



Better organization of self-management education and use of the clinical information system were associated with better primary care for coronary heart disease patients; an observational study

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2012-001344
Article Type:	Research
Date Submitted by the Author:	19-Apr-2012
Complete List of Authors:	van Lieshout, Jan; Scientific Institute for Quality of Healthcare Radboud University Nijmegen Medical Centre, Frigola, Eva; Unitat de Docència, Formació i Recerca, Ludt, Sabine; University Hospital of Heidelberg, General Practice and Health Services Research Grol, Richard; Radboud University Nijmegen Medical Centre, Scientific Institute for Quality in Healthcar Wensing, Michel; Radboud University Nijmegen Medical Centre, Scientific Institute for Quality in Healthcar
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Cardiovascular medicine, General practice / Family practice, Health services research
Keywords:	PRIMARY CARE, Coronary heart disease < CARDIOLOGY, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

1
2
3 **Better organization of self-management education and use of the clinical information**
4 **system were associated with better primary care for coronary heart disease patients; an**
5 **observational study**
6
7

8 **Authors**
9

10 Jan van Lieshout, Eva Frigola Capell, Sabine Ludt, Richard Grol, Michel Wensing
11

12
13
14
15 Jan van Lieshout, MD, Ph.D., corresponding author
16

17 Scientific Institute for Quality of Health Care, Radboud University Nijmegen Medical Centre,
18

19 PO Box 9101, 114, 6500 HB Nijmegen, Netherlands
20

21 Telephone 31 24 3615305
22

23 Fax: 31 24 3540166
24

25 Email: j.vanlieshout@iq.umcn.nl
26
27
28
29

30 Eva Frigola Capell, MSc
31

32 Unitat de Docència, Formació i Recerca, C. Sant Elies 42. Barcelona 08006, Spain
33

34 efrigola_capell@hotmail.com
35
36
37
38

39 Sabine Ludt, MD
40

41 Department of General Practice and Health Services Research, University of Heidelberg,
42

43 Voßstr. 2, D-69115 Heidelberg, Germany
44

45 Sabine.Ludt@med.uni-heidelberg.de
46
47
48
49

50 Richard Grol, Ph.D., Professor
51

52 Scientific Institute for Quality of Health Care, Radboud University Nijmegen Medical Centre,
53

54 PO Box 9101, 114, 6500 HB Nijmegen, Netherlands
55

56 R.Grol@iq.umcn.nl
57
58
59
60

1
2
3
4
5 Michel Wensing, Ph.D., Habil, Professor
6

7 Scientific Institute for Quality of Health Care, Radboud University Nijmegen Medical Centre,
8

9 PO Box 9101, 114, 6500 HB Nijmegen, Netherlands
10

11 M.Wensing@iq.umcn.nl
12
13

14
15
16 **Subject headings**
17

18 Primary care, Coronary heart disease, Chronic Care Model, Self management Support, Quality of
19

20 Care, Clinical information system, Observational study
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Abstract

Objectives

Cardiovascular risk management (CVRM) received by patients shows large variation across countries. In this study we explored which aspects of primary care organization are associated with key components of CVRM in coronary heart disease (CHD) patients.

Design

Observational study.

Setting

273 primary care practices in Austria, Belgium, England, Finland, France, Germany, the Netherlands, Slovenia, Switzerland, and Spain.

Participants

A random sample of 4563 CHD patients identified by coded diagnoses in eight countries, based on prescription lists and while visiting the practice in one country each.

Main outcome measure

we performed an audit in primary care practices in 10 European countries. We used six indicators to measure key components of CVRM: risk factor recording, anti platelet therapy, influenza vaccination, blood pressure levels (systolic <140, diastolic <90 mmHg), and LDL cholesterol <2.5 mmol/l. Data from structured questionnaires were used to construct an overall measure and 6 domain measures of practice organization based on 39 items

Using multilevel regression analyses we explored the effects of practice organization on CVRM, controlling for patient characteristics.

Results

Better overall organization of a primary care practice was associated with higher scores on three indicators: risk factor registration (B=0.0307, p<0.0001), anti-platelet therapy (OR 1.05, p=0.0245), and influenza vaccination (OR 1.12, p<0.0001). Overall practice organization was not found to be related with recorded blood pressure or cholesterol levels. Only the organisational domains 'self-

1
2
3 management support' and 'use of clinical information systems' were linked to three CVRM
4 indicators.
5

6 7 Conclusions

8
9 A better organisation of a primary care practice was associated with better CVRM in CHD patients.

10
11 Direct support for patients and clinicians seemed most influential.
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

Article Focus

- This paper focuses on cardiovascular risk management (CVRM) in patients with coronary heart diseases (CHD) in primary care across Europe.
- A better health care organization is expected to be related to a higher quality of care.
- The aim of our study was to examine which factors of organization of a primary care practice are associated with quality of CVRM in CHD patients.

Key Messages

- A primary care practice with overall better practice organization had higher performance scores for risk factor registration, antiplatelet prescription and influenza vaccination in CHD patients.
- A better organization of 'self-management support' and 'clinical information systems' was associated with higher scores on three performance indicators.
- The difference between a rather poor score and a good score on an organizational domain may improve the outcome up to 30%.

Strengths and Limitations

- The international character of our study provided control for contextual confounders, such as specific reimbursement system or national policies.
- Sampling procedures had limitations with respect to representativeness.
- A limitation was that the measures of the organizational domains were post-hoc constructed.

Introduction

Providing high-quality healthcare for patients with chronic diseases poses major challenges for health care systems. In many countries policy makers aim to strengthen the ability of primary care to provide chronic illness care, so that large patient populations can be supported reliably over a long period of time. The Chronic Care Model (CCM) proposed that six organizational components are crucial to achieve this: 'health care organization', 'delivery system design', 'decision support', 'clinical information systems', 'self-management support', and 'community resources and policies'.^{1,2} Box 1 shows a brief description of the six domains. Other organisational models, such as the Patient-Centered Medical Home³, specified similar components. Although these models are based on some research⁴⁻¹⁰, their positive impact on clinical and preventive performance needs further research as implementing best practices for chronic illness management shows little success.¹¹ While it has been claimed that all organizational components are important, it would be informative to get better insight into the relative value of different domains. For instance, a study on diabetes care in 17 centres found that 'delivery system design' was positively correlated to outcomes, whereas 'clinical information systems' and 'self-management support' were not significantly associated.⁶

This paper focuses on cardiovascular risk management (CVRM) in patients with coronary heart diseases (CHD) in primary care across Europe. CHD is a condition with high morbidity and mortality worldwide.¹² Practice guidelines with recommendations for effective secondary preventive therapy are widely available.^{13,14} Although the effects of anti platelet therapy and of control of blood pressure and serum cholesterol levels are beyond discussion, research showed that preventive treatment is suboptimal in Europe and the US.^{15,16} Preventive treatment for patients with established CHD is mostly delivered in primary care, especially in countries with a strong primary care oriented health care system. Substantial variation is observed regarding CVRM received by patients. We expect better health care organization to be related to a higher quality of care. The aim of our study was to examine which factors of organization of a primary care practice are associated with quality of CVRM in CHD patients.

