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Title:

MORE IS NOT ALWAYS BETTER IN PRIMARY CARE EITHER: AN OBSERVATIONAL STUDY OF CLINICAL PRACTICE PATTERNS OF GENERAL PRACTITIONERS AND CARE OUTCOMES

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ABSTRACT

Objectives:

To explain the variability in the frequency of potentially preventable hospitalisations (ambulatory care sensitive conditions [ACSCs]) based on factors at multiple levels (individual, health professional, health centre and health district), and specifically using resource efficiency indicators for general practitioners (GPs).

Design:

Cross-sectional study. We analysed primary care electronic health records and hospital discharge data using multilevel mixed models.

Setting:

Primary care network of the Basque Health Service (Spain)

Participants:

All the residents in the Basque Country ≥ 14 years of age, covered by the public healthcare system (n=1,959,682), and all the GPs (n=1,193) and health centres (n=130).

Main outcome measures:

Individuals admitted for ACSCs, over a 12 month period.

Results:

Admissions for ACSCs were less frequent among patients who were female, middle-aged or from the highest socioeconomic classes. The health centre variables considered and GP list size were not found to be significant. After adjusting for the variables studied including morbidity, the risk of hospital admission was higher among individuals under the care of GPs with greater than expected numbers of patient visits and prescribing costs (OR=1.27 [95% confidence interval 1.18 to 1.37); 1.16 [1.08 to 1.25]), and who make fewer referrals than the mean among their colleagues (OR=1.33 [1.22 to 1.44])

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Conclusions:

Although the importance of primary care for the health of the population is unquestionable, we should define outcome-based criteria when assessing its activities. Specifically, GPs who hold more patient visits, have higher prescribing costs and are more reluctant to refer patients to specialists obtain poorer outcomes.

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Strengths of the study

- The main strength of this study is that we analysed data for an entire healthcare system, providing near universal care for the population of a defined geographical area.

- It not only assesses the relationship between preventable diseases and variables at different levels, ranked in accordance with the hierarchical nature of the data, but also compares the risk of admission of patients seen by doctors with different clinical practice patterns.

- We used a robust system for adjusting for patient morbidity (the Johns Hopkins ACG case-mix system).

Limitations.

- The health information system of the Basque Country and, as is commonly the case with the use of administrative databases and electronic health records, there may be some incomplete or inaccurate data.

- The ecological nature of the socioeconomic variable used (deprivation index) might have diluted the effect of individual socioeconomic characteristics. Also, social characteristics other than the ones studied have an effect on the need for healthcare and its outcomes.

- This paper is focused on the organization of public health service provision and planning, and thus, private health provision is beyond the scope of our analysis.

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- There are factors unrelated to primary care itself that could have an effect on hospital admissions.

- The use of a list of conditions adapted for our setting (in this case, Spain) has advantages from the point of view of the validity of our results, but it may make it difficult to generalize the findings to other areas.

- In relation to external validity, Spain has primary care health services that are well-established and easy to access by the population, with higher rates of visits to doctors and generally lower rates of ACSC admissions than reported for other settings. It might not be possible to extrapolate our findings to other settings with different characteristics.

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INTRODUCTION

Healthcare organizations often analyse variations in physician practice patterns for monitoring the quality and efficiency of primary care health services. In this way, it is assessed whether the use of healthcare resources by health professionals is what would be expected as a function of the morbidity in the population served. This information is very important: it allows physicians themselves to reflect on their own way of working and managers to identify health professionals with markedly different patterns of resource use to their colleagues.

It is widely agreed that some prescriptions, referrals to specialized care, requests for ancillary tests and primary care visits are not justified,[1] and hence, it could be argued that the rates of all of these should be reduced. However, analysing each indicator separately makes it difficult to reach conclusions: we should not assert that a primary care physician's use of resources is excessive (or insufficient) without assessing their patient's outcomes. For example, situations of apparent efficiency may be, in reality, a failure to provide the necessary care to certain groups of patients resulting from lack of accessibility or poor clinical practice. In fact, numerous studies have indicated that a lower use of primary care resources is associated with adverse effects on the health of the population[2,3] and certain attempts in the USA to reduce the number of ambulatory visits,[4] through the introduction of co-payments, may have a negative impact in terms of people´s health. The effects of decreasing spending on prescriptions are also not fully known. Although in some cases (such as the excessive use of antibiotics) the need for cutting back is unquestionable,[5,6] in other cases such a reduction may have unintended

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consequences. In relation to this, some authors have observed an inverse correlation between the number of prescriptions and hospitalisation costs,[7] and that the use of disincentives for prescribing such as a co-payment may lead to discontinuation of treatments by chronic patients and worsening of the health of vulnerable populations.[8] As a result, to assess physicians in a fair manner and promote changes in clinical practice patterns with the goal of improving healthcare efficiency, we must take into account the impact of the care provided on outcomes.

In this context, an accepted method for assessing outcomes is to consider ambulatory care sensitive conditions (ACSCs).[9] These are a series of conditions for which it should be possible to avoid hospital admission by providing timely and effective ambulatory care, through the following types of interventions: prevention at the primary care level, early diagnosis and treatment of acute diseases, and adequate control and follow-up of chronic diseases. Although based on hospital discharge reports, data on admissions for ACSCs provide us with indirect information regarding primary care, in particular, accessibility of this level of care and its ability to resolve health problems. In America, ACSCs have mainly been used to measure access, while in other countries with national health services, they have principally been used to assess quality of care.[10] In any case, factors unrelated to primary care also influence hospital admissions, meaning that this instrument needs to be adapted to the context in which it is to be applied.[10] For this reason, in our study, we used lists of ACSCs that have been established for Spanish populations[11] and have already been used by other authors.[12–14]

Numerous studies have indicated differences in ACSC admission rates as a function of the demographic,[15] clinical[16,17] and social[14,18,19] characteristics of patients. In addition, the rate has been found to be

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associated with factors attributable to healthcare systems and organizations.[3,20] However, few studies have analysed its relationship with factors related to general practitioners (GPs), and to our knowledge, none have explored their way of working and clinical practice patterns. In this context, the objective of this study was to explain the variability in the rate of potentially preventable hospitalisations (i.e., admissions for ACSCs) based on multilevel characteristics and factors (individual, health professional, health centre and health district) and, in particular, considering indicators of the efficiency of resource use by GPs.

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METHODS

This was a cross-sectional study analysing the outcomes of the public primary care network for a 1-year period (2007/2008, Basque Country, Spain).

Ethical considerations

The Clinical Research Ethics Committee of the Basque Country approved this study (PI2012151).

Setting

The Government of the Basque Country has been responsible for planning and provision of healthcare services for the population in this region since 1983. Public healthcare provision is delivered by the Basque Health Service (Osakidetza), a public organization funded through taxes that provides nearly universal care to residents in the region. Care is free at the point of delivery, except for prescriptions, for which there is co-payment that varies depending on the type of disease and patient status (with exemptions for those who are retired or disabled, among others).

When this study was conducted, primary care health services in our setting were organized into seven health districts, corresponding to geographical areas. The primary care health districts are economically, financially and administratively independent and are funded by annual contracts with the Health Department of the Government of the Basque Country. Each of these districts has 9 to 22 health centres.

Primary care health professionals work in care teams. At the individual level, every resident is on the list of a general practitioner, who is a family doctor or paediatrician depending on the patient's age (≥14 years vs younger). These primary care doctors act as gatekeepers to other levels of

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care. Electronic health records, which started to be introduced in 1990, are now used by all primary care doctors.

Study population and period

The observation period was set at 1 year, from 1 September 2007 to 31 August 2008. The study population included all residents ≥14 years of age who were covered by the public healthcare system in the Basque Country on 31 August 2008 and who had been covered for at least 6 months in the previous year, regardless of whether they had used or had any contact with the Basque Health System (Osakidetza) in that period. That is, almost the entire population of the Basque Country was included.

In this study, we analysed data from across the public health service network: 130 health centres and 1193 GPs. The total number of registered inhabitants was 1,959,682, meaning that the GP lists were composed of a mean of 1643 people.

Sources of data:

We used the two following sources of data:

- Electronic health records of the Basque primary healthcare system, which contain demographic, administrative and clinical data, including diagnoses, prescriptions, ancillary test results and referrals, generated in relation to each patient visit.
- The minimum basic data set, which gathers information on all hospital discharges from across the Basque network of public hospitals, including data on patient characteristics, hospitalisation episodes, diagnoses and procedures.

Variables and statistical analysis

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At the level of the individual patient, we used demographic(age and sex), morbidity and socioeconomic characteristics as explanatory variables.

In order to include a manageable number of diseases, we classified all the patient diagnoses (ICD-9-CM codes) made by the GPs during the study year into Aggregated Diagnosis Groups (ADGs).[21] The ADG system assigns ICD-9-CM codes to one of 32 categories, as a function of clinical criteria, the expected resource use and type of care required for each health problem. It is part of the Johns Hopkins Adjusted Clinical Group (ACG) case-mix system, which is described elsewhere.[22]

As a proxy for the socioeconomic status of patients, we used a deprivation index based on census data, created for the MEDEA[23] project. Census tracts are the smallest territorial units for which census population data are available in Spain and they are mainly defined by criteria related to population size, and geographic and social features. Though the number of residents varies between tracts, the median is 1,200. For this study, the deprivation index was categorized into five groups, the fifth corresponding to the areas with the greatest deprivation and the first to the least deprived areas. It is an indicator of access to economic and material resources in a community and it has been shown to be correlated with rates of mortality[24] and morbidity.[25]

At the GP level, to estimate their work load, we considered the number of patients on their list. Using this information, the GP lists were divided into four groups (quartiles), those in the highest quartile being large, those in the second and third quartiles medium-sized and those in the lowest quartile small.

We used a similar approach to characterise the primary care health centres. In this case, the variables used were area-level demographic factors

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(percentages of people above 65 years of age and of immigrants),[26] size of the centre (number of GPs on the staff) and level of satisfaction of the centre's staff with their work environment. The last of these variables corresponds to the overall satisfaction score for the health centre, calculated from the results of an internal survey carried out on a regular basis by Osakidetza in all its organisations.[27] Like GPs, the health centres were categorised into quartiles, the level of satisfaction being rated as high for those in the highest quartile, moderate for those in the middle two quartiles and low for those in the lowest quartile.

All the analysis was performed using SAS version 9.2.

For the first stage of analysis, we considered the following response variables at the patient level: the number of visits to the GP, number of forms for referrals to specialists issued by the GP, and costs to the Department of Health of drugs prescribed to the patient during the year of the study.

We constructed multilevel mixed models[28] to identify which GPs were outliers in terms of resource use. Taking into account the hierarchical nature of the data, we used the explanatory variables as fixed effects and included random intercepts for each of the higher levels: GP, health centre and health district. As a function of the distribution of the response variables, we used different regression models: in the case of prescribing costs, we built a normal regression model (Proc MIXED, RMLE), while for the visits and referrals, we used negative binomial regression models (Proc GLIMMIX, LAPLACE). These models allowed us, using an empirical Bayesian approach,[29] to estimate the differences between the performance of each GP and the mean for each the response variables, after adjusting for the other variables, as well as 95% confidence intervals for the estimators. For visits and referrals, the estimators were exponentiated to obtain the

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incidence rate ratios. We considered doctors to be outliers (high or low) when their estimators statistically differed from zero (prescribing costs) or one (visits and referrals).

For the second stage, in addition to variables considered in the first stage, we used classifications of each doctor (high/intermediate/low) with respect their use of healthcare resources (visits, referrals and prescribing costs) as explanatory variables, following the aforementioned procedure, and the appearance of preventable hospitalisations as the response variable. For this purpose, we identified patients who had had one or more admissions attributable to ACSCs, using the list established in Spain by Caminal et al.[11]

Using these variables, we constructed a multilevel mixed-effect logistic regression (Proc GLIMMIX, LAPLACE). In this case, we used the aforementioned explanatory variables (including the GP's classifications by resource use) as fixed effects and a random intercept for each of the three higher levels (GP, health centre and health district). The results are expressed as odd ratios (ORs).

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RESULTS

During the 12 months of the study, 70.2% of patients made at least one visit to their GP. The annual means per patient were: 4.47 primary care visits, 0.4 referrals and €153.28 in prescribing costs.

Figure 1 shows the distribution of GPs into the three levels of resource use. The percentages of GPs with higher and lower than expected resource use per patient were as follows: 228 (19.1%) and 140 (11.7%) for visits; 21.1% and 15.4% for referrals; and 17.9% and 16.3% for prescribing costs, respectively.

A total of 21,051 people were admitted one or more times for an ACSC, corresponding to 1.07% of the total population. ACSC admission rates were associated with demographic characteristics of patients (Table 1), though not linearly. Based on the crude rates, admissions appeared to increase with age; however, after adjusting for the variables studied including morbidity, we obtained a J-shaped bimodal distribution, with a peak among the youngest people and a higher peak at the oldest ages. With respect to sex, men were more likely to have preventable hospitalisations. As for the deprivation index, more disadvantaged social groups had higher rates of ACSC admissions, although there were only statistically significant differences comparing the most and least disadvantaged populations. Regarding morbidity, in general, we observed that the risk of admission for ACSCs was associated with the diagnostic groups (ADGs) for acute diseases, major symptoms, recurrent health problems (except allergy), chronic diseases and psychosocial problems. However, this was not the case for chronic disorders that often require specialized care, other than mental health (Table 2).

