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The primary-secondary care interface: does provision of more services in primary care reduce referrals to medical specialists?

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ABSTRACT

Great variation in referral rates between primary care physicians has been the main reason to influence physician's referral behaviour, by for example, stimulating extra services. This study investigated the extent to which the number of therapeutic and diagnostic services performed by primary care physicians influenced referrals. Data was derived from electronic medical records of 70 general practices for the period 2006 until 2010. For the total patient population (N = 651,089 patient years) and specific patients groups for whom specific services were performed mostly (28 groups;10 services), logistic multilevel regression analyses were conducted to determine associations between the number of services performed in a practice and referrals to medical specialists. The total number of services performed in a practice was not associated with the referral rate (OR:1.00). Only for two specific services was a significant association found: a lower referral rate for minor surgery for patient with sebaceous cysts (OR:0.98) and a higher rate for Doppler diagnostic tests for patients with other peripheral arterial diseases (OR:1.04). As the number of services in general practice was rarely associated with referrals, other measures might be more effective in changing referral behaviour. Another explanation for our results could be that certain preconditions have not been met.

1. INTRODUCTION

The primary-secondary care interface plays a pivotal role in cost containment strategies in many countries, since primary health care is generally less expensive than secondary, specialised health care [1]. In times of economic crisis and rising

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health care costs, increased attention on primary care is therefore understandable [2] and [3]. In many European countries, and health plans in the United States, patients have a primary care physician who acts as a formal gatekeeper and thereby determines whether or not a patient requires secondary care [4] and [5]. The referral behaviour of primary care physicians is considered a vital component of demand management and thus of restraining health care costs.

Primary care physicians generally refer patients to a medical specialist for diagnosis or investigation, treatment, and reassurance of physician and/or patient [6]. A physician's decision to refer a patient is made in close interaction with the patient, in which patient characteristics such as diagnosis, age and gender, are the most important inputs to the referral decision [7] and [8]. Physician and practice characteristics, such as length of experience, gender, willingness to take risk and practice type (single-handed, group practice etc.) have also been shown to influence the referral decision [6] and [8]. However, after controlling for patient, physician and practice characteristics a large variation still exists in referral rates at physician and practice level [9]. It has been suggested that this variation indicates a suboptimal referral process [10]. At first glance, large variation seems negative as it implies that some patients receive sub-optimal care: both under- and over-referrals. But variation in referrals could also suggest opportunities for cost containment in cases of over-referral. This large variation has been the driving force for health care professionals to develop guidelines and increase knowledge about common (chronic) diseases in primary care, but also for health policy makers to strengthen primary health care, by for example, influencing physicians' referral behaviour with financial incentives through financing possibilities for extra staff or stimulating extra services through a system of reimbursement.

But do extra services in primary care result in fewer referrals to secondary care?

Despite the emphasis on strengthening primary care, there is little (consistent) information on the extent to which extra services impact on the referral behaviour of primary care physicians. Stimulating more services in primary care is only of financial interest if extra primary care services are a direct substitute for specialty care, and not a complement. Extra (diagnostic) services, through early detection and prevention, could also improve quality of care and might delay or prevent future need for specialty care (e.g. diabetes care). Several studies have shown that primary health care can be substitute for specialty care, but primary care services can not be a substitute on a one-to-one ratio with specialty care services; more than one extra primary care service needs to be performed to substitute for one specialty care encounter [11] and [12]. These extra services could be due to treatment of patients who would otherwise not be treated or referred, or for whom more services are needed to prevent a referral.