Methods

1
2
3 This study was part of the EPA Cardio project, an international observational study on cardiovascular
4 risk management in 10 European countries.¹⁷ The participating countries comprised a convenience
5 sample: Austria, Belgium, England, Finland, France, Germany, the Netherlands, Slovenia,
6
7 Switzerland, and Spain. In stratified samples of primary care practices in each of these countries
8
9 randomly sampled medical records were reviewed to provide data on cardiovascular risk management
10
11 and structured questionnaires among participating general practitioners were used to provide data on
12
13 practice organization. Practices were stratified according to urbanization and size sampling based on
14
15 regional or national lists of practices; in Austria and Switzerland a convenience sample was included.
16
17 Patients were included based on coded diagnoses in most countries; in Austria prescription lists were
18
19 used to include patients and in France patients visiting the practice were included when eligible. Data
20
21 collection took place in 2008-2009.
22
23
24
25

26 27 *Indicators for cardiovascular risk management*

28
29 Data from medical records were linked to internationally validated indicators on cardiovascular risk
30
31 management, which were developed in a structured Delphi procedure.¹⁸ Primary care physician panels
32
33 from nine countries initially evaluated 650 indicators for cardiovascular risk management. This
34
35 resulted in a core set of 44 indicators, which were then operationalized in specific measures and tested
36
37 in a pilot study.¹⁹ This study is based on performance indicators related to preventive treatments in
38
39 CHD patients. The first indicator was an aggregate score which indicated the number of risk factors
40
41 recorded per patient. Risk factors considered were: smoking behaviour, body mass index, physical
42
43 activity, blood pressure, and cholesterol levels (range 0-5). Five other indicators, all dichotomous,
44
45 were: anti platelet therapy unless contraindicated, influenza vaccination offered, systolic blood
46
47 pressure (SBP) <140 mmHg, diastolic blood pressure (DBP) <90 mmHg, and LDL cholesterol <2.5
48
49 mmol/l.
50
51
52

53 54 *Organization of primary practice*

55
56 A large set of questions on practice organization was included in structured questionnaires, which
57
58 were partly administered in written form and partly in interviews with the general practitioner in the
59
60

1
2
3 participating practices who was the research participating contact person. These questions mainly
4
5 comprised items from the European Practice Assessment (EPA) instrument. This EPA instrument was
6
7 previously validated in an international project.²⁰ We constructed post hoc measures by linking items
8
9 to one of the six domains of the Chronic Care Model as published before.²¹ All items were formulated
10
11 positively, with 'yes' indicating the presence of a characteristic. We dichotomised all answers as either
12
13 'yes' or 'no', the latter consisting of 'no', 'missing value', or 'not applicable'. The aggregated scores
14
15 of the following five CCM domains were positively correlated: 'health care organization' (seven
16
17 items), 'delivery system design' (15 items), 'decision support' (three items), 'clinical information
18
19 systems' (six items), and 'self-management support' (four items). These correlations were highly
20
21 significant with Spearman's rho values varying from 0.2 to over 0.6. In addition, an overall measure of
22
23 structured chronic care was defined with a scale from 0 to 5, with equal weight for each CCM domain.
24
25 Factor analysis showed a Cronbach's alpha of 0.74. One CCM domain, 'community resources and
26
27 policies' (four items), was left out of the overall score due to difference in focus and lower correlation
28
29 with other domains.
30
31

32 33 *Data-Analysis*

34
35 In order to examine the associations between practice organization and performance indicators we
36
37 applied multilevel regression analyses, using indicators for cardiovascular risk management as
38
39 outcomes. Age and gender were included as explanatory variables (covariates) at the patient level. The
40
41 second level was the practice level at which the organizational measures were specified. On this level,
42
43 we entered two factors: the domain 'community resources and policies' was a predictor in all analyses;
44
45 furthermore we entered either one of the five other domains or the overall aggregated score. The third
46
47 level was the country level (as a fixed factor). The analyses were performed for each of the six
48
49 outcomes separately. The risk factor recording was analyzed in a linear regression model, while the
50
51 dichotomous outcomes, antiplatelet therapy, influenza vaccination, blood pressure and cholesterol
52
53 levels, were handled in binomial logistic regression models. We considered p-values of 0.05 or less to
54
55 indicate statistical significance. Patients with a missing value were ignored for that outcome. For the
56
57 descriptive data presentation we used SPSS 16; the regression analyses were conducted using SAS9.
58
59
60

Results

From the 284 practices in the EPA Cardio study 11 practices were excluded due to low numbers of patients. We included 273 primary care practices with data on 4563 patients (Table 1). The number of practices varied from 12 in Finland to 36 in England and Spain. Overall, one third of the patients was female; in Switzerland and Belgium less than 25%; in Finland and England about 38%. On average patients were over 69 years of age. Patients in Spain were on average the eldest: over 73 years of age. Table 2 presents figures on performance indicators. Overall performance varied from 46% of the maximum score for LDL treatment target and 60% for systolic treatment target up to 87% for antiplatelet therapy and diastolic treatment target.

Table 3 presents the results of the regression analyses. Overall better practice organization was associated with more reliable risk factor registration ($B=0.0307$, $p<0.0001$), antiplatelet prescribing ($OR=1.0533$, $p=0.0245$), and influenza vaccination ($OR=1.1246$, $p<0.0001$). The same associations were found for the component 'clinical information systems'. The component 'self-management support' was associated with better risk factor registration ($B=0.1676$, $p<0.0001$), influenza vaccination ($OR 1.55$, $p=0.0004$), and LDL treatment target ($OR 1.15$, $p=0.0252$). The component 'delivery system design' was associated with better risk factor registration ($B=0.0352$, $p=0.0002$) and vaccination ($OR 1.13$, $p=0.0036$). The domains 'health care organization' and 'decision support' were associated with influenza vaccination only. The domain 'community resources and policies' was found to be associated with DBP.

Discussion

Main results

A primary care practice with overall better practice organization had higher performance scores for risk factor registration, antiplatelet prescription and influenza vaccination in CHD patients. A better organization of 'self-management support' and 'clinical information systems' was also found to be associated with higher scores on three performance indicators. These findings support the belief that

1
2
3 practice organization has impact on quality of CVRM in CHD patients, although the observational
4
5 design does not allow causal inferences.

6
7 The organizational domain 'self-management support' related to having information leaflets available
8
9 in the practice concerning CVD (e.g. CHD, stroke, hypertension, stop smoking etc); presence of a
10
11 directory of prevention activities/organizations locally available (e.g. gyms, walking group, weight-
12
13 watchers); offering written information on life style regularly; and offering advice about websites for
14
15 education on health risks or healthy life style regularly. The organizational domain 'clinical
16
17 information system' referred to access to internet and email in the practice, virus protection, use of a
18
19 pass word, use of a computer-supported patient file system, and computer-generated medication
20
21 prescriptions.

