting, principally in the traditional model, and establishes ties with practitioners that are reinforced by dispensing gifts [32]. This would affect the prescription behaviour, as observed in our study.

The satisfaction needs model can also explain the lower percentage of low-quality drug prescriptions observed among physicians in the PC teams, and these results are consistent with other studies [29, 39]. The lower percentage of low-quality drugs prescribed in this group is probably related to a better integration within the PC system and greater interaction with other colleagues [40]. Other authors believe that the lower percentage of low-quality drugs prescribed among physicians in PC teams is due to the existence of diversity in the beliefs and attitudes of the various team members [41].

The physician's need to have a good relationship with his/her patients can explain the influence of variables related to service demand [6, 42]. Several studies have shown that drug prescription is influenced by the patient's expectations [43, 44] and by the physician's perception of the patient's expectations [43, 44]. In this study, we found that the quality of drugs prescribed is related to the number of patients under care and the number of patients who are retirees. We also found the quality of drugs prescribed to be related to the socio-economic status of the population.

The association between the lower percentage of low-quality drugs prescribed and the number of patients under care is probably due to a reduction of time the physician can spend with each patient. Having less time to spend with the patient, the physician probably reduces time-consuming activities such as diagnosis and counselling, and instead relies on prescription, which may consequently be illogical and irrational [1]. In addition, patients tend to see drugs as consumer goods [45], and in the context of the satisfaction needs model and a care environment where prescription cost is partly or totally subsidised, such prescription behaviour improves patient–physician relationships.

Even though the percentage of visits by retirees is directly related to the percentage of prescriptions of IVNE, the association is not strong enough to be statistically significant. This association is probably related to a greater prevalence of symptoms of low significance in this population, which are in many cases treated with IVNE drugs [29]. However, since the cost of doctor visits for the economically passive population is lower, there may be higher demand, which could also explain this association. Finally, since the full cost of drugs prescribed to retirees is subsidised, the demand is probably higher, and the physician then responds by prescribing to please the patient often using placebos [29].

We also measured two aggregate variables of the municipality where the physician practices: the percentage of residents who were born in that municipality and the percentage of unemployment. A high percentage of residents born in the municipality (related to practices in rural areas) is directly associated with a greater percentage of low-quality drugs prescribed. This result is in agreement with those in other studies that show a greater willingness to visit the doctor at any opportunity, due to the low cost, and the feeling of being vulnerable because of isolation are causes of low prescription quality [46]. However, the unemployment rate behaves as a protection factor against poor prescription practices. Some authors have postulated that low prescription rates in settings where the population is of low socio-economic status could be associated with low numbers of prescription for symptoms of low significance [29], which are again generally prescriptions of low therapeutic utility. However, these interpretations must be made with caution due to the possibility of ecological fallacy in the measurement of these variables.

There are three main limitations to this study. First, since the current analysis is based on cross-sectional data, the validity of the conclusions could be limited by

the difficulty in differentiating between cause and effect. In this case, however, the factors associated with quality prescription (i.e. residency in NHS or opinion about information sources) are variables that are unlikely to change during the period of time in which the dependent variable is measured, therefore a cross-sectional analysis is as useful as a longitudinal analysis [47]. Second, the measure of opinions and attitudes towards representatives, journals and guides could be biased by a doctor's tendency to answer what is more socially acceptable. Nevertheless, we believe that the bias can mainly affect the doctors' poor quality prescription, which would always push the results towards a void hypothesis. Third, we must remember that these indicators measure the quality of drugs prescribed, but not that of the prescription itself, because the measure does not take into account whether the prescription is indicated for that particular case. Thus, the indicators impart in and of themselves an optimistic evaluation of the quality of prescription, generally increasing the specificity and lowering the sensitivity of the measure. However, these indicators can be useful by approximating the prescription quality when the proportion of low-quality drugs prescribed is relatively high, such as in our study.

Our results suggest that in order to increase prescription quality in PC settings, it is necessary to increase physician education and training targeting, specifically PC practice. Our results also suggest a need to limit the educational activities of the pharmaceutical industry (especially those occurring through marketing visits to doctors) and that the only sources of drug prescription information that should be considered appropriate are those arising from independent agencies, such as prescription guides and bulletins. Several studies show that passive distribution of such information is not enough, and that distribution should be accompanied by educational strategies that require personal contact and generate positive attitudes among the physicians towards these information sources [48].

Finally, the results of this study underscore the need to complete the reform of our PC system following the guidelines established in Alma Ata [17]. This course of action will help achieve a better integration of clinical practitioners within the Public Health System and will help physicians improve professional relationships with colleagues and patients.

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