Results of studies focussing on the effect of extra services on referral behaviour show inconsistent results. Krasnik et al. found lower referral rates with an increase in diagnostic and therapeutic services within primary care [13]. Groenewegen and van Dijk et al. found lower referral rates with a larger number of services within primary care for only some specific services and/or patients groups [14] and [15]. Lowy et al. found no reduction in referral rate with an increased number of minor surgery services [16]. These studies show that at least some extra primary care services might have the potential to influence physicians' referral rates, and thereby substitute

primary health care for specialty care. But to better help health policy, more information is needed to decide which services and patient groups should be focused on when stimulating substitution.
This paper contributes to the literature on the primary-secondary care interface. Using data from electronic medical records (EMRs) of general practitioners (GPs), we investigated the impact of performing specific therapeutic and diagnostic services within primary care in the Netherlands, so called modernisation and innovation (M&I) services, on referral behaviour of primary care physicians. In the Netherlands, the GP remuneration system consists of both capitation fees and fee-for-services for consultation and home visits. M&I services form a separate group of therapeutic and diagnostic services that are expected to encourage substitution from secondary to primary health care or improve quality and are remunerated with a fee independent of the consultation fees. These services comprise a relatively small part of the GP remuneration system. The services can be divided into two parts: i) a predefined set of services with freely negotiable fees; and ii) regional initiatives which are reimbursed by a supplement on top of the capitation fee. In this paper, we focus only on predefined services such as 'minor surgery' and 'cognitive function tests'. In 2010, 50 different services were in operation. Between 2006 and 2010, the median number of therapeutic and diagnostic services in general practice had increased from 109 to 178 per 1,000 patients [17]. Specialist care is remunerated on a diagnosis-related group based payment system in the Netherlands. This study investigated the association between the total number of therapeutic and diagnostic services and the number of referrals, and therefore investigated whether these M&I services really have substitution potential. Furthermore, the association between the number of services and referrals was investigated for specific services and patient groups. The following research question were answered:

1. To what extent did the number of therapeutic and diagnostic services performed within general practice influence the referral rate of primary care physicians?
2. To what degree did this impact differ between services and specific patient groups? We expected more substitution potential for therapeutic than diagnostic services, since diagnostic services could reveal morbidity that is not treatable by GPs and could be a the reason for referral.

2. Materials and Methods

2.1. Study design and population

This was an observational cross-sectional study analysing the association between the number of therapeutic and diagnostic services and referral behaviour of GPs in the Netherlands from 2006 until 2010. Combined data from 2006-2010 was used from the EMRs of general practices that participated in the Netherlands Primary Care Database (NPCD; formerly known as LINH) [18]. The NPCD GP database contains longitudinal data at the patient level in terms of contacts, morbidity, prescriptions and referrals, with small yearly changes in practice composition. The NPCDis registered with the Dutch Data Protection Authority; data is handled according to

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national data protection guidelines (anonymous patient records and opt-out), making ethical approval by an ethics committee unnecessary.
For this study, we only included data from practices that passed a number of checks regarding the quality of data on care episodes (morbidity), referrals to secondary care, contacts and prescriptions. Table 1 shows the number of general practices and patients for all years considered. Reasons for excluding practices for a specific year (non-exclusive) were 1) incomplete data on care episodes (±25% of excluded practice years), 2) incomplete data on contact (±30%), 3) incomplete data on prescriptions (±30%) and/or 4) incomplete data on referrals (±50%). Overall, the practices included were representative of Dutch general practices with respect to the degree of urbanisation and region, but not with respect to practice type (overrepresentation of group practices or health centres and underrepresentation of single-handed practices).

[TABLE 1]

2.2. Patient groups

For those services that were performed relatively often (>3 per 1000 registered patient and by >45% of practices) or that were expected to have high substitution potential based on expert evaluation (10 out of 50 services), associations between the number of services and referrals were estimated for specific patient groups.
These specific patient groups were defined on the basis of the diagnoses for which the service was performed most often. In principle, the four most common diagnoses were selected. However, when a specific set of less than four diagnoses was found, we deviated from this rule. Analyses were limited to patient groups for whom in at least 30 practices, at least 30 patients with the diagnosis concerned were present during the period 2006-2010, excluding six out of 34 patient groups. Table 2 presents the therapeutic and diagnostic services, and the specific patient groups.

[TABLE2]

2.3. Measurements

2.3.1. Independent variable: therapeutic and diagnostic services

In the analysis of the total patient population, the number of therapeutic and diagnostic services per 1000 registered patients within the practice per year was included as an independent variable (each year for a practice was included in the analyses separately). In the analyses for the specific patient groups, the number of specific services per 100 registered patients within the practice for the total 2006-2010 period was included. Services focusing on integrated care for chronic diseases were excluded from all analyses, as other measures to stimulate integrated care were introduced in the study period.