22
23 Table 4 illustrates that the difference between a rather poor score and a good score on an
24
25 organizational domain may improve the outcome by only 2-6% or as much as up to 30%. It presents
26
27 the estimated outcome in a primary care practice with every predictor average except one, varying this
28
29 predictor from a 10th percentile score to a 90th percentile score (to avoid focus on the extremes). For
30
31 instance, an average patient in an otherwise average practice on the lower end (10th percentile)
32
33 regarding self-management support has a 50% chance of receiving an influenza vaccination as
34
35 opposed to a patient on the better end of the range (90th percentile) having a 79% chance of receiving
36
37 an influenza vaccination.
38

39 40 41 *Related research*

42
43 While the impact of practice organization mainly concerned aspects of preventive performance related
44
45 to the process (risk factor registration, drug prescription, and vaccination) rather than intermediate
46
47 outcome indicators as risk factor scores (blood pressure and cholesterol levels), it should be noted that
48
49 antiplatelet therapy has a well-assessed effect on cardiovascular events and mortality.²² Likewise, the
50
51 benefits of influenza vaccination in preventing complications are well-documented and guidelines
52
53 recommend vaccination to patients with cardiovascular diseases.^{13,14,23} This implies that better
54
55 organization of primary care was associated with improved survival and fewer cardiovascular events
56
57 in patient with CHD.
58
59
60

1
2
3 Previous research has shown that various domains of practice organization impacts on indicators of
4 clinical performance,^{4-10,24,25} A systematic review of trials implementing service organisation
5 interventions in CHD patients in primary care found weak evidence for effectiveness related to blood
6 pressure and cholesterol levels.²⁶
7
8

9
10 When testing the various domains, we found that not all domains had equal effects on performance.
11
12 The components 'self-management support' and 'clinical information system' proved to be most
13 consistently related to cardiovascular risk management. We cannot rule out the possibility that our
14 measures of these domains may have been more accurate than those of other domains or that the
15 participating primary care practices had specific characteristics explaining the findings. On the other
16 hand, both clinical information system and self-management are directly linked to decisions and
17 behaviours of patients and clinicians, which have known impact on cardiovascular risk.
18
19
20
21
22
23
24
25
26

27 *Strengths and weaknesses*

28
29 The international character of our study provided control for contextual confounders, such as specific
30 reimbursement system or national policies. The EPA Cardio study was based on random sampling of
31 patients using well developed measures of cardiovascular risk management and practice organization.
32
33 The sampling of countries and practices had limitations with respect to representativeness. In the
34 sample female patients may be slightly underrepresented. In various national databases male CHD
35 prevalence is 1.5 to 2 times the female prevalence.²⁷⁻²⁹ We had data on sex and age and entered these
36 data as independent factors in our models. A further limitation was that the measures of the CCM were
37 post-hoc constructed.
38
39
40
41
42
43
44
45
46
47

48 *Conclusion*

49
50 Our observational study provided data from a real life situation in contrast to academic settings or trial
51 results with controlled interventions. High scores appear to be possible on all outcomes, yet
52 improvements in primary care for CHD patients are possible throughout our country sample. Working
53 according to CCM principles is positively related to better quality of care on most outcomes. This
54 accounts especially for the domains 'clinical information systems' and 'self-management support'.
55
56
57
58
59
60

1
2
3 ‘Self-management support’ is the mainstay of the CCM, making the patient a real partner in patient
4 practice collaboration. As the use of computerization is involved in all other domains the domain
5
6
7 ‘clinical information systems’ is essential as well. Its effects proved to be significant in this study,
8
9 which involved ten countries with different health care organizations, adding to the importance of
10
11 these domains and robustness of the findings. This study reinforces the importance of strengthening
12
13 the organization of primary care practices for improving their clinical performance.
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

Authors contributions:

JvL had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. JvL led decisions about content and submission. All authors contributed to data analysis and interpretation, and the writing and editing of the report. All authors approved the final version of the report.

Licence for publication:

The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all authors, an exclusive licence (or non exclusive for government employees) on a worldwide basis to the BMJ Publishing Group Ltd and its Licensees to permit this article (if accepted) to be published in BMJ editions and any other BMJ PGL products and sublicences to exploit all subsidiary rights, as set out in our licence (<http://resources.bmj.com/bmj/authors/checklists-forms/licence-for-publication>)."

Acknowledgements:

The following individuals were part of the EPA Cardio group: Stephen Campbell ((UK), Ester Cornelis (Belgium), Glyn Elwyn (UK), Reinhold Glehr (Austria), Margalit Goldfracht (Israel), Hector Falcoff (France), Beat Künzi (Switzerland), Lilian Michlig (Switzerland), Esko Kumpusalo (Finland), Janko Kersnik (Slovenia), Kati Kettunen (Finland), Solene Martin (France), Davorina Petek (Slovenia), Ingrid Pichler (Austria), Martin Roland (UK), Marianne Samuelson (France), Veerle van der Stighelen (Belgium), and Trudy van der Weijden (Netherlands).

Statistical analyses were performed by Jan Mulder and Jan Koetsenruijter .

Competing interests:

All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

Funding:

The study was supported by a grant from the Bertelsmann Foundation, Gütersloh, Germany. The Bertelsmann Foundation had no involvement in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

Ethical approval:

Ethical approval was waived in some countries and obtained in other countries where appropriate.

Data sharing:

No additional data available.

References

- 1 Improving chronic illness care. <http://www.improvingchroniccare.org/>. Accessed 24 February 2012.
- 2 Bodenheimer T, Wagner EH, Grumbach K. Improving Primary Care for Patients With Chronic Illness. *JAMA*. 2002;288(14):1775-1779.
- 3 ACEP Board of Directors. The Patient-Centered Medical Home Model. *Ann Emerg Med*. 2009;53(2):289-291.
- 4 Tsai AC, Morton SC, Mangione CM, et al. A meta-analysis of interventions to improve care for chronic illnesses. *Am J Manag Care*. 2005;11(8):478-488.
- 5 Friedberg MW, Coltin KL, Safran DG, et al. Associations between structural capabilities of primary care practices and performance on selected quality measures. *Ann Intern Med*. 2009;151(7):456-463.
- 6 Sperl-Hillen JM, Solberg LI, Hroschikoski MC, et al. Do all components of the chronic care model contribute equally to quality improvement? *Jt Comm J Qual Saf*. 2004;30(6):303-309.
- 7 Koelling TM, Johnson ML, Cody RJ, Aaronson KD. Discharge education improves clinical outcomes in patients with chronic heart failure. *Circulation*. 2005;111(2):179-185.
- 8 Bosworth HB, Olsen MK, Grubber JM, et al. Two self-management interventions to improve hypertension control: a randomized trial. *Ann Intern Med*. 2009;151(10):687-695.
- 9 Demiris G, Afrin LB, Speedie S, et al. Patient-centered applications: use of information technology to promote disease management and wellness. A white paper by the AMIA knowledge in motion working group. *J Am Med Inform Assoc*. 2008;15(1):8-13.