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With respect to the variables at the doctor level (Table 3), the risk of ACSC admissions was higher for patients of GPs with a greater than expected mean number of visits and prescribing costs (OR=1.29 [1.21 to 1.37]; 1.16 [1.09 to 1.24]) or with a lower than expected mean rate of referrals (OR=1.33 [1.24 to 1.41]). The number of patients on the GP's list did not reach statistical significance (p=0.0935).

In our analysis, none of the health centre characteristics (size, level of satisfaction of staff, and percentages of elderly individuals and of immigrants in the population) reached statistical significance.

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DISCUSSION

Main findings

Our results indicate that various characteristics of patients and GPs have an effect on the risk of hospital admission for potentially preventable conditions. At the patient level, the rate of these admissions was significantly higher in two age groups, the youngest and the oldest patients, in males, and in various groups with acute, recurrent or chronic disorders, as well as those with psychosocial problems; on the other hand, the admission rate was lower in people from the most advantaged socioeconomic status. At the doctor level, once we had adjusted for morbidity and the other variables analysed, the risk of admission for ACSCs was higher in people seen by GPs with greater than expected numbers of visits by patients and prescribing costs and with lower rates of referrals than other doctors. Differences in admissions as a function of variables characterizing the health centre (number of GPs; satisfaction with the work environment; percentage of elderly individuals and of immigrants in the population) or GP list size were not statistically significant.

Strengths and limitations

The main strength of this study is that we analysed data for an entire healthcare system, providing near universal care for the population of a defined geographical area. Further, it not only assesses the relationship between preventable diseases and variables at different levels, ranked in accordance with the hierarchical nature of the data, but also compares the risk of admission of patients seen by doctors with different clinical practice patterns. In addition, we used a robust system for adjusting for patient morbidity, namely, the Johns Hopkins ACG case-mix system. However, we should also recognize some limitations. First, the data analysed come from the daily records entered in the health information system of the

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Basque Country and, as is commonly the case with the use of administrative databases and electronic health records, there may be some incomplete or inaccurate data. Second, the ecological nature of the socioeconomic variable used (deprivation index) might have diluted the effect of individual socioeconomic characteristics; it is also known that social characteristics other than the ones studied have an effect on the need for healthcare and its outcomes.[30] Further, this paper is focused on the organization of public health service provision and planning, and thus, private health provision is beyond the scope of our analysis.

With respect to the definition of ACSCs, it should be taken into account that there are factors unrelated to primary care itself that could have an effect on hospital admissions. The use of a list of conditions adapted for our setting (in this case, Spain) has advantages from the point of view of the validity of our results, but it may make it difficult to generalize the findings to other areas. Additionally, in relation to external validity, Spain has primary care health services that are well-established and easy to access by the population,[31] with higher rates of visits to doctors and generally lower rates of ACSC admissions than reported for other settings.[32] Hence, it might not be possible to extrapolate our findings to other settings with different characteristics.

Comparison with other studies

Our results are partially consistent with previous research. Various different authors have established that ACSC admissions are associated with certain individual-based factors including being male[13,33,34], being elderly,[15,34] having a low socioeconomic status,[14,18,19,35] being from disadvantaged ethnic or racial groups,[19,36] and having chronic diseases[16,17,37] or mental health problems.[38,39] However, our results differ from those of other authors such as Casalino et al,[40] who found an inverse relationship between the size of primary healthcare teams and ACSC

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admissions. What is more, associations with factors related to access to primary care health services that have been often described, such as an inverse correlation between ACSC admissions and the patient-to-doctor ratio,[3,20] were also not found in our data. Although some authors have assessed the relationship between ACSC admissions and the number of visits to GPs by patients[3,37,41–43] and, even, the mean daily number of consultations held by doctors in a geographical area,[14] we are not aware of any studies similar to ours. In particular, we studied the association between potentially preventable admissions and efficiency indicators of GPs based on the ratio between the observed and expected consumption of resources: number of visits by patients, referrals and prescribing costs.

Significance of the study. Potential explanations and implications for doctors and managers

The benefits of primary care on the health of people and populations have been demonstrated and widely recognised.[2] Other authors have described the added value to the care of a generalist approach, especially for complex patients with multimorbidity, this giving rise to the paradox that GPs provide poorer quality healthcare than specialists in the treatment of specific diseases, but achieve better outcomes in overall health of people and populations.[44]

However, as in other healthcare contexts, doing more is not always better in primary care. From our analysis, it seems that certain clinical practice patterns of primary care doctors have an effect on the outcomes of care. In particular, we can state that GPs holding an excessive number of visits with patients is associated with higher rates of preventable admissions, as is GPs having higher prescribing costs, while those who play the role of strong “gatekeepers” and are more reluctant to “pass the baton” to specialists also achieve poorer results. Given this, indicators that

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measure the performance of health professionals should be interpreted with care, unless they are accompanied by other indicators of care outcomes. Otherwise, interventions focused on modifying clinical practice patterns may have undesired consequences.

Unanswered questions and future research

This study indicates how certain ways of working among primary care doctors achieve different outcomes in terms of preventable hospitalization of patients. However, it does not allow us to establish the causes of these differences. Visits to GPs are diverse in nature: they may occur on the initiative of the patient or of the doctor, they have many underlying reasons (for example, for assessing symptoms or diseases, social problems, provision of advice, or administrative procedures), and they may vary in terms of duration, structure, procedures performed, and the involvement of other primary care health professionals, such as nurses. Several factors increase prescribing costs: excessive prescribing, inappropriate treatments, and selection of the most expensive option. Important factors regarding referrals are whether they are appropriate and timely, as well as the type of specialist patients are referred to, and the subsequent level of coordination between the GP and the specialist in the shared management of the patient. In relation to this, there is a need for future studies analysing primary care outcomes that consider other factors related to visits, referrals and prescriptions. Furthermore, our results should be tested in other settings or specific population groups (for example, patients with multimorbidity or with specific diseases). In any case, our findings provide a starting point for discussion and research concerning what should be the limits in terms of the "quantity" of primary care provided to meet the needs of the population.

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WHAT THIS PAPER ADDS

- WHAT IS ALREADY KNOWN
  - Variability in the rate of potentially preventable hospitalizations (i.e., admissions for ambulatory care sensitive conditions, ACSCs) is used to assess access to primary healthcare and the quality of this care.
  - The risk of this type of hospitalization is higher in individuals with poor access to primary healthcare services and also those with certain characteristics (namely, being elderly, male, or from disadvantaged social, ethnic or racial groups, as well as having particular physical and/or mental diseases).

- WHAT THIS STUDY ADDS:
  - Clinical practice patterns of general practitioners (GPs) are associated with the risk of ACSC admissions among their patients.
  - ACSC admissions are more frequent when GPs hold more visits per patient, have higher prescribing costs, and are reluctant to refer their patients to specialists.
  - Patients receiving a greater "quantity" of care in primary care obtain the poorest outcomes.

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Authors' contributions

JFO and GG participated in the design of the study. JFO performed the validation of databases. ACA and GG were responsible for statistical analyses. JFO wrote the draft of manuscript. All authors participate in interpretation of data, critically reviewed and gave final approval to the manuscript.

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Competing interests

The authors declare that they have not competing interests.

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Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained

Ethical Approval

The Clinical Research Ethics Committee of the Basque Country approved this study (PI2012151).

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A grant (10/00319) from Fondo de Investigación Sanitaria was received in support of this project.

Role of the funder and statement of independence of researchers from funders

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de Investigación Sanitaria, Osakidetza (Basque Health Service) or O+berri

(Basque Institute for Healthcare Innovation)

Data sharing statement

There are no additional data available.

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Table 1. Multilevel analysis. Impact of sociodemographic variables on hospital admission for ambulatory care sensitive conditions (ACSCs)

	No. of patients	No. of patients with ≥1 ACSC	OR	Likelihood ratio test
TOTAL	1,959,682	21,051 (1.07%)		
Age groups (years)				< 0.0001
14-24	196,804	564 (0.29%)	reference	
25-34	351,095	1,090 (0.31%)	0.92 (0.81 to 1.02)	
35-44	381,810	1,411 (0.37%)	0.77 (0.66 to 0.87)	
45-54	330,703	1,897 (0.57%)	0.71 (0.60 to 0.81)	
55-64	274,850	2,851 (1.04%)	0.68 (0.58 to 0.78)	
65-69	100,891	1,576 (1.56%)	0.65 (0.54 to 0.76)	
70-74	101,478	2,379 (2.34%)	0.74 (0.64 to 0.85)	
75-79	95,636	3,257 (3.41%)	0.85 (0.75 to 0.95)	
80-84	67,296	3,092 (4.59%)	1.03 (0.93 to 1.14)	
85+	59,119	2,934 (4.96%)	1.38 (1.28 to 1.49)	
Sex				< 0.0001
Male	955,138	11,990 (1.26%)	1.41 (1.37 to 1.44)	
Women	1,004,544	9,061 (0.90%)	reference	
Deprivation Index				0.0139
1	390,386	2,995 (0.77%)	0.92 (0.85 to 0.99)	
2	387,231	4,041 (1.04%)	1.02 (0.96 to 1.08)	

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3	394,884	4,375 (1.11%)	0.99 (0.93 to 1.05)
4	391,844	4,678 (1.19%)	0.97 (0.92 to 1.03)
5	395,337	4,962 (1.26%)	reference

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Table 2. Multilevel analysis. Impact of the morbidity variables on hospital admissions for ambulatory care sensitive conditions (ACSCs)

Aggregated Diagnosis Groups	No. of patients	No. of patients with ≥1 ACSC	OR	Likelihood ratio test
1. Time Limited: Minor	245,892	4,904 (1.99%)	0.98 (0.94 to 1.02)	0.4445
2. Time Limited: Minor-Primary Infections	535,848	12,363 (2.31%)	1.92 (1.89 to 1.96)	<0.0001
3. Time Limited: Major	48,055	6,275 (13.06%)	3.40 (3.35 to 3.44)	<0.0001
4. Time Limited: Major. Primary Infections	50,853	6,642 (13.06%)	5.34 (5.3 to 5.38)	<0.0001
5. Allergies	52,289	683 (1.31%)	0.93 (0.84 to 1.02)	0.1174
6. Asthma	44,212	2,040 (4.61%)	3.29 (3.23 to 3.35)	<0.0001
7. Likely to Recur: Discrete	265,298	6,936 (2.61%)	1.15 (1.12 to 1.19)	<0.0001
8. Likely to Recur: Discrete-Infections	153,097	4,966 (3.24%)	2.06 (2.02 to 2.1)	<0.0001
9. Likely to Recur: Progressive	37,633	7,762 (20.63%)	5.57 (5.53 to 5.61)	<0.0001
10. Chronic Medical: Stable	463,513	16,291 (3.51%)	2.64 (2.6 to 2.69)	<0.0001
11. Chronic Medical: Unstable	151,413	15,164 (10.01%)	7.78 (7.74 to 7.82)	<0.0001
12. Chronic Specialty: Stable - Orthopaedic	35,199	1,418 (4.03%)	1.09 (1.02 to 1.16)	0.0163
13. Chronic Specialty: Stable - Ear, Nose, Throat	22,348	540 (2.42%)	0.92 (0.81 to 1.02)	0.1152
14. Chronic Specialty: Stable - Eye	38,059	1,161 (3.05%)	0.84 (0.76 to 0.91)	<0.0001
16. Chronic Specialty: Unstable - Orthopaedic	12,006	350 (2.92%)	0.88 (0.75 to 1.02)	0.0736
17. Chronic Specialty: Unstable - Ear, Nose, Throat	2,180	70 (3.21%)	2.02 (1.72 to 2.31)	<0.0001
18. Chronic Specialty: Unstable - Eye	33,479	1,343 (4.01%)	0.99 (0.92 to 1.06)	0.7590
20. Dermatologic	98,720	1,451 (1.47%)	0.84 (0.77 to 0.9)	<0.0001
21. Injuries/Adverse Effects: Minor	78,973	1,760 (2.23%)	0.90 (0.84 to 0.96)	0.001
22. Injuries /Adverse Effects: Major	79,568	3,490 (4.39%)	1.11 (1.06 to 1.16)	<0.0001
23. Psychosocial: Time Limited, Minor	71,206	3,563 (5.00%)	2.09 (2.04 to 2.14)	<0.0001
24. Psychosocial: Recurrent or Persistent, Stable	104,605	2,872 (2.75%)	1.08 (1.02 to 1.13)	0.0055
25. Psychosocial: Recurrent or Persistent, Unstable	30,667	2,303 (7.51%)	1.77 (1.71 to 1.83)	<0.0001

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26. Signs/Symptoms: Minor	281,636	6,227 (2.21%)	0.87 (0.83 to 0.91)	<0.0001
27. Signs/Symptoms: Uncertain	391,194	9,869 (2.52%)	1.15 (1.11 to 1.18)	<0.0001
28. Signs/Symptoms: Major	164,059	8,095 (4.93%)	1.60 (1.56 to 1.64)	<0.0001
29. Discretionary	150,922	4,324 (2.87%)	1.01 (0.97 to 1.06)	0.5712
30. See and reassure	27,910	1,247 (4.47%)	1.20 (1.12 to 1.27)	<0.0001
31. Preventive/administrative	851,425	17,603 (2.07%)	1.61 (1.57 to 1.66)	<0.0001
32. Malignancy	28,033	1,643 (5.86%)	0.92 (0.85 to 0.99)	0.0208
33. Pregnancy	31,130	159 (0.51%)	1.01 (0.84 to 1.19)	0.8965
34. Dental	52,218	793 (1.52%)	0.91 (0.82 to 0.99)	0.0248

