Influences of rurality on action to diagnose cancer by primary care practitioners– results from a Europe-wide survey in 20 countries

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FUNDING

The study on how practicing in a rural setting may impact upon primary care practitioners, access to tests, investigative decisions and attitudes to cancer diagnosis has received no external funding.

HIGHLIGHTS

- Rural cancer patients are repeatedly demonstrated to have poorer cancer outcomes than urban counterparts.
- In this study we report data from 1,779 representative primary care practitioners from across Europe.
- The study finds compelling evidence that, across Europe, rural primary care practitioners have less direct access to cancer investigations.
- However, the study also finds that rural primary care practitioners across Europe do not delay diagnostic action for patients with potential cancer symptoms compared to their urban counterparts.
- Together the results strongly suggest that health service structure and provision, rather than physician behaviour, is a much more likely source of rural cancer inequality.

ABSTRACT

Background

Rural-dwellers have poorer cancer outcomes than urban counterparts, for reasons which are unclear. At healthcare institution level, poorer access to investigations and different clinical decision-making by rural primary healthcare practitioners (PCPs) could be important.

Aim

To compare access to investigations, attitudes to cancer diagnosis and clinical decision-making between rural and urban PCPs.

Setting

A vignette-based cross-sectional survey of rural and urban PCPs in 20 European countries.

Methods

Data on PCPs' decision-making and attitudes to cancer diagnosis were based on clinical scenarios. Comparisons were made using tests of proportion, univariable and multivariable binary logistic regression.

Results

Of the 1,779 PCPs completing the survey 541 (30.4%) practiced rurally. Rural PCPs had significantly less direct access to all investigative modalities: ultrasound; endoscopy; x-ray and advanced screening (all $p<0.001$). Rural PCPs were as likely as urban PCPs to take diagnostic action (investigation and/or referral) at the index consultation in all four clinical vignettes ((OR, 95% CI) for lung: 0.90, 0.72-1.12; ovarian: 0.95, 0.75-1.19; breast: 0.87, 0.69-1.09; colorectal: 0.98, 0.75-1.30). Rural PCPs were less likely to refer to a specialist at the index consultation for ovarian cancer (OR 0.71 95% CI 0.51-0.99). Rural PCPs were significantly more likely to report that their patients faced barriers to accessing specialist care, but practitioners did not report greater difficulties making specialist referral than their urban counterparts

Conclusions

European rural PCPs report poorer access to investigations but are at least as likely as urban PCPs to investigate or refer patients that might have cancer at the index consultation.

Abstract Word Count: 250 words

INTRODUCTION

Rural-dwellers have poorer cancer outcomes compared to city-dwellers but underlying mechanisms are poorly understood.[1]. Poorer rural cancer outcomes are important socially and economically since 24% of Europeans live rurally.[2] Evidence for poorer rural cancer outcomes has accumulated over thirty years.[3]. A 1990 case-control study found poorer case-survival rates in non-metropolitan South Australians after adjusting for disease stage.[4]. In 2000, a Scottish analysis of 63,976 people diagnosed from 1991-1995 found that increasing distance from cancer centres was associated with poorer survival for prostate and lung cancer.[5] A Scottish study based on 12,339 people diagnosed with common cancers found lower one-year survival among those living more than 60 minutes from a cancer centre.[6] More recently, a study of 737,495 people diagnosed with cancer in England between 2006 and 2010 reported that those living more than 30 minutes from their GP were more likely to have an emergency presentation and less likely to have screen-detected cancer.[7] Studies of a Danish national cohort of 256,662 cancer patients diagnosed between 2005 and 2016 found that increased distance to hospital was associated with longer diagnostic intervals and later stage for harder to diagnose cancers.[8,9]

A recent systematic review reported that, of 39 observational studies from seven countries, most showed poorer outcomes for rural patients with cancer.[1] Narrative synthesis of the data suggested that inequities can exist at the levels of: the individual patient (their demographics and behavioural risk factors); healthcare institutions; urban/rural community environments and culture; and at the level of health policy and service organisation.[1] At a healthcare institutions level, rural communities could have fewer and less specialised healthcare practitioners, with more limited access to investigations.[1]

Most Europeans with potential cancer symptoms present first to a primary care practitioner (PCP) whose decision-making and diagnostic actions will influence the subsequent promptness of cancer diagnosis.[10] It seems plausible that geographical setting could influence PCPs' diagnostic decision-making when faced with patients who might have cancer. However, we could identify no studies, explicitly comparing attitudes to primary care cancer diagnosis and decision-making intentions between urban and rural PCPs.