1
2
3 10 Chaudhry B, Wang J, Wu S, et al. Systematic review: impact of health information technology on
4 quality, efficiency, and costs of medical care. *Ann Intern Med.* 2006;144(10):742-752.
5
6

7
8
9 11 Bernstein J. The elusive benefits of chronic care management. *Arch Intern Med* 2011; 171 (5), 466-
10 467.
11

12
13
14
15 12 World Health Organization. Cardiovascular diseases (CVDs). WHO, 2011.
16
17 <http://www.who.int/mediacentre/factsheets/fs317/en/index.html>. Accessed July 29, 2011.
18
19

20
21 13 Graham I, Atar D, Borch-Johnsen K, et al; European Society of Cardiology (ESC); European
22 Association for Cardiovascular Prevention and Rehabilitation (EACPR); Council on Cardiovascular
23 Nursing; European Association for Study of Diabetes (EASD); International Diabetes Federation
24 Europe (IDF-Europe); European Stroke Initiative (EUSI); Society of Behavioural Medicine (ISBM);
25 European Society of Hypertension (ESH); WONCA Europe (European Society of General
26 Practice/Family Medicine); European Heart Network (EHN); European Atherosclerosis Society
27 (EAS). European guidelines on cardiovascular disease prevention in clinical practice: full text. Fourth
28 Joint Task Force of the European Society of Cardiology and other societies on cardiovascular disease
29 prevention in clinical practice (constituted by representatives of nine societies and by invited experts).
30
31 *Eur J Cardiovasc Prev Rehabil.* 2007;14 (Suppl 2):S1-113.
32
33
34
35
36
37
38
39
40
41
42

43
44 14 Fraker TD Jr, Fihn SD, Gibbons RJ, et al; American College of Cardiology; American Heart
45 Association; American College of Cardiology/American Heart Association Task Force on Practice
46 Guidelines Writing Group. 2007 chronic angina focused update of the ACC/AHA 2002 Guidelines for
47 the management of patients with chronic stable angina: a report of the American College of
48 Cardiology/American Heart Association Task Force on Practice Guidelines Writing Group to develop
49 the focused update of the 2002 Guidelines for the management of patients with chronic stable angina.
50
51 *Circulation.* 2007;116(23):2762-2772.
52
53
54
55
56
57
58
59
60

1
2
3 15 Kotseva K, Wood D, De Backer G, et al; EUROASPIRE Study Group. EUROASPIRE III: a survey
4 on the lifestyle, risk factors and use of cardioprotective drug therapies in coronary patients from 22
5 European countries. *Eur J Cardiovasc Prev Rehabil*. 2009;16(2):121-137.
6
7

8
9
10
11 16 Chan PS, Oetgen WJ, Buchanan D, et al. Cardiac performance measure compliance in outpatients:
12 the American College of Cardiology and National Cardiovascular Data Registry's PINNACLE
13 (Practice Innovation And Clinical Excellence) program. *J Am Coll Cardiol*. 2010;56(1):8-14.
14
15

16
17
18
19 17 Wensing M, Ludt S, Campbell S, et al; EPA Cardio Project Group.
20 European Practice Assessment of Cardiovascular risk management (EPA Cardio): protocol of an
21 international observational study in primary care. *Implement Sci*. 2009;4:3.
22
23

24
25
26
27 18 Campbell SM, Ludt S, Van Lieshout J, et al. Quality indicators for the prevention and management
28 of cardiovascular disease in primary care in nine European countries. *Eur J Cardiovasc Prev Rehabil*.
29 2008;15(5):509-515.
30
31

32
33
34
35 19 Ludt S, Campbell S, Van Lieshout J, et al. Development and pilot of an internationally standardized
36 measure of cardiovascular risk management in European primary care. *BMC Health Services*
37 *Research*. 2011; 11(1):70.
38
39

40
41
42
43 20 Engels Y, Dautzenberg M, Campbell S, et al. Testing a European set of indicators for the
44 evaluation of the management of primary care practices. *Fam Pract*. 2006;23(1):137-147.
45
46

47
48
49 21 Van Lieshout J, Goldfracht M, Campbell S, et al. Characteristics of primary care in Europe which
50 contribute to chronic disease management: an observational study. *Br J Gen Pract*. 2011;61:25-31
51
52

1
2
3 22 Antithrombotic Trialists' Collaboration. Collaborative meta-analysis of randomised trials of
4 antiplatelet therapy for prevention of death, myocardial infarction, and stroke in high risk patients.
5
6 *BMJ*. 2002;324(7329):71-86.
7
8

9
10
11 23 Keller T, Weeda VB, van Dongen CJ, et al. Influenza vaccines for preventing coronary heart
12 disease. Cochrane Database of Systematic Reviews 2008, Issue 3. Art. No.: CD005050. DOI:
13 10.1002/14651858.CD005050.pub2.
14
15

16
17
18 24 Vargas RB, Mangione CM, Asch S, et al. Can a chronic care model collaborative reduce heart
19 disease risk in patients with diabetes? *J Gen Intern Med*. 2007;22(2):215-222.
20
21

22
23
24 25 Asch SM, Baker DW, Keeseey JW, et al. Does the collaborative model improve care for chronic
25 heart failure? *Med Care*. 2005;43(7):667-675.
26
27

28
29
30 26 Buckley BS, Byrne MC, Smith SM. Service organisation for the secondary prevention of ischaemic
31 heart disease in primary care. Cochrane Database of Systematic Reviews 2010, Issue 3. Art. No.:
32 CD006772. DOI: 10.1002/14651858.CD006772.pub2.
33
34

35
36
37 27 P Scarborough, P Bhatnagar, K Whickramasinge, et al. Coronary heart disease statistics 2010
38 edition. <http://www.bhf.org.uk/publications/view-publication.aspx?ps=1001546>. Accessed 24
39 February 2012.
40
41

42
43
44 28 Gommer AM, Poos MJJC. Prevalentie, incidentie en sterfte naar leeftijd en geslacht. In:
45 Volksgezondheid Toekomst Verkenning, Nationaal Kompas Volksgezondheid. Bilthoven: RIVM,
46 <<http://www.nationaalkompas.nl>> Nationaal Kompas Volksgezondheid\Gezondheid en ziekte\Ziekten
47 en aandoeningen\Hartvaatstelsel\Coronaire hartziekten, 7 december 2010.
48
49
50
51
52
53
54
55
56 <http://www.nationaalkompas.nl/gezondheid-en-ziekte/ziekten-en->
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

[aandoeningen/hartvaatstelsel/coronaire-hartziekten/cijfers-coronaire-hartziekten-prevalentie-incidentie-en-sterfte-uit-de-vtv-2010/](#). Accessed 24 February 2012.

29 Robert Koch-Institut, Berlin 2011. Daten und Fakten: Ergebnisse der Studie “Gesundheit in Deutschland aktuell 2009“. <http://www.gbe-bund.de/>. Accessed 24 February 2012.

For peer review only

Table 1

Countries, practices and patients included

Country	Number of practices	Number of patients	% female	Mean age
Austria	23	307	36.1	71.5
Belgium	23	269	23.6	66.8
England	36	540	38.0	67.9
Finland	12	245	38.4	72.1
France	25	346	27.9	68.5
Germany	26	463	36.9	69.0
Netherlands	35	507	29.1	69.4
Slovenia	35	822	35.8	68.2
Spain	36	722	37.0	73.3
Switzerland	22	342	22.4	67.8
Total	273	4563	33.4	69.5

Table 2

Indicators for cardiovascular risk management. Percentage of maximum score in risk factor registration (with standard deviation) and percentage of the patients with positive scores for the binary outcomes is shown (n= 4563 patients with CHD).