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Table 3. Multilevel analysis. Impact of the variables related to the general practitioner (GP) and primary care centre on hospitalization for ambulatory care sensitive conditions

	No. of patients	No. of patients with ≥1 ACSC	OR	Likelihood ratio test
Characteristics of the GP				
List size				0.0935
large	387,451	3,594 (0.93%)	0.96 (0.87 to 1.05)	
medium-sized	1,180,860	12,950 (1.10%)	reference	
small	391,371	4,507 (1.15%)	0.92 (0.84 to 1.00)	
Frequency of patient visits				<0.0001
high	356,361	3,592 (1.01%)	1.29 (1.21 to 1.37)	
intermediate	1,382,634	15,128 (1.09%)	reference	
low	220,678	2,331 (1.05%)	1.08 (0.99 to 1.17)	
Rate of referral				<0.0001
high	485,792	5,005 (1.03%)	1.02 (0.95 to 1.09)	
intermediate	1,175,905	13,031 (1.11%)	reference	
low	297,985	3,015 (1.01%)	1.33 (1.24 to 1.41)	
Prescribing costs				0.0003
high	349,560	3,836 (1.10%)	1.16 (1.09 to 1.24)	
intermediate	1,298,466	13,823 (1.07%)	reference	
low	311,656	3,836 (1.09%)	1.02 (0.94 to 1.09)	
Characteristics of the primary care centre				
Size of the centre				0.5684
large	370,318	3,561 (0.96%)	1.03 (0.86 to 1.21)	
medium-sized	1,269,509	13,914 (1.10%)	reference	

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small	319,855	3,576 (1.12%)	0.94 (0.81 to 1.07)	
Staff satisfaction				0.6945
high	389,948	4,531 (1.16%)	0.99 (0.86 to 1.12)	
intermediate	1,187,944	12,844 (1.08%)	reference	
low	381,790	3,676 (0.96%)	0.94 (0.80 to 1.08)	
Percentage of immigrants in the population				0.9170
high	393,285	4,754 (1.21%)	0.98 (0.83 to 1.14)	
intermediate	1,173,120	12,045 (1.03%)	reference	
low	393,277	4,252 (1.08%)	1.02 (0.89 to 1.16)	
Percentage of elderly individuals in the population				0.5818
high	389,721	4,474 (1.15%)	1.02 (0.89 to 1.16)	
intermediate	1,186,379	12927 (1.09%)	reference	
low	383,582	3,650 (0.95%)	1.08 (0.93 to 1.23)	

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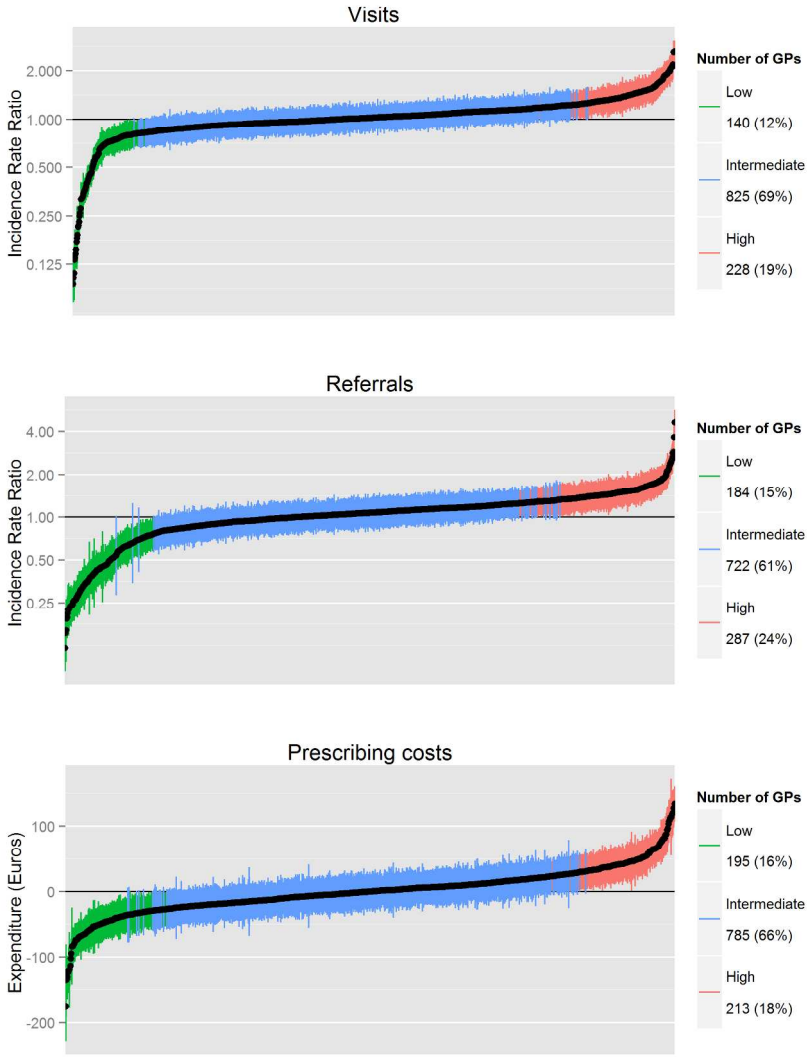
Figure 1.
Relative consumption of resources by the 1,193 general practioners (GPs), by rank from lowest to highest. Differences with respect to an average GP expressed as ratios (visits, referrals) or in absolute values (prescribing costs). Vertical bars correspond to 95% confidence intervals



199x279mm (300 x 300 DPI)

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Reported
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Abstract (pag. 9)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract (pag. 9-10)
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction (pag. 11-12)
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction (last sentences; pag 13)
Methods			
Study design	4	Present key elements of study design early in the paper	Methods (pag. 14)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods : Setting, Study population and period, Sources of data (pag. 14-15)
Participants	6	(*a*) *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Methods: Study population and period (pag. 15)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods: Variables and statistical analysis (pag.16-18)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods: Variables and statistical analysis (pag.16-18)
Bias	9	Describe any efforts to address potential sources of bias	Discussion: Strength and limitations (pag.21)
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods: Variables and statistical analysis (pag.16-17)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Methods: Variables and statistical analysis (pag.16-17)
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A (There were not missing data)
		(*e*) Describe any sensitivity analyses	N/A

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Results			**Reported**
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Results (pag.19)
		(b) Indicate number of participants with missing data for each variable of interest	There were not missing data
Outcome data	15*	*Cross-sectional study*—Report numbers of outcome events or summary measures	Results (pag.19)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results- tables 1,2,3 (pag.31-36)
		(*b*) Report category boundaries when continuous variables were categorized	Methods (pag.16-18) Results - table 1 (pag.31-32)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion: Main findings (pag. 21)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion: Strengths and limitations (pag.21-22)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion: Main findings, Strengths and limitations, Comparison with other studies, Significance of the study, Potential explanations and implications for doctors and managers. (pag.21-24)
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion: Strengths and limitations, Unanswered questions and future research. (pag.21-22,24)
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Acknowledgments . (pag.26)

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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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Variability in potentially preventable hospitalisations: an observational study of clinical practice patterns of general practitioners and care outcomes in the Basque Country (Spain).

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Title:

VARIABILITY IN POTENTIALLY PREVENTABLE HOSPITALISATIONS: AN OBSERVATIONAL STUDY OF CLINICAL PRACTICE PATTERNS OF GENERAL PRACTITIONERS AND CARE OUTCOMES IN THE BASQUE COUNTRY (SPAIN)

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ABSTRACT

Objectives:

To explain the variability in the frequency of potentially preventable hospitalisations (ambulatory care sensitive conditions [ACSCs]) based on factors at multiple levels (individual, health professional, health centre and health district), and specifically using resource efficiency indicators for general practitioners (GPs).

Design:

Cross-sectional study. We analysed primary care electronic health records and hospital discharge data using multilevel mixed models.

Setting:

Primary care network of the Basque Health Service (Spain)

Participants:

All the residents in the Basque Country ≥ 14 years of age, covered by the public healthcare system (n=1,959,682), and all the GPs (n=1,193) and health centres (n=130).

Main outcome measures:

Individuals admitted for ACSCs, over a 12 month period.

Results:

Admissions for ACSCs were less frequent among patients who were female, middle-aged or from the highest socioeconomic classes. The health centre variables considered and GP list size were not found to be significant.

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After adjusting for the variables studied including morbidity, the risk of hospital admission was higher among individuals under the care of GPs with greater than expected numbers of patient visits and prescribing costs (OR=1.27 [95% confidence interval 1.18 to 1.37); 1.16 [1.08 to 1.25]), and who make fewer referrals than the mean among their colleagues (OR=1.33 [1.22 to 1.44])

Conclusions:

When assessing activities and procedure indicators in primary care, we should, also, define outcome-based criteria. Specifically, GPs who hold more patient visits, have higher prescribing costs and are more reluctant to refer patients to specialists obtain poorer outcomes.

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Strengths of the study

- The main strength of this study is that we analysed data for an entire healthcare system, providing near universal care for the population of a defined geographical area.

- It not only assesses the relationship between preventable diseases and variables at different levels, ranked in accordance with the hierarchical nature of the data, but also compares the risk of admission of patients seen by doctors with different clinical practice patterns.

- We used a robust system for adjusting for patient morbidity (the Johns Hopkins ACG case-mix system).

Limitations.

- The observational design of the study hampers ascribing causality to the associations observed.

- The health information system of the Basque Country and, as is commonly the case with the use of administrative databases and electronic health records, there may be some incomplete or inaccurate data.

- The ecological nature of the socioeconomic variable used (deprivation index) might have diluted the effect of individual socioeconomic characteristics. Also, social characteristics other than the ones studied have an effect on the need for healthcare and its outcomes.

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- This paper is focused on the organization of public health service provision and planning, and thus, private health provision is beyond the scope of our analysis.

- There are factors unrelated to primary care itself that could have an effect on hospital admissions.

- The use of a list of conditions adapted for our setting (in this case, Spain) has advantages from the point of view of the validity of our results, but it may make it difficult to generalize the findings to other areas.

- In relation to external validity, Spain has primary care health services that are well-established and easy to access by the population, with higher rates of visits to doctors and generally lower rates of ACSC admissions than reported for other settings. It might not be possible to extrapolate our findings to other settings with different characteristics.

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INTRODUCTION

Healthcare organizations often analyse variations in physician practice patterns for monitoring the quality and efficiency of primary care health services. In this way, it is assessed whether the use of healthcare resources by health professionals is what would be expected as a function of the morbidity in the population served. This information is very important: it allows physicians themselves to reflect on their own way of working and managers to identify health professionals with markedly different patterns of resource use to their colleagues.

It is widely agreed that some prescriptions, referrals to specialized care, requests for ancillary tests and primary care visits are not justified,[1] and hence, it could be argued that the rates of all of these should be reduced. However, analysing each indicator separately makes it difficult to reach conclusions: we should not assert that a primary care physician's use of resources is excessive (or insufficient) without assessing their patient's outcomes. For example, situations of apparent efficiency may be, in reality, a failure to provide the necessary care to certain groups of patients resulting from lack of accessibility or poor clinical practice. In fact, numerous studies have indicated that a lower use of primary care resources is associated with adverse effects on the health of the population[2,3] and certain attempts in the USA to reduce the number of ambulatory visits,[4] through the introduction of co-payments, may have a negative impact in terms of people´s health. The effects of decreasing spending on prescriptions are also not fully known and lack of association between quality and costs of prescribing has been reported.[5] Although in some cases (such as the excessive use of antibiotics) the need for cutting

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back is unquestionable,[6,7] in other cases such a reduction may have unintended consequences. In relation to this, some authors have observed an inverse correlation between the number of prescriptions and hospitalisation costs,[8] and that the use of disincentives for prescribing such as a co-payment may lead to discontinuation of treatments by chronic patients and worsening of the health of vulnerable populations.[9] As a result, to assess physicians in a fair manner and promote changes in clinical practice patterns with the goal of improving healthcare efficiency, we must take into account the impact of the care provided on outcomes.

In this context, an accepted method for assessing outcomes is to consider ambulatory care sensitive conditions (ACSCs).[10] These are a series of conditions for which it should be possible to avoid hospital admission by providing timely and effective ambulatory care, through the following types of interventions: prevention at the primary care level, early diagnosis and treatment of acute diseases, and adequate control and follow-up of chronic diseases. Although based on hospital discharge reports, data on admissions for ACSCs provide us with indirect information regarding primary care, in particular, accessibility of this level of care and its ability to resolve health problems. In America, ACSCs have mainly been used to measure access, while in other countries with national health services, they have principally been used to assess quality of care.[11] In any case, factors unrelated to primary care also influence hospital admissions, meaning that this instrument needs to be adapted to the context in which it is to be applied.[11] For this reason, in our study, we used lists of ACSCs that have been established for Spanish populations[12] and have already been used by other authors.[13–15]

Numerous studies have indicated differences in ACSC admission rates as a function of the demographic,[16] clinical[17,18] and social[15,19,20]

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characteristics of patients. In addition, the rate has been found to be associated with factors attributable to healthcare systems and organizations.[3,21] However, few studies have analysed its relationship with factors related to general practitioners (GPs), and to our knowledge, none have explored their way of working and clinical practice patterns. In this context, the objective of this study was to explain the variability in the rate of potentially preventable hospitalisations (i.e., admissions for ACSCs) based on multilevel characteristics and factors (individual, health professional, health centre and health district) and, in particular, considering indicators of the efficiency of resource use by GPs.