2.3.2. Dependent variable: referrals

Per patient per year (total patient population) or for each care episode (specific patient groups) it was determined whether a new referral had been issued in the

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specific year or in any of the contacts within the care episode. In the analysis of the total patient population, all new referrals to medical specialists were included, whereas in the analyses for the specific patient groups only new referrals to medical specialists to whom patients were most likely to be referred were included (see Table 2). Referral was included as dichotomous variable (0/1).

2.3.3. Covariates: patient and practice characteristics

Patient and practice characteristics were determined per patient or practice per year. Patient characteristics included age (categorised), gender, morbidity and distance to secondary care services. Morbidity was defined as the number of chronic diseases in a year, and was based on a list of chronic diseases used by the Dutch National Institute for Public Health and the Environment [19]. Distance to the closest secondary care service (including hospitals, outdoor departments and independent clinics) by road was assessed on the basis of postal codes. For a patient, the distance to the closest secondary care service might influence GPs' referral behaviour, since GPs might be more reluctant to refer patients living further away from secondary case services, or patients living near secondary care services may more strongly insist on a referral [9]. Practice characteristics included workload, guideline adherence, presence of a primary care nurse and type of practice. Workload in general practice might positively influence referral rates to secondary care, since referral of patients will generally lead to a lower workload [20]. Workload was defined as the number of face-to-face contacts of GPs in the practice divided by the number of registered patients within the practice. Guideline adherence was based on 16 guideline adherence indicators, in turn based on clinical guidelines [21], [22] and [23]. These condition-specific guidelines comprise a range of recommendations and considerations that are related to each other and that are often ordered in a decision tree. Quality indicators were developed based on the key recommendations that were easy to extract from EMRs. Previous research showed that guideline adherence indicators related to referrals are generally more often followed than guideline adherence indicators related to prescription, and therefore we differentiated between indicators related to prescription and referrals [23].The mean adherence is calculated per indicator per practice per year. The average of all indicators for guidelines related to referrals or prescriptions is calculated per practice per year and included as covariance in the analyses. The presence of a primary care nurse was determined per practice per year. Primary care nurses are predominantly involved in care for chronically ill patients. They are expected to improve care for chronically ill patients and to reduce GP workloads and thereby prevent referrals to secondary care [24]. Practice type was distinguished between 1) single-handed-, 2) duo-, 3) group practice or health centre. Practice type has been shown to influence referral rate, with lower referral rates within group practices or health centres [25].

2.4. Statistical analyses

The association between therapeutic and diagnostic services and referral behaviour for the total patient population was analysed by logistic multilevel regression analysis, using a model with three-levels, since the data is hierarchically structured (measurements in each year nested within patients and patients nested within general practices). Multilevel analysis corrects for the cluster effect of hierarchically

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structured data. Variation between practices can vary between years, and therefore practice variation on the intercept was estimated for each year separately. On patient level, we estimated variation on the intercept for all years together. [26]. For the specific patient groups, we performed logistic multilevel regression analyses with a three-level model due to hierarchically structured data (care episodes nested within patients and patients within general practices). Variation on the intercept was estimated across years at both practice and patient level, since some practices had too few patients per year to estimate variation per year. For patient groups where less than 30% of patients had two or more care episodes, care episodes were only nested within practices (two-level hierarchical structure).
All analyses were performed using MLwiN 2.25 (IGLS estimation; 1st order PQL). All analyses were adjusted for patient and practice characteristics across years. To correct for multiple testing, the significance level was set at $p < 0.01$.

3. RESULTS

3.1. Descriptive figures: patient and practice characteristics

Table 3 shows the patient and practice characteristics of the total patient population. Half the patients were female, the mean age was 38.8 years (SD:22.3), 25.7% of the patients had one or more chronic diseases and on average 15.8% of the patients were referred to a medical specialist per year. On average GPs had 2.6 (SD:0.4) face-to-face contacts per registered patient (workload) and 135 (IQR:82-200) therapeutic and diagnostic services were performed per 1000 registered patients per year. Adherence to guideline indicators related to referrals was higher than adherence to guideline indicators related to prescriptions (90.1% vs. 57.4 %). A primary care nurse was working in three quarters of the practices.