	Risk factor registration (std. deviation)	Anti-platelet therapy	Influenza vaccination	SBP <140 mmHg	DBP <90 mmHg	LDL < 2.5 mmol/l
Austria	80.6 (18.6)	86.4	52.8	61.4	85.9	56.1
Belgium	80.8 (21.2)	90.7	89.2	55.9	85.2	44.8
England	87.5 (16.6)	92.0	86.7	69.7	95.9	65.5
Finland	70.1 (24.4)	93.2	72.5	50.2	84.4	65.8
France	81.4 (16.5)	90.4	59.1	58.9	89.5	38.2
Germany	80.4 (19.2)	67.5	71.5	58.0	81.3	30.4
Netherlands	59.8 (31.7)	85.2	96.4	43.6	85.7	45.1
Slovenia	77.4 (24.8)	93.9	31.8	56.8	79.8	38.2
Spain	58.1 (32.9)	80.2	67.5	72.8	96.1	45.9
Switzerland	76.8 (24.2)	95.3	55.2	65.4	87.2	46.3
Total	74.0 (26.8)	87.0	66.1	60.1	87.1	46.3

Table 3a Primary analyses of effects of practice organization characteristics on indicators of cardiovascular risk management

	Linear regression		Logistic regression									
	Risk factor registration		Antiplatelet therapy		Influenza vaccination		SBD<140 mmHg		DBD<90 mmHg		LDL<2.5 mmol/l	
	B	p	OR	p	OR	p	OR	p	OR	p	OR	p
Age	-0.0042	0.0207	1.0040	N.S.	1.0688	<.0001	1.0230	<.0001	0.9858	0.0036	0.9886	0.0035
Gender												
1 = female	0.0200	N.S.	1.7695	<.0001	1.0619	N.S.	0.9601	N.S.	0.9954	N.S.	0.7192	0.0001
2 = male												
CCM-composite (score from 0 to 5)	0.0307	<.0001	1.0533	0.0245	1.1246	<.0001	1.0028	N.S.	1.0091	N.S.	1.0037	N.S.
Community resources and policies (n=4)	0.0084	N.S.	0.9049	N.S.	0.8513	N.S.	1.0078	N.S.	1.1556	0.0283	1.1035	N.S.

Table 3b Secondary analyses of effects of practice organization characteristics on indicators of cardiovascular risk management

	Linear regression		Logistic regression									
	Risk factor registration		Antiplatelet therapy		Influenza vaccination		SBD<140 mmHg		DBD<90 mmHg		LDL<2.5 mmol/l	
	B	p	OR	p	OR	p	OR	p	OR	p	OR	p
Health care organization (n=7)	0.0280	N.S.	1.0371	N.S.	1.1928	0.0243	0.9938	N.S.	0.9807	N.S.	0.9802	N.S.
Clinical information systems (n=6)	0.0498	0.0236	1.3192	0.0016	1.4768	0.0002	1.0575	N.S.	1.0558	N.S.	0.9627	N.S.
Self-management support (n=4)	0.1676	<.0001	1.0539	N.S.	1.5477	0.0004	0.9685	N.S.	- ¹		1.1469	0.0252
Decision support (n=3)	0.0685	N.S.	1.1954	N.S.	1.4338	0.0411	1.0767	N.S.	1.0664	N.S.	1.1165	N.S.
Delivery system design (n=15)	0.0352	0.0002	1.0597	N.S.	1.1342	0.0036	1.0022	N.S.	0.9763	N.S.	1.0033	N.S.

1
2
3
4
5 Legend_ Results of regression analyses (B values and OR) with $p < 0.05$ as significance level, a three level model.
6

7 Three level model: outcomes on patient level with age and gender as covariates; practice characteristics was the next level and country the third level. Country
8 proved to be a significant factor in all analyses ($p < 0.0001$, data not shown).
9

10
11 3a practice level with two variables: 1. community resources and policies; and 2. the Chronic Care Model composite score of the other five domains,
12 comprising health care organization, clinical information systems, self-management support, decision support, and delivery system design.
13

14
15 3b practice level with two variables: 1. community resources and policies; and 2. one of the other five domains: health care organization, clinical information
16 systems, self-management support, decision support, or delivery system design. Only the estimates of these last domains are displayed in table 3b.
17
18

19 ¹ Analysis found no estimate.
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

Table 4

Estimated cardiovascular performance for practices with low or high scores on measures of practice organization .

	Performance indicators	Practice with low scores	Practice with high scores
CCM-composite	Risk factor registration	0.74	0.76
	Antiplatelet therapy	0.86	0.88
	Influenza vaccination	0.63	0.69
Clinical information systems	Risk factor registration	0.72	0.75
	Antiplatelet therapy	0.78	0.89
	Influenza vaccination	0.45	0.72
Self-management support	Risk factor registration	0.69	0.79
	Influenza vaccination	0.50	0.79
	LDL<2.5 mmol/l	0.44	0.48

Legend. Performance scores have a range from 0-1 (0=poor, 1= perfect). Low/high scores on practice organization variables were defined as P10 and P90 values on the variable.

Box 1. Features of the Chronic Care Model

Community Resources and Policies	Provider organizations are linked to community-based resources, eg, exercise programs, senior centres, and self help groups.
Health Care Organization	Chronic care is seen as a priority with adequate reimbursement.
Self-management Support	Patients themselves become the principal caregivers, taught to manage their illnesses, with lifestyle issues under the direct control of the patient. Self-management support involves collaboratively helping patients and their families acquire the skills and confidence to manage their chronic illness, providing self-management tools, and routinely assessing problems and accomplishments.
Delivery System Design	Planned management of chronic conditions is separated from acute care. Non physicians support patient self-management, arrange for routine periodic tasks and ensure appropriate follow up.
Decision Support	Evidence-based clinical practice guidelines provide standards for optimal chronic care integrated into daily practice. Specialist expertise is available without full specialty referral. Guidelines are reinforced by educational sessions for practice teams.
Clinical Information Systems	Registries, a central feature of the chronic care model, are lists of all patients with a particular chronic condition in a health care organisation. Reminder systems help teams comply with practice guidelines. The system provides feedback showing how each professional is performing on chronic illness measures. Registries are used to plan both the individual patient care and the population-based care.

1
2
3 Supplemental file

4
5 The **study protocol** has been published as:

6
7
8 Wensing M, Ludt S, Campbell S, van Lieshout J, Volbracht E, Grol R; EPA Cardio Project Group.
9 European Practice Assessment of Cardiovascular risk management (EPA Cardio): protocol of an
10 international observational study in primary care.
11 Implement Sci. 2009 Jan 7;4:3.

12
13 Available at:

14 <http://www.implementationscience.com/content/4/1/3>
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



What components of chronic care organization relate to better primary care for coronary heart disease patients? An observational study.

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2012-001344.R1
Article Type:	Research
Date Submitted by the Author:	19-Jul-2012
Complete List of Authors:	van Lieshout, Jan; Scientific Institute for Quality of Healthcare Radboud University Nijmegen Medical Centre, Frigola, Eva; Unitat de Docència, Formació i Recerca, Ludt, Sabine; University Hospital of Heidelberg, General Practice and Health Services Research Grol, Richard; Radboud University Nijmegen Medical Centre, Scientific Institute for Quality in Healthcar Wensing, Michel; Radboud University Nijmegen Medical Centre, Scientific Institute for Quality in Healthcar
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Cardiovascular medicine, General practice / Family practice, Health services research
Keywords:	PRIMARY CARE, Coronary heart disease < CARDIOLOGY, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

~~Better organization of self-management education and use of the clinical information system were associated with~~ What components of chronic care organization relate to better primary care for coronary heart disease patients; a? An observational study.