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METHODS

This was a cross-sectional study analysing the outcomes of the public primary care network for a 1-year period (2007/2008, Basque Country, Spain).

Ethical considerations

The Clinical Research Ethics Committee of the Basque Country approved this study (PI2012151).

Setting

The Government of the Basque Country has been responsible for planning and provision of healthcare services for the population in this region since 1983. Public healthcare provision is delivered by the Basque Health Service (Osakidetza), a public organization funded through taxes that provides nearly universal care to residents in the region. Care is free at the point of delivery, except for prescriptions, for which there is co-payment that varies depending on the type of disease and patient status (with exemptions for those who are retired or disabled, among others).

When this study was conducted, primary care health services in our setting were organized into seven health districts, corresponding to geographical areas. The primary care health districts are economically, financially and administratively independent and are funded by annual contracts with the Health Department of the Government of the Basque Country. Each of these districts has 9 to 22 health centres.

Primary care health professionals work in care teams. At the individual level, every resident is on the list of a general practitioner, who is a family doctor or paediatrician depending on the patient's age (≥14 years vs younger). These primary care doctors act as gatekeepers to other levels of

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care. General practitioners are salaried and their payment is composed of two parts: a larger fixed emolument and a small one (less than 10% of total) based on the number of patients assigned to their lists of patients; there are not financial incentives to the physicians for the number of visits they provide nor the fulfilment of objectives, such as restraints in prescriptions expenditure or number of referrals. Electronic health records, which started to be introduced in 1990, are now used by all primary care doctors.

Study population and period

The observation period was set at 1 year, from 1 September 2007 to 31 August 2008. The study population included all residents ≥14 years of age who were covered by the public healthcare system in the Basque Country on 31 August 2008 and who had been covered for at least 6 months in the previous year, regardless of whether they had used or had any contact with the Basque Health System (Osakidetza) in that period. That is, almost the entire population of the Basque Country was included.

In this study, we analysed data from across the public health service network: 130 health centres and 1193 GPs. The total number of registered inhabitants was 1,959,682, meaning that the GP lists were composed of a mean of 1643 people.

Sources of data:

We used the two following sources of data:

- Electronic health records of the Basque primary healthcare system, which contain demographic, administrative and clinical data, including diagnoses, prescriptions, ancillary test results and referrals, generated in relation to each patient visit.
- The minimum basic data set, which gathers information on all hospital discharges from across the Basque network of public hospitals, including

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data on patient characteristics, hospitalisation episodes, diagnoses and procedures.

Variables and statistical analysis

At the level of the individual patient, we used demographic(age and sex), morbidity and socioeconomic characteristics as explanatory variables.

In order to include a manageable number of diseases, we classified all the patient diagnoses (ICD-9-CM codes) made by the GPs during the study year into Aggregated Diagnosis Groups (ADGs).[22] The ADG system assigns ICD-9-CM codes to one of 32 categories, as a function of clinical criteria, the expected resource use and type of care required for each health problem. It is part of the Johns Hopkins Adjusted Clinical Group (ACG) case-mix system, which is described elsewhere.[23]

As a proxy for the socioeconomic status of patients, we used a deprivation index based on census data, created for the MEDEA[24] project. Census tracts are the smallest territorial units for which census population data are available in Spain and they are mainly defined by criteria related to population size, and geographic and social features. Though the number of residents varies between tracts, the median is 1,200. For this study, the deprivation index was categorized into five groups, the fifth corresponding to the areas with the greatest deprivation and the first to the least deprived areas. It is an indicator of socioeconomic status of people living in a community and it has been shown to be correlated with rates of mortality[25] and morbidity.[26]

At the GP level, to estimate their work load, we considered the number of patients on their list. Using this information, the GP lists were divided

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into four groups (quartiles), those in the highest quartile being large, those in the second and third quartiles medium-sized and those in the lowest quartile small.

We used a similar approach to characterise the primary care health centres. In this case, the variables used were area-level demographic factors (percentages of people above 65 years of age and of immigrants),[27] size of the centre (number of GPs on the staff) and level of satisfaction of the centre's staff with their work environment. The last of these variables corresponds to the overall satisfaction score for the health centre, calculated from the results of an internal survey carried out on a regular basis by Osakidetza in all its organisations.[28] Like GPs, the health centres were categorised into quartiles, the level of satisfaction being rated as high for those in the highest quartile, moderate for those in the middle two quartiles and low for those in the lowest quartile.

All the analysis was performed using SAS version 9.2.

For the first stage of analysis, we considered the following response variables at the patient level: the number of visits to the GP, number of forms for referrals to specialists issued by the GP, and costs to the Department of Health of drugs prescribed to the patient during the year of the study.

We constructed multilevel mixed models[29] to identify which GPs were outliers in terms of resource use. Taking into account the hierarchical nature of the data, we used the explanatory variables as fixed effects and included random intercepts for each of the higher levels: GP, health centre and health district. As a function of the distribution of the response variables, we used different regression models: in the case of prescribing costs, we built a normal regression model (Proc MIXED, RMLE), while for the

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visits and referrals, we used negative binomial regression models (Proc GLIMMIX, LAPLACE). These models allowed us, using an empirical Bayesian approach,[30] to estimate the differences between the performance of each GP and the mean for each the response variables, after adjusting for the other variables, as well as 95% confidence intervals for the estimators. For visits and referrals, the estimators were exponentiated to obtain the incidence rate ratios. We considered doctors to be outliers (high or low) when their estimators statistically differed from zero (prescribing costs) or one (visits and referrals).

For the second stage, in addition to variables considered in the first stage, we used classifications of each doctor (high/intermediate/low) with respect their use of healthcare resources (visits, referrals and prescribing costs) as explanatory variables, following the aforementioned procedure, and the appearance of preventable hospitalisations as the response variable. For this purpose, we identified patients who had had one or more admissions attributable to ACSCs, using the list established in Spain by Caminal et al.[12]

Using these variables, we constructed a multilevel mixed-effect logistic regression (Proc GLIMMIX, LAPLACE). In this case, we used the aforementioned explanatory variables (including the GP's classifications by resource use) as fixed effects and a random intercept for each of the three higher levels (GP, health centre and health district). The results are expressed as odd ratios (ORs).

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RESULTS

During the 12 months of the study, 70.2% of patients made at least one visit to their GP. The annual means per patient were: 4.47 primary care visits, 0.4 referrals and €153.28 in prescribing costs.

Figure 1 shows the distribution of GPs into the three levels of resource use. The percentages of GPs with higher and lower than expected resource use per patient were as follows: 228 (19.1%) and 140 (11.7%) for visits; 21.1% and 15.4% for referrals; and 17.9% and 16.3% for prescribing costs, respectively.

A total of 21,051 people were admitted one or more times for an ACSC, corresponding to 1.07% of the total population. ACSC admission rates were associated with demographic characteristics of patients (Table 1), though not linearly. Based on the crude rates, admissions appeared to increase with age; however, after adjusting for the variables studied including morbidity, we obtained a J-shaped bimodal distribution, with a peak among the youngest people and a higher peak at the oldest ages. With respect to sex, men were more likely to have preventable hospitalisations. As for the deprivation index, more disadvantaged social groups had higher rates of ACSC admissions, although there were only statistically significant differences comparing the most and least disadvantaged populations. Regarding morbidity, in general, we observed that the risk of admission for ACSCs was associated with the diagnostic groups (ADGs) for acute diseases, major symptoms, recurrent health problems (except allergy), chronic diseases and psychosocial problems. However, this was not the case for chronic disorders that often require specialized care, other than mental health (Table 2).

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With respect to the variables at the doctor level (Table 3), the risk of ACSC admissions was higher for patients of GPs with a greater than expected mean number of visits and prescribing costs (OR=1.29 [1.21 to 1.37]; 1.16 [1.09 to 1.24]) or with a lower than expected mean rate of referrals (OR=1.33 [1.24 to 1.41]). The number of patients on the GP's list did not reach statistical significance (p=0.0935).

In our analysis, none of the health centre characteristics (size, level of satisfaction of staff, and percentages of elderly individuals and of immigrants in the population) reached statistical significance.

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DISCUSSION

Main findings

Our results indicate that various characteristics of patients and GPs have an effect on the risk of hospital admission for potentially preventable conditions. At the patient level, the rate of these admissions was significantly higher in two age groups, the youngest and the oldest patients, in males, and in various groups with acute, recurrent or chronic disorders, as well as those with psychosocial problems; on the other hand, the admission rate was lower in people from the most advantaged socioeconomic status. At the doctor level, once we had adjusted for morbidity and the other variables analysed, the risk of admission for ACSCs was higher in people seen by GPs with greater than expected numbers of visits by patients and prescribing costs and with lower rates of referrals than other doctors. Differences in admissions as a function of variables characterizing the health centre (number of GPs; satisfaction with the work environment; percentage of elderly individuals and of immigrants in the population) or GP list size were not statistically significant.

Strengths and limitations

The main strength of this study is that we analysed data for an entire healthcare system, providing near universal care for the population of a defined geographical area. Further, it not only assesses the relationship between preventable diseases and variables at different levels, ranked in accordance with the hierarchical nature of the data, but also compares the risk of admission of patients seen by doctors with different clinical practice patterns. In addition, we used a robust system for adjusting for patient morbidity, namely, the Johns Hopkins ACG case-mix system.

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In our setting, patients are included in the physicians' lists according to administrative criteria. Geographic proximity to the dwelling is the unique factor for assigning the patient to the health center. Although, on paper, each patient can chose among the doctors of her/his health center, actually such option is very limited and infrequently taken. First, there are not publicly available performance metrics of primary care providers that can guide patient preferences. Besides, patients find restrictions to change their doctor: in order to achieve equitable workloads, health centers establish rules to distribute patients and each GP have assigned a similar number of persons adjusting by age groups. Thus, even though the allocation of patients to doctors is not entirely driven by hazard, it seems very difficult that populations with particular unobserved characteristics (such as health services-seeking preferences, unmeasured health status or treatment adherence) were concentered on the lists of some GPs.

However, we should also recognize some limitations. First, the data analysed come from the daily records entered in the health information system of the Basque Country and, as is commonly the case with the use of administrative databases and electronic health records, there may be some incomplete or inaccurate data. Second, the ecological nature of the socioeconomic variable used (deprivation index) might have diluted the effect of individual socioeconomic characteristics; it is also known that social characteristics other than the ones studied have an effect on the need for healthcare and its outcomes.[31] Further, this paper is focused on the organization of public health service provision and planning, and thus, private health provision is beyond the scope of our analysis.

With respect to the definition of ACSCs, it should be taken into account that there are factors unrelated to primary care itself that could have an effect on hospital admissions. The use of a list of conditions adapted for our setting (in this case, Spain) has advantages from the point of view of the validity of our results, but it may make it difficult to generalize the

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findings to other areas. Additionally, in relation to external validity, Spain has primary care health services that are well-established and easy to access by the population,[32] with higher rates of visits to doctors and generally lower rates of ACSC admissions than reported for other settings.[33] Hence, it might not be possible to extrapolate our findings to other settings with different characteristics.

Comparison with other studies

Our results are partially consistent with previous research. Various different authors have established that ACSC admissions are associated with certain individual-based factors including being male[14,34,35], being elderly,[16,35] having a low socioeconomic status,[15,19,20,36] being from disadvantaged ethnic or racial groups,[20,37] and having chronic diseases[17,18,38] or mental health problems.[39,40] However, our results differ from those of other authors such as Casalino et al,[41] who found an inverse relationship between the size of primary healthcare teams and ACSC admissions. What is more, associations with factors related to access to primary care health services that have been often described, such as an inverse correlation between ACSC admissions and the patient-to-doctor ratio,[3,21] were also not found in our data. Although some authors have assessed the relationship between ACSC admissions and the number of visits to GPs by patients[3,38,42–44] and, even, the mean daily number of consultations held by doctors in a geographical area,[15] we are not aware of any studies similar to ours. In particular, we studied the association between potentially preventable admissions and efficiency indicators of GPs based on the ratio between the observed and expected consumption of resources: number of visits by patients, referrals and prescribing costs.

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Significance of the study. Potential explanations and implications for doctors and managers

The benefits of primary care on the health of people and populations have been demonstrated and widely recognised.[2] Other authors have described the added value to the care of a generalist approach, especially for complex patients with multimorbidity, this giving rise to the paradox that GPs provide poorer quality healthcare than specialists in the treatment of specific diseases, but achieve better outcomes in overall health of people and populations.[45]

However, as in other healthcare contexts, doing more is not always better in primary care. From our analysis, it seems that certain clinical practice patterns of primary care doctors have an effect on the outcomes of care. In particular, we can state that GPs holding an excessive number of visits with patients is associated with higher rates of preventable admissions, as is GPs having higher prescribing costs, while those who play the role of strong "gatekeepers" and are more reluctant to "pass the baton" to specialists also achieve poorer results. Given this, indicators that measure the performance of health professionals should be interpreted with care, unless they are accompanied by other indicators of care outcomes. Otherwise, interventions focused on modifying clinical practice patterns may have undesired consequences. On the other hand, from a health policy perspective, our results can assist the idea that an excessive fragmentation between health care levels could result in detriments to the population health. In contrast, the assumption of shared values and objectives by primary and specialized care can aid to a seamless, coordinated and person-centred assistance.

