Use of blood tests in general practice: a collaborative study in eight European countries

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SUMMARY

Background. Laboratory tests are routine examinations in general practice and are associated with increasing costs in industrialized countries.

Aim. The objective of this collaborative study was to determine the differences in general practitioners' use of blood tests in different European countries and to evaluate the relationship between these differences and organizational aspects of the health care system and also characteristics of the participating general practices.

Method. A descriptive study was conducted by eight European sentinel networks. Voluntary participating general practitioners registered all blood tests requested for four weeks, specifying the type of test, and age group and sex of patients. Details of all face-to-face encounters with patients by age group and sex were collected for the same period. Information on the participating practices and general practitioners was collected by questionnaire.

Results. The request rate for blood tests varied considerably between countries. The characteristics of general practitioners and practice were only slightly or were not associated with the use of blood tests while dummy 'country' variables were strongly associated. The number of general practitioners per 1000 inhabitants was the most positively associated variable partly explaining the intercountry variation.

Conclusion. This European study suggests that some national characteristics of the health system could determine the use of blood tests in general practice and underlines the need for further investigation in order to develop successful strategies for promoting the optimal use of diagnostic technology.

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Introduction

LABORATORY tests are routine examinations in general practice and are associated with increasing costs in industrialized countries.[1,2] In the present era of cost containment irrational and inconsistent prescribing by general practitioners is criticized.[3] Interest in audit has initiated several studies assessing the number and cost of laboratory tests, and their relation to quality of care.[4] Assessment of the use of technology in health care has become part of health policy in Europe and in most other western countries.[5,6]

A study of the use of blood tests in general practice was conducted within the framework of the Eurosentinel project in eight European countries (Belgium, Ireland, Italy, the Netherlands, Portugal, Spain, Switzerland, and the United Kingdom). The objective of this collaborative study was to determine the differences in general practitioners' use of blood tests in different European countries and to evaluate the relationship between these differences and organizational aspects of the health care system and also characteristics of the participating general practices. It was not intended to evaluate the appropriateness of the blood tests in relation to specific symptoms or diagnoses, nor to evaluate the impact of the requests for blood tests on the outcome of the health problems for the patients.

Method

A sentinel network of general practitioners can be defined as a system that supplies regular and standardized reports on specific diseases and procedures for a sample of the population in primary health care. Such networks have proven to be an excellent tool for the study of health problems and health procedures at the primary health care level.[7-9]

The Eurosentinel concerted action, funded by the European Community Medical Research Programme, began in 1989 and the first phase ended in June 1991. The purpose of the Eurosentinel project was to coordinate activities in the field of sentinel practices with voluntary general practitioners in the different member countries. The ultimate goal was to establish a European network of sentinel general practices. Eleven networks from nine European countries participated in the Eurosentinel project.[10] Each network had at least 30 participants routinely recording information about a small number of carefully chosen conditions, selected according to their local relevance.

From the beginning, it was intended that the Eurosentinel project should not only focus on recording health problems, but that more research oriented projects such as that presented here, should also be carried out provided they did not overload the participating networks.

The numerator for this study was made up of all patients for whom one or more blood tests was ordered by their general practitioner, performed either in the laboratory or in the practice. A weekly registration form printed with the general practitioner's code and the week number was used, with room for 50 patients, recording the age group and sex of the patient and the prescribed

tests according to the following categories: haemoglobin concentration/blood count; iron concentration/iron binding capacity/ferritin concentration; cholesterol concentration; other lipid tests; glucose concentration; liver function tests; thyroid function tests; other blood tests. A second weekly form was used to collect the denominator data — all face-to-face encounters, recorded by age group and sex. The number of encounters per week was used as an indicator of the workload of the general practitioner.

Information on the organizational characteristics of the practice was collected by questionnaire, completed when the general practitioner agreed to participate in the study. The questionnaire asked for the age and sex of the general practitioner; the number of years since qualifying; current professional responsibilities in hospital; the number of general practitioner partners in the practice; the location of the practice (urban, rural); the distance between the practice and the nearest hospital; the distance between the practice and the laboratory; and whether or not blood tests were performed in the practice.