The Örenäs Research Group is a is a European group of primary care researchers that studies the primary care factors that relate to cancer survival. A trans-European collaboration that surveyed PCPs in 20 different European countries [11] gathered data from PCPs in rural and urban settings on their access to investigations, attitudes and decision-making around cancer diagnosis in primary care. This gives the opportunity to explore whether these factors differ significantly between rural and urban European PCPs.

METHODS

Objectives

The objectives of this study were to:

1. Compare rural and urban PCPs' direct access to cancer investigations.
2. Compare likelihood that rural or urban PCPs will arrange investigations or referral at the index consultation for patients with potential cancer symptoms.
3. Compare attitudes of rural and urban PCPs to factors associated with cancer diagnosis in primary care.

Design and study setting

The study used data from a cross-sectional Örenäs Research Group electronic survey of PCPs in 20 European countries.[11]. Development and piloting of the survey has been previously described.[11] The survey comprised four sections, with Section 1 seeking demographic information including respondents' own assessment of their practices' geographical setting (urban, rural, island/remote and mixed). Section 2 sought information about availability of relevant investigations. Section 3 comprised four clinical vignettes describing symptomatic presentation by four patients, one each with symptoms suggestive of lung, colorectal, ovarian and breast cancer, and presented respondents with questions about their management decisions. Section 4 comprised twenty statements seeking respondents' attitudes to health system factors that might affect primary care cancer diagnosis.

Participants

Subjects were eligible for the survey if they were doctors working mainly in primary care. These doctors included general practitioners and other doctors with specialist training but working in the community and accessible directly by patients without referral.

Recruitment

An Örenäs Research Group member acted as national lead in each participating country and emailed survey invitations to PCPs in their areas, aiming to recruit at least 50 participants. Local leads with difficulty achieving required sample sizes increased the number of responses by using snowballing, a recognised technique for recruiting hard-to-reach populations in health studies.[12] Consent was implied by agreeing to take part.

Data management

Data were collected using SurveyMonkey (SurveyMonkey, California, USA). Anonymised data were extracted by MH and securely transferred to PM to be managed on a secure server at the Institute of

Applied Health Sciences, University of Aberdeen, UK. PM, RA and WK had access to the data in full compliance with institutional information governance and quality assurance policies.

Data and outcomes

The following data were extracted from the survey: country of origin; respondents' characteristics (years since graduation, gender); geographical setting of PCP's practice; access to investigations; management decisions based on four clinical vignettes; agreement with 20 statements reflecting attitudes to health service factors affecting primary care cancer diagnosis.[13] For each attitudinal statement 5-point Likert scale responses were combined into three categories: disagree; neither disagree or agree; and agree.

PCPs responding that they worked in an urban, rural or island/remote setting were included. For subsequent analysis, we combined rural and island/remote into a single rural variable. We excluded those practising in a mixed setting and those with missing values. Country of origin was recoded to designate participating countries using the Kringos classification which uses three dimensions to designate the strength of national primary care systems.[14] Access to individual investigations was re-categorized as access to ultrasound, endoscopy, x-ray and advanced scanning. Four composite binary variables, one for each vignette, were produced to indicate if responding PCPs would take diagnostic action (investigate directly, refer for investigation and/or refer to secondary care) following the index consultation in each vignette.

Statistical analysis

We compared rural versus urban PCPs by personal characteristics, country and Kringos categories using descriptive statistics and the Chi-squared test. We then compared self-reported direct access to investigative modalities (ultrasound, endoscopy, x-ray and advanced scanning), overall intention to take diagnostic action, and intention to refer to secondary care at the index consultation in each clinical vignettes using the Chi-squared test. Unadjusted odds that rural PCPs would take diagnostic action or refer to secondary care at each index consultation were compared to those for urban PCPs, using univariable binary logistic regression. Subsequent multivariable analysis was used to estimate the odds ratios with adjustment for gender, years since graduation, Kringos classification[14] and direct access to relevant investigations. Because the proportions of rural respondents varied between countries a sensitivity analysis adjusted for country rather than Kringos category was conducted.[14] Urban and rural PCPs' level of agreement with 20 attitudinal statements about health service factors were compared using the chi-squared test for trend. To allow for multiple comparisons a simple Bonferroni correction (0.05/number of tests) was used where five or more tests were conducted.[15]