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Unanswered questions and future research

This study indicates how certain ways of working among primary care doctors are associated to different outcomes in terms of preventable hospitalization of patients. However, it does not allow us to establish the causes of these differences. Visits to GPs are diverse in nature: they may occur on the initiative of the patient or of the doctor, they have many underlying reasons (for example, for assessing symptoms or diseases, social problems, provision of advice, or administrative procedures), and they may vary in terms of duration, structure, procedures performed, and the involvement of other primary care health professionals, such as nurses. Several factors increase prescribing costs: excessive prescribing, inappropriate treatments, and selection of the most expensive option. Important factors regarding referrals are whether they are appropriate and timely, as well as the type of specialist patients are referred to, and the subsequent level of coordination between the GP and the specialist in the shared management of the patient. In relation to this, there is a need for future studies analysing primary care outcomes that consider other factors related to visits, referrals and prescriptions. Furthermore, our results should be tested in other settings or specific population groups (for example, patients with multimorbidity or with specific diseases). In any case, our findings provide a starting point for discussion and research concerning what should be the limits in terms of the "quantity" of primary care provided to meet the needs of the population.

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Authors' contributions

JFO and GG participated in the design of the study. JFO performed the validation of databases. ACA and GG were responsible for statistical analyses. JFO wrote the draft of manuscript. All authors participate in interpretation of data, critically reviewed and gave final approval to the manuscript.

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Competing interests

The authors declare that they have not competing interests.

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Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained

Ethical Approval

The Clinical Research Ethics Committee of the Basque Country approved this study (PI2012151).

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Role of the funder and statement of independence of researchers from funders

This article presents an independent research partially funded by Fondo de Investigación Sanitaria. The findings, conclusions and views in this manuscript are those of the authors and not necessarily those of the Fondo

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de Investigación Sanitaria, Osakidetza (Basque Health Service) or O+berri (Basque Institute for Healthcare Innovation)

Data sharing statement

There are no additional data available.

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WHAT THIS PAPER ADDS

- WHAT IS ALREADY KNOWN
  - Variability in the rate of potentially preventable hospitalizations (i.e., admissions for ambulatory care sensitive conditions, ACSCs) is used to assess access to primary healthcare and the quality of this care.
  - The risk of this type of hospitalization is higher in individuals with poor access to primary healthcare services and also those with certain characteristics (namely, being elderly, male, or from disadvantaged social, ethnic or racial groups, as well as having particular physical and/or mental diseases).

- WHAT THIS STUDY ADDS:
  - Clinical practice patterns of general practitioners (GPs) are associated with the risk of ACSC admissions among their patients.
  - ACSC admissions are more frequent when GPs hold more visits per patient, have higher prescribing costs, and are reluctant to refer their patients to specialists.
  - Patients receiving a greater "quantity" of care in primary care obtain the poorest outcomes.

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Table 1. Multilevel analysis. Impact of sociodemographic variables on hospital admission for ambulatory care sensitive conditions (ACSCs)

	No. of patients	No. of patients with ≥1 ACSC	OR	Likelihood ratio test
TOTAL	1,959,682	21,051 (1.07%)		
Age groups (years)				< 0.0001
14-24	196,804	564 (0.29%)	reference	
25-34	351,095	1,090 (0.31%)	0.92 (0.81 to 1.02)	
35-44	381,810	1,411 (0.37%)	0.77 (0.66 to 0.87)	
45-54	330,703	1,897 (0.57%)	0.71 (0.60 to 0.81)	
55-64	274,850	2,851 (1.04%)	0.68 (0.58 to 0.78)	
65-69	100,891	1,576 (1.56%)	0.65 (0.54 to 0.76)	
70-74	101,478	2,379 (2.34%)	0.74 (0.64 to 0.85)	
75-79	95,636	3,257 (3.41%)	0.85 (0.75 to 0.95)	
80-84	67,296	3,092 (4.59%)	1.03 (0.93 to 1.14)	
85+	59,119	2,934 (4.96%)	1.38 (1.28 to 1.49)	
Sex				< 0.0001
Male	955,138	11,990 (1.26%)	1.41 (1.37 to 1.44)	
Women	1,004,544	9,061 (0.90%)	reference	
Deprivation Index				0.0139
1	390,386	2,995 (0.77%)	0.92 (0.85 to 0.99)	
2	387,231	4,041 (1.04%)	1.02 (0.96 to 1.08)	

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3	394,884	4,375 (1.11%)	0.99 (0.93 to 1.05)
4	391,844	4,678 (1.19%)	0.97 (0.92 to 1.03)
5	395,337	4,962 (1.26%)	reference

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Table 2. Multilevel analysis. Impact of the morbidity variables on hospital admissions for ambulatory care sensitive conditions (ACSCs)

Aggregated Diagnosis Groups	No. of patients	No. of patients with ≥1 ACSC	OR	Likelihood ratio test
1. Time Limited: Minor	245,892	4,904 (1.99%)	0.98 (0.94 to 1.02)	0.4445
2. Time Limited: Minor-Primary Infections	535,848	12,363 (2.31%)	1.92 (1.89 to 1.96)	<0.0001
3. Time Limited: Major	48,055	6,275 (13.06%)	3.40 (3.35 to 3.44)	<0.0001
4. Time Limited: Major. Primary Infections	50,853	6,642 (13.06%)	5.34 (5.3 to 5.38)	<0.0001
5. Allergies	52,289	683 (1.31%)	0.93 (0.84 to 1.02)	0.1174
6. Asthma	44,212	2,040 (4.61%)	3.29 (3.23 to 3.35)	<0.0001
7. Likely to Recur: Discrete	265,298	6,936 (2.61%)	1.15 (1.12 to 1.19)	<0.0001
8. Likely to Recur: Discrete-Infections	153,097	4,966 (3.24%)	2.06 (2.02 to 2.1)	<0.0001
9. Likely to Recur: Progressive	37,633	7,762 (20.63%)	5.57 (5.53 to 5.61)	<0.0001
10. Chronic Medical: Stable	463,513	16,291 (3.51%)	2.64 (2.6 to 2.69)	<0.0001
11. Chronic Medical: Unstable	151,413	15,164 (10.01%)	7.78 (7.74 to 7.82)	<0.0001
12. Chronic Specialty: Stable - Orthopaedic	35,199	1,418 (4.03%)	1.09 (1.02 to 1.16)	0.0163
13. Chronic Specialty: Stable - Ear, Nose, Throat	22,348	540 (2.42%)	0.92 (0.81 to 1.02)	0.1152
14. Chronic Specialty: Stable - Eye	38,059	1,161 (3.05%)	0.84 (0.76 to 0.91)	<0.0001
16. Chronic Specialty: Unstable - Orthopaedic	12,006	350 (2.92%)	0.88 (0.75 to 1.02)	0.0736
17. Chronic Specialty: Unstable - Ear, Nose, Throat	2,180	70 (3.21%)	2.02 (1.72 to 2.31)	<0.0001
18. Chronic Specialty: Unstable - Eye	33,479	1,343 (4.01%)	0.99 (0.92 to 1.06)	0.7590
20. Dermatologic	98,720	1,451 (1.47%)	0.84 (0.77 to 0.9)	<0.0001
21. Injuries/Adverse Effects: Minor	78,973	1,760 (2.23%)	0.90 (0.84 to 0.96)	0.001
22. Injuries /Adverse Effects: Major	79,568	3,490 (4.39%)	1.11 (1.06 to 1.16)	<0.0001
23. Psychosocial: Time Limited, Minor	71,206	3,563 (5.00%)	2.09 (2.04 to 2.14)	<0.0001
24. Psychosocial: Recurrent or Persistent, Stable	104,605	2,872 (2.75%)	1.08 (1.02 to 1.13)	0.0055
25. Psychosocial: Recurrent or Persistent, Unstable	30,667	2,303 (7.51%)	1.77 (1.71 to 1.83)	<0.0001

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26. Signs/Symptoms: Minor	281,636	6,227 (2.21%)	0.87 (0.83 to 0.91)	<0.0001
27. Signs/Symptoms: Uncertain	391,194	9,869 (2.52%)	1.15 (1.11 to 1.18)	<0.0001
28. Signs/Symptoms: Major	164,059	8,095 (4.93%)	1.60 (1.56 to 1.64)	<0.0001
29. Discretionary	150,922	4,324 (2.87%)	1.01 (0.97 to 1.06)	0.5712
30. See and reassure	27,910	1,247 (4.47%)	1.20 (1.12 to 1.27)	<0.0001
31. Preventive/administrative	851,425	17,603 (2.07%)	1.61 (1.57 to 1.66)	<0.0001
32. Malignancy	28,033	1,643 (5.86%)	0.92 (0.85 to 0.99)	0.0208
33. Pregnancy	31,130	159 (0.51%)	1.01 (0.84 to 1.19)	0.8965
34. Dental	52,218	793 (1.52%)	0.91 (0.82 to 0.99)	0.0248

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Table 3. Multilevel analysis. Impact of the variables related to the general practitioner (GP) and primary care centre on hospitalization for ambulatory care sensitive conditions

	No. of patients	No. of patients with ≥1 ACSC	OR	Likelihood ratio test
Characteristics of the GP				
List size				0.0935
large	387,451	3,594 (0.93%)	0.96 (0.87 to 1.05)	
medium-sized	1,180,860	12,950 (1.10%)	reference	
small	391,371	4,507 (1.15%)	0.92 (0.84 to 1.00)	
Frequency of patient visits				<0.0001
high	356,361	3,592 (1.01%)	1.29 (1.21 to 1.37)	
intermediate	1,382,634	15,128 (1.09%)	reference	
low	220,678	2,331 (1.05%)	1.08 (0.99 to 1.17)	
Rate of referral				<0.0001
high	485,792	5,005 (1.03%)	1.02 (0.95 to 1.09)	
intermediate	1,175,905	13,031 (1.11%)	reference	
low	297,985	3,015 (1.01%)	1.33 (1.24 to 1.41)	
Prescribing costs				0.0003
high	349,560	3,836 (1.10%)	1.16 (1.09 to 1.24)	
intermediate	1,298,466	13,823 (1.07%)	reference	
low	311,656	3,836 (1.09%)	1.02 (0.94 to 1.09)	
Characteristics of the primary care centre				
Size of the centre				0.5684
large	370,318	3,561 (0.96%)	1.03 (0.86 to 1.21)	
medium-sized	1,269,509	13,914 (1.10%)	reference	

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small	319,855	3,576 (1.12%)	0.94 (0.81 to 1.07)	
Staff satisfaction				0.6945
high	389,948	4,531 (1.16%)	0.99 (0.86 to 1.12)	
intermediate	1,187,944	12,844 (1.08%)	reference	
low	381,790	3,676 (0.96%)	0.94 (0.80 to 1.08)	
Percentage of immigrants in the population				0.9170
high	393,285	4,754 (1.21%)	0.98 (0.83 to 1.14)	
intermediate	1,173,120	12,045 (1.03%)	reference	
low	393,277	4,252 (1.08%)	1.02 (0.89 to 1.16)	
Percentage of elderly individuals in the population				0.5818
high	389,721	4,474 (1.15%)	1.02 (0.89 to 1.16)	
intermediate	1,186,379	12927 (1.09%)	reference	
low	383,582	3,650 (0.95%)	1.08 (0.93 to 1.23)	

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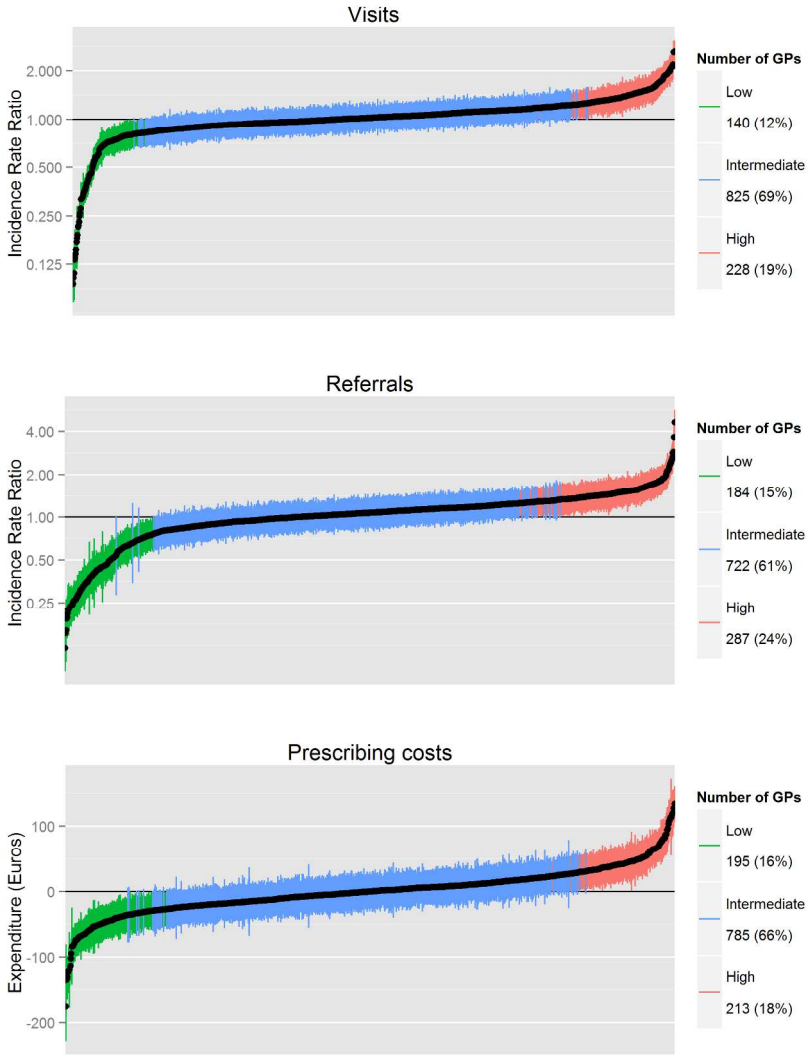
Figure 1.
Relative consumption of resources by the 1,193 general practioners (GPs), by rank from lowest to highest. Differences with respect to an average GP expressed as ratios (visits, referrals) or in absolute values (prescribing costs). Vertical bars correspond to 95% confidence intervals



199x279mm (300 x 300 DPI)

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Reported
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Abstract (pag. 9)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract (pag. 9-10)
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction (pag. 11-12)
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction (last sentences; pag 13)
Methods			
Study design	4	Present key elements of study design early in the paper	Methods (pag. 14)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods : Setting, Study population and period, Sources of data (pag. 14-15)
Participants	6	(*a*) *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Methods: Study population and period (pag. 15)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods: Variables and statistical analysis (pag.16-18)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods: Variables and statistical analysis (pag.16-18)
Bias	9	Describe any efforts to address potential sources of bias	Discussion: Strength and limitations (pag.21)
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods: Variables and statistical analysis (pag.16-17)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Methods: Variables and statistical analysis (pag.16-17)
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A (There were not missing data)
		(*e*) Describe any sensitivity analyses	N/A

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Results			**Reported**
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Results (pag.19)
		(b) Indicate number of participants with missing data for each variable of interest	There were not missing data
Outcome data	15*	*Cross-sectional study*—Report numbers of outcome events or summary measures	Results (pag.19)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results- tables 1,2,3 (pag.31-36)
		(*b*) Report category boundaries when continuous variables were categorized	Methods (pag.16-18) Results - table 1 (pag.31-32)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion: Main findings (pag. 21)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion: Strengths and limitations (pag.21-22)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion: Main findings, Strengths and limitations, Comparison with other studies, Significance of the study, Potential explanations and implications for doctors and managers. (pag.21-24)
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion: Strengths and limitations, Unanswered questions and future research. (pag.21-22,24)
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Acknowledgments . (pag.26)

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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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Variability in potentially preventable hospitalisations: an observational study of clinical practice patterns of general practitioners and care outcomes in the Basque Country (Spain).

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Title:

VARIABILITY IN POTENTIALLY PREVENTABLE HOSPITALISATIONS: AN OBSERVATIONAL STUDY OF CLINICAL PRACTICE PATTERNS OF GENERAL PRACTITIONERS AND CARE OUTCOMES IN THE BASQUE COUNTRY (SPAIN)

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VARIABILITY IN POTENTIALLY PREVENTABLE HOSPITALISATIONS: AN OBSERVATIONAL STUDY OF CLINICAL PRACTICE PATTERNS OF GENERAL PRACTITIONERS AND CARE OUTCOMES IN THE BASQUE COUNTRY (SPAIN)

ABSTRACT

Objectives:

To explain the variability in the frequency of potentially preventable hospitalisations (ambulatory care sensitive conditions [ACSCs]) based on factors at multiple levels (individual, health professional, health centre and health district), and specifically using resource efficiency indicators for general practitioners (GPs).

Design:

Cross-sectional study. We analysed primary care electronic health records and hospital discharge data using multilevel mixed models.

Setting:

Primary care network of the Basque Health Service (Spain)

Participants:

All the residents in the Basque Country ≥ 14 years of age, covered by the public healthcare system (n=1,959,682), and all the GPs (n=1,193) and health centres (n=130).

Main outcome measures:

Individuals admitted for ACSCs, over a 12 month period.

Results:

Admissions for ACSCs were less frequent among patients who were female, middle-aged or from the highest socioeconomic classes. The health centre variables considered and GP list size were not found to be significant. After adjusting for the variables studied including morbidity, the risk of hospital admission was higher among individuals under the care of GPs with greater than expected numbers of patient visits and prescribing costs (OR=1.27 [95% confidence interval 1.18 to 1.37); 1.16 [1.08 to 1.25]), and who make fewer referrals than the mean among their colleagues (OR=1.33 [1.22 to 1.44])

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Conclusions:

When assessing activities and procedure indicators in primary care, we should, also, define outcome-based criteria. Specifically, GPs who hold more patient visits, have higher prescribing costs and are more reluctant to refer patients to specialists obtain poorer outcomes.

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Strengths of the study

- The main strength of this study is that we analysed data for an entire healthcare system, providing near universal care for the population of a defined geographical area.

- It not only assesses the relationship between preventable diseases and variables at different levels, ranked in accordance with the hierarchical nature of the data, but also compares the risk of admission of patients seen by doctors with different clinical practice patterns.

- We used a robust system for adjusting for patient morbidity (the Johns Hopkins ACG case-mix system).

Limitations.

- The observational design of the study hampers ascribing causality to the associations observed.

- The health information system of the Basque Country and, as is commonly the case with the use of administrative databases and electronic health records, there may be some incomplete or inaccurate data.

- The ecological nature of the socioeconomic variable used (deprivation index) might have diluted the effect of individual socioeconomic characteristics. Also, social characteristics other than the ones studied have an effect on the need for healthcare and its outcomes.

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- This paper is focused on the organization of public health service provision and planning, and thus, private health provision is beyond the scope of our analysis.

- There are factors unrelated to primary care itself (such as variation in outpatient specialized care quality or hospital admission criteria) that could have an effect on hospital admissions.

- The use of a list of conditions adapted for our setting (in this case, Spain) has advantages from the point of view of the validity of our results, but it may make it difficult to generalize the findings to other areas.

- In relation to external validity, Spain has primary care health services that are well-established and easy to access by the population, with higher rates of visits to doctors and generally lower rates of ACSC admissions than reported for other settings. It might not be possible to extrapolate our findings to other settings with different characteristics.

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INTRODUCTION

Healthcare organizations often analyse variations in physician practice patterns for monitoring the quality and efficiency of primary care health services. In this way, it is assessed whether the use of healthcare resources by health professionals is what would be expected as a function of the morbidity in the population served. This information is very important: it allows physicians themselves to reflect on their own way of working and managers to identify health professionals with markedly different patterns of resource use to their colleagues.

It is widely agreed that some prescriptions, referrals to specialized care, requests for ancillary tests and primary care visits are not justified,[1] and hence, it could be argued that the rates of all of these should be reduced. However, analysing each indicator separately makes it difficult to reach conclusions: we should not assert that a primary care physician's use of resources is excessive (or insufficient) without assessing their patient's outcomes. For example, situations of apparent efficiency may be, in reality, a failure to provide the necessary care to certain groups of patients resulting from lack of accessibility or poor clinical practice. In fact, numerous studies have indicated that a lower use of primary care resources is associated with adverse effects on the health of the population[2,3] and certain attempts in the USA to reduce the number of ambulatory visits,[4] through the introduction of co-payments, may have a negative impact in terms of people´s health. The effects of decreasing spending on prescriptions are also not fully known and lack of association between quality and costs of prescribing has been reported.[5] Although in some cases (such as the excessive use of antibiotics) the need for cutting

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back is unquestionable,[6,7] in other cases such a reduction may have unintended consequences. In relation to this, some authors have observed an inverse correlation between the number of prescriptions and hospitalisation costs,[8] and that the use of disincentives for prescribing such as a co-payment may lead to discontinuation of treatments by chronic patients and worsening of the health of vulnerable populations.[9] As a result, to assess physicians in a fair manner and promote changes in clinical practice patterns with the goal of improving healthcare efficiency, we must take into account the impact of the care provided on outcomes.

In this context, an accepted method for assessing outcomes is to consider ambulatory care sensitive conditions (ACSCs).[10] These are a series of conditions for which it should be possible to avoid hospital admission by providing timely and effective ambulatory care, through the following types of interventions: prevention at the primary care level, early diagnosis and treatment of acute diseases, and adequate control and follow-up of chronic diseases. Although based on hospital discharge reports, data on admissions for ACSCs provide us with indirect information regarding primary care, in particular, accessibility of this level of care and its ability to resolve health problems. In America, ACSCs have mainly been used to measure access, while in other countries with national health services, they have principally been used to assess quality of care.[11] In any case, factors unrelated to primary care also influence hospital admissions, meaning that this instrument needs to be adapted to the context in which it is to be applied.[11] For this reason, in our study, we used lists of ACSCs that have been established for Spanish populations[12] and have already been used by other authors.[13–15]

Numerous studies have indicated differences in ACSC admission rates as a function of the demographic,[16] clinical[17,18] and social[15,19,20]

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characteristics of patients. In addition, the rate has been found to be associated with factors attributable to healthcare systems and organizations.[3,21] However, few studies have analysed its relationship with factors related to general practitioners (GPs), and to our knowledge, none have explored their way of working and clinical practice patterns. In this context, the objective of this study was to explain the variability in the rate of potentially preventable hospitalisations (i.e., admissions for ACSCs) based on multilevel characteristics and factors (individual, health professional, health centre and health district) and, in particular, considering indicators of the efficiency of resource use by GPs.

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METHODS

This was a cross-sectional study analysing the outcomes of the public primary care network for a 1-year period (2007/2008, Basque Country, Spain).

Ethical considerations

The Clinical Research Ethics Committee of the Basque Country approved this study (PI2012151).

Setting

The Government of the Basque Country has been responsible for the planning and provision of healthcare services for the population in this region since 1983. Public healthcare provision is delivered by the Basque Health Service (Osakidetza), a public organization funded through taxes that provides nearly universal care to residents in the region. Care is free at the point of delivery, except for prescriptions, for which there is co-payment that varies depending on the type of disease and patient status (with exemptions for those who are retired or disabled, among others).

When this study was conducted, primary care health services in our setting were organized into seven health districts, corresponding to geographical areas. The primary care health districts are economically, financially and administratively independent and are funded by annual contracts with the Health Department of the Government of the Basque Country. Each of these districts has 9 to 22 health centres.

Primary care health professionals work in care teams. At the individual level, every resident is on the list of a general practitioner, who is a family doctor or paediatrician depending on the patient's age (≥14 years vs younger). These primary care doctors act as gatekeepers to other levels of

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care. General practitioners are salaried and their payment is composed of two parts: a larger fixed remuneration and a small one (less than 10% of total) based on the number of patients assigned to their lists of patients; there are not financial incentives to the physicians for the number of visits they provide nor the fulfilment of objectives, such as restraints in prescriptions expenditure or number of referrals.

In our setting, patients are included in the physicians' lists according to administrative criteria. Geographic proximity to the dwelling is the unique factor for assigning the patient to the health center. Although, on paper, each patient can chose among the doctors of her/his health center, actually such option is very limited and infrequently taken. First, there are not publicly available performance metrics of primary care providers that can guide patient preferences. Besides, patients find restrictions to change their doctor: in order to achieve equitable workloads, health centers establish rules to distribute patients and each GP have assigned a similar number of persons adjusting by age groups. Thus, even though the allocation of patients to doctors is not entirely driven by hazard, it seems very difficult that populations with particular unobserved characteristics were concentered on the lists of some GPs.

Electronic health records, which started to be introduced in 1990, are now used by all primary care doctors.

Study population and period

The observation period was set at 1 year, from 1 September 2007 to 31 August 2008. The study population included all residents ≥14 years of age who were covered by the public healthcare system in the Basque Country on 31 August 2008 and who had been covered for at least 6 months in the previous year, regardless of whether they had used or had any contact with

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the Basque Health System (Osakidetza) in that period. That is, almost the entire population of the Basque Country was included.

In this study, we analysed data from across the public health service network: 130 health centres and 1193 GPs. The total number of registered inhabitants was 1,959,682, meaning that the GP lists were composed of a mean of 1643 people.

Sources of data:

We used the two following sources of data:

- Electronic health records of the Basque primary healthcare system, which contain demographic, administrative and clinical data, including diagnoses, prescriptions, ancillary test results and referrals, generated in relation to each patient visit.
- The minimum basic data set, which gathers information on all hospital discharges from across the Basque network of public hospitals, including data on patient characteristics, hospitalisation episodes, diagnoses and procedures.

Variables and statistical analysis

At the level of the individual patient, we used demographic(age and sex), morbidity and socioeconomic characteristics as explanatory variables.