The number of general practitioners per 1000 inhabitants is a characteristic of the health care system and was obtained from an interface study.[11] For Switzerland, specialists were included as they are involved in the primary care sector.[12]

A pilot study in March 1989 showed the feasibility of a more research oriented project at a European level within the framework of sentinel networks of general practitioners. The study was carried out during four successive weeks in October 1989 with the participation of sentinel networks from eight European networks. Considering participation for two weeks as a minimum, 340 general practitioners were included in the study.

Analysis

The rate of requesting blood tests was defined as the number of patients tested divided by the total number of patients attending (observed request rate). In order to make comparisons between countries, it was necessary to take into account the differences in the age and sex distribution of the patients seen by each general practitioner. The observed request rate was standardized for age and sex using the indirect method of standardization. The distribution of all contacts over all participating networks was used in order to calculate the specific request rates by age group and sex for the attending population. The age and sex standardized request rate for each general practitioner was calculated by multiplying the observed request rate by a standardization factor for the general practitioner. This standardization factor was calculated as the global request rate (total number of tests divided by the total number of patients) multiplied by the number of encounters for the general practitioner divided by the expected number of tests for the general practitioner. The expected number of tests for the general practitioner was calculated as the sum of the expected number of tests in each age and sex group for the general practitioner (specific request rate multiplied by the number of encounters for the general practitioner).

Univariate relationships among variables were examined using Pearson correlation coefficients. Linear modelling with a least squares method was used to determine the associations. The goodness of fit was measured with the coefficient of determination, R^2, representing the proportion of the total sum of squares (total variation) that is explained (explained variation) by the regression line.[13] The logarithm (base 10) of the age and sex standardized request rate was used in order to make the distribution of the request rates closer to a normal distribution. The logarithm of the rate of each of the 340 general practitioners (dependent variable) was regressed on the following independent variables: characteristics of general practitioners and their practices, and 'country' variables. Seven countries were included as dummy variables (the eighth being the 'reference' country).

These 'country' variables represented all organizational characteristics of the health care system except for practice variables, included separately. The data were analysed using *SPSS-PC* software.

Results

The 340 selected general practitioners had 156 021 patient contacts and ordered a total of 37 772 blood tests during a total of 1310 doctor-observation weeks.

Patient characteristics

The age and sex distribution of all the patients seen differed considerably from country to country. The overall male to female ratio was 0.69:1 ranging from 0.55:1 in Portugal to 0.80:1 in Switzerland. In all countries, women aged 25–64 years accounted for the highest proportion of patient contacts (25–36%).

General practitioner characteristics

The mean age of the participating general practitioners was 38.8 years and overall 75% of them were men. However, in Portugal more than half of the participants were women doctors. The mean number of years since graduating ranged from 10.9 years in Italy to 18.3 in the UK. In Ireland, Switzerland and the UK some of the participating general practitioners had current professional responsibilities in hospital (17%, 23% and 39%, respectively).

Practice characteristics

The mean number of patient contacts in a week was 119 (Table 1). In Belgium, Italy and Switzerland, most general practitioners were single-handed (61%, 64% and 63%, respectively). Most of the Portuguese general practitioners (80%) and all British general practitioners were working in group practices of four partners or more. In Italy, Portugal and the Netherlands, the largest group of practices was less than 1 km from a laboratory (43%, 71% and 49%, respectively) while in Ireland and Switzerland, about half of the practices were more than 10 km from a laboratory (52% and 53%, respectively). In Ireland, Portugal, Spain and the UK the proportions situated more than 10 km from a hospital were 45%, 45%, 44% and 31%, respectively. Most of the Dutch and Swiss doctors (82% and 73%, respectively) and half of the Irish general practitioners (55%) were performing some tests in their practice (not including glucose concentration).

The majority of the participating doctors were located in a region with 2000–50 000 inhabitants except in Ireland where about half of the doctors (48%) were working in a region of fewer than 2000 inhabitants and in Spain where 29% of general practitioners were working in a region with fewer than 2000 inhabitants and 46% in cities with more than 50 000 inhabitants.