Authors

Jan van Lieshout, Eva Frigola Capell, Sabine Ludt, Richard Grol, Michel Wensing

Jan van Lieshout, MD, Ph.D., corresponding author

Scientific Institute for Quality of Health Care, Radboud University Nijmegen Medical Centre,

PO Box 9101, 114, 6500 HB Nijmegen, Netherlands

Telephone 31 24 3615305

Fax: 31 24 3540166

Email: j.vanlieshout@iq.umcn.nl

Eva Frigola Capell, MSc

Unitat de Docència, Formació i Recerca, C. Sant Elies 42. Barcelona 08006, Spain

efrigola_capell@hotmail.com

Sabine Ludt, MD

Department of General Practice and Health Services Research, University of Heidelberg,

Voßstr. 2, D-69115 Heidelberg, Germany

Sabine.Ludt@med.uni-heidelberg.de

Richard Grol, Ph.D., Professor

Scientific Institute for Quality of Health Care, Radboud University Nijmegen Medical Centre,

PO Box 9101, 114, 6500 HB Nijmegen, Netherlands

R.Grol@iq.umcn.nl

1
2
3
4
5 Michel Wensing, Ph.D., Habil, Professor
6

7 Scientific Institute for Quality of Health Care, Radboud University Nijmegen Medical Centre,
8

9 PO Box 9101, 114, 6500 HB Nijmegen, Netherlands
10

11 M.Wensing@iq.umcn.nl
12

13
14
15
16 **Subject headings**

17
18 Primary care, Coronary heart disease, Chronic Care Model, Self management Support, Quality of
19

20 Care, Clinical information system, Observational study
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Abstract

Objectives

Cardiovascular risk management (CVRM) received by patients shows large variation across countries. In this study we explored which aspects of primary care organization are associated with key components of CVRM in coronary heart disease (CHD) patients.

Design

Observational study.

Setting

273 primary care practices in Austria, Belgium, England, Finland, France, Germany, the Netherlands, Slovenia, Switzerland, and Spain.

Participants

A random sample of 4563 CHD patients identified by coded diagnoses in eight countries, based on prescription lists and while visiting the practice in one country each.

Main outcome measure

We performed an audit in primary care practices in 10 European countries. We used six indicators to measure key components of CVRM: risk factor recording, anti platelet therapy, influenza vaccination, blood pressure levels (systolic <140, diastolic <90 mmHg), and LDL cholesterol <2.5 mmol/l. Data from structured questionnaires were used to construct an overall measure and 6 domain measures of practice organization based on 39 items

Using multilevel regression analyses we explored the effects of practice organization on CVRM, controlling for patient characteristics.

Results

Better overall organization of a primary care practice was associated with higher scores on three indicators: risk factor registration (B=0.0307, p<0.0001), anti-platelet therapy (OR 1.05, p=0.0245), and influenza vaccination (OR 1.12, p<0.0001). Overall practice organization was not found to be related with recorded blood pressure or cholesterol levels. Only the organisational domains 'self-

1
2
3 management support' and 'use of clinical information systems' were linked to three CVRM
4 indicators.
5

6 7 Conclusions

8
9 A better organisation of a primary care practice was associated with better scores on process indicators
10 of CVRM in CHD patients, but not on intermediate patient outcome measures. Direct support for
11 patients and clinicians seemed most influential.
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Article Focus

- This paper focuses on cardiovascular risk management (CVRM) in patients with coronary heart diseases (CHD) in primary care across Europe.
- A better health care organization is expected to be related to a higher quality of care.
- The aim of our study was to examine which factors of organization of a primary care practice are associated with quality of CVRM in CHD patients.

Key Messages

- A primary care practice with overall better practice organization had higher performance scores for risk factor registration, antiplatelet prescription and influenza vaccination in CHD patients.
- A better organization of 'self-management support' and 'clinical information systems' was associated with higher scores on three performance indicators.
- The difference between a rather poor score and a good score on an organizational domain may improve the outcome up to 30%.

Strengths and Limitations

- The international character of our study provided control for contextual confounders, such as specific reimbursement system or national policies.
- Sampling procedures had limitations with respect to representativeness.
- A limitation was that the measures of the organizational domains were post-hoc constructed.

Introduction

Providing high-quality healthcare for patients with chronic diseases poses major challenges for health care systems. In many countries policy makers aim to strengthen the ability of primary care to provide chronic illness care, so that large patient populations can be supported reliably over a long period of time. The Chronic Care Model (CCM) proposed that six organizational components are crucial to achieve this: 'health care organization', 'delivery system design', 'decision support', 'clinical information systems', 'self-management support', and 'community resources and policies'.^{1,2} Box 1 shows a brief description of the six domains. Other organisational models, such as the Patient-Centered Medical Home³, specified similar components. Although these models are based on some research⁴⁻¹⁰, their positive impact on clinical and preventive performance needs further research as implementing best practices for chronic illness management shows little success.¹¹ While it has been claimed that all organizational components are important, it would be informative to get better insight into the relative value of different domains. For instance, a study on diabetes care in 17 centres found that 'delivery system design' was positively correlated to outcomes, whereas 'clinical information systems' and 'self-management support' were not significantly associated.⁶

This paper focuses on cardiovascular risk management (CVRM) in patients with coronary heart diseases (CHD) in primary care across Europe. CHD is a condition with high morbidity and mortality worldwide.¹² Practice guidelines with recommendations for effective secondary preventive therapy are widely available.^{13,14} Although the effects of anti platelet therapy and of control of blood pressure and serum cholesterol levels are beyond discussion, research showed that preventive treatment is suboptimal in Europe and the US.^{15,16} Preventive treatment for patients with established CHD is mostly delivered in primary care, especially in countries with a strong primary care oriented health care system. Substantial variation is observed regarding CVRM received by patients. We expect better health care organization to be related to a higher quality of care. The aim of our study was to examine which factors of organization of a primary care practice are associated with quality of CVRM in CHD patients.

Methods

1
2
3 This study was part of the EPA Cardio project, an international observational study on cardiovascular
4 risk management in 10 European countries.¹⁷ The participating countries comprised a convenience
5 sample: Austria, Belgium, England, Finland, France, Germany, the Netherlands, Slovenia,
6
7 Switzerland, and Spain. In stratified samples of primary care practices in each of these countries
8
9 randomly sampled medical records were reviewed to provide data on cardiovascular risk management
10
11 and structured questionnaires among participating general practitioners were used to provide data on
12
13 practice organization. Practices were stratified according to urbanization and size sampling based on
14
15 regional or national lists of practices; in Austria and Switzerland a convenience sample was included.
16
17 Patients were included based on coded diagnoses in most countries; in Austria prescription lists were
18
19 used to include patients and in France patients visiting the practice were included when eligible. Data
20
21 collection took place in 2008-2009.
22
23
24
25
26

27 *Indicators for cardiovascular risk management*

28
29 Data from medical records were linked to internationally validated indicators on cardiovascular risk
30
31 management, which were developed in a structured Delphi procedure.¹⁸ Primary care physician panels
32
33 from nine countries initially evaluated 650 indicators for cardiovascular risk management. This
34
35 resulted in a core set of 44 indicators, which were then operationalized in specific measures and tested
36
37 in a pilot study.¹⁹ This study is based on performance indicators related to preventive treatments in
38
39 CHD patients. Data were obtained from patient medical records. The first indicator was an aggregate
40
41 score which indicated the number of risk factors recorded per patient. Risk factors considered were:
42
43 smoking behaviour, body mass index, physical activity, blood pressure, and cholesterol levels (range
44
45 0-5). Five other indicators, all dichotomous, were: a record of anti platelet therapy unless
46
47 contraindicated, influenza vaccination offered, systolic blood pressure (SBP) <140 mmHg, diastolic
48
49 blood pressure (DBP) <90 mmHg, and LDL cholesterol <2.5 mmol/l.
50
51
52
53

54 *Organization of primary practice*

55
56 A large set of questions on practice organization was included in structured questionnaires, which
57
58 were partly administered in written form and partly in interviews with the general practitioner in the
59
60

1
2
3 participating practices who was the research participating contact person. These questions mainly
4
5 comprised items from the European Practice Assessment (EPA) instrument. This EPA instrument was
6
7 previously validated in an international project.²⁰ We constructed post hoc measures by linking items
8
9 to one of the six domains of the Chronic Care Model as published before.²¹ All items were formulated
10
11 positively, with 'yes' indicating the presence of a characteristic. We dichotomised all answers as either
12
13 'yes' or 'no', the latter consisting of 'no', 'missing value', or 'not applicable'. The aggregated scores
14
15 of the following five CCM domains were positively correlated: 'health care organization' (seven
16
17 items), 'delivery system design' (15 items), 'decision support' (three items), 'clinical information
18
19 systems' (six items), and 'self-management support' (four items). These correlations were highly
20
21 significant with Spearman's rho values varying from 0.2 to over 0.6. ~~In addition~~For that reason, an
22
23 overall measure of structured chronic care was defined with a scale from 0 to 5, with equal weight for
24
25 each CCM domain. Factor analysis showed a Cronbach's alpha of 0.74. One CCM domain,
26
27 'community resources and policies' (four items), was left out of the overall score due to difference in
28
29 focus and lower correlation with other domains.
30
31

32 33 *Data-Analysis*

34
35 In order to examine the associations between practice organization and performance indicators we
36
37 applied multilevel regression analyses, using indicators for cardiovascular risk management as
38
39 outcomes. Age and gender were included as explanatory variables (covariates) at the patient level. The
40
41 second level was the practice level at which the organizational measures were specified. On this level,
42
43 we entered two factors: the domain 'community resources and policies' was a predictor in all analyses;
44
45 furthermore we entered either one of the five other domains or the overall aggregated score. The third
46
47 level was the country level (as a fixed factor). The analyses were performed for each of the six
48
49 outcomes separately. The risk factor recording was analyzed in a linear regression model, while the
50
51 dichotomous outcomes, antiplatelet therapy, influenza vaccination, blood pressure and cholesterol
52
53 levels, were handled in binomial logistic regression models. We considered p-values of 0.05 or less to
54
55 indicate statistical significance. Patients with a missing value were ignored for that outcome. For the
56
57 descriptive data presentation we used SPSS 16; the regression analyses were conducted using SAS9.
58
59
60

Results

From the 284 practices in the EPA Cardio study 11 practices were excluded due to low numbers of patients. We included 273 primary care practices with data on 4563 patients (Table 1). The number of practices varied from 12 in Finland to 36 in England and Spain. Overall, one third of the patients was female; in Switzerland and Belgium less than 25%; in Finland and England about 38%. On average patients were over 69 years of age. Patients in Spain were on average the eldest: over 73 years of age. Table 2 presents figures on performance indicators. Overall performance varied from 46% of the maximum score for LDL treatment target and 60% for systolic treatment target up to 87% for antiplatelet therapy and diastolic treatment target.

Table 3 presents the results of the regression analyses. Overall better practice organization was associated with more reliable risk factor registration ($B=0.0307$, $p<0.0001$), antiplatelet prescribing ($OR=1.0533$, $p=0.0245$), and influenza vaccination ($OR=1.1246$, $p<0.0001$). The same associations were found for the component 'clinical information systems'. The component 'self-management support' was associated with better risk factor registration ($B=0.1676$, $p<0.0001$), influenza vaccination ($OR 1.55$, $p=0.0004$), and LDL treatment target ($OR 1.15$, $p=0.0252$). The component 'delivery system design' was associated with better risk factor registration ($B=0.0352$, $p=0.0002$) and vaccination ($OR 1.13$, $p=0.0036$). The domains 'health care organization' and 'decision support' were associated with influenza vaccination only. The domain 'community resources and policies' was found to be associated with DBP.

Discussion

Main results

A primary care practice with overall better practice organization showed better had higher performance-scores- for risk factor registration, anti-platelet prescription and influenza vaccination in CHD patients. A better organization of 'self-management support' and 'clinical information systems' was also found to be associated with higher scores on three performance indicators. These findings

1
2
3 support the belief that practice organization has impact on quality of CVRM in CHD patients across
4 different healthcare systems; although the observational design does not allow causal inferences.

5
6
7 In Table 4 we illustrate the potential impact of the associations found in our study. It illustrates that the
8 difference between the difference between a poorly organized practice and a well organized practice
9 was associated with smaller and larger impact on clinical performance. It presents the estimated
10 outcome in a primary care practice with every predictor average except one, varying this predictor
11 from a 10th percentile score to a 90th percentile score (to avoid focus on the extremes). With the
12 largest difference as a clear example, an average patient in an otherwise average practice on the lower
13 end (10th percentile) regarding self-management support has a 50% chance of receiving an influenza
14 vaccination as opposed to a patient in a practice on the better end of the range (90th percentile) having
15 a 79% chance of receiving an influenza vaccination.

16
17
18
19
20
21
22
23
24
25 The findings related to organizational domain ‘self-management support’ were of particular interest,
26 given the current focus on self-management in the health policies of many countries. In our study the
27 domain related to having information leaflets available in the practice concerning cardiovascular
28 diseases CVD (e.g. CHD, stroke, hypertension, stop smoking etc); presence of a directory of
29 prevention activities/organizations locally available (e.g. gyms, walking group, weight-watchers);
30 offering written information on life style regularly; and offering advice about websites for education
31 on health risks or healthy life style regularly. It is encouraging that such practical items are indeed
32 associated with better clinical processes, although the causality remains unknown.

33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
The organizational domain ‘clinical information system’ referred to access to internet and email in the
practice, virus protection, use of a pass word, use of a computer-supported patient file system, and
computer-generated medication prescriptions. As data on clinical performance depended on medical
records, we actually measured to some extent not only performance but also quality of recording.
Optimal use of computerized medical record systems leads to better scores for both practice
organization and clinical performance. But as CVRM mainly is a collaborative task, health care
professionals need to be able to rely on the data recorded.

Table 4 illustrates that the difference between a rather poor score and a good score on an
organizational domain may improve the outcome by only 2-6% or as much as up to 30%. It presents

1
2
3 the estimated outcome in a primary care practice with every predictor average except one, varying this
4 predictor from a 10th percentile score to a 90th percentile score (to avoid focus on the extremes). For
5 instance, an average patient in an otherwise average practice on the lower end (10th percentile)
6 regarding self-management support has a 50% chance of receiving an influenza vaccination as
7 opposed to a patient on the better end of the range (90th percentile) having a 79% chance of receiving
8 an influenza vaccination.
9

10 11 12 13 14 15 16 17 *Related research*

18
19 While the relevance impact of a well organized practice organization mainly concerned aspects of
20 preventive procedures performance related to the process (risk factor registration, drug prescription,
21 and vaccination) rather than intermediate outcomes of healthcare indicators as risk factor scores (blood
22 pressure and cholesterol levels),²¹ However, it should be noted that better prescribing of antiplatelet
23 therapy has a well-assessed effect on cardiovascular events and mortality.²² Likewise, the benefits of
24 influenza vaccination in preventing complications are well-documented and guidelines recommend
25 vaccination to patients with cardiovascular diseases.^{13,14, 23} This suggests implies that better
26 organization of primary care was indeed associated with improved survival and fewer cardiovascular
27 events in patient with CHD.
28
29

30
31 Previous research found associations between has shown that various domains of practice organization
32 and impacts on indicators of clinical performance,^{4-10,24,25} A and a systematic review of trials of
33 implementing service organisational interventions in CHD patients in primary care found limited
34 evidence for weak evidence for effectsiveness related to on outcomes such as blood pressure and
35 serum cholesterol levels.²⁶
36

37
38 In our explorative analysis of the relevance of When testing the various organizational domains, we
39 found differential that not all domains had equal effects on performance. The components 'self-
40 management support' and 'clinical information system' were found proved to be most consistently
41 related to cardiovascular risk management. We cannot rule out the possibility that our measures of
42 these domains may have been more accurate than those of other domains or that the participating
43 primary care practices had specific characteristics explaining the findings. On the other hand, both
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 clinical information system and self-management are directly linked to decisions and behaviours of
4 ~~patients-clinicians~~ and ~~-clinicianspatients~~, which have known impact on cardiovascular risk. [Clinical](#)
5 [information systems may be crucial because its well known contribution to the other domains. Self-](#)
6 [management support is the one domain targeting the patient, offering another aspect than the care and](#)
7 [practice related domains.](#)
8
9 [The question is how the impact of organization of healthcare on \(intermediate\) patient outcomes can](#)
10 [be optimized. Our study may have missed the power to detect small effects. Further down the line](#)
11 [\(system, process, patient outcomes\) more factors become relevant and influential and to prove effect](#)
12 [of care domains subsequently becomes more difficult.](#)

23 *Strengths and weaknesses*

24
25 ~~The international character of our study provided control for contextual confounders, such as specific~~
26 ~~reimbursement system or national policies.~~ The EPA Cardio study was based on random sampling of
27 patients using well developed measures of cardiovascular risk management and practice organization,
28 [although the measure of CCM was post-hoc constructed. The international character of our study](#)
29 [contributed to its generalizability and provided control for contextual confounders, such as specific](#)
30 [reimbursement system or national policies.](#) The sampling of countries and practices had limitations
31 with respect to representativeness, [but provided arguably more generalizable evidence than many trials](#)
32 [of organizational changes in healthcare.](#) In the ~~patient~~ samples ~~women female patients-seemed~~ ~~may be~~
33 ~~slightly~~ underrepresented. In various national databases male CHD prevalence is 1.5 to 2 times the
34 female prevalence.²⁷⁻²⁹ [Particularly in Belgium and Switzerland low numbers of female s were](#)
35 [included which cannot be accounted for. We suggest that the impact of this on our result was limited,](#)
36 [because had data on sex and age were controlled for in and entered these data as independent factors](#)
37 [the analyses in our models.](#) A further limitation was that the measures of the CCM were post-hoc
38 constructed.

56 *Conclusion*

1
2
3 Our observational study provided data from a real life situation in contrast with many trials of
4 organizational changes in primary care. We found that a better organized practice, measured in terms
5 of implementation of the Chronic Care Model, had better clinical processes in the targeted
6 cardiovascular domain. Most notably, we found that with many trials of organizational changes in
7 primary care to academic settings or trial results with controlled interventions. We found that a better
8 organized practice, measured in terms of implementation of the Chronic Care Model, had better
9 clinical processes in the targeted cardiovascular domain. High scores appear to be possible on all
10 outcomes, yet improvements in primary care for CHD patients are possible throughout our country
11 sample. Working according to CCM principles is positively related to better quality of care, especially
12 on process outcomes on most outcomes. Most notably, we found that This accounts especially for the
13 domains 'clinical information systems' and 'self-management support' were relevant. The impact on
14 cardiovascular outcomes was less obvious, which may be due to a range of factors. Nevertheless,
15 'Self-management support' is the mainstay of the CCM, making the patient a real partner in patient
16 practice collaboration. As the use of computerization is involved in all other domains the domain
17 'clinical information systems' is essential as well. Its effects proved to be significant in this study,
18 which involved ten countries with different health care organizations, adding to the importance of
19 these domains and robustness of the findings. This study reinforces the importance of strengthening
20 the organization of primary care practices for improving their clinical performance.
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Authors contributions:

JvL had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. JvL led decisions about content and submission. All authors contributed to data analysis and interpretation, and the writing and editing of the report. All authors approved the final version of the report.

Licence for publication:

The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all authors, an exclusive licence (or non exclusive for government employees) on a worldwide basis to the BMJ Publishing Group Ltd and its Licensees to permit this article (if accepted) to be published in BMJ editions and any other BMJ PGL products and sublicences to exploit all subsidiary rights, as set out in our licence (<http://resources.bmj.com/bmj/authors/checklists-forms/licence-for-publication>)."

Acknowledgements:

The following individuals were part of the EPA Cardio group: Stephen Campbell ((UK), Ester Cornelis (Belgium), Glyn Elwyn (UK), Reinhold Glehr (Austria), Margalit Goldfracht (Israel), Hector Falcoff (France), Beat Künzi (Switzerland), Lilian Michlig (Switzerland), Esko Kumpusalo (Finland), Janko Kersnik (Slovenia), Kati Kettunen (Finland), Solene Martin (France), Davorina Petek (Slovenia), Ingrid Pichler (Austria), Martin Roland (UK), Marianne Samuelson (France), Veerle van der Stighelen (Belgium), and Trudy van der Weijden (Netherlands).

Statistical analyses were performed by Jan Mulder and Jan Koetsenruijter .

Competing interests:

All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

Funding:

The study was supported by a grant from the Bertelsmann Foundation, Gütersloh, Germany. The Bertelsmann Foundation had no involvement in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

Ethical approval:

Ethical approval was waived in some countries and obtained in other countries.

[The ethical committees with references for the approvals granted](#) where appropriate:

[Austria: Med Uni Graz, Auenbruggerplatz 2, A-8036 Graz, Prof Peter Rehak; Belgium: Commissie Medische Ethiek UZ Leuven, Campus Gasthuisberg, Herestraat 49, B-3000 Leuven; Finland: Ethics committee of the Kuopio University Hospital, Kuopio, Finland; France: