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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

For peer review only

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

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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3 Conclusions:

4 Although the importance of primary care for the health of the population is
5 unquestionable, we should define outcome-based criteria when assessing its
6 activities. Specifically, GPs who hold more patient visits, have higher
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8 prescribing costs and are more reluctant to refer patients to specialists
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10 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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3 - There are factors unrelated to primary care itself that could have an
4 effect on hospital admissions.
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9 - The use of a list of conditions adapted for our setting (in this
10 case, Spain) has advantages from the point of view of the validity of
11 our results, but it may make it difficult to generalize the findings
12 to other areas.
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17 - In relation to external validity, Spain has primary care health
18 services that are well-established and easy to access by the
19 population, with higher rates of visits to doctors and generally
20 lower rates of ACSC admissions than reported for other settings. It
21 might not be possible to extrapolate our findings to other settings
22 with different characteristics.
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3 MORE IS NOT ALWAYS BETTER IN PRIMARY CARE EITHER: AN OBSERVATIONAL STUDY OF
4 CLINICAL PRACTICE PATTERNS OF GENERAL PRACTITIONERS AND CARE OUTCOMES
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10 INTRODUCTION

11 Healthcare organizations often analyse variations in physician practice
12 patterns for monitoring the quality and efficiency of primary care health
13 services. In this way, it is assessed whether the use of healthcare
14 resources by health professionals is what would be expected as a function
15 of the morbidity in the population served. This information is very
16 important: it allows physicians themselves to reflect on their own way of
17 working and managers to identify health professionals with markedly
18 different patterns of resource use to their colleagues.
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28 It is widely agreed that some prescriptions, referrals to specialized care,
29 requests for ancillary tests and primary care visits are not justified,[1]
30 and hence, it could be argued that the rates of all of these should be
31 reduced. However, analysing each indicator separately makes it difficult to
32 reach conclusions: we should not assert that a primary care physician's use
33 of resources is excessive (or insufficient) without assessing their
34 patient's outcomes. For example, situations of apparent efficiency may be,
35 in reality, a failure to provide the necessary care to certain groups of
36 patients resulting from lack of accessibility or poor clinical practice. In
37 fact, numerous studies have indicated that a lower use of primary care
38 resources is associated with adverse effects on the health of the
39 population[2,3] and certain attempts in the USA to reduce the number of
40 ambulatory visits,[4] through the introduction of co-payments, may have a
41 negative impact in terms of people's health. The effects of decreasing
42 spending on prescriptions are also not fully known. Although in some cases
43 (such as the excessive use of antibiotics) the need for cutting back is
44 unquestionable,[5,6] in other cases such a reduction may have unintended
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3 consequences. In relation to this, some authors have observed an inverse
4 correlation between the number of prescriptions and hospitalisation
5 costs,[7] and that the use of disincentives for prescribing such as a co-
6 payment may lead to discontinuation of treatments by chronic patients and
7 worsening of the health of vulnerable populations.[8] As a result, to
8 assess physicians in a fair manner and promote changes in clinical practice
9 patterns with the goal of improving healthcare efficiency, we must take
10 into account the impact of the care provided on outcomes.
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19 In this context, an accepted method for assessing outcomes is to consider
20 ambulatory care sensitive conditions (ACSCs).[9] These are a series of
21 conditions for which it should be possible to avoid hospital admission by
22 providing timely and effective ambulatory care, through the following types
23 of interventions: prevention at the primary care level, early diagnosis and
24 treatment of acute diseases, and adequate control and follow-up of chronic
25 diseases. Although based on hospital discharge reports, data on admissions
26 for ACSCs provide us with indirect information regarding primary care, in
27 particular, accessibility of this level of care and its ability to resolve
28 health problems. In America, ACSCs have mainly been used to measure access,
29 while in other countries with national health services, they have
30 principally been used to assess quality of care.[10] In any case, factors
31 unrelated to primary care also influence hospital admissions, meaning that
32 this instrument needs to be adapted to the context in which it is to be
33 applied.[10] For this reason, in our study, we used lists of ACSCs that
34 have been established for Spanish populations[11] and have already been
35 used by other authors.[12-14]
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54 Numerous studies have indicated differences in ACSC admission rates as a
55 function of the demographic,[15] clinical[16,17] and social[14,18,19]
56 characteristics of patients. In addition, the rate has been found to be
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3 associated with factors attributable to healthcare systems and
4 organizations.[3,20] However, few studies have analysed its relationship
5 with factors related to general practitioners (GPs), and to our knowledge,
6 none have explored their way of working and clinical practice patterns. In
7 this context, the objective of this study was to explain the variability in
8 the rate of potentially preventable hospitalisations (i.e., admissions for
9 ACSCs) based on multilevel characteristics and factors (individual, health
10 professional, health centre and health district) and, in particular,
11 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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3 care. Electronic health records, which started to be introduced in 1990,
4 are now used by all primary care doctors.
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8 Study population and period

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10 The observation period was set at 1 year, from 1 September 2007 to 31
11 August 2008. The study population included all residents ≥ 14 years of age
12 who were covered by the public healthcare system in the Basque Country on
13 31 August 2008 and who had been covered for at least 6 months in the
14 previous year, regardless of whether they had used or had any contact with
15 the Basque Health System (Osakidetza) in that period. That is, almost the
16 entire population of the Basque Country was included.
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19 In this study, we analysed data from across the public health service
20 network: 130 health centres and 1193 GPs. The total number of registered
21 inhabitants was 1,959,682, meaning that the GP lists were composed of a
22 mean of 1643 people.
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32 Sources of data:

33 We used the two following sources of data:

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

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3 At the level of the individual patient, we used demographic (age and sex),
4 morbidity and socioeconomic characteristics as explanatory variables.
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9 In order to include a manageable number of diseases, we classified all the
10 patient diagnoses (ICD-9-CM codes) made by the GPs during the study year
11 into Aggregated Diagnosis Groups (ADGs).[21] The ADG system assigns ICD-9-
12 CM codes to one of 32 categories, as a function of clinical criteria, the
13 expected resource use and type of care required for each health problem. It
14 is part of the Johns Hopkins Adjusted Clinical Group (ACG) case-mix system,
15 which is described elsewhere.[22]
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23 As a proxy for the socioeconomic status of patients, we used a deprivation
24 index based on census data, created for the MEDEA[23] project. Census
25 tracts are the smallest territorial units for which census population data
26 are available in Spain and they are mainly defined by criteria related to
27 population size, and geographic and social features. Though the number of
28 residents varies between tracts, the median is 1,200. For this study, the
29 deprivation index was categorized into five groups, the fifth corresponding
30 to the areas with the greatest deprivation and the first to the least
31 deprived areas. It is an indicator of access to economic and material
32 resources in a community and it has been shown to be correlated with rates
33 of mortality[24] and morbidity.[25]
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45 At the GP level, to estimate their work load, we considered the number of
46 patients on their list. Using this information, the GP lists were divided
47 into four groups (quartiles), those in the highest quartile being large,
48 those in the second and third quartiles medium-sized and those in the
49 lowest quartile small.
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55 We used a similar approach to characterise the primary care health centres.
56 In this case, the variables used were area-level demographic factors
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3 (percentages of people above 65 years of age and of immigrants), [26] size
4 of the centre (number of GPs on the staff) and level of satisfaction of the
5 centre's staff with their work environment. The last of these variables
6 corresponds to the overall satisfaction score for the health centre,
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8 calculated from the results of an internal survey carried out on a regular
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10 basis by Osakidetza in all its organisations. [27] Like GPs, the health
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12 centres were categorised into quartiles, the level of satisfaction being
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14 rated as high for those in the highest quartile, moderate for those in the
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16 middle two quartiles and low for those in the lowest quartile.
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21 All the analysis was performed using SAS version 9.2.
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25 For the first stage of analysis, we considered the following response
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27 variables at the patient level: the number of visits to the GP, number of
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29 forms for referrals to specialists issued by the GP, and costs to the
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31 Department of Health of drugs prescribed to the patient during the year of
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33 the study.
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37 We constructed multilevel mixed models [28] to identify which GPs were
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39 outliers in terms of resource use. Taking into account the hierarchical
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41 nature of the data, we used the explanatory variables as fixed effects and
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43 included random intercepts for each of the higher levels: GP, health centre
44
45 and health district. As a function of the distribution of the response
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47 variables, we used different regression models: in the case of prescribing
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49 costs, we built a normal regression model (Proc MIXED, RMLE), while for the
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51 visits and referrals, we used negative binomial regression models (Proc
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53 GLIMMIX, LAPLACE). These models allowed us, using an empirical Bayesian
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55 approach, [29] to estimate the differences between the performance of each
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57 GP and the mean for each the response variables, after adjusting for the
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59 other variables, as well as 95% confidence intervals for the estimators.
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61 For visits and referrals, the estimators were exponentiated to obtain the

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3 incidence rate ratios. We considered doctors to be outliers (high or low)
4 when their estimators statistically differed from zero (prescribing costs)
5 or one (visits and referrals).
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10 For the second stage, in addition to variables considered in the first
11 stage, we used classifications of each doctor (high/intermediate/low) with
12 respect their use of healthcare resources (visits, referrals and
13 prescribing costs) as explanatory variables, following the aforementioned
14 procedure, and the appearance of preventable hospitalisations as the
15 response variable. For this purpose, we identified patients who had had one
16 or more admissions attributable to ACSCs, using the list established in
17 Spain by Caminal et al.[11]
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26 Using these variables, we constructed a multilevel mixed-effect logistic
27 regression (Proc GLIMMIX, LAPLACE). In this case, we used the
28 aforementioned explanatory variables (including the GP's classifications by
29 resource use) as fixed effects and a random intercept for each of the three
30 higher levels (GP, health centre and health district). The results are
31 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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3 With respect to the variables at the doctor level (Table 3), the risk of
4 ACSC admissions was higher for patients of GPs with a greater than expected
5 mean number of visits and prescribing costs (OR=1.29 [1.21 to 1.37]; 1.16
6 [1.09 to 1.24]) or with a lower than expected mean rate of referrals
7 (OR=1.33 [1.24 to 1.41]). The number of patients on the GP's list did not
8 reach statistical significance (p=0.0935).
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15 In our analysis, none of the health centre characteristics (size, level of
16 satisfaction of staff, and percentages of elderly individuals and of
17 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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3 Basque Country and, as is commonly the case with the use of administrative
4 databases and electronic health records, there may be some incomplete or
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6 inaccurate data. Second, the ecological nature of the socioeconomic
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8 variable used (deprivation index) might have diluted the effect of
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10 individual socioeconomic characteristics; it is also known that social
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12 characteristics other than the ones studied have an effect on the need for
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14 healthcare and its outcomes.[30] Further, this paper is focused on the
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16 organization of public health service provision and planning, and thus,
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18 private health provision is beyond the scope of our analysis.
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20 With respect to the definition of ACSCs, it should be taken into account
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22 that there are factors unrelated to primary care itself that could have an
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24 effect on hospital admissions. The use of a list of conditions adapted for
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26 our setting (in this case, Spain) has advantages from the point of view of
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28 the validity of our results, but it may make it difficult to generalize the
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30 findings to other areas. Additionally, in relation to external validity,
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32 Spain has primary care health services that are well-established and easy
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34 to access by the population,[31] with higher rates of visits to doctors and
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36 generally lower rates of ACSC admissions than reported for other
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38 settings.[32] Hence, it might not be possible to extrapolate our findings
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40 to other settings with different characteristics.

41 42 43 Comparison with other studies

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45 Our results are partially consistent with previous research. Various
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47 different authors have established that ACSC admissions are associated with
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49 certain individual-based factors including being male[13,33,34], being
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51 elderly,[15,34] having a low socioeconomic status,[14,18,19,35] being from
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53 disadvantaged ethnic or racial groups,[19,36] and having chronic
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55 diseases[16,17,37] or mental health problems.[38,39] However, our results
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57 differ from those of other authors such as Casalino et al,[40] who found an
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59 inverse relationship between the size of primary healthcare teams and ACSC
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3 admissions. What is more, associations with factors related to access to
4 primary care health services that have been often described, such as an
5 inverse correlation between ACSC admissions and the patient-to-doctor
6 ratio, [3,20] were also not found in our data. Although some authors have
7 assessed the relationship between ACSC admissions and the number of visits
8 to GPs by patients [3,37,41-43] and, even, the mean daily number of
9 consultations held by doctors in a geographical area, [14] we are not aware
10 of any studies similar to ours. In particular, we studied the association
11 between potentially preventable admissions and efficiency indicators of GPs
12 based on the ratio between the observed and expected consumption of
13 resources: number of visits by patients, referrals and prescribing costs.
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26 Significance of the study. Potential explanations and implications for
27 doctors and managers
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30 The benefits of primary care on the health of people and populations have
31 been demonstrated and widely recognised. [2] Other authors have described
32 the added value to the care of a generalist approach, especially for
33 complex patients with multimorbidity, this giving rise to the paradox that
34 GPs provide poorer quality healthcare than specialists in the treatment of
35 specific diseases, but achieve better outcomes in overall health of people
36 and populations. [44]
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45 However, as in other healthcare contexts, doing more is not always better
46 in primary care. From our analysis, it seems that certain clinical practice
47 patterns of primary care doctors have an effect on the outcomes of care. In
48 particular, we can state that GPs holding an excessive number of visits
49 with patients is associated with higher rates of preventable admissions, as
50 is GPs having higher prescribing costs, while those who play the role of
51 strong "gatekeepers" and are more reluctant to "pass the baton" to
52 specialists also achieve poorer results. Given this, indicators that
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3 measure the performance of health professionals should be interpreted with
4 care, unless they are accompanied by other indicators of care outcomes.
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6 Otherwise, interventions focused on modifying clinical practice patterns
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8 may have undesired consequences.
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10 11 12 13 Unanswered questions and future research

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15 This study indicates how certain ways of working among primary care doctors
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17 achieve different outcomes in terms of preventable hospitalization of
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19 patients. However, it does not allow us to establish the causes of these
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21 differences. Visits to GPs are diverse in nature: they may occur on the
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23 initiative of the patient or of the doctor, they have many underlying
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25 reasons (for example, for assessing symptoms or diseases, social problems,
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27 provision of advice, or administrative procedures), and they may vary in
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29 terms of duration, structure, procedures performed, and the involvement of
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31 other primary care health professionals, such as nurses. Several factors
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33 increase prescribing costs: excessive prescribing, inappropriate
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35 treatments, and selection of the most expensive option. Important factors
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37 regarding referrals are whether they are appropriate and timely, as well as
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39 the type of specialist patients are referred to, and the subsequent level
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41 of coordination between the GP and the specialist in the shared management
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43 of the patient. In relation to this, there is a need for future studies
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45 analysing primary care outcomes that consider other factors related to
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47 visits, referrals and prescriptions. Furthermore, our results should be
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49 tested in other settings or specific population groups (for example,
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51 patients with multimorbidity or with specific diseases). In any case, our
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53 findings provide a starting point for discussion and research concerning
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55 what should be the limits in terms of the "quantity" of primary care
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57 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.

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

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Data sharing statement

There are no additional data available.

REFERENCES

- 1 The King's Fund. Improving the Quality of Care in English General Practice: A report of an independent inquiry commissioned by The King's Fund. London: : The King's Fund 2011.
- 2 Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. *Milbank Q* 2005;**83**:457-502. doi:10.1111/j.1468-0009.2005.00409.x
- 3 Rizza P, Bianco A, Pavia M, et al. Preventable hospitalization and access to primary health care in an area of Southern Italy. *BMC Health Serv Res* 2007;**7**:134. doi:10.1186/1472-6963-7-134
- 4 Trivedi AN, Moloo H, Mor V. Increased ambulatory care copayments and hospitalizations among the elderly. *N Engl J Med* 2010;**362**:320-8. doi:10.1056/NEJMsa0904533
- 5 Arnold SR, Straus SE. Interventions to improve antibiotic prescribing practices in ambulatory care. *Cochrane Database Syst Rev* 2005;:CD003539. doi:10.1002/14651858.CD003539.pub2
- 6 Keyhani S, Falk R, Howell EA, et al. Overuse and systems of care: a systematic review. *Med Care* 2013;**51**:503-8. doi:10.1097/MLR.0b013e31828dbafe
- 7 Stuart BC, Doshi JA, Terza JV. Assessing the impact of drug use on hospital costs. *Health Serv Res* 2009;**44**:128-44. doi:10.1111/j.1475-6773.2008.00897.x
- 8 Austvoll-Dahlgren A, Aaserud M, Vist G, et al. Pharmaceutical policies: effects of cap and co-payment on rational drug use. *Cochrane Database Syst Rev* 2008;:CD007017. doi:10.1002/14651858.CD007017
- 9 Agency for Healthcare Research and Quality. Guide to prevention quality indicators: hospital admission for ambulatory care sensitive conditions. 2007.http://qualityindicators.ahrq.gov/downloads/modules/pqi/v31/pqi_technical_specs_v31.pdf (accessed 4 Nov2014).
- 10 Purdy S, Griffin T, Salisbury C, et al. Ambulatory care sensitive conditions: terminology and disease coding need to be more specific to

- aid policy makers and clinicians. *Public Health* 2009;**123**:169-73.
doi:10.1016/j.puhe.2008.11.001
- 11 Caminal J, Starfield B, Sánchez E, et al. The role of primary care in preventing ambulatory care sensitive conditions. *Eur J Public Health* 2004;**14**:246-51.
- 12 Bermúdez-Tamayo C, Márquez-Calderón S, Rodríguez del Aguila MM, et al. [Organizational characteristics of primary care and hospitalization for to the main ambulatory care sensitive conditions]. *Aten Primaria* 2004;**33**:305-11.
- 13 Magan P, Otero A, Alberquilla A, et al. Geographic variations in avoidable hospitalizations in the elderly, in a health system with universal coverage. *BMC Health Serv Res* 2008;**8**:42. doi:10.1186/1472-6963-8-42
- 14 Magán P, Alberquilla A, Otero A, et al. Hospitalizations for ambulatory care sensitive conditions and quality of primary care: their relation with socioeconomic and health care variables in the Madrid regional health service (Spain). *Med Care* 2011;**49**:17-23.
doi:10.1097/MLR.0b013e3181ef9d13
- 15 Bardsley M, Blunt I, Davies S, et al. Is secondary preventive care improving? Observational study of 10-year trends in emergency admissions for conditions amenable to ambulatory care. *BMJ Open* 2013;**3**.
doi:10.1136/bmjopen-2012-002007
- 16 Wolff JL, Starfield B, Anderson G. Prevalence, expenditures, and complications of multiple chronic conditions in the elderly. *Arch Intern Med* 2002;**162**:2269-76.
- 17 Saver BG, Wang C-Y, Dobie SA, et al. The central role of comorbidity in predicting ambulatory care sensitive hospitalizations. *Eur J Public Health* 2014;**24**:66-72. doi:10.1093/eurpub/ckt019
- 18 Roos LL, Walld R, Uhanova J, et al. Physician visits, hospitalizations, and socioeconomic status: ambulatory care sensitive conditions in a canadian setting. *Health Serv Res* 2005;**40**:1167-85. doi:10.1111/j.1475-6773.2005.00407.x
- 19 Moy E, Chang E, Barrett M, et al. Potentially preventable hospitalizations - United States, 2001-2009. *MMWR Surveill Summ* 2013;**62 Suppl 3**:139-43.
- 20 Laditka JN, Laditka SB, Probst JC. More may be better: evidence of a negative relationship between physician supply and hospitalization for ambulatory care sensitive conditions. *Health Serv Res* 2005;**40**:1148-66.
doi:10.1111/j.1475-6773.2005.00403.x
- 21 Weiner JP, Starfield BH, Steinwachs DM, et al. Development and application of a population-oriented measure of ambulatory care case-mix. *Medical care* 1991;**29**:452-72.
- 22 Johns Hopkins University, School of Public Health. The Johns Hopkins University ACG case-mix system.
http://acg.jhsph.org/index.php?option=com_content&view=article&id=46&Itemid=366 (accessed 4 Nov2014).

- 1
2
3 23 Domínguez-Berjón MF, Borrell C, Cano-Serral G, et al. [Constructing a
4 deprivation index based on census data in large Spanish cities (the MEDEA
5 project)]. *Gac Sanit* 2008;**22**:179-87.
- 6
7 24 Borrell C, Mari-Dell'olmo M, Serral G, et al. Inequalities in mortality
8 in small areas of eleven Spanish cities (the multicenter MEDEA project).
9 *Health Place* 2010;**16**:703-11. doi:10.1016/j.healthplace.2010.03.002
- 10
11 25 Orueta JF, Nuño-Solinís R, García-Alvarez A, et al. Prevalence of
12 multimorbidity according to the deprivation level among the elderly in
13 the Basque Country. *BMC Public Health* 2013;**13**:918. doi:10.1186/1471-
14 2458-13-918
- 15
16 26 Eustat (Instituto Vasco de Estadística). Population statistics. Vitoria-
17 Gasteiz: 2004.
18 [http://en.eustat.es/estadisticas/tema_159/opt_0/ti_Population/temas.html](http://en.eustat.es/estadisticas/tema_159/opt_0/ti_Population/temas.html#axzz37p2gs8HG)
19 #axzz37p2gs8HG (accessed 4 Nov2014).
- 20
21 27 Osakidetza Comarca Uribe. Satisfacción de las personas. Comarca Uribe:
22 2010. <http://uribe.osakidetza.net/es/html/4/2123.shtml> (accessed 4
23 Nov2014).
- 24
25 28 Raudenbush SW, Bryk AS. Hierarchical Linear Models: Applications and
26 Data Analysis Methods. SAGE Publications 2002.
- 27
28 29 Snijders TAB, Bosker RJ. Multilevel Analysis: An Introduction to Basic
29 and Advanced Multilevel Modeling. Sage Publications 1999.
- 30
31 30 Rosen AK, Reid R, Broemeling A-M, et al. Applying a risk-adjustment
32 framework to primary care: can we improve on existing measures? *Ann Fam*
33 *Med* 2003;**1**:44-51.
- 34
35 31 Kringos D, Boerma W, Bourgueil Y, et al. The strength of primary care in
36 Europe: an international comparative study. *Br J Gen Pract* 2013;**63**:e742-
37 750. doi:10.3399/bjgp13X674422
- 38
39 32 OECD. Health at a Glance 2013. Paris: : Organisation for Economic Co-
40 operation and Development 2013. [http://www.oecd-](http://www.oecd-ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-02content/book/health_glance-2013-en)
41 [ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-](http://www.oecd-ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-02content/book/health_glance-2013-en)
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- 43
44 33 Stranges E, Stocks C. Potentially Preventable Hospitalizations for Acute
45 and Chronic Conditions, 2008: Statistical Brief #99. In: Healthcare Cost
46 and Utilization Project (HCUP) Statistical Briefs. Rockville (MD): :
47 Agency for Health Care Policy and Research (US) 2006.
48 <http://www.ncbi.nlm.nih.gov/books/NBK52655/> (accessed 29 Oct2014).
- 49
50 34 Ansari Z, Haider SI, Ansari H, et al. Patient characteristics associated
51 with hospitalisations for ambulatory care sensitive conditions in
52 Victoria, Australia. *BMC Health Serv Res* 2012;**12**:475. doi:10.1186/1472-
53 6963-12-475
- 54
55 35 Giuffrida A, Gravelle H, Roland M. Measuring quality of care with
56 routine data: avoiding confusion between performance indicators and
57 health outcomes. *BMJ* 1999;**319**:94-8.
- 58
59 36 O'Neil SS, Lake T, Merrill A, et al. Racial disparities in
60 hospitalizations for ambulatory care-sensitive conditions. *Am J Prev Med*
2010;**38**:381-8. doi:10.1016/j.amepre.2009.12.026

- 1
2
3 37 Eggli Y, Desquins B, Seker E, et al. Comparing potentially avoidable
4 hospitalization rates related to ambulatory care sensitive conditions in
5 Switzerland: the need to refine the definition of health conditions and
6 to adjust for population health status. *BMC Health Serv Res* 2014;**14**:25.
7 doi:10.1186/1472-6963-14-25
- 8
9 38 Himelhoch S, Weller WE, Wu AW, et al. Chronic medical illness,
10 depression, and use of acute medical services among Medicare
11 beneficiaries. *Med Care* 2004;**42**:512-21.
- 12
13 39 Yoon J, Yano EM, Altman L, et al. Reducing costs of acute care for
14 ambulatory care-sensitive medical conditions: the central roles of
15 comorbid mental illness. *Med Care* 2012;**50**:705-13.
16 doi:10.1097/MLR.0b013e31824e3379
- 17
18 40 Casalino LP, Pesko MF, Ryan AM, et al. Small primary care physician
19 practices have low rates of preventable hospital admissions. *Health Aff*
20 (Millwood) 2014;**33**:1680-8. doi:10.1377/hlthaff.2014.0434
- 21
22 41 Rosano A, Loha CA, Falvo R, et al. The relationship between avoidable
23 hospitalization and accessibility to primary care: a systematic review.
24 *Eur J Public Health* 2013;**23**:356-60. doi:10.1093/eurpub/cks053
- 25
26 42 Gibson OR, Segal L, McDermott RA. A systematic review of evidence on the
27 association between hospitalisation for chronic disease related
28 ambulatory care sensitive conditions and primary health care resourcing.
29 *BMC Health Serv Res* 2013;**13**:336. doi:10.1186/1472-6963-13-336
- 30
31 43 Gao J, Moran E, Li Y-F, et al. Predicting potentially avoidable
32 hospitalizations. *Med Care* 2014;**52**:164-71.
33 doi:10.1097/MLR.0000000000000041
- 34
35 44 Stange KC, Ferrer RL. The paradox of primary care. *Ann Fam Med*
36 2009;**7**:293-9. doi:10.1370/afm.1023
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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

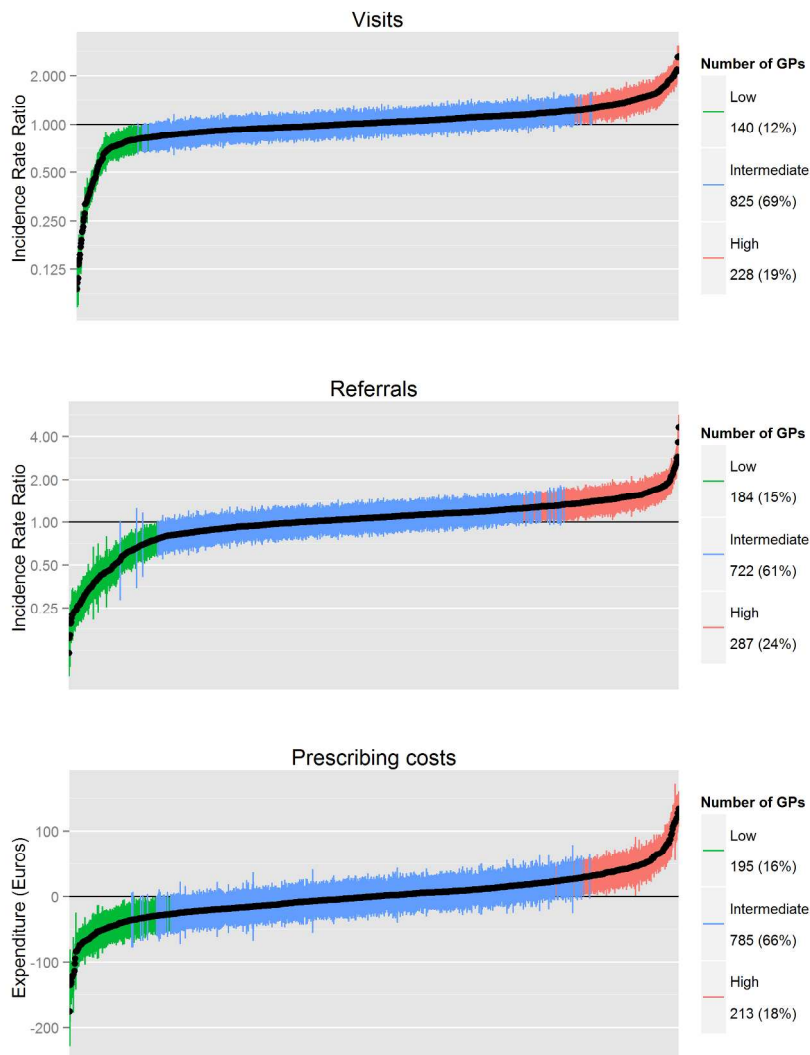
	No. of patients	No. of patients with ≥ 1 ACSC	OR	Likelihood ratio test
Characteristics of the GP				
List size				0.0935
large	387,451	3,594 (0.93%)	0.96 (0.87 to 1.05)	
medium-sized	1,180,860	12,950 (1.10%)	reference	
small	391,371	4,507 (1.15%)	0.92 (0.84 to 1.00)	
Frequency of patient visits				<0.0001
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	12,927 (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 practitioners (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) <i>Cross-sectional study</i> —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*	<i>Cross-sectional study</i> —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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4 *Give information separately for cases and controls in case-control studies and, if applicable, for exposed and
5 unexposed groups in cohort and cross-sectional studies.
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BMJ Open

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.

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3 After adjusting for the variables studied including morbidity, the risk of
4 hospital admission was higher among individuals under the care of GPs with
5 greater than expected numbers of patient visits and prescribing costs
6 (OR=1.27 [95% confidence interval 1.18 to 1.37]; 1.16 [1.08 to 1.25]), and
7 who make fewer referrals than the mean among their colleagues (OR=1.33
8 [1.22 to 1.44])
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10 Conclusions:

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12 When assessing activities and procedure indicators in primary care, we
13 should, also, define outcome-based criteria. Specifically, GPs who hold
14 more patient visits, have higher prescribing costs and are more reluctant
15 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.

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

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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3 back is unquestionable,[6,7] in other cases such a reduction may have
4 unintended consequences. In relation to this, some authors have observed an
5 inverse correlation between the number of prescriptions and hospitalisation
6 costs,[8] and that the use of disincentives for prescribing such as a co-
7 payment may lead to discontinuation of treatments by chronic patients and
8 worsening of the health of vulnerable populations.[9] As a result, to
9 assess physicians in a fair manner and promote changes in clinical practice
10 patterns with the goal of improving healthcare efficiency, we must take
11 into account the impact of the care provided on outcomes.
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21 In this context, an accepted method for assessing outcomes is to consider
22 ambulatory care sensitive conditions (ACSCs).[10] These are a series of
23 conditions for which it should be possible to avoid hospital admission by
24 providing timely and effective ambulatory care, through the following types
25 of interventions: prevention at the primary care level, early diagnosis and
26 treatment of acute diseases, and adequate control and follow-up of chronic
27 diseases. Although based on hospital discharge reports, data on admissions
28 for ACSCs provide us with indirect information regarding primary care, in
29 particular, accessibility of this level of care and its ability to resolve
30 health problems. In America, ACSCs have mainly been used to measure access,
31 while in other countries with national health services, they have
32 principally been used to assess quality of care.[11] In any case, factors
33 unrelated to primary care also influence hospital admissions, meaning that
34 this instrument needs to be adapted to the context in which it is to be
35 applied.[11] For this reason, in our study, we used lists of ACSCs that
36 have been established for Spanish populations[12] and have already been
37 used by other authors.[13-15]
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55 Numerous studies have indicated differences in ACSC admission rates as a
56 function of the demographic,[16] clinical[17,18] and social[15,19,20]
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3 characteristics of patients. In addition, the rate has been found to be
4 associated with factors attributable to healthcare systems and
5 organizations.[3,21] However, few studies have analysed its relationship
6 with factors related to general practitioners (GPs), and to our knowledge,
7 none have explored their way of working and clinical practice patterns. In
8 this context, the objective of this study was to explain the variability in
9 the rate of potentially preventable hospitalisations (i.e., admissions for
10 ACSCs) based on multilevel characteristics and factors (individual, health
11 professional, health centre and health district) and, in particular,
12 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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3 care. General practitioners are salaried and their payment is composed of
4 two parts: a larger fixed emolument and a small one (less than 10% of
5 total) based on the number of patients assigned to their lists of patients;
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7 there are not financial incentives to the physicians for the number of
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9 visits they provide nor the fulfilment of objectives, such as restraints in
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11 prescriptions expenditure or number of referrals. Electronic health
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13 records, which started to be introduced in 1990, are now used by all
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15 primary care doctors.
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17 18 19 Study population and period

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21 The observation period was set at 1 year, from 1 September 2007 to 31
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23 August 2008. The study population included all residents ≥ 14 years of age
24
25 who were covered by the public healthcare system in the Basque Country on
26
27 31 August 2008 and who had been covered for at least 6 months in the
28
29 previous year, regardless of whether they had used or had any contact with
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31 the Basque Health System (Osakidetza) in that period. That is, almost the
32
33 entire population of the Basque Country was included.

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35 In this study, we analysed data from across the public health service
36
37 network: 130 health centres and 1193 GPs. The total number of registered
38
39 inhabitants was 1,959,682, meaning that the GP lists were composed of a
40
41 mean of 1643 people.
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43 Sources of data:

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45 We used the two following sources of data:

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

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14 At the level of the individual patient, we used demographic (age and sex),
15 morbidity and socioeconomic characteristics as explanatory variables.
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19 In order to include a manageable number of diseases, we classified all the
20 patient diagnoses (ICD-9-CM codes) made by the GPs during the study year
21 into Aggregated Diagnosis Groups (ADGs).[22] The ADG system assigns ICD-9-
22 CM codes to one of 32 categories, as a function of clinical criteria, the
23 expected resource use and type of care required for each health problem. It
24 is part of the Johns Hopkins Adjusted Clinical Group (ACG) case-mix system,
25 which is described elsewhere.[23]
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34 As a proxy for the socioeconomic status of patients, we used a deprivation
35 index based on census data, created for the MEDEA[24] project. Census
36 tracts are the smallest territorial units for which census population data
37 are available in Spain and they are mainly defined by criteria related to
38 population size, and geographic and social features. Though the number of
39 residents varies between tracts, the median is 1,200. For this study, the
40 deprivation index was categorized into five groups, the fifth corresponding
41 to the areas with the greatest deprivation and the first to the least
42 deprived areas. It is an indicator of socioeconomic status of people living
43 in a community and it has been shown to be correlated with rates of
44 mortality[25] and morbidity.[26]
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56 At the GP level, to estimate their work load, we considered the number of
57 patients on their list. Using this information, the GP lists were divided
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3 into four groups (quartiles), those in the highest quartile being large,
4 those in the second and third quartiles medium-sized and those in the
5 lowest quartile small.
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10 We used a similar approach to characterise the primary care health centres.
11 In this case, the variables used were area-level demographic factors
12 (percentages of people above 65 years of age and of immigrants), [27] size
13 of the centre (number of GPs on the staff) and level of satisfaction of the
14 centre's staff with their work environment. The last of these variables
15 corresponds to the overall satisfaction score for the health centre,
16 calculated from the results of an internal survey carried out on a regular
17 basis by Osakidetza in all its organisations. [28] Like GPs, the health
18 centres were categorised into quartiles, the level of satisfaction being
19 rated as high for those in the highest quartile, moderate for those in the
20 middle two quartiles and low for those in the lowest quartile.
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32 All the analysis was performed using SAS version 9.2.
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36 For the first stage of analysis, we considered the following response
37 variables at the patient level: the number of visits to the GP, number of
38 forms for referrals to specialists issued by the GP, and costs to the
39 Department of Health of drugs prescribed to the patient during the year of
40 the study.
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46 We constructed multilevel mixed models [29] to identify which GPs were
47 outliers in terms of resource use. Taking into account the hierarchical
48 nature of the data, we used the explanatory variables as fixed effects and
49 included random intercepts for each of the higher levels: GP, health centre
50 and health district. As a function of the distribution of the response
51 variables, we used different regression models: in the case of prescribing
52 costs, we built a normal regression model (Proc MIXED, RMLE), while for the
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3 visits and referrals, we used negative binomial regression models (Proc
4 GLIMMIX, LAPLACE). These models allowed us, using an empirical Bayesian
5 approach,[30] to estimate the differences between the performance of each
6 GP and the mean for each the response variables, after adjusting for the
7 other variables, as well as 95% confidence intervals for the estimators.
8 For visits and referrals, the estimators were exponentiated to obtain the
9 incidence rate ratios. We considered doctors to be outliers (high or low)
10 when their estimators statistically differed from zero (prescribing costs)
11 or one (visits and referrals).
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21 For the second stage, in addition to variables considered in the first
22 stage, we used classifications of each doctor (high/intermediate/low) with
23 respect their use of healthcare resources (visits, referrals and
24 prescribing costs) as explanatory variables, following the aforementioned
25 procedure, and the appearance of preventable hospitalisations as the
26 response variable. For this purpose, we identified patients who had had one
27 or more admissions attributable to ACSCs, using the list established in
28 Spain by Caminal et al.[12]
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37 Using these variables, we constructed a multilevel mixed-effect logistic
38 regression (Proc GLIMMIX, LAPLACE). In this case, we used the
39 aforementioned explanatory variables (including the GP's classifications by
40 resource use) as fixed effects and a random intercept for each of the three
41 higher levels (GP, health centre and health district). The results are
42 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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3 With respect to the variables at the doctor level (Table 3), the risk of
4 ACSC admissions was higher for patients of GPs with a greater than expected
5 mean number of visits and prescribing costs (OR=1.29 [1.21 to 1.37]; 1.16
6 [1.09 to 1.24]) or with a lower than expected mean rate of referrals
7 (OR=1.33 [1.24 to 1.41]). The number of patients on the GP's list did not
8 reach statistical significance (p=0.0935).
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15 In our analysis, none of the health centre characteristics (size, level of
16 satisfaction of staff, and percentages of elderly individuals and of
17 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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3 In our setting, patients are included in the physicians' lists according to
4 administrative criteria. Geographic proximity to the dwelling is the unique
5 factor for assigning the patient to the health center. Although, on paper,
6 each patient can chose among the doctors of her/his health center, actually
7 such option is very limited and infrequently taken. First, there are not
8 publicly available performance metrics of primary care providers that can
9 guide patient preferences. Besides, patients find restrictions to change
10 their doctor: in order to achieve equitable workloads, health centers
11 establish rules to distribute patients and each GP have assigned a similar
12 number of persons adjusting by age groups. Thus, even though the allocation
13 of patients to doctors is not entirely driven by hazard, it seems very
14 difficult that populations with particular unobserved characteristics (such
15 as health services-seeking preferences, unmeasured health status or
16 treatment adherence) were centered on the lists of some GPs.
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30 However, we should also recognize some limitations. First, the data
31 analysed come from the daily records entered in the health information
32 system of the Basque Country and, as is commonly the case with the use of
33 administrative databases and electronic health records, there may be some
34 incomplete or inaccurate data. Second, the ecological nature of the
35 socioeconomic variable used (deprivation index) might have diluted the
36 effect of individual socioeconomic characteristics; it is also known that
37 social characteristics other than the ones studied have an effect on the
38 need for healthcare and its outcomes.[31] Further, this paper is focused on
39 the organization of public health service provision and planning, and thus,
40 private health provision is beyond the scope of our analysis.
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50 With respect to the definition of ACSCs, it should be taken into account
51 that there are factors unrelated to primary care itself that could have an
52 effect on hospital admissions. The use of a list of conditions adapted for
53 our setting (in this case, Spain) has advantages from the point of view of
54 the validity of our results, but it may make it difficult to generalize the
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3 findings to other areas. Additionally, in relation to external validity,
4 Spain has primary care health services that are well-established and easy
5 to access by the population, [32] with higher rates of visits to doctors and
6 generally lower rates of ACSC admissions than reported for other
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8 settings. [33] Hence, it might not be possible to extrapolate our findings
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10 to other settings with different characteristics.
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13 14 15 16 17 Comparison with other studies 18

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

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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3 We thank the MEDEA research team in the Basque Country for the calculation
4 and provision of the deprivation index. At the same time we want to
5
6 explicitly thank Montse Calvo for her work in geocodifying the data.
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11 12 13 14 **Authors' contributions**

15
16 JFO and GG participated in the design of the study. JFO performed the
17 validation of databases. ACA and GG were responsible for statistical
18 analyses. JFO wrote the draft of manuscript. All authors participate in
19 interpretation of data, critically reviewed and gave final approval to the
20 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

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3 de Investigación Sanitaria, Osakidetza (Basque Health Service) or O+berri
4 (Basque Institute for Healthcare Innovation)
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8 Data sharing statement
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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.

REFERENCES

- 1 The King's Fund. Improving the Quality of Care in English General Practice: A report of an independent inquiry commissioned by The King's Fund. London: : The King's Fund 2011.
- 2 Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. *Milbank Q* 2005;**83**:457-502. doi:10.1111/j.1468-0009.2005.00409.x
- 3 Rizza P, Bianco A, Pavia M, et al. Preventable hospitalization and access to primary health care in an area of Southern Italy. *BMC Health Serv Res* 2007;**7**:134. doi:10.1186/1472-6963-7-134
- 4 Trivedi AN, Moloo H, Mor V. Increased ambulatory care copayments and hospitalizations among the elderly. *N Engl J Med* 2010;**362**:320-8. doi:10.1056/NEJMs0904533
- 5 Fleetcroft R, Cookson R, Steel N, et al. Correlation between prescribing quality and pharmaceutical costs in English primary care: national cross-sectional analysis. *Br J Gen Pract* 2011;**61**:e556-564. doi:10.3399/bjgp11X593839
- 6 Arnold SR, Straus SE. Interventions to improve antibiotic prescribing practices in ambulatory care. *Cochrane Database Syst Rev* 2005;:CD003539. doi:10.1002/14651858.CD003539.pub2
- 7 Keyhani S, Falk R, Howell EA, et al. Overuse and systems of care: a systematic review. *Med Care* 2013;**51**:503-8. doi:10.1097/MLR.0b013e31828dbafe
- 8 Stuart BC, Doshi JA, Terza JV. Assessing the impact of drug use on hospital costs. *Health Serv Res* 2009;**44**:128-44. doi:10.1111/j.1475-6773.2008.00897.x
- 9 Austvoll-Dahlgren A, Aaserud M, Vist G, et al. Pharmaceutical policies: effects of cap and co-payment on rational drug use. *Cochrane Database Syst Rev* 2008;:CD007017. doi:10.1002/14651858.CD007017
- 10 Agency for Healthcare Research and Quality. Guide to prevention quality indicators: hospital admission for ambulatory care sensitive conditions. 2007.http://qualityindicators.ahrq.gov/downloads/modules/pqi/v31/pqi_technical_specs_v31.pdf (accessed 4 Nov2014).
- 11 Purdy S, Griffin T, Salisbury C, et al. Ambulatory care sensitive conditions: terminology and disease coding need to be more specific to aid policy makers and clinicians. *Public Health* 2009;**123**:169-73. doi:10.1016/j.puhe.2008.11.001
- 12 Caminal J, Starfield B, Sánchez E, et al. The role of primary care in preventing ambulatory care sensitive conditions. *Eur J Public Health* 2004;**14**:246-51.
- 13 Bermúdez-Tamayo C, Márquez-Calderón S, Rodríguez del Aguila MM, et al. [Organizational characteristics of primary care and hospitalization for

- to the main ambulatory care sensitive conditions]. *Aten Primaria* 2004;**33**:305-11.
- 14 Magán P, Otero A, Alberquilla A, et al. Geographic variations in avoidable hospitalizations in the elderly, in a health system with universal coverage. *BMC Health Serv Res* 2008;**8**:42. doi:10.1186/1472-6963-8-42
- 15 Magán P, Alberquilla A, Otero A, et al. Hospitalizations for ambulatory care sensitive conditions and quality of primary care: their relation with socioeconomic and health care variables in the Madrid regional health service (Spain). *Med Care* 2011;**49**:17-23. doi:10.1097/MLR.0b013e3181ef9d13
- 16 Bardsley M, Blunt I, Davies S, et al. Is secondary preventive care improving? Observational study of 10-year trends in emergency admissions for conditions amenable to ambulatory care. *BMJ Open* 2013;**3**. doi:10.1136/bmjopen-2012-002007
- 17 Wolff JL, Starfield B, Anderson G. Prevalence, expenditures, and complications of multiple chronic conditions in the elderly. *Arch Intern Med* 2002;**162**:2269-76.
- 18 Saver BG, Wang C-Y, Dobie SA, et al. The central role of comorbidity in predicting ambulatory care sensitive hospitalizations. *Eur J Public Health* 2014;**24**:66-72. doi:10.1093/eurpub/ckt019
- 19 Roos LL, Walld R, Uhanova J, et al. Physician visits, hospitalizations, and socioeconomic status: ambulatory care sensitive conditions in a canadian setting. *Health Serv Res* 2005;**40**:1167-85. doi:10.1111/j.1475-6773.2005.00407.x
- 20 Moy E, Chang E, Barrett M, et al. Potentially preventable hospitalizations - United States, 2001-2009. *MMWR Surveill Summ* 2013;**62** **Suppl 3**:139-43.
- 21 Laditka JN, Laditka SB, Probst JC. More may be better: evidence of a negative relationship between physician supply and hospitalization for ambulatory care sensitive conditions. *Health Serv Res* 2005;**40**:1148-66. doi:10.1111/j.1475-6773.2005.00403.x
- 22 Weiner JP, Starfield BH, Steinwachs DM, et al. Development and application of a population-oriented measure of ambulatory care case-mix. *Medical care* 1991;**29**:452-72.
- 23 Johns Hopkins University, School of Public Health. The Johns Hopkins University ACG case-mix system. http://acg.jhsph.org/index.php?option=com_content&view=article&id=46&Itemid=366 (accessed 4 Nov2014).
- 24 Domínguez-Berjón MF, Borrell C, Cano-Serral G, et al. [Constructing a deprivation index based on census data in large Spanish cities(the MEDEA project)]. *Gac Sanit* 2008;**22**:179-87.
- 25 Borrell C, Mari-Dell'olmo M, Serral G, et al. Inequalities in mortality in small areas of eleven Spanish cities (the multicenter MEDEA project). *Health Place* 2010;**16**:703-11. doi:10.1016/j.healthplace.2010.03.002
- 26 Orueta JF, Nuño-Solinís R, García-Alvarez A, et al. Prevalence of multimorbidity according to the deprivation level among the elderly in

- 1
2
3 the Basque Country. BMC Public Health 2013;**13**:918. doi:10.1186/1471-
4 2458-13-918
- 5
6 27 Eustat (Instituto Vasco de Estadística). Population statistics. Vitoria-
7 Gasteiz: 2004.
8 [http://en.eustat.es/estadisticas/tema_159/opt_0/ti_Population/temas.html](http://en.eustat.es/estadisticas/tema_159/opt_0/ti_Population/temas.html#axzz37p2gs8HG)
9 #axzz37p2gs8HG (accessed 4 Nov2014).
- 10
11 28 Osakidetza Comarca Uribe. Satisfacción de las personas. Comarca Uribe:
12 2010. <http://uribe.osakidetza.net/es/html/4/2123.shtml> (accessed 4
13 Nov2014).
- 14
15 29 Raudenbush SW, Bryk AS. Hierarchical Linear Models: Applications and
16 Data Analysis Methods. SAGE Publications 2002.
- 17
18 30 Snijders TAB, Bosker RJ. Multilevel Analysis: An Introduction to Basic
19 and Advanced Multilevel Modeling. Sage Publications 1999.
- 20
21 31 Rosen AK, Reid R, Broemeling A-M, et al. Applying a risk-adjustment
22 framework to primary care: can we improve on existing measures? Ann Fam
23 Med 2003;**1**:44-51.
- 24
25 32 Kringos D, Boerma W, Bourgueil Y, et al. The strength of primary care in
26 Europe: an international comparative study. Br J Gen Pract 2013;**63**:e742-
27 750. doi:10.3399/bjgp13X674422
- 28
29 33 OECD. Health at a Glance 2013. Paris: : Organisation for Economic Co-
30 operation and Development 2013. [http://www.oecd-](http://www.oecd-ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-02content/book/health_glance-2013-en)
31 [ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-](http://www.oecd-ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-02content/book/health_glance-2013-en)
32 02content/book/health_glance-2013-en (accessed 4 Nov2014).
- 33
34 34 Stranges E, Stocks C. Potentially Preventable Hospitalizations for Acute
35 and Chronic Conditions, 2008: Statistical Brief #99. In: Healthcare Cost
36 and Utilization Project (HCUP) Statistical Briefs. Rockville (MD): :
37 Agency for Health Care Policy and Research (US) 2006.
38 <http://www.ncbi.nlm.nih.gov/books/NBK52655/> (accessed 29 Oct2014).
- 39
40 35 Ansari Z, Haider SI, Ansari H, et al. Patient characteristics associated
41 with hospitalisations for ambulatory care sensitive conditions in
42 Victoria, Australia. BMC Health Serv Res 2012;**12**:475. doi:10.1186/1472-
43 6963-12-475
- 44
45 36 Giuffrida A, Gravelle H, Roland M. Measuring quality of care with
46 routine data: avoiding confusion between performance indicators and
47 health outcomes. BMJ 1999;**319**:94-8.
- 48
49 37 O'Neil SS, Lake T, Merrill A, et al. Racial disparities in
50 hospitalizations for ambulatory care-sensitive conditions. Am J Prev Med
51 2010;**38**:381-8. doi:10.1016/j.amepre.2009.12.026
- 52
53 38 Eggli Y, Desquins B, Seker E, et al. Comparing potentially avoidable
54 hospitalization rates related to ambulatory care sensitive conditions in
55 Switzerland: the need to refine the definition of health conditions and
56 to adjust for population health status. BMC Health Serv Res 2014;**14**:25.
57 doi:10.1186/1472-6963-14-25
- 58
59 39 Himelhoch S, Weller WE, Wu AW, et al. Chronic medical illness,
60 depression, and use of acute medical services among Medicare
beneficiaries. Med Care 2004;**42**:512-21.

- 1
2
3 40 Yoon J, Yano EM, Altman L, et al. Reducing costs of acute care for
4 ambulatory care-sensitive medical conditions: the central roles of
5 comorbid mental illness. *Med Care* 2012;**50**:705-13.
6 doi:10.1097/MLR.0b013e31824e3379
- 7 41 Casalino LP, Pesko MF, Ryan AM, et al. Small primary care physician
8 practices have low rates of preventable hospital admissions. *Health Aff*
9 (Millwood) 2014;**33**:1680-8. doi:10.1377/hlthaff.2014.0434
- 10 42 Rosano A, Loha CA, Falvo R, et al. The relationship between avoidable
11 hospitalization and accessibility to primary care: a systematic review.
12 *Eur J Public Health* 2013;**23**:356-60. doi:10.1093/eurpub/cks053
- 13 43 Gibson OR, Segal L, McDermott RA. A systematic review of evidence on the
14 association between hospitalisation for chronic disease related
15 ambulatory care sensitive conditions and primary health care resourcing.
16 *BMC Health Serv Res* 2013;**13**:336. doi:10.1186/1472-6963-13-336
- 17 44 Gao J, Moran E, Li Y-F, et al. Predicting potentially avoidable
18 hospitalizations. *Med Care* 2014;**52**:164-71.
19 doi:10.1097/MLR.0000000000000041
- 20 45 Stange KC, Ferrer RL. The paradox of primary care. *Ann Fam Med*
21 2009;**7**:293-9. doi:10.1370/afm.1023
- 22
23
24
25
26
27
28
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30
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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

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

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

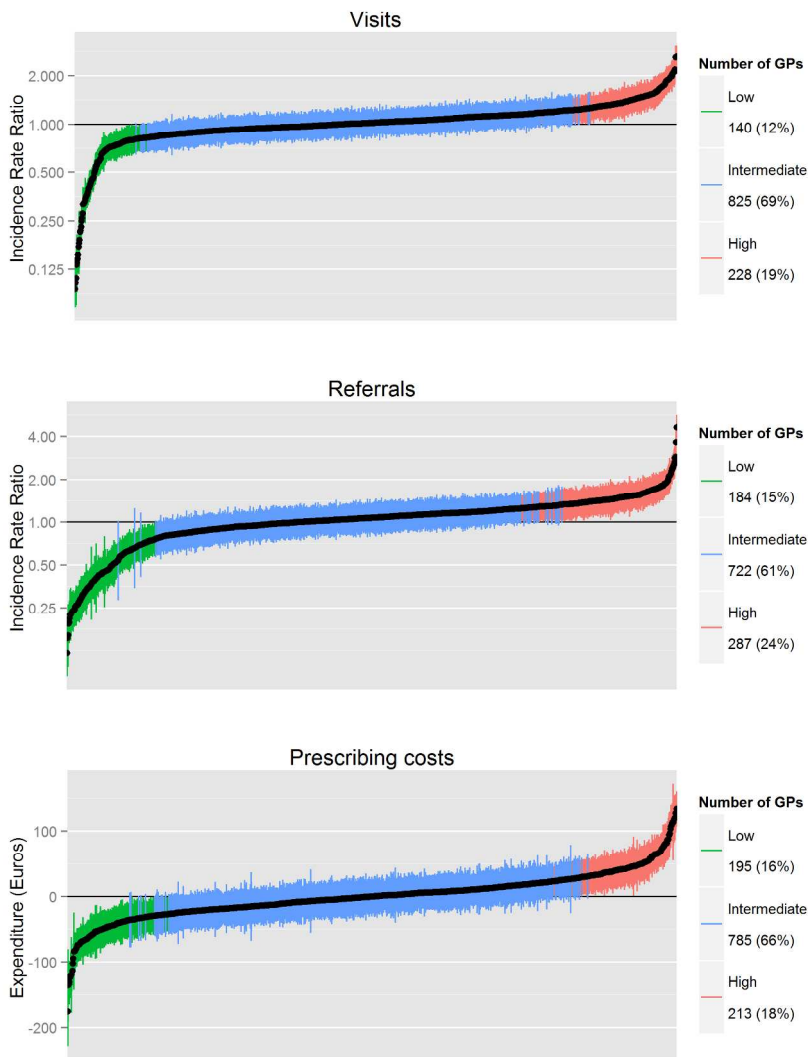
	No. of patients	No. of patients with ≥ 1 ACSC	OR	Likelihood ratio test
Characteristics of the GP				
List size				0.0935
large	387,451	3,594 (0.93%)	0.96 (0.87 to 1.05)	
medium-sized	1,180,860	12,950 (1.10%)	reference	
small	391,371	4,507 (1.15%)	0.92 (0.84 to 1.00)	
Frequency of patient visits				<0.0001
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	

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	12,927 (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 practitioners (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)

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) <i>Cross-sectional study</i> —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*	<i>Cross-sectional study</i> —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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3 Conclusions:

4 When assessing activities and procedure indicators in primary care, we
5 should, also, define outcome-based criteria. Specifically, GPs who hold
6 more patient visits, have higher prescribing costs and are more reluctant
7 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.

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

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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3 back is unquestionable,[6,7] in other cases such a reduction may have
4 unintended consequences. In relation to this, some authors have observed an
5 inverse correlation between the number of prescriptions and hospitalisation
6 costs,[8] and that the use of disincentives for prescribing such as a co-
7 payment may lead to discontinuation of treatments by chronic patients and
8 worsening of the health of vulnerable populations.[9] As a result, to
9 assess physicians in a fair manner and promote changes in clinical practice
10 patterns with the goal of improving healthcare efficiency, we must take
11 into account the impact of the care provided on outcomes.
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21 In this context, an accepted method for assessing outcomes is to consider
22 ambulatory care sensitive conditions (ACSCs).[10] These are a series of
23 conditions for which it should be possible to avoid hospital admission by
24 providing timely and effective ambulatory care, through the following types
25 of interventions: prevention at the primary care level, early diagnosis and
26 treatment of acute diseases, and adequate control and follow-up of chronic
27 diseases. Although based on hospital discharge reports, data on admissions
28 for ACSCs provide us with indirect information regarding primary care, in
29 particular, accessibility of this level of care and its ability to resolve
30 health problems. In America, ACSCs have mainly been used to measure access,
31 while in other countries with national health services, they have
32 principally been used to assess quality of care.[11] In any case, factors
33 unrelated to primary care also influence hospital admissions, meaning that
34 this instrument needs to be adapted to the context in which it is to be
35 applied.[11] For this reason, in our study, we used lists of ACSCs that
36 have been established for Spanish populations[12] and have already been
37 used by other authors.[13-15]
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55 Numerous studies have indicated differences in ACSC admission rates as a
56 function of the demographic,[16] clinical[17,18] and social[15,19,20]
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3 characteristics of patients. In addition, the rate has been found to be
4 associated with factors attributable to healthcare systems and
5 organizations.[3,21] However, few studies have analysed its relationship
6 with factors related to general practitioners (GPs), and to our knowledge,
7 none have explored their way of working and clinical practice patterns. In
8 this context, the objective of this study was to explain the variability in
9 the rate of potentially preventable hospitalisations (i.e., admissions for
10 ACSCs) based on multilevel characteristics and factors (individual, health
11 professional, health centre and health district) and, in particular,
12 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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3 care. General practitioners are salaried and their payment is composed of
4 two parts: a larger fixed remuneration and a small one (less than 10% of
5 total) based on the number of patients assigned to their lists of patients;
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7 there are not financial incentives to the physicians for the number of
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9 visits they provide nor the fulfilment of objectives, such as restraints in
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11 prescriptions expenditure or number of referrals.
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15 In our setting, patients are included in the physicians' lists according to
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17 administrative criteria. Geographic proximity to the dwelling is the unique
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19 factor for assigning the patient to the health center. Although, on paper,
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21 each patient can chose among the doctors of her/his health center, actually
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23 such option is very limited and infrequently taken. First, there are not
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25 publicly available performance metrics of primary care providers that can
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27 guide patient preferences. Besides, patients find restrictions to change
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29 their doctor: in order to achieve equitable workloads, health centers
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31 establish rules to distribute patients and each GP have assigned a similar
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33 number of persons adjusting by age groups. Thus, even though the allocation
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35 of patients to doctors is not entirely driven by hazard, it seems very
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37 difficult that populations with particular unobserved characteristics were
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39 centered on the lists of some GPs.
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41 Electronic health records, which started to be introduced in 1990, are now
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43 used by all primary care doctors.
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46 Study population and period

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48 The observation period was set at 1 year, from 1 September 2007 to 31
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50 August 2008. The study population included all residents ≥ 14 years of age
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52 who were covered by the public healthcare system in the Basque Country on
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54 31 August 2008 and who had been covered for at least 6 months in the
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56 previous year, regardless of whether they had used or had any contact with
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3 the Basque Health System (Osakidetza) in that period. That is, almost the
4 entire population of the Basque Country was included.

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6 In this study, we analysed data from across the public health service
7 network: 130 health centres and 1193 GPs. The total number of registered
8 inhabitants was 1,959,682, meaning that the GP lists were composed of a
9 mean of 1643 people.
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13 14 15 Sources of data:

16 We used the two following sources of data:

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18 - Electronic health records of the Basque primary healthcare system, which
19 contain demographic, administrative and clinical data, including diagnoses,
20 prescriptions, ancillary test results and referrals, generated in relation
21 to each patient visit.
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23 - The minimum basic data set, which gathers information on all hospital
24 discharges from across the Basque network of public hospitals, including
25 data on patient characteristics, hospitalisation episodes, diagnoses and
26 procedures.
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33 34 35 Variables and statistical analysis

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37 At the level of the individual patient, we used demographic (age and sex),
38 morbidity and socioeconomic characteristics as explanatory variables.
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46 In order to include a manageable number of diseases, we classified all the
47 patient diagnoses (ICD-9-CM codes) made by the GPs during the study year
48 into Aggregated Diagnosis Groups (ADGs).[22] The ADG system assigns ICD-9-
49 CM codes to one of 32 categories, as a function of clinical criteria, the
50 expected resource use and type of care required for each health problem. It
51 is part of the Johns Hopkins Adjusted Clinical Group (ACG) case-mix system,
52 which is described elsewhere.[23]
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4 As a proxy for the socioeconomic status of patients, we used a deprivation
5 index based on census data, created for the MEDEA[24] project. Census
6 tracts are the smallest territorial units for which census population data
7 are available in Spain and they are mainly defined by criteria related to
8 population size, and geographic and social features. Though the number of
9 residents varies between tracts, the median is 1,200. For this study, the
10 deprivation index was categorized into five groups, the fifth corresponding
11 to the areas with the greatest deprivation and the first to the least
12 deprived areas. It is an indicator of socioeconomic status of people living
13 in a community and it has been shown to be correlated with rates of
14 mortality[25] and morbidity.[26]
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26 At the GP level, to estimate their work load, we considered the number of
27 patients on their list. Using this information, the GP lists were divided
28 into four groups (quartiles), those in the highest quartile being large,
29 those in the second and third quartiles medium-sized and those in the
30 lowest quartile small.
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37 We used a similar approach to characterise the primary care health centres.
38 In this case, the variables used were area-level demographic factors
39 (percentages of people above 65 years of age and of immigrants), [27] size
40 of the centre (number of GPs on the staff) and level of satisfaction of the
41 centre's staff with their work environment. The last of these variables
42 corresponds to the overall satisfaction score for the health centre,
43 calculated from the results of an internal survey carried out on a regular
44 basis by Osakidetza in all its organisations.[28] Like GPs, the health
45 centres were categorised into quartiles, the level of satisfaction being
46 rated as high for those in the highest quartile, moderate for those in the
47 middle two quartiles and low for those in the lowest quartile.
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3 All the analysis was performed using SAS version 9.2.
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7 For the first stage of analysis, we considered the following response
8 variables at the patient level: the number of visits to the GP, number of
9 forms for referrals to specialists issued by the GP, and costs to the
10 Department of Health of drugs prescribed to the patient during the year of
11 the study.
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17 We constructed multilevel mixed models[29] to identify which GPs were
18 outliers in terms of resource use. Taking into account the hierarchical
19 nature of the data, we used the explanatory variables as fixed effects and
20 included random intercepts for each of the higher levels: GP, health centre
21 and health district. As a function of the distribution of the response
22 variables, we used different regression models: in the case of prescribing
23 costs, we built a normal regression model (Proc MIXED, RMLE), while for the
24 visits and referrals, we used negative binomial regression models (Proc
25 GLIMMIX, LAPLACE). These models allowed us, using an empirical Bayesian
26 approach,[30] to estimate the differences between the performance of each
27 GP and the mean for each the response variables, after adjusting for the
28 other variables, as well as 95% confidence intervals for the estimators.
29 For visits and referrals, the estimators were exponentiated to obtain the
30 incidence rate ratios. We considered doctors to be outliers (high or low)
31 when their estimators statistically differed from zero (prescribing costs)
32 or one (visits and referrals).
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48 For the second stage, in addition to variables considered in the first
49 stage, we used classifications of each doctor (high/intermediate/low) with
50 respect their use of healthcare resources (visits, referrals and
51 prescribing costs) as explanatory variables, following the aforementioned
52 procedure, and the appearance of preventable hospitalisations as the
53 response variable. For this purpose, we identified patients who had had one
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3 or more admissions attributable to ACSCs, using the list established in
4 Spain by Caminal et al.[12]
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8 Using these variables, we constructed a multilevel mixed-effect logistic
9 regression (Proc GLIMMIX, LAPLACE). In this case, we used the
10 aforementioned explanatory variables (including the GP's classifications by
11 resource use) as fixed effects and a random intercept for each of the three
12 higher levels (GP, health centre and health district). The results are
13 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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3 With respect to the variables at the doctor level (Table 3), the risk of
4 ACSC admissions was higher for patients of GPs with a greater than expected
5 mean number of visits and prescribing costs (OR=1.29 [1.21 to 1.37]; 1.16
6 [1.09 to 1.24]) or with a lower than expected mean rate of referrals
7 (OR=1.33 [1.24 to 1.41]). The number of patients on the GP's list did not
8 reach statistical significance (p=0.0935).
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15 In our analysis, none of the health centre characteristics (size, level of
16 satisfaction of staff, and percentages of elderly individuals and of
17 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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3 However, we should also recognize some limitations. First, the data
4 analysed come from the daily records entered in the health information
5 system of the Basque Country and, as is commonly the case with the use of
6 administrative databases and electronic health records, there may be some
7 incomplete or inaccurate data. Second, the ecological nature of the
8 socioeconomic variable used (deprivation index) might have diluted the
9 effect of individual socioeconomic characteristics; it is also known that
10 social factors other than the ones studied have an effect on the need for
11 healthcare and its outcomes.[31] Similarly, other characteristics of
12 patients (such as health services-seeking preferences, unmeasured health
13 status or treatment adherence) were not observed. Further, this paper is
14 focused on the organization of public health service provision and
15 planning, and thus, private health provision is beyond the scope of our
16 analysis.

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

29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 Comparison with other studies

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

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39 Although from an observational study as ours is not possible to demonstrate
40 causal correlations, our analysis suggest that certain clinical practice
41 patterns of primary care doctors have an effect on the outcomes of care. In
42 particular, we have observed that GPs holding a more than expected number
43 of visits with patients, higher prescribing costs or lower referrals rate
44 is associated with higher rates of preventable admissions.
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52 In our opinion, physicians practice styles may play a central role and a
53 plausible hypothesis is that some doctors try to avoid referrals and, due
54 to that, their patients need more prescriptions and following visits to GP;
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3 conceivably this sequence might generate some inappropriate accessibility
4 to specialized care for patients.
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8 Other alternative explanations (such as, populations with particular
9 unobserved characteristics being concentrated on the lists of some GPs or
10 that patients after a hospital discharge due to ACSC seek for GPs attention
11 but elude being referred to specialized care) seem unlikely. Physician
12 training can influence referral decision making, but in the Basque Country
13 most of GPs have completed the Family Medicine Residency Program and only a
14 very scarce number of doctors are not family physicians. GPs are not
15 allowed to make choices about the specialist to whom refer their patients
16 nor receive additional compensations for referrals. Even though in our
17 setting there are GPs working in rural and urban locations, the uneven
18 distribution of specialists between geographic areas has not affected our
19 results, since health center random effects are included in the
20 estimations.
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34 The benefits of primary care on the health of people and populations have
35 been demonstrated and widely recognised.[2] Other authors have described
36 the added value to the care of a generalist approach, especially for
37 complex patients with multimorbidity, this giving rise to the paradox that
38 GPs provide poorer quality healthcare than specialists in the treatment of
39 specific diseases, but achieve better outcomes in overall health of people
40 and populations.[45]
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49 However, as in other healthcare contexts, doing more is not always better
50 in primary care. From our results, we can state that GPs performing an
51 excessive number of visits with patients is associated with higher rates of
52 preventable admissions, as is GPs having higher prescribing costs, while
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3 those who play the role of strong "gatekeepers" and are more reluctant to
4 "pass the baton" to specialists also achieve poorer results.
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8 Given this, indicators that measure the performance of health professionals
9 should be interpreted with care, unless they are accompanied by other
10 indicators of care outcomes. Otherwise, interventions focused on modifying
11 clinical practice patterns may have undesired consequences. On the other
12 hand, from a health policy perspective, our results can assist the idea
13 that an excessive fragmentation between health care levels could result in
14 detriments to the population health. In contrast, the assumption of shared
15 values and objectives by primary and specialized care can aid to a
16 seamless, coordinated and person-centred assistance.
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30 Unanswered questions and future research

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32 This study indicates how certain ways of working among primary care doctors
33 are associated to different outcomes in terms of preventable
34 hospitalization of patients. However, it does not allow us to establish the
35 causes of these differences. Visits to GPs are diverse in nature: they may
36 occur on the initiative of the patient or of the doctor, they have many
37 underlying reasons (for example, for assessing symptoms or diseases, social
38 problems, provision of advice, or administrative procedures), and they may
39 vary in terms of duration, structure, procedures performed, and the
40 involvement of other primary care health professionals, such as nurses.
41 Several factors increase prescribing costs: excessive prescribing,
42 inappropriate treatments, and selection of the most expensive option.
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44 Important factors regarding referrals are whether they are appropriate and
45 timely, as well as the type of specialist patients are referred to, and the
46 subsequent level of coordination between the GP and the specialist in the
47 shared management of the patient. In relation to this, there is a need for
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3 future studies analysing primary care outcomes that consider other factors
4 related to visits, referrals and prescriptions. Furthermore, our results
5 should be tested in other settings or specific population groups (for
6 example, patients with multimorbidity or with specific diseases). In any
7 case, our findings provide a starting point for discussion and research
8 concerning what should be the limits in terms of the "quantity" of primary
9 care provided to meet the needs of the population.
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25 support of this project.
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32 and provision of the deprivation index. At the same time we want to
33 explicitly thank Montse Calvo for her work in geocodifying the data.
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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.

REFERENCES

- 1 The King's Fund. Improving the Quality of Care in English General Practice: A report of an independent inquiry commissioned by The King's Fund. London: : The King's Fund 2011.
- 2 Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. *Milbank Q* 2005;**83**:457-502. doi:10.1111/j.1468-0009.2005.00409.x
- 3 Rizza P, Bianco A, Pavia M, et al. Preventable hospitalization and access to primary health care in an area of Southern Italy. *BMC Health Serv Res* 2007;**7**:134. doi:10.1186/1472-6963-7-134
- 4 Trivedi AN, Moloo H, Mor V. Increased ambulatory care copayments and hospitalizations among the elderly. *N Engl J Med* 2010;**362**:320-8. doi:10.1056/NEJMs0904533
- 5 Fleetcroft R, Cookson R, Steel N, et al. Correlation between prescribing quality and pharmaceutical costs in English primary care: national cross-sectional analysis. *Br J Gen Pract* 2011;**61**:e556-564. doi:10.3399/bjgp11X593839
- 6 Arnold SR, Straus SE. Interventions to improve antibiotic prescribing practices in ambulatory care. *Cochrane Database Syst Rev* 2005;:CD003539. doi:10.1002/14651858.CD003539.pub2
- 7 Keyhani S, Falk R, Howell EA, et al. Overuse and systems of care: a systematic review. *Med Care* 2013;**51**:503-8. doi:10.1097/MLR.0b013e31828dbafe
- 8 Stuart BC, Doshi JA, Terza JV. Assessing the impact of drug use on hospital costs. *Health Serv Res* 2009;**44**:128-44. doi:10.1111/j.1475-6773.2008.00897.x
- 9 Austvoll-Dahlgren A, Aaserud M, Vist G, et al. Pharmaceutical policies: effects of cap and co-payment on rational drug use. *Cochrane Database Syst Rev* 2008;:CD007017. doi:10.1002/14651858.CD007017
- 10 Agency for Healthcare Research and Quality. Guide to prevention quality indicators: hospital admission for ambulatory care sensitive conditions. 2007.http://qualityindicators.ahrq.gov/downloads/modules/pqi/v31/pqi_technical_specs_v31.pdf (accessed 4 Nov2014).
- 11 Purdy S, Griffin T, Salisbury C, et al. Ambulatory care sensitive conditions: terminology and disease coding need to be more specific to aid policy makers and clinicians. *Public Health* 2009;**123**:169-73. doi:10.1016/j.puhe.2008.11.001
- 12 Caminal J, Starfield B, Sánchez E, et al. The role of primary care in preventing ambulatory care sensitive conditions. *Eur J Public Health* 2004;**14**:246-51.
- 13 Bermúdez-Tamayo C, Márquez-Calderón S, Rodríguez del Aguila MM, et al. [Organizational characteristics of primary care and hospitalization for

- 1
2
3 to the main ambulatory care sensitive conditions]. *Aten Primaria*
4 2004;**33**:305-11.
- 5
6 14 Magan P, Otero A, Alberquilla A, et al. Geographic variations in
7 avoidable hospitalizations in the elderly, in a health system with
8 universal coverage. *BMC Health Serv Res* 2008;**8**:42. doi:10.1186/1472-
9 6963-8-42
- 10
11 15 Magán P, Alberquilla A, Otero A, et al. Hospitalizations for ambulatory
12 care sensitive conditions and quality of primary care: their relation
13 with socioeconomic and health care variables in the Madrid regional
14 health service (Spain). *Med Care* 2011;**49**:17-23.
15 doi:10.1097/MLR.0b013e3181ef9d13
- 16
17 16 Bardsley M, Blunt I, Davies S, et al. Is secondary preventive care
18 improving? Observational study of 10-year trends in emergency admissions
19 for conditions amenable to ambulatory care. *BMJ Open* 2013;**3**.
20 doi:10.1136/bmjopen-2012-002007
- 21
22 17 Wolff JL, Starfield B, Anderson G. Prevalence, expenditures, and
23 complications of multiple chronic conditions in the elderly. *Arch Intern*
24 *Med* 2002;**162**:2269-76.
- 25
26 18 Saver BG, Wang C-Y, Dobie SA, et al. The central role of comorbidity in
27 predicting ambulatory care sensitive hospitalizations. *Eur J Public*
28 *Health* 2014;**24**:66-72. doi:10.1093/eurpub/ckt019
- 29
30 19 Roos LL, Walld R, Uhanova J, et al. Physician visits, hospitalizations,
31 and socioeconomic status: ambulatory care sensitive conditions in a
32 canadian setting. *Health Serv Res* 2005;**40**:1167-85. doi:10.1111/j.1475-
33 6773.2005.00407.x
- 34
35 20 Moy E, Chang E, Barrett M, et al. Potentially preventable
36 hospitalizations - United States, 2001-2009. *MMWR Surveill Summ* 2013;**62**
37 **Suppl 3**:139-43.
- 38
39 21 Laditka JN, Laditka SB, Probst JC. More may be better: evidence of a
40 negative relationship between physician supply and hospitalization for
41 ambulatory care sensitive conditions. *Health Serv Res* 2005;**40**:1148-66.
42 doi:10.1111/j.1475-6773.2005.00403.x
- 43
44 22 Weiner JP, Starfield BH, Steinwachs DM, et al. Development and
45 application of a population-oriented measure of ambulatory care case-
46 mix. *Medical care* 1991;**29**:452-72.
- 47
48 23 Johns Hopkins University, School of Public Health. The Johns Hopkins
49 University ACG case-mix system.
50 http://acg.jhsph.org/index.php?option=com_content&view=article&id=46&Itemid=366 (accessed 4 Nov2014).
- 51
52 24 Domínguez-Berjón MF, Borrell C, Cano-Serral G, et al. [Constructing a
53 deprivation index based on census data in large Spanish cities(the MEDEA
54 project)]. *Gac Sanit* 2008;**22**:179-87.
- 55
56 25 Borrell C, Mari-Dell'olmo M, Serral G, et al. Inequalities in mortality
57 in small areas of eleven Spanish cities (the multicenter MEDEA project).
58 *Health Place* 2010;**16**:703-11. doi:10.1016/j.healthplace.2010.03.002
- 59
60 26 Orueta JF, Nuño-Solinís R, García-Alvarez A, et al. Prevalence of
multimorbidity according to the deprivation level among the elderly in

- 1
2
3 the Basque Country. *BMC Public Health* 2013;**13**:918. doi:10.1186/1471-
4 2458-13-918
- 5
6 27 Eustat (Instituto Vasco de Estadística). Population statistics. Vitoria-
7 Gasteiz: 2004.
8 [http://en.eustat.es/estadisticas/tema_159/opt_0/ti_Population/temas.html](http://en.eustat.es/estadisticas/tema_159/opt_0/ti_Population/temas.html#axzz37p2gs8HG)
9 #axzz37p2gs8HG (accessed 4 Nov2014).
- 10
11 28 Osakidetza Comarca Uribe. Satisfacción de las personas. Comarca Uribe:
12 2010. <http://uribe.osakidetza.net/es/html/4/2123.shtml> (accessed 4
13 Nov2014).
- 14
15 29 Raudenbush SW, Bryk AS. Hierarchical Linear Models: Applications and
16 Data Analysis Methods. SAGE Publications 2002.
- 17
18 30 Snijders TAB, Bosker RJ. Multilevel Analysis: An Introduction to Basic
19 and Advanced Multilevel Modeling. Sage Publications 1999.
- 20
21 31 Rosen AK, Reid R, Broemeling A-M, et al. Applying a risk-adjustment
22 framework to primary care: can we improve on existing measures? *Ann Fam*
23 *Med* 2003;**1**:44-51.
- 24
25 32 Kringos D, Boerma W, Bourgueil Y, et al. The strength of primary care in
26 Europe: an international comparative study. *Br J Gen Pract* 2013;**63**:e742-
27 750. doi:10.3399/bjgp13X674422
- 28
29 33 OECD. Health at a Glance 2013. Paris: : Organisation for Economic Co-
30 operation and Development 2013. [http://www.oecd-](http://www.oecd-ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-02content/book/health_glance-2013-en)
31 [ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-](http://www.oecd-ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-02content/book/health_glance-2013-en)
32 [02content/book/health_glance-2013-en](http://www.oecd-ilibrary.org/;jsessionid=4ho9u8gumc0h9.x-oecd-live-02content/book/health_glance-2013-en) (accessed 4 Nov2014).
- 33
34 34 Stranges E, Stocks C. Potentially Preventable Hospitalizations for Acute
35 and Chronic Conditions, 2008: Statistical Brief #99. In: Healthcare Cost
36 and Utilization Project (HCUP) Statistical Briefs. Rockville (MD): :
37 Agency for Health Care Policy and Research (US) 2006.
38 <http://www.ncbi.nlm.nih.gov/books/NBK52655/> (accessed 29 Oct2014).
- 39
40 35 Ansari Z, Haider SI, Ansari H, et al. Patient characteristics associated
41 with hospitalisations for ambulatory care sensitive conditions in
42 Victoria, Australia. *BMC Health Serv Res* 2012;**12**:475. doi:10.1186/1472-
43 6963-12-475
- 44
45 36 Giuffrida A, Gravelle H, Roland M. Measuring quality of care with
46 routine data: avoiding confusion between performance indicators and
47 health outcomes. *BMJ* 1999;**319**:94-8.
- 48
49 37 O'Neil SS, Lake T, Merrill A, et al. Racial disparities in
50 hospitalizations for ambulatory care-sensitive conditions. *Am J Prev Med*
51 2010;**38**:381-8. doi:10.1016/j.amepre.2009.12.026
- 52
53 38 Eggli Y, Desquins B, Seker E, et al. Comparing potentially avoidable
54 hospitalization rates related to ambulatory care sensitive conditions in
55 Switzerland: the need to refine the definition of health conditions and
56 to adjust for population health status. *BMC Health Serv Res* 2014;**14**:25.
57 doi:10.1186/1472-6963-14-25
- 58
59 39 Himelhoch S, Weller WE, Wu AW, et al. Chronic medical illness,
60 depression, and use of acute medical services among Medicare
beneficiaries. *Med Care* 2004;**42**:512-21.

- 1
2
3 40 Yoon J, Yano EM, Altman L, et al. Reducing costs of acute care for
4 ambulatory care-sensitive medical conditions: the central roles of
5 comorbid mental illness. *Med Care* 2012;**50**:705-13.
6 doi:10.1097/MLR.0b013e31824e3379
- 7 41 Casalino LP, Pesko MF, Ryan AM, et al. Small primary care physician
8 practices have low rates of preventable hospital admissions. *Health Aff*
9 (Millwood) 2014;**33**:1680-8. doi:10.1377/hlthaff.2014.0434
- 10 42 Rosano A, Loha CA, Falvo R, et al. The relationship between avoidable
11 hospitalization and accessibility to primary care: a systematic review.
12 *Eur J Public Health* 2013;**23**:356-60. doi:10.1093/eurpub/cks053
- 13 43 Gibson OR, Segal L, McDermott RA. A systematic review of evidence on the
14 association between hospitalisation for chronic disease related
15 ambulatory care sensitive conditions and primary health care resourcing.
16 *BMC Health Serv Res* 2013;**13**:336. doi:10.1186/1472-6963-13-336
- 17 44 Gao J, Moran E, Li Y-F, et al. Predicting potentially avoidable
18 hospitalizations. *Med Care* 2014;**52**:164-71.
19 doi:10.1097/MLR.000000000000041
- 20 45 Stange KC, Ferrer RL. The paradox of primary care. *Ann Fam Med*
21 2009;**7**:293-9. doi:10.1370/afm.1023
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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

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	12,927 (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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6 Competing interests
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8 The authors declare that they have not competing interests.

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11 Institute. Spanish Ministry of Health, Social Services and Equality).
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18 Transparency declaration
19

20 The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being
21 reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as
22 planned (and, if relevant, registered) have been explained
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29 Ethical Approval
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32 The Clinical Research Ethics Committee of the Basque Country approved this study (PI2012151).
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38 Details of funding
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9 Role of the funder and statement of independence of researchers from funders

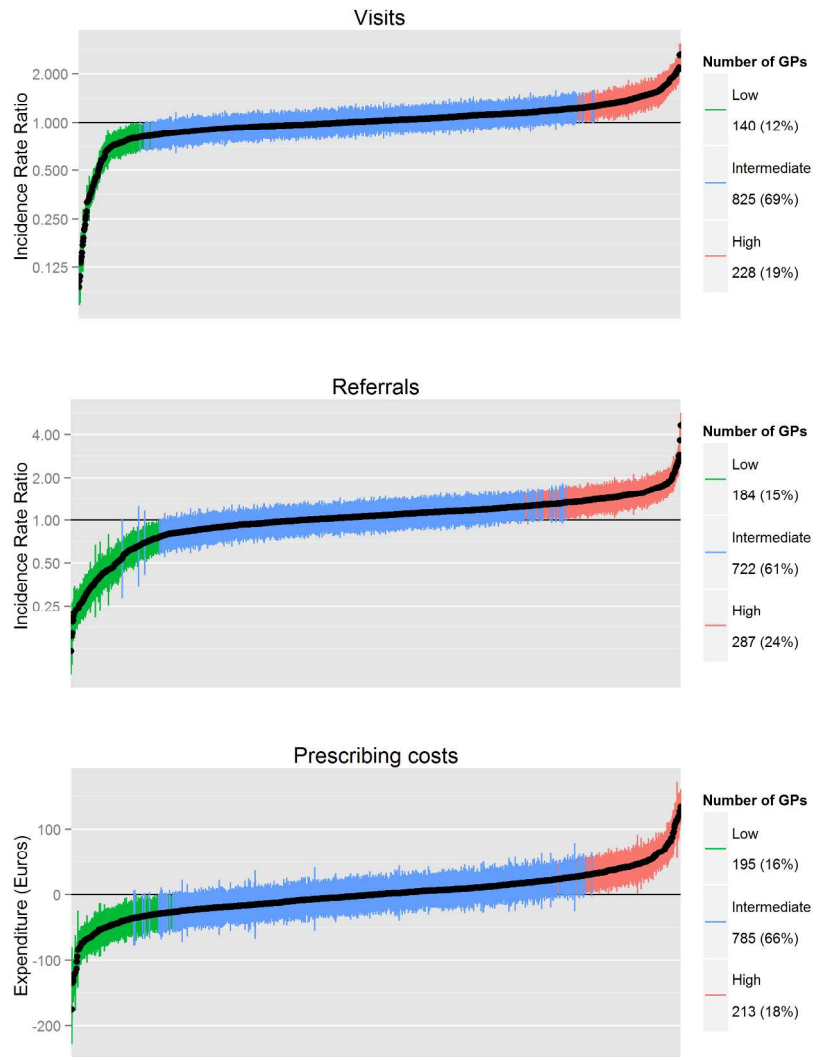
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12 conclusions and views in this manuscript are those of the authors and not necessarily those of the Fondo de
13 Investigación Sanitaria, Osakidetza (Basque Health Service) or O+berri (Basque Institute for Healthcare Innovation)
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18 Data sharing statement

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20 There are no additional data available.
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Figure 1.
Relative consumption of resources by the 1,193 general practitioners (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) <i>Cross-sectional study</i> —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*	<i>Cross-sectional study</i> —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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