Blood test requests

The request rate for blood tests by age group and by sex varied considerably between networks. The request rate was highest for the 25–64 years age group in all countries except Switzerland where it was 65–74 years. Differences in the younger age groups were most striking for boys aged 0–4 years — request rates were 0.1% in Ireland, 0.6% in the UK, 10.3% in Italy and 13.1% in Switzerland.

The mean proportion of patients for whom a blood test was ordered (number of patients tested/number of attending patients standardized for age and sex) was 7.7%, ranging from 5.1% in the UK to 15.5% in Switzerland (Figure 1). The spread of the distribution was smallest in Belgium and the Netherlands (interquartile range less than three) but widest in Switzerland, the

Table 1. Number of selected general practitioners, number of patient encounters and mean number of encounters in a week for the participating networks.

| Country	Network	Number of selected GPs	Total number of patient encounters	Mean number of patient encounters in a week (standard deviation)	
Belgium	Huisartsenpeilpraktijken/ médecins vigies	49	26 109	136	(55)
Ireland	Sentinel practice network	29	14 760	130	(40)
Italy	Rete sentinella 'M Negri' Institute — CSeRMEG	47	22 163	116	(107)
Netherlands	Peilstations	51	26 803	135	(43)
Portugal	Medicos sentinela	51	13 695	76[a]	(18)
Spain	Red Espanola de atencion primaria	70	33 321	123	(60)
Switzerland	Sentinella	30	12 679	107	(41)
UK	Weekly returns service	13	6491	142	(45)
Total		340	156 021	119	(62)

[a]Part of the basic weekly worktime of the Portuguese GPs was spent in emergency work, leaving 23–29 hours for work in the surgery.

UK and Italy. All countries had outliers (defined as values more than 1.5 interquartile range from the 75th percentile) except Italy and the UK. The mean number of test categories investigated for each tested patient varied from 1.6 in the UK to 4.1 in Belgium where combinations of tests were more often requested, as was also the case in Italy, Portugal and Spain. The haemoglobin concentration/blood count and glucose concentration were the most frequently requested blood tests (21.2% and 17.4% of all tests, respectively).

Explanatory variables

Correlation was carried out in order to identify the determinants of the rate of requesting blood tests (Table 2). The highest association with the logarithm age and sex standardized test request rate among practice and general practitioner characteristics was the number of contacts per week. The distance from hospital was the most significant of the geographical variables.

The logarithm age and sex standardized request rate for blood
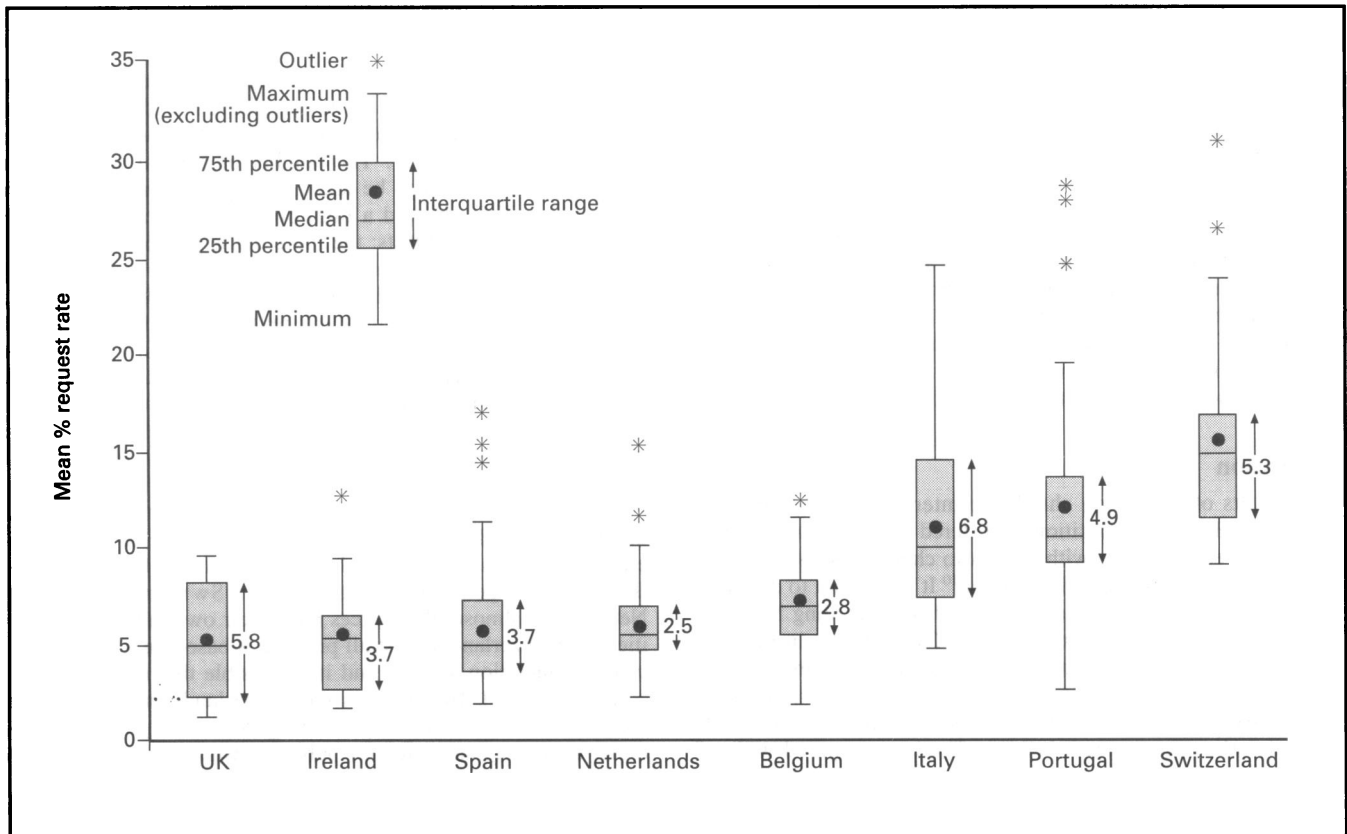
Figure 1. Mean request rate for each country, standardized for age and sex of patients.