RESULTS

The survey was completed by 2,086 PCPs from 20 European countries. 1238 (59.3%) practiced in an urban setting, 485 (23.3%) in a rural setting, 56 (2.7%) in a remote or island setting, 295 (14.1%) in a mixed setting, with 12 (0.6%) missing values. The sample for this analysis described in Table 1 comprised 1,779 individuals of whom 541 (30.4%) were considered rural. Rural PCPs were 47.2% male compared to 34.0% of urban respondents (p<0.001) and rural PCPs were significantly more likely to be qualified for longer (p<0.001) but no more likely to be qualified in another specialty. After excluding PCPs who stated that their geographical location was 'mixed', the proportion of rural PCPs ranged from 1.8% of French respondents to 71.4% of Swiss respondents (p<0.001). Using the Kringos classification urban respondents were significantly more likely to practice in a strong primary care system (46.4% versus 39.7%, (p<0.001)).[14]

Rural PCPs reported significantly less direct access to each of the four investigative modalities (all p<0.001) (Table 2). The largest difference was for endoscopy, with 923 (74.6%) of urban respondents reporting direct access compared to 312 (57.7%) of rural respondents. (Table 2).

The odds of rural PCPs intending diagnostic action (investigation and/or referral) at the index consultation was not significantly different from the odds of urban PCPs intending diagnostic action for any of the four vignettes following adjustments for gender, years since graduation, Kringos classification and direct access to relevant investigations. (Table 3). In sensitivity analysis, adjusting for country rather than Kringos system, there were no significant differences between rural and urban PCPs in intended diagnostic action. (Supplementary table)

The proportion of rural PCPs intending specialist referral at the index consultation, and the odds (unadjusted and adjusted) of specialist referral by rural PCPs did not differ significantly from Urban PCPs for the lung or breast vignettes. A significantly lower proportion of urban PCPs intended to refer in the colorectal vignette (71.4% vs 78.9%, p<0.001) but the odds of referral by rural PCPs were not significantly greater following adjustment (OR 1.30 (95% CI 0.97-1.76). Rural PCPs, however, appeared significantly less likely to refer in the ovarian vignette following adjustment (OR 0.71 (95% CI 0.51-0.99) (Table 4). In sensitivity analysis, adjusted for country rather than Kringos system, there were no significant differences in referral intentions of rural or urban PCPs. (Supplementary table)

The comparison of PCPs attitudes is shown in Table 5. More Rural PCPs agreed that referrals were welcome and could be made to specialists they knew. More rural PCPs agreed that their patients had

greater travelling and costs for to see a specialist, but that costs were met by insurance companies. Rural PCPs indicated lower access to fast-track referral pathways but a greater ability for patients to self-refer to specialists. Rural PCPs more often agreed they had more time to think within consultations and were less likely to refer to reduce workload than urban PCPs. There were no important differences between urban and rural PCPs in attitudes to cost versus quality within the healthcare systems.

DISCUSSION

Main findings

Rural PCPs were more likely to be male and to have been qualified for longer. They were less likely to have had direct access to all investigative modalities. Rural PCPs were just as likely to intend diagnostic action at the index consultation as urban counterparts and were as likely indicate that they would refer in three of the four clinical vignettes. Rural PCPs perceived easier access to specialist referral and advice and being under less pressure than urban counterparts. Rural PCPs were more likely to agree that their patients had more travel and greater cost to be investigated for potential cancer.

Comparison with other literature

There is some evidence that PCPs are aware of the characteristics of the health system and their individual practice or clinic context when making diagnostic decisions.[13,16]. However, we found similar diagnostic and referral intentions by rural and urban PCPs in keeping with a New Zealand government report that rural and urban GPs had similar referral rates.[17]. Our data contradicts a previous survey amongst 100 Tasmanian GPs, where rural respondents believed distance from cancer centres influenced patient management and a social survey in 1,603 Norfolk residents partly attributing fewer out-patient attendances by rural-dwellers to the influence of access to GP behaviour.[18,19]. Neither study measured actual PCP intentions as we have. While both of these studies were cited as potentially explanatory by a recent large English study reporting delayed cancer diagnosis in rural patients, our data are more current and comprehensive, and downplay differential GP referral practices as a root cause of rural cancer inequality.[7] On the other hand Canadian researchers found inter-provincial variation in direct GP access to investigations for potential cancer, and suggested this could influence GPs' behaviour and the relative speed of patients' diagnostic work-up, a possibility we cannot exclude.[20] Rural GPs are also significantly more likely to undertake primary excision of suspicious skin lesions that subsequently prove to be melanoma, a cancer not explored in this study, and which may be influenced by travel-burden and access issues.[21]

Strengths and limitations

This study provides the first trans-European evidence on how healthcare institution factors could influence rural cancer outcomes. The study is large and diverse, including responses from 20 European countries, and controlling for the range of international healthcare-service delivery models, including those with strong, medium and weak traditions of primary care.[14] One third of the sample were rural practitioners, close to the proportion of Europe's population living rurally. The data were collected using a robust and carefully developed survey instrument enabling the first meaningful and large-scale comparison of geographical variation in PCPs attitudes and decision-making for patients with symptoms that could be due to cancer.

Respondents were asked to self-designate the geographical location of their practice, as there is no Europe-wide classification of rurality and concepts of rurality may differ across Europe. The proportion of urban versus rural respondents varied considerably between responding countries. This may reflect differing levels of urbanization in responding countries but may be related to the "snowball" recruitment methods used in some participating countries. We included Kringos classification as a co-variate in adjusted analyses, and a sensitivity analysis using country as a covariate did not alter the main results. Respondents practicing in "mixed" geographical settings (n=295, 14% of all respondents) were excluded from the analysis. Clinical decision-making comparisons were made using vignettes; while these may not be representative of "real-world" decisions, the vignettes were rigorously developed using evidence-based methodology.[22] Vignettes were used successfully in an earlier study of primary care physicians' behaviour conducted in Nova Scotia Canada, where the stated referral decisions of 225 doctors in response to hypothetical scenarios correlated well with referral data for similar cases obtained from health services and insurance records.[23] Furthermore, a meta-analysis of 111 vignette-based studies demonstrated further close concordance with participants' observed behaviour.[24] The data were collected in 2016 and it is likely that national health systems have continued to evolve in the intervening period, possibly including geographically-focussed re-structuring.

Implications

The finding that rural GPs throughout Europe have less direct access to investigations for patients with suspected cancer is important. Policy-makers need to be able to reduce this disparity if they are to reduce inequalities in the diagnosis of cancer in rural-dwellers. Improving access to medical investigations offers an exciting service design challenge (e.g. point-of-care testing). The finding that rural PCPs perceive greater barriers in terms of travel, cost and provision for their patients highlights that rural European PCPs are key stakeholders in future research and policy to improve outcomes for

their patients who have cancer. Rural PCPs have experienced and reflected on the challenges faced by their patients and this will be key in informing how to research and improve rural cancer issues. Importantly, rural PCPs appear to be no less likely to make secondary care referrals for patients that might have cancer. This contradicts speculation that rural PCPs are influenced by geography when making cancer diagnostic decisions, a concern that has been widely voiced and perceived as a potential mechanism for rural cancer inequalities. This large and diverse sample provides strong evidence that, when consulted by patients that might have cancer, rural PCPs' investigative instincts and decision-making are not blunted by their geographical location. There are dual caveats to interpreting the study. First, there are differing proportions of rural practitioners in the constituent national samples. Second, economic and topographical considerations mean that rurality will likely impact healthcare in different ways in different European countries. Whilst adjustments have been made to account for this in the current analysis, future collaborative research could be mutually instructive to practitioners and policy makers alike by comparing and contrasting the mechanisms by which rurality impacts cancer care across Europe.

Conclusions

Rural PCPs throughout Europe report poorer access to investigations for potential cancer than Urban PCPs and perceive greater cost, travel and access barriers for their patients. However, rural PCPs across Europe are just as likely to refer or investigate patients that might have cancer at the index consultation as their urban colleagues.

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DECLARTION OF INTERESTS

PM, WK, RA, ME, ES, DP, HT, PV, DM and MH have no competing interests to declare.

ETHICAL APPROVAL

Consent by the participating PCPs was implied by agreeing to take part in the survey.

Ethical approval for the study has been given by the University of Bath Research Ethics Approval Committee for Health (approval date: 24th November 2014; REACH reference number: EP 14/15 66; UK National Health Service ethical approval is not required).

Table 1: *Description of the 1,779 respondents to European survey on cancer diagnostics - 1238 urban vs 541 rural/island primary care physicians*

		Urban n (%)	Rural n (%)
GENDER	**Female**	812 (66.0)	282 (52.8)
	Male	419 (34.0)	252 (47.2)
	Not Stated	7	7
	Total	1238	541
			P<0.001[1]
YEARS SINCE GRADUATION	**Less than 10**	220 (17.9)	47 (8.7)
	10 to 19	315 (25.6)	156 (29.0)
	20 to 29	357 (29.0)	174 (32.3)
	30 to 39	292 (23.7)	142 (26.4)
	40 or more	47 (3.8)	19 (3.5)
	Prefer not to say	7	3
	Total	1238	541
			P=0.003[2]
TRAINED IN GP AND ANOTHER SPECIALTY	**Yes**	93 (7.5)	36 (6.7)
	No	1145 (92.5)	505 (93.3)
	Total	1238	541
			P=0.588[1]
COUNTRY	**Bulgaria**	44 (3.6)	5 (0.9)
	Croatia	31 (2.5)	23 (4.3)
	Denmark	68 (5.5)	14 (2.6)
	England	28 (2.3)	14 (2.6)
	Finland	56 (4.5)	6 (1.1)
	France	54 (4.4)	1 (0.2)
	Germany	61 (4.9)	42 (7.8)
	Greece	20 (1.6)	34 (6.3)
	Israel	66 (5.3)	9 (1.7)
	Italy	31 (2.5)	24 (4.4)
	Netherlands	55 (4.4)	56 (10.4)
	Norway	50 (4.0)	15 (2.8)
	Poland	108 (8.7)	12 (2.2)
	Portugal	44 (3.6)	7 (1.3)
	Romania	108 (8.7)	60 (11.1)
	Scotland	21 (1.7)	19 (3.5)
	Slovenia	44 (3.6)	31 (5.7)
	Spain	302 (24.4)	99 (18.3)
	Sweden	29 (2.3)	25 (4.6)

	Switzerland	18 (1.5)	45 (8.3)
	Total	1238	541
			P<0.001[3]
KRINGOS CLASSIFICATION	**Strong**	574 (46.4)	215 (39.7)
Strength of national primary care system	**Medium**	503 (40.6)	255 (47.1)
	Weak	64 (5.2)	39 (7.2)
	Unclassified	97 (7.8)	32 (5.9)
	Total	1238	541
			P=0.007[3]

[1]Chi-squared test with continuity correction

[2] Chi-squared test for trend

[3] Pearson's Chi-squared

Note: Responses of "Prefer not to say" and "Not stated" were excluded from statistical analysis

Table 2: *Direct access to investigations by urban vs rural primary care physicians in European survey on cancer diagnostics*

	Direct access available to PCP	Urban	Rural	P value[1]
ULTRASOUND	**Yes**	1176 (95.0)	480 (88.7)	
	No	62 (5.0)	61 (11.3)	**P<0.001**[1]
ENDOSCOPY	**Yes**	923 (74.6)	312 (57.7)	
	No	315 (25.4)	229 (42.3)	**P<0.001**[1]
X-RAY	**Yes**	1175 (94.9)	482 (89.1)	
	No	63 (5.1)	59 (10.9)	**P<0.001**[1]
ADVANCED SCANNING	**Yes**	825 (66.6)	279 (51.6)	
	No	413 (33.4)	675 (48.4)	**P<0.001**[1]

[1] Chi-squared test with continuity correction

TABLE 3: *Comparison of rural and urban PCPs' stated diagnostic actions (investigation or referral) at index consultation for each of the four clinical vignettes*

		Action taken n (%)	No action taken n (%)	Unadjusted OR (95% CI) rural vs urban	Adjusted OR (95% CI) rural vs urban[1]
Lung Cancer	**Urban**	682 (55.1)	556 (44.9)		
	Rural	301 (55.6)	240 (44.4)	1.02 (0.83-1.25)	0.90 (0.72-1.12)[1]
Ovarian Cancer	**Urban**	689 (55.7)	549 (44.3)		
	Rural	319 (59.0	222 (41.0)	1.15 (0.93-1.41)	0.95 (0.75-1.19)[1]
Breast Cancer	**Urban**	725 (58.6)	513 (41.4)		
	Rural	318 (58.8)	223 (41.2)	1.01 (0.82-1.24)	0.87 (0.70-1.09)[1]
Colorectal Cancer	**Urban**	980 (79.2)	258 (20.8)		
	Rural	431 (79.7)	110 (20.3)	1.03 (0.80-1.33)	0.98 (0.75-1.30)[1]

[1] Adjusted for gender, years since graduation, Kringos classification, direct access to relevant investigations

TABLE 4 : *Specialist referral made by those taking diagnostic action at index consultation for each of the four clinical vignettes (rural vs urban) including unadjusted and adjusted odds that diagnostic action at index consultation is specialist referral (rural vs urban)*

		Referred to a specialist n (%)	Not referred n (%)	Unadjusted OR (95% CI) rural vs urban	Adjusted OR (95% CI)[1] rural vs urban
Lung Cancer (n=983)	**Urban**	151 (22.1)	531 (77.9)		
	Rural	78 (25.9)	222 (74.0)	1.23 (0.90-1.69)	1.12 (0.75-1.68)[1]
Ovarian Cancer (n=1008)	**Urban**	280 (40.6)	409 (59.4)		
	Rural	116 (36.4)	203 (63.6)	0.84 (0.64-1.10)	0.71 (0.51-0.99)[1]
Breast Cancer (n=1043)	**Urban**	513 (70.8)	212 (29.2)		
	Rural	225 (70.8)	93 (29.2)	1.00 (0.75-1.34)	0.94 (0.68-1.30)[1]
Colorectal Cancer (n=1411)	**Urban**	700 (71.4)	280 (28.6)		
	Rural	340 (78.9)	91 (21.1)	1.50 (1.14-1.96)	1.30 (0.97-1.76)[1]

[1] Adjusted for gender, years since graduation, Kringos classification, direct access to relevant investigations

TABLE 5: *Comparing rural and urban PCPs attitudes to health service factors affecting diagnosis of cancer in primary care (3-point Likert scale)*

		DISAGREE	NEITHER AGREE OR DISAGREE	AGREE	P value[1,2]
I am able to refer to a specialist that I know personally	**URBAN n (%)**	**416 (39.0)**	**172 (16.1)**	**480 (44.9)**	**P=0.001[1,2]**
	RURAL n (%)	**142 (30.0)**	**85 (18.0)**	**246 (52.0)**	
Here specialists usually welcome referrals	**URBAN n (%)**	**293 (27.2)**	**343 (31.8)**	**441 (40.9)**	**P=0.001[1,2]**
	RURAL n (%)	**101 (21.4)**	**136 (28.8)**	**235 (49.8)**	
I can easily telephone a specialist for informal discussion	URBAN n (%)	303 (28.4)	204 (19.1)	559 (52.4)	P=0.020[1,2]
	RURAL n (%)	116 (24.5)	75 (15.9)	282 (59.6)	
I am able to refer directly to a named specialist	URBAN n (%)	291 (27.0)	96 (8.9)	690 (64.1)	P=0.522[1,2]
	RURAL n (%)	113 (24.0)	56 (11.9)	302 (64.1)	
My colleagues criticise me if I have referred a patient	URBAN n (%)	631 (58.6)	227 (21.1)	218 (20.3)	P=0.532[1,2]
	RURAL n (%)	273 (57.8)	94 (19.9)	105 (22.2)	
Seeing a specialist can be costly for patients	**URBAN n (%)**	**620 (57.8)**	**123 (11.5)**	**330 (30.8)**	**P<0.001[1,2]**
	RURAL n (%)	**194 (41.4)**	**56 (11.9)**	**219 (46.7)**	
We have access to a fast-track specialist appointment system	URBAN n (%)	238 (22.1)	93 (8.6)	746 (69.3)	P=0.006[1,2]
	RURAL n (%)	**129 (27.3)**	**53 (11.2)**	**291 (61.5)**	
We have a budget or quota for diagnostic tests	URBAN n (%)	573 (53.6)	171 (16.0)	325 (30.4)	P=0.176[1,2]
	RURAL n (%)	266 (57.1)	73 (15.7)	127 (27.3)	
Referral costs are usually paid by insurance companies	**URBAN n (%)**	**620 (58.5)**	**140 (13.2)**	**300 (28.3)**	**P<0.001[1,2]**
	RURAL n (%)	**216 (46.3)**	**58 (12.4)**	**193 (41.3)**	
Patients can self-refer to specialists	**URBAN n (%)**	**841 (78.5)**	**105 (9.8)**	**125 (11.7)**	**P=0.002[1,2]**
	RURAL n (%)	**331 (70.1)**	**69 (14.6)**	**72 (15.3)**	
In my practice patients often have to travel a long way	**URBAN n (%)**	**866 (81.5)**	**95 (8.9)**	**101 (9.5)**	**P<0.001[1,2]**
	RURAL n (%)	**230 (49.1)**	**65 (13.9)**	**173 (37.0)**	
I am very busy and sometimes refer to help reduce my work	**URBAN n (%)**	**632 (58.9)**	**200 (18.6)**	**241 (22.5)**	**P<0.001[1,2]**
	RURAL n (%)	**328 (69.6)**	**79 (16.8)**	**64 (13.6)**	
I am likely to refer if a patient requests referral	URBAN n (%)	357 (33.2)	267 (24.8)	451 (42.0)	P=0.736[1,2]
	RURAL n (%)	148 (31.2)	145 (30.5)	182 (38.3)	
We are under media or public pressure to refer earlier	URBAN n (%)	343 (31.8)	242 (22.5)	492 (45.7)	P=0.308[1,2]
	RURAL n (%)	138 (29.0)	111 (23.3)	227 (47.7)	
The local health system encourages us to refer any patients	URBAN n (%)	330 (30.7)	272 (25.3)	472 (43.9)	P=0.011[1,2]
	RURAL n (%)	121 (25.6)	111 (23.5)	240 (50.8)	
I usually have time in the consultation to think carefully	URBAN n (%)	334 (31.0)	214 (19.9)	529 (49.1)	P=0.008[1,2]
	RURAL n (%)	**116 (24.5)**	**96 (20.3)**	**262 (55.3)**	
Common presentations are covered by local or national guidelines	URBAN n (%)	145 (13.5)	242 (22.5)	688 (64.0)	P=0.785[1,2]
	RURAL n (%)	65 (13.9)	96 (20.6)	306 (65.5)	
In general patients prefer a GP to look after them	URBAN n (%)	222 (20.5)	424 (39.2)	435 (40.2)	P=0.003[1,2]

	RURAL n (%)	69 (14.6)	184 (38.9)	220 (46.5)	
Here high quality care for patient more important than costs	URBAN n (%)	152 (14.2)	211 (19.7)	709 (66.1)	P=0.632[1,2]
	RURAL n (%)	78 (16.5)	80 (16.9)	314 (66.5)	
Referring or not referring doesn't affect me financially	URBAN n (%)	158 (14.8)	136 (12.7)	776 (72.5)	P=0.404[1,2]
	RURAL n (%)	60 (12.8)	62 (13.2)	346 (73.9)	

[1] P-value from the Chi-squared test for trend with Bonferroni correction applied (accepted level of significance is p=0.05/20 (p=0.0025)

SUPPLEMENTARY TABLE: *Comparison of rural and urban PCPs' stated diagnostic actions (investigation or referral) and likelihood of referral at index consultation for those intending action for each of the four clinical vignettes – adjusted for country rather than Kringos classification*

	Adjusted OR for diagnostic action taken (95% CI) rural vs urban	**Adjusted OR for specialist referral (95% CI) urban vs rural[1]**
Lung Cancer	0.91 (0.72-1.15)[1]	1.46 (0.92-2.31)[1]
Ovarian Cancer	0.95 (0.74-1.21)[1]	0.94 (0.66-1.35)[1]
Breast Cancer	1.06 (0.83-1.35)[1]	0.75 (0.52-1.08)[1]
Colorectal Cancer	0.79 (0.59-1.05)[1]	1.41(1.02-1.96)[1]

[1]Adjusted for gender, years since graduation, country, direct access to relevant investigations