In order to include a manageable number of diseases, we classified all the patient diagnoses (ICD-9-CM codes) made by the GPs during the study year into Aggregated Diagnosis Groups (ADGs).[22] The ADG system assigns ICD-9-CM codes to one of 32 categories, as a function of clinical criteria, the expected resource use and type of care required for each health problem. It is part of the Johns Hopkins Adjusted Clinical Group (ACG) case-mix system, which is described elsewhere.[23]

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As a proxy for the socioeconomic status of patients, we used a deprivation index based on census data, created for the MEDEA[24] project. Census tracts are the smallest territorial units for which census population data are available in Spain and they are mainly defined by criteria related to population size, and geographic and social features. Though the number of residents varies between tracts, the median is 1,200. For this study, the deprivation index was categorized into five groups, the fifth corresponding to the areas with the greatest deprivation and the first to the least deprived areas. It is an indicator of socioeconomic status of people living in a community and it has been shown to be correlated with rates of mortality[25] and morbidity.[26]

At the GP level, to estimate their work load, we considered the number of patients on their list. Using this information, the GP lists were divided into four groups (quartiles), those in the highest quartile being large, those in the second and third quartiles medium-sized and those in the lowest quartile small.

We used a similar approach to characterise the primary care health centres. In this case, the variables used were area-level demographic factors (percentages of people above 65 years of age and of immigrants),[27] size of the centre (number of GPs on the staff) and level of satisfaction of the centre's staff with their work environment. The last of these variables corresponds to the overall satisfaction score for the health centre, calculated from the results of an internal survey carried out on a regular basis by Osakidetza in all its organisations.[28] Like GPs, the health centres were categorised into quartiles, the level of satisfaction being rated as high for those in the highest quartile, moderate for those in the middle two quartiles and low for those in the lowest quartile.

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All the analysis was performed using SAS version 9.2.

For the first stage of analysis, we considered the following response variables at the patient level: the number of visits to the GP, number of forms for referrals to specialists issued by the GP, and costs to the Department of Health of drugs prescribed to the patient during the year of the study.

We constructed multilevel mixed models[29] to identify which GPs were outliers in terms of resource use. Taking into account the hierarchical nature of the data, we used the explanatory variables as fixed effects and included random intercepts for each of the higher levels: GP, health centre and health district. As a function of the distribution of the response variables, we used different regression models: in the case of prescribing costs, we built a normal regression model (Proc MIXED, RMLE), while for the visits and referrals, we used negative binomial regression models (Proc GLIMMIX, LAPLACE). These models allowed us, using an empirical Bayesian approach,[30] to estimate the differences between the performance of each GP and the mean for each the response variables, after adjusting for the other variables, as well as 95% confidence intervals for the estimators. For visits and referrals, the estimators were exponentiated to obtain the incidence rate ratios. We considered doctors to be outliers (high or low) when their estimators statistically differed from zero (prescribing costs) or one (visits and referrals).

For the second stage, in addition to variables considered in the first stage, we used classifications of each doctor (high/intermediate/low) with respect their use of healthcare resources (visits, referrals and prescribing costs) as explanatory variables, following the aforementioned procedure, and the appearance of preventable hospitalisations as the response variable. For this purpose, we identified patients who had had one

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or more admissions attributable to ACSCs, using the list established in Spain by Caminal et al.[12]

Using these variables, we constructed a multilevel mixed-effect logistic regression (Proc GLIMMIX, LAPLACE). In this case, we used the aforementioned explanatory variables (including the GP's classifications by resource use) as fixed effects and a random intercept for each of the three higher levels (GP, health centre and health district). The results are expressed as odd ratios (ORs).

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RESULTS

During the 12 months of the study, 70.2% of patients made at least one visit to their GP. The annual means per patient were: 4.47 primary care visits, 0.4 referrals and €153.28 in prescribing costs.

Figure 1 shows the distribution of GPs into the three levels of resource use. The percentages of GPs with higher and lower than expected resource use per patient were as follows: 228 (19.1%) and 140 (11.7%) for visits; 21.1% and 15.4% for referrals; and 17.9% and 16.3% for prescribing costs, respectively.

A total of 21,051 people were admitted one or more times for an ACSC, corresponding to 1.07% of the total population. ACSC admission rates were associated with demographic characteristics of patients (Table 1), though not linearly. Based on the crude rates, admissions appeared to increase with age; however, after adjusting for the variables studied including morbidity, we obtained a J-shaped bimodal distribution, with a peak among the youngest people and a higher peak at the oldest ages. With respect to sex, men were more likely to have preventable hospitalisations. As for the deprivation index, more disadvantaged social groups had higher rates of ACSC admissions, although there were only statistically significant differences comparing the most and least disadvantaged populations. Regarding morbidity, in general, we observed that the risk of admission for ACSCs was associated with the diagnostic groups (ADGs) for acute diseases, major symptoms, recurrent health problems (except allergy), chronic diseases and psychosocial problems. However, this was not the case for chronic disorders that often require specialized care, other than mental health (Table 2).

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With respect to the variables at the doctor level (Table 3), the risk of ACSC admissions was higher for patients of GPs with a greater than expected mean number of visits and prescribing costs (OR=1.29 [1.21 to 1.37]; 1.16 [1.09 to 1.24]) or with a lower than expected mean rate of referrals (OR=1.33 [1.24 to 1.41]). The number of patients on the GP's list did not reach statistical significance (p=0.0935).

In our analysis, none of the health centre characteristics (size, level of satisfaction of staff, and percentages of elderly individuals and of immigrants in the population) reached statistical significance.

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DISCUSSION

Main findings

Our results indicate that various characteristics of patients and GPs are associated with the risk of hospital admission for potentially preventable conditions. At the patient level, the rate of these admissions was significantly higher in two age groups, the youngest and the oldest patients, in males, and in various groups with acute, recurrent or chronic disorders, as well as those with psychosocial problems; on the other hand, the admission rate was lower in people from the most advantaged socioeconomic status. At the doctor level, once we had adjusted for morbidity and the other variables analysed, the risk of admission for ACSCs was higher in people seen by GPs with greater than expected numbers of visits by patients and prescribing costs and with lower rates of referrals than other doctors. Differences in admissions as a function of variables characterizing the health centre (number of GPs; satisfaction with the work environment; percentage of elderly individuals and of immigrants in the population) or GP list size were not statistically significant.

Strengths and limitations

The main strength of this study is that we analysed data for an entire healthcare system, providing near universal care for the population of a defined geographical area. Further, it not only assesses the relationship between preventable diseases and variables at different levels, ranked in accordance with the hierarchical nature of the data, but also compares the risk of admission of patients seen by doctors with different clinical practice patterns. In addition, we used a robust system for adjusting for patient morbidity, namely, the Johns Hopkins ACG case-mix system.

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However, we should also recognize some limitations. First, the data analysed come from the daily records entered in the health information system of the Basque Country and, as is commonly the case with the use of administrative databases and electronic health records, there may be some incomplete or inaccurate data. Second, the ecological nature of the socioeconomic variable used (deprivation index) might have diluted the effect of individual socioeconomic characteristics; it is also known that social factors other than the ones studied have an effect on the need for healthcare and its outcomes.[31] Similarly, other characteristics of patients (such as health services-seeking preferences, unmeasured health status or treatment adherence) were not observed. Further, this paper is focused on the organization of public health service provision and planning, and thus, private health provision is beyond the scope of our analysis.

With respect to the definition of ACSCs, it should be taken into account that there are factors unrelated to primary care itself that could have an effect on hospital admissions. The use of a list of conditions adapted for our setting (in this case, Spain) has advantages from the point of view of the validity of our results, but it may make it difficult to generalize the findings to other areas. Additionally, in relation to external validity, Spain has primary care health services that are well-established and easy to access by the population,[32] with higher rates of visits to doctors and generally lower rates of ACSC admissions than reported for other settings.[33] Hence, it might not be possible to extrapolate our findings to other settings with different characteristics.

Comparison with other studies

Our results are partially consistent with previous research. Various different authors have established that ACSC admissions are associated with certain individual-based factors including being male[14,34,35], being

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elderly,[16,35] having a low socioeconomic status,[15,19,20,36] being from disadvantaged ethnic or racial groups,[20,37] and having chronic diseases[17,18,38] or mental health problems.[39,40] However, our results differ from those of other authors such as Casalino et al,[41] who found an inverse relationship between the size of primary healthcare teams and ACSC admissions. What is more, associations with factors related to access to primary care health services that have been often described, such as an inverse correlation between ACSC admissions and the patient-to-doctor ratio,[3,21] were also not found in our data. Although some authors have assessed the relationship between ACSC admissions and the number of visits to GPs by patients[3,38,42–44] and, even, the mean daily number of consultations held by doctors in a geographical area,[15] we are not aware of any studies similar to ours. In particular, we studied the association between potentially preventable admissions and efficiency indicators of GPs based on the ratio between the observed and expected consumption of resources: number of visits by patients, referrals and prescribing costs.

Significance of the study. Potential explanations and implications for doctors and managers

Although from an observational study as ours is not possible to demonstrate causal correlations, our analysis suggest that certain clinical practice patterns of primary care doctors have an effect on the outcomes of care. In particular, we have observed that GPs holding a more than expected number of visits with patients, higher prescribing costs or lower referrals rate is associated with higher rates of preventable admissions.

In our opinion, physicians practice styles may play a central role and a plausible hypothesis is that some doctors try to avoid referrals and, due to that, their patients need more prescriptions and following visits to GP;

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conceivably this sequence might generate some inappropriate accessibility to specialized care for patients.

Other alternative explanations (such as, populations with particular unobserved characteristics being concentered on the lists of some GPs or that patients after a hospital discharge due to ACSC seek for GPs attention but elude being referred to specialized care) seem unlikely. Physician training can influence referral decision making, but in the Basque Country most of GPs have completed the Family Medicine Residency Program and only a very scarce number of doctors are not family physicians. GPs are not allowed to make choices about the specialist to whom refer their patients nor receive additional compensations for referrals. Even though in our setting there are GPs working in rural and urban locations, the uneven distribution of specialists between geographic areas has not affected our results, since health center random effects are included in the estimations.

The benefits of primary care on the health of people and populations have been demonstrated and widely recognised.[2] Other authors have described the added value to the care of a generalist approach, especially for complex patients with multimorbidity, this giving rise to the paradox that GPs provide poorer quality healthcare than specialists in the treatment of specific diseases, but achieve better outcomes in overall health of people and populations.[45]

However, as in other healthcare contexts, doing more is not always better in primary care. From our results, we can state that GPs performing an excessive number of visits with patients is associated with higher rates of preventable admissions, as is GPs having higher prescribing costs, while

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those who play the role of strong "gatekeepers" and are more reluctant to "pass the baton" to specialists also achieve poorer results.

Given this, indicators that measure the performance of health professionals should be interpreted with care, unless they are accompanied by other indicators of care outcomes. Otherwise, interventions focused on modifying clinical practice patterns may have undesired consequences. On the other hand, from a health policy perspective, our results can assist the idea that an excessive fragmentation between health care levels could result in detriments to the population health. In contrast, the assumption of shared values and objectives by primary and specialized care can aid to a seamless, coordinated and person-centred assistance.

Unanswered questions and future research

This study indicates how certain ways of working among primary care doctors are associated to different outcomes in terms of preventable hospitalization of patients. However, it does not allow us to establish the causes of these differences. Visits to GPs are diverse in nature: they may occur on the initiative of the patient or of the doctor, they have many underlying reasons (for example, for assessing symptoms or diseases, social problems, provision of advice, or administrative procedures), and they may vary in terms of duration, structure, procedures performed, and the involvement of other primary care health professionals, such as nurses. Several factors increase prescribing costs: excessive prescribing, inappropriate treatments, and selection of the most expensive option. Important factors regarding referrals are whether they are appropriate and timely, as well as the type of specialist patients are referred to, and the subsequent level of coordination between the GP and the specialist in the shared management of the patient. In relation to this, there is a need for

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future studies analysing primary care outcomes that consider other factors related to visits, referrals and prescriptions. Furthermore, our results should be tested in other settings or specific population groups (for example, patients with multimorbidity or with specific diseases). In any case, our findings provide a starting point for discussion and research concerning what should be the limits in terms of the "quantity" of primary care provided to meet the needs of the population.

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WHAT THIS PAPER ADDS

- WHAT IS ALREADY KNOWN
  - Variability in the rate of potentially preventable hospitalizations (i.e., admissions for ambulatory care sensitive conditions, ACSCs) is used to assess access to primary healthcare and the quality of this care.
  - The risk of this type of hospitalization is higher in individuals with poor access to primary healthcare services and also those with certain characteristics (namely, being elderly, male, or from disadvantaged social, ethnic or racial groups, as well as having particular physical and/or mental diseases).

- WHAT THIS STUDY ADDS:
  - Clinical practice patterns of general practitioners (GPs) are associated with the risk of ACSC admissions among their patients.
  - ACSC admissions are more frequent when GPs hold more visits per patient, have higher prescribing costs, and are reluctant to refer their patients to specialists.
  - Patients receiving a greater "quantity" of care in primary care obtain the poorest outcomes.

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Table 1. Multilevel analysis. Impact of sociodemographic variables on hospital admission for ambulatory care sensitive conditions (ACSCs)

	No. of patients	No. of patients with ≥1 ACSC	OR	Likelihood ratio test
TOTAL	1,959,682	21,051 (1.07%)		
Age groups (years)				< 0.0001
14-24	196,804	564 (0.29%)	reference	
25-34	351,095	1,090 (0.31%)	0.92 (0.81 to 1.02)	
35-44	381,810	1,411 (0.37%)	0.77 (0.66 to 0.87)	
45-54	330,703	1,897 (0.57%)	0.71 (0.60 to 0.81)	
55-64	274,850	2,851 (1.04%)	0.68 (0.58 to 0.78)	
65-69	100,891	1,576 (1.56%)	0.65 (0.54 to 0.76)	
70-74	101,478	2,379 (2.34%)	0.74 (0.64 to 0.85)	
75-79	95,636	3,257 (3.41%)	0.85 (0.75 to 0.95)	
80-84	67,296	3,092 (4.59%)	1.03 (0.93 to 1.14)	
85+	59,119	2,934 (4.96%)	1.38 (1.28 to 1.49)	
Sex				< 0.0001
Male	955,138	11,990 (1.26%)	1.41 (1.37 to 1.44)	
Women	1,004,544	9,061 (0.90%)	reference	
Deprivation Index				0.0139
1	390,386	2,995 (0.77%)	0.92 (0.85 to 0.99)	
2	387,231	4,041 (1.04%)	1.02 (0.96 to 1.08)	

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3	394,884	4,375 (1.11%)	0.99 (0.93 to 1.05)
4	391,844	4,678 (1.19%)	0.97 (0.92 to 1.03)
5	395,337	4,962 (1.26%)	reference

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Table 2. Multilevel analysis. Impact of the morbidity variables on hospital admissions for ambulatory care sensitive conditions (ACSCs)

Aggregated Diagnosis Groups	No. of patients	No. of patients with ≥1 ACSC	OR	Likelihood ratio test
1. Time Limited: Minor	245,892	4,904 (1.99%)	0.98 (0.94 to 1.02)	0.4445
2. Time Limited: Minor-Primary Infections	535,848	12,363 (2.31%)	1.92 (1.89 to 1.96)	<0.0001
3. Time Limited: Major	48,055	6,275 (13.06%)	3.40 (3.35 to 3.44)	<0.0001
4. Time Limited: Major. Primary Infections	50,853	6,642 (13.06%)	5.34 (5.3 to 5.38)	<0.0001
5. Allergies	52,289	683 (1.31%)	0.93 (0.84 to 1.02)	0.1174
6. Asthma	44,212	2,040 (4.61%)	3.29 (3.23 to 3.35)	<0.0001
7. Likely to Recur: Discrete	265,298	6,936 (2.61%)	1.15 (1.12 to 1.19)	<0.0001
8. Likely to Recur: Discrete-Infections	153,097	4,966 (3.24%)	2.06 (2.02 to 2.1)	<0.0001
9. Likely to Recur: Progressive	37,633	7,762 (20.63%)	5.57 (5.53 to 5.61)	<0.0001
10. Chronic Medical: Stable	463,513	16,291 (3.51%)	2.64 (2.6 to 2.69)	<0.0001
11. Chronic Medical: Unstable	151,413	15,164 (10.01%)	7.78 (7.74 to 7.82)	<0.0001
12. Chronic Specialty: Stable - Orthopaedic	35,199	1,418 (4.03%)	1.09 (1.02 to 1.16)	0.0163
13. Chronic Specialty: Stable - Ear, Nose, Throat	22,348	540 (2.42%)	0.92 (0.81 to 1.02)	0.1152
14. Chronic Specialty: Stable - Eye	38,059	1,161 (3.05%)	0.84 (0.76 to 0.91)	<0.0001
16. Chronic Specialty: Unstable - Orthopaedic	12,006	350 (2.92%)	0.88 (0.75 to 1.02)	0.0736
17. Chronic Specialty: Unstable - Ear, Nose, Throat	2,180	70 (3.21%)	2.02 (1.72 to 2.31)	<0.0001
18. Chronic Specialty: Unstable - Eye	33,479	1,343 (4.01%)	0.99 (0.92 to 1.06)	0.7590
20. Dermatologic	98,720	1,451 (1.47%)	0.84 (0.77 to 0.9)	<0.0001
21. Injuries/Adverse Effects: Minor	78,973	1,760 (2.23%)	0.90 (0.84 to 0.96)	0.001
22. Injuries /Adverse Effects: Major	79,568	3,490 (4.39%)	1.11 (1.06 to 1.16)	<0.0001
23. Psychosocial: Time Limited, Minor	71,206	3,563 (5.00%)	2.09 (2.04 to 2.14)	<0.0001
24. Psychosocial: Recurrent or Persistent, Stable	104,605	2,872 (2.75%)	1.08 (1.02 to 1.13)	0.0055
25. Psychosocial: Recurrent or Persistent, Unstable	30,667	2,303 (7.51%)	1.77 (1.71 to 1.83)	<0.0001

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26. Signs/Symptoms: Minor	281,636	6,227 (2.21%)	0.87 (0.83 to 0.91)	<0.0001
27. Signs/Symptoms: Uncertain	391,194	9,869 (2.52%)	1.15 (1.11 to 1.18)	<0.0001
28. Signs/Symptoms: Major	164,059	8,095 (4.93%)	1.60 (1.56 to 1.64)	<0.0001
29. Discretionary	150,922	4,324 (2.87%)	1.01 (0.97 to 1.06)	0.5712
30. See and reassure	27,910	1,247 (4.47%)	1.20 (1.12 to 1.27)	<0.0001
31. Preventive/administrative	851,425	17,603 (2.07%)	1.61 (1.57 to 1.66)	<0.0001
32. Malignancy	28,033	1,643 (5.86%)	0.92 (0.85 to 0.99)	0.0208
33. Pregnancy	31,130	159 (0.51%)	1.01 (0.84 to 1.19)	0.8965
34. Dental	52,218	793 (1.52%)	0.91 (0.82 to 0.99)	0.0248

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Table 3. Multilevel analysis. Impact of the variables related to the general practitioner (GP) and primary care centre on hospitalization for ambulatory care sensitive conditions

	No. of patients	No. of patients with ≥1 ACSC	OR	Likelihood ratio test
Characteristics of the GP				
List size				0.0935
large	387,451	3,594 (0.93%)	0.96 (0.87 to 1.05)	
medium-sized	1,180,860	12,950 (1.10%)	reference	
small	391,371	4,507 (1.15%)	0.92 (0.84 to 1.00)	
Frequency of patient visits				<0.0001
high	356,361	3,592 (1.01%)	1.29 (1.21 to 1.37)	
intermediate	1,382,634	15,128 (1.09%)	reference	
low	220,678	2,331 (1.05%)	1.08 (0.99 to 1.17)	
Rate of referral				<0.0001
high	485,792	5,005 (1.03%)	1.02 (0.95 to 1.09)	
intermediate	1,175,905	13,031 (1.11%)	reference	
low	297,985	3,015 (1.01%)	1.33 (1.24 to 1.41)	
Prescribing costs				0.0003
high	349,560	3,836 (1.10%)	1.16 (1.09 to 1.24)	
intermediate	1,298,466	13,823 (1.07%)	reference	
low	311,656	3,836 (1.09%)	1.02 (0.94 to 1.09)	
Characteristics of the primary care centre				
Size of the centre				0.5684
large	370,318	3,561 (0.96%)	1.03 (0.86 to 1.21)	
medium-sized	1,269,509	13,914 (1.10%)	reference	

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small	319,855	3,576 (1.12%)	0.94 (0.81 to 1.07)	
Staff satisfaction				0.6945
high	389,948	4,531 (1.16%)	0.99 (0.86 to 1.12)	
intermediate	1,187,944	12,844 (1.08%)	reference	
low	381,790	3,676 (0.96%)	0.94 (0.80 to 1.08)	
Percentage of immigrants in the population				0.9170
high	393,285	4,754 (1.21%)	0.98 (0.83 to 1.14)	
intermediate	1,173,120	12,045 (1.03%)	reference	
low	393,277	4,252 (1.08%)	1.02 (0.89 to 1.16)	
Percentage of elderly individuals in the population				0.5818
high	389,721	4,474 (1.15%)	1.02 (0.89 to 1.16)	
intermediate	1,186,379	12927 (1.09%)	reference	
low	383,582	3,650 (0.95%)	1.08 (0.93 to 1.23)	

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Authors' contributions

JFO and GG participated in the design of the study. JFO performed the validation of databases. ACA and GG were responsible for statistical analyses. JFO wrote the draft of manuscript. All authors participate in interpretation of data, critically reviewed and gave final approval to the manuscript.

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Competing interests

The authors declare that they have not competing interests.

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Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained

Ethical Approval

The Clinical Research Ethics Committee of the Basque Country approved this study (PI2012151).

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Role of the funder and statement of independence of researchers from funders

This article presents an independent research partially funded by Fondo de Investigación Sanitaria. The findings, conclusions and views in this manuscript are those of the authors and not necessarily those of the Fondo de Investigación Sanitaria, Osakidetza (Basque Health Service) or O+berri (Basque Institute for Healthcare Innovation)

Data sharing statement

There are no additional data available.

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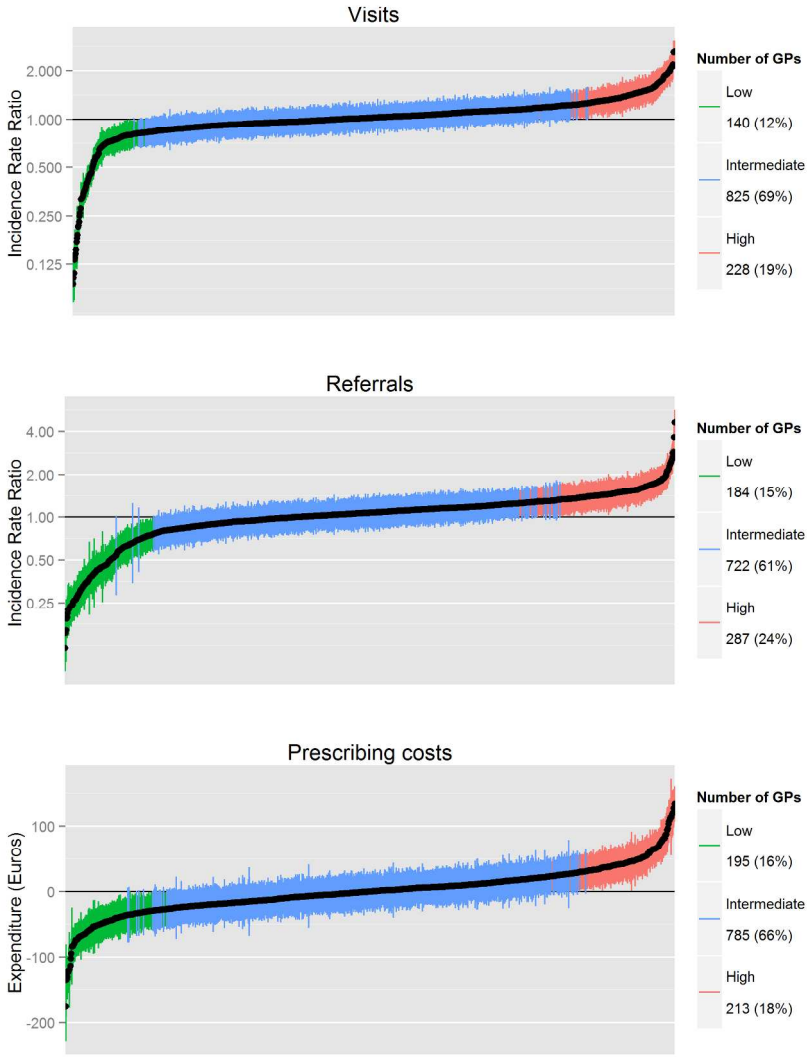
Figure 1.
Relative consumption of resources by the 1,193 general practioners (GPs), by rank from lowest to highest. Differences with respect to an average GP expressed as ratios (visits, referrals) or in absolute values (prescribing costs). Vertical bars correspond to 95% confidence intervals



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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Reported
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Abstract (pag. 9)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract (pag. 9-10)
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction (pag. 11-12)
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction (last sentences; pag 13)
Methods			
Study design	4	Present key elements of study design early in the paper	Methods (pag. 14)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods : Setting, Study population and period, Sources of data (pag. 14-15)
Participants	6	(*a*) *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Methods: Study population and period (pag. 15)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods: Variables and statistical analysis (pag.16-18)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods: Variables and statistical analysis (pag.16-18)
Bias	9	Describe any efforts to address potential sources of bias	Discussion: Strength and limitations (pag.21)
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods: Variables and statistical analysis (pag.16-17)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Methods: Variables and statistical analysis (pag.16-17)
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A (There were not missing data)
		(*e*) Describe any sensitivity analyses	N/A

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Results			**Reported**
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Results (pag.19)
		(b) Indicate number of participants with missing data for each variable of interest	There were not missing data
Outcome data	15*	*Cross-sectional study*—Report numbers of outcome events or summary measures	Results (pag.19)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results- tables 1,2,3 (pag.31-36)
		(*b*) Report category boundaries when continuous variables were categorized	Methods (pag.16-18) Results - table 1 (pag.31-32)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion: Main findings (pag. 21)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion: Strengths and limitations (pag.21-22)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion: Main findings, Strengths and limitations, Comparison with other studies, Significance of the study, Potential explanations and implications for doctors and managers. (pag.21-24)
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion: Strengths and limitations, Unanswered questions and future research. (pag.21-22,24)
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Acknowledgments . (pag.26)

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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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