Table 2. Pearson correlation with the logarithm age and sex standardized rate of requesting laboratory blood tests.

Variable	Pearson's r
General practitioner	
Age	−0.04
Sex[a]	−0.14**
Number of years since qualifying	−0.05
Hospital responsibilities[b]	−0.20
Practice	
Number of GPs working in the practice	−0.07
Location[c]	−0.01
Distance from hospital[d]	−0.15**
Distance from laboratory[d]	−0.14**
Testing in the practice[e]	−0.03
Number of contacts per week	−0.35***
Health system	
Number of GPs per 1000 inhabitants	0.52***

The real numeric values were taken into account except for the following variables: [a]Male = 1, female = 0. [b]Current responsibilities = 1, no responsibilties = 0. [c]Area <2000 inhabitants = 1, city with population 2000–50 000 inhabitants = 2, city with >50 000 inhabitants = 3. [d]Distance from hospital/laboratory: <1 km = 1, 1–5 km = 2, 6–10 km = 3, >10 km = 4. [e]Yes = 1, no = 0. **P<0.01. ***P<0.001.

tests increased for the 340 general practitioners with the number of general practitioners per 1000 inhabitants (Table 2). In the four networks with the lowest request rates (UK, Ireland, Spain and the Netherlands), the number of general practitioners per 1000 inhabitants (0.5, 0.5, 0.5 and 0.6, respectively) was two or three times lower than in Belgium (1.2), Italy (1.2), Portugal (1.8) and Switzerland (1.4).

The logarithm standardized request rate was regressed on factors related to general practitioners (age, sex, number of years since qualifying and responsibilities in hospital), on practice characteristics (number of general practitioner partners in the practice, location (urban, rural), distance between the practice and the hospital, distance between the practice and the laboratory, whether or not tests performed in the practice and mean number of contacts in a week) and on the countries. The regression analysis revealed that these 17 variables together explained 49% of the variation in the rate of requesting blood tests. Analysis of the residuals revealed a nearly normal distribution and only three outliers (greater than three standard deviations). The 'country' variables made a major contribution to the explanation of the variation (45%). The variable related to practice characteristics explained only 15% of the variation while the characteristics of general practitioners explained only 2%.

Discussion

The results of this study should be interpreted carefully. The Eurosentinel general practitioners differed from all general practitioners in each country with respect to characteristics including age, sex and geographical distribution.[10] It is difficult to define to what extent these differences influenced the recording habits of the participating general practitioners. Participation in the sentinel networks is voluntary and therefore there is no random sampling. However, as this selection bias was present in all the networks involved, international comparisons seem valid. An existing network, once created, is cost effective compared with *ad hoc* studies because the sentinel general practitioners already have a positive attitude towards accurate and meticulous recording.

The data found here have been compared with other sources of information. For Belgium, Spain and the Netherlands, request rates for blood tests found in the Eurosentinel study were comparable to those found in other studies.[14-16] For Ireland, the west Cork pilot study showed similar results (Comber H, personal communication). For Switzerland and the UK, the Eurosentinel general practitioners seemed to order more blood tests than in other studies.[17,18] Other sources of information were not available for Italy and Portugal.

Differences in the use of blood tests can be linked to patient characteristics (including morbidity), characteristics of general practitioners and their practice, and the organization of the health system. Information on morbidity pattern and diagnosis was not available in this study. The age and sex specific request rates for blood tests showed important variations between countries. In order to eliminate this source of variation, the request rates were standardized for the age and the sex of the attending patients.

Physicians' training has often been associated with the use of laboratory tests. Physicians have been found to be influenced by the patterns of their supervisors[19] and doctors trained in medical schools which are academically oriented tend to use more tests than other physicians.[20] Differences in vocational training may also influence the test rates.[21] It has been suggested that the trend to test more could be correlated with the number of years in practice.[22] In this study, none of the characteristics of general practitioners (age, number of years since qualifying and responsibilities in hospital) was significantly associated with the rate of requesting blood tests, except for the variable sex but this had a very low correlation coefficient.

Among the practice characteristics, three variables were associated with a lower use of laboratory tests. General practitioners with a heavier workload may make less use of tests because of a lack of time, greater clinical experience, more symptomatic treatment orientation and more frequent contacts with the same patients while general practitioners working a long way from a hospital or laboratory may have less accessibility to the laboratory.

However, all these factors related to the doctor or practice explained only a small part of the variance (2% and 15%, respectively). Do the characteristics of the different national health care systems explain it better? The number of general practitioners per 1000 inhabitants can be taken as an indicator of the health care policy. This showed a high positive correlation with the request rate for blood tests: the more dense the medical population, the more patient contacts result in a blood test, probably reflecting the competition for patients between doctors. However, the results of this study reveal that similar organizational characteristics do not necessarily imply similar behaviours concerning the ordering of laboratory tests. General practitioners have a list of patients and access to specialists is via the general practitioner (totally or partially compulsory) in the four countries with low request rates (UK, Ireland, Spain and the Netherlands) but this is also true in Italy and Portugal with high request rates.

There is no patient registration in Belgium and Switzerland and there is totally free access to specialists, but the Swiss general practitioners had a much higher request rate for blood tests than Belgian general practitioners. In Switzerland and the Netherlands almost all practices have their own laboratory facilities. In Switzerland almost all practice is based on a fee-for-service remuneration system, and it is possible that these facilities could be abused. However, in the Netherlands investigation in the practice is not financially advantageous to the general practitioner as the capitation fee for publicly insured patients includes the various components of the general practitioner's activities.

This European study suggests that characteristics related to each country could determine the rate at which blood tests are ordered. Some of these characteristics are linked to the health

system: the number of general practitioners in the population could operate on the economic principle of an increasing supply resulting in an increasing demand. However, these 'country' variables cannot explain the difference between the general practitioners within each country. Individual and/or cultural characteristics of the patient or the general practitioner, such as quest for diagnostic certainty,[23] disease centred or patient centred attitudes,[24] and medical decision making strategies[25] should also be investigated in order to develop successful strategies for promoting optimal use of diagnostic technology.

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Food for thought...

'Pooled analyses of trials with acyclovir failed to detect a significant reduction of [postherpetic] pain... at one or six months, but found a 35% reduction at three months.'

Lancaster T, Silagy C, Gray S. Primary care management of acute herpes zoster: systematic review of evidence from randomized controlled trials. January *Journal*, p.39.