[TABLE 3]

3.2. Effect of therapeutic and diagnostic services and referral rate in total patient population

The number of therapeutic and diagnostic services performed was not associated with the number of referrals to specialist care (Table 4), so, it did not matter for the chance of referral whether a high or low number of therapeutic and diagnostic services were performed within a general practice. In contrast, patient characteristics strongly influenced the chance of referral: being female, being older and having more chronic diseases was positively associated with referrals to specialist care. Of the practice characteristics both a higher adherence to guideline indicators related to referrals and having a duo practice were negatively associated with referrals.

[TABLE 4]

3.3. Association between therapeutic and diagnostic services and referral rate for specific patient groups

Looking in more detail at the impact of services for specific patient groups for which these services are commonly performed, revealed only an association of services in

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two patient groups (Table 5). For patients with 'other peripheral arterial disease', the number of Doppler diagnostic tests was positively associated with referrals to internal medicine, dermatology, neurology, surgery or orthopaedics. The number of minor surgery services for patients with 'sebaceous cyst' was negatively associated with referrals to (plastic) surgery or dermatology. It is important to note that patients for whom a therapeutic or diagnostic service was performed, could still be referred to a medical specialist.

[TABLES 5]

The associations between patients characteristics and referral rates were not equal across all patient groups and services. Variation in patient characteristics was mostly due to a selection of patient groups (for example age with diabetes mellitus) or to characteristics not contributing to the decision to be referred (for example chronic diseases with surgery). In general, the associations between practice characteristics and referrals were similar. In 80% of the patients groups, a higher adherence to guidelines regarding referrals was associated with fewer referrals to medical specialists, and in 35% of the patient groups, having a duo practice was associated with fewer referrals. Other practice characteristics were rarely associated with referral rates.
The referral percentage of patients for whom a service was performed ranged from 0.8% for 'minor surgery' for patients with lacerations/cuts to 35.9% for 'services to replace specialists visit' for patients with a naevus/mole.

4. DISCUSSION

This study showed that the total number of therapeutic and diagnostic service performed within general practice in the Netherlands was not associated with the referral behaviour of these GPs. For the vast majority of services performed within general practice for specific patient groups no association was found. A lower referral rate was found for one service (minor surgery) for one of the three investigated patient groups investigated. A higher referral rate was found for Doppler diagnostic tests for patients with other peripheral arterial disease.
Previous research has shown inconsistent results with respect to the effect of extra services performed within primary care on referrals to medical specialists [13], [14], [15] and [16]. We found a negative association for minor surgery services within general practice and referrals for patients with sebaceous cysts, in accordance with previous research [14], although, to prevent one referral approximately six minor surgery services need to be performed.
We did not find an association between the number of therapeutic and diagnostic services performed within general practice and the referral behaviour of GPs. A reason for the lack of substitution potential may be found in preconditions for substitution that are currently not met. Substitution of primary health care for secondary care requires: i) a selection of medical specialist services manageable in general practice agreed by both GPs and medical specialists, ii) GPs who are able to properly perform services, iii) the right incentives for both GPs and medical

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specialists, and iv) patients who trust GPs to perform these services rather than demanding an encounter with a medical specialist [27]. Diagnostic services such as lung function tests and Doppler diagnostic tests may not represent services that prevent a referral, since these services could reveal morbidity that is not treatable by GPs and could therefore be the reason for a referral [28]. In accordance, we found that 22% of the patients for whom a Doppler diagnostic test was performed within general practice were referred to a medical specialist. This could explain the lack of association for diagnostic services, but not for therapeutic services such as therapeutic injection and postoperative consultation. For substitution to evolve, GPs should also execute services, so that patients need not be referred after a service has been performed by a GP.

Incentives for both GPs and medical specialists need to be aligned so as to motivate both GPs and medical specialists to substitute primary care for secondary care. Potentially negative financial consequences for either GPs or medical specialists could prevent secondary health care from being substituted by primary care, as it could harm the relationship between both types of physicians. In the Netherlands, specialist care is remunerated on a diagnosis-related group based payment, with an incentive for substitution from primary care to secondary care, the opposite of the desired transfer. In order to support the process of substitution from secondary to primary care, financial incentives between GPs and medical specialists should be aligned.

Finally, substitution requires patients to trust GPs in performing the therapeutic and diagnostic services. When patients lack trust in GPs, they may request a referral to a medical specialist for reassurance or a second opinion. Other research has shown that patients in particular put pressure on GPs for referral in order to seek reassurance [29] and [30].

4.1. Strengths and limitations

Our study was based on a large dataset with GP data on consultations, morbidity, prescriptions and referrals based on EMR, which enabled us to analyse the association between the number of therapeutic and diagnostic services and referrals to medical specialists for different services and for specific patient groups. A number of issues should be considered. First, data was only available for services for which money was claimed. GPs might perform more services without claiming the fee. This could have affected our results in both directions. Further, the severity of the care episodes was not known and could also have influenced the results. We tried to solve this by determining the effect of therapeutic and diagnostic services at practice level and setting a minimum of 30 care episodes per practice. As only cross-sectional analyses were performed, no conclusion can be drawn regarding causality. It might be that increasing the number of specific services within a practice could affect the referral behaviour of GPs. However, analysing the effect of an increase in the total number of services within a practice on GPs' referral behaviour (this was not possible for specific services) did not show a substitution effect (OR:1.00; 95%CI:1.00-1.00). We adjusted for multiple testing with a relatively mild correction. Using a more conservative correction (Bonferroni method) only showed a significant negative association for the number of minor surgery services for patients with 'sebaceous

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cysts'. Finally, both increases and decreases in the number of referrals could be beneficial for patients. We did not take into account the quality of care or health outcomes. This should be addressed in future research.

4.2. Policy implications

The number of total therapeutic and diagnostic services is not associated with the referral behaviour of GPs in the Netherlands. This implies that general practices that increasingly perform more of these services do not necessarily refer fewer patients to medical specialists. The M&I services represent a diverse group of therapeutic and diagnostic services, of which the increasing numbers of some services might reduce referrals to medical specialists, although we did not find such. How should health policy deal with these results? Health policy makers should address the preconditions for substitution, such as alignment of incentives (for example integrated tariffs), facilitation of the process of agreement on substitutable services between GPs and medical specialists, and patient trust. Alternatively, instead of focusing on increasing the number of these services, health policy makers could put more emphasis on other measures to decrease referrals to medical specialists, by for example, support for GP decisions based on EMR data or regular specialist outreach services that could prevent referrals and could be used for learning purposes for GPs [4] and [31].

Competing interests

The authors declare that they have no competing interests.

Authors' contribution

CD, JK, JJ en DH were involved in the conception of the research question. CD and BK performed the analyses. All authors had full access to all the data and contributed to the interpretation of the data. CD drafted the manuscript, which was reviewed by all authors. All authors read and approved the final manuscript.

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TABLES

Table 1.: Number of general practices and patients included in the analyses for all considered years.

	2006	2007	2008	2009	2010	Total
General practices	33	39	40	24	30	70
Patients	138,993	151,488	151,932	98,167	110,509	651,089

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Table 2. : Therapeutic and diagnostic services with corresponding patient groups and referral specialty in secondary care.

Service	**Patient groups (ICPC)**	**Specialty in secondary care**
Diagnostic services		
Audiometry	Hearing complaint (H02)	ENT
	Tinnitus, ringing/buzzing ear (H03)	
	Presbyacusis (H84)	
	Deafness (H86)	
Doppler diagnostic test	Hypertension uncomplicated (K86)	Internal medicine
	Other peripheral arterial disease (K92)	Dermatology
	Leg/thigh symptom/complaint (L14)	Neurology
	Diabetes mellitus (T90)	Surgery
		Orthopaedics
Lung function test (spirometry)	Shortness of breath/dyspnoea (R02)	Pulmonary medicine
	Cough (R05)	
	Chronic obstructive pulmonary disease (R95)	
	Asthma (R96)	
ECG-diagnostics (performance of ECG, interpretation and discussion of results with patient)	Chest symptom/complaint (L04)	Internal medicine
	Palpitations/awareness of heart (K04)	Cardiology
	Hypertension uncomplicated (K86)	
	Diabetes mellitus (T90)	
Blood pressure test within 24 hours	Elevated blood pressure (K85)	Internal medicine
	Hypertension uncomplicated (K86)	Cardiology
	Hypertension complicated (K87)	
	Diabetes mellitus (T90)	
Arrhythmias$	Palpitations/awareness of heart (K04)	Cardiology
Therapeutic services		

Service	Patient groups (ICPC)	Specialty in secondary care
Minor surgery	Laceration/cut (S18)	Plastic surgery
	Neoplasm skin benign/unspecified or naevus/mole (S79 en S82)	Surgery
	Sebaceous cyst (S93)	Dermatology
Postoperative consultation including removing suture material	Laceration/cut (S18)	Plastic surgery
	Malignant neoplasm of skin (S77)	Surgery
	Naevus/mole (S82)	Dermatology
Service to replace specialists visit	Rheumatoid/seropositive arthritis (L88)	All
	Anaemia, Vitamin B12/folate deficiency (B81)	
	Malignant neoplasm prostate (Y77)	
Therapeutic injection (Cyriax)	Shoulder symptom/complaint (L08)	Orthopaedics
	Shoulder syndrome (L92)	
	Tennis elbow (L93)	
	Musculoskeletal disease, other (L99)	

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Table 3.: Patient and practice characteristics.

	2006-2010
Patient characteristics (651,089 patient years)	
Gender (% female)	50.4%
Age	
0-14 years	17.8%
15-24 years	12.4%
25-44 years	28.2%
45-64 years	27.7%
65-74 years	7.7%
75 or older	6.2%
Chronic diseases	
No chronic disease	74.3%
1 chronic disease	18.8%
2 chronic diseases	4.9%
3 or more chronic diseases	2.1%
Distance to secondary care services (km)#	4 (1-12)
Referral (% patients)	15.8%
Practice characteristics (166 practice years)	
Workload (nr. face-to-face contacts/patient)$	2.57 (0.35)
Therapeutic and diagnostic services per 1000 patients#	135 (82-200)
Referrals per 1000 patients$	186 (57.1)
Adherence to guideline indicators prescription $	57.4% (5.3)
Adherence to guideline indicators referrals$	90.1% (4.3)
Primary care nurse	75%
Practice type	
Single-handed	30%
Duo	19%
Group/health centre	51%

median (interquartile range); $ mean (standard deviation)

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Table 4.: Logistic multilevel regression analysis on effects of therapeutic and diagnostic services on referrals to medical specialists in general population, 2006-2010.

	Referral to medical specialists OR (95% CI)
Gender (reference male)	1.30 (1.28-1.31)*
Age (reference 0-14 years)	
15-24 years	1.05 (1.02-1.09)*
25-44 years	1.39 (1.36-1.43)*
45-64 years	1.63 (1.59-1.67)*
65-74 years	1.82 (1.77-1.88)*
75 or older	1.70 (1.64-1.76)*
Chronic diseases (reference no)	
1 chronic disease	2.21 (2.17-2.25)*
2 chronic diseases	3.29 (3.20-3.38)*
3 or more chronic diseases	4.56 (4.38-4.75)*
Distance to secondary care services (km)	1.00 (1.00-1.00)
Workload (nr. face-to-face contacts/patient)	1.14 (0.98-1.32)
Therapeutic and diagnostic services per 1000 patients	1.00 (1.00-1.00)
Adherence to guideline indicators prescription	1.01 (1.00-1.02)
Adherence to guideline indicators referrals	0.96 (0.95-0.97)*
Primary care nurse	1.10 (0.98-1.23)
Practice type (reference single-handed)	
Duo	0.81 (0.70-0.93)*
Group/health centre	0.86 (0.77-0.97)

CI: confidence interval;*p < 0.01; #association: 0.9994 (95%CI:0.9988-1.0000)

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Table 5. :Logistic multilevel regression analyses on effect of therapeutic and diagnostic services on referrals to medical specialists in specific patient groups (individually estimated), 2006-2010[$,#].

Service	**Patient groups (ICPC)**	**Number of practices/patients**	**Referral to medical specialists OR (95%CI) services per 100 care episodes**	**Referral percentage of patient with service**
Diagnostic services				
Audiometry	Hearing complaint (H02)	43/4,533	1.00 (0.98-1.01)	25.5
Doppler diagnostic test	Hypertension uncomplicated (K86)	70/60,678	1.17 (1.01-1.36)	23.7
	Other peripheral arterial disease (K92)	34/2,637	1.04 (1.01-1.06)*	28.6
	Leg/thigh symptom/complaint (L14)	61/10,977	1.01 (0.95-1.07)	17.6
	Diabetes mellitus (T90)	70/30,168	1.01 (0.99-1.03)	20.8
Lung function test (spirometry)	Shortness of breath/dyspnoea (R02)	54/6,209	0.98 (0.96-1.00)	4.8
	Cough (R05)	70/32,100	0.93 (0.86-1.00)	3.7
	Chronic obstructive pulmonary disease (R95)	62/10,288	1.00 (1.00-1.01)	5.9
	Asthma (R96)	70/24,086	1.00 (0.99-1.01)	2.2
ECG-diagnostics (performance of ECG, interpretation and discussion of results with patient)	Chest symptom/complaint (L04)	66/15,462	1.03 (0.99-1.07)	6.7
	Palpitations/awareness of heart (K04)	51/5,469	0.99 (0.97-1.01)	8.6
	Hypertension uncomplicated (K86)	70/60,687	1.00 (0.98-1.03)	10.5

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Service	**Patient groups (ICPC)**	**Number of practices/patients**	**Referral to medical specialists OR (95%CI) services per 100 care episodes**	**Referral percentage of patient with service**
	Diabetes mellitus (T90)	70/30,168	0.99 (0.98-1.01)	8.7
Blood pressure test within 24 hours	Elevated blood pressure (K85)	57/9,448	1.03 (1.00-1.06)	2.3
	Hypertension uncomplicated (K86)	70/60,687	1.01 (0.99-1.03)	4.3
	Hypertension complicated (K87)	42/8,821	1.03 (0.99-1.07)	6.4
	Diabetes mellitus (T90)	70/30,168	1.02 (0.99-1.04)	7.5
Arrhythmias	Palpitations/awareness of heart (K04)	51/5,469	0.99 (0.96-1.02)	6.6
Therapeutic services				
Minor surgery	Laceration/cut (S18)	64/12,698	0.99 (0.96-1.01)	0.8
	Neoplasm skin benign/unspecified or naevus/mole (S79 en S82)	69/18,433	0.99 (0.97-1.00)	3.0
	Sebaceous cyst (S93)	60/7,238	0.98 (0.97-0.99)*	2.8
Postoperative consultation including removing suture material	Laceration/cut (S18)	64/12,698	1.01 (0.96-1.06)	0.8
	Naevus/mole (S82)	57/8,461	1.02 (0.93-1.12)	35.9
Service to replace specialists visit	Rheumatoid/seropositive arthritis (L88)	31/2,419	1.00 (0.95-1.04)	4.3
Therapeutic injection (Cyriax)	Shoulder symptom/complaint (L08)	67/14,679	1.02 (0.99-1.05)	8.5
	Shoulder syndrome (L92)	60/9,943	1.00 (0.99-1.01)	7.5

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Service	Patient groups (ICPC)	Number of practices/patients	Referral to medical specialists OR (95%CI) services per 100 care episodes	Referral percentage of patient with service
	Tennis elbow (L93)	45/4,044	1.01 (0.98-1.04)	5.1
	Musculoskeletal disease, other (L99)	69/20,058	1.01 (0.99-1.02)	5.5

CI: confidence interval; [$]adjusted for gender, age, chronic diseases, distance to secondary care services, workload, guideline adherence, presence primary care nurse and practice type; [#]associations between patient and practice characteristics and referral rates are available under request by the first author; [*]$p < 0.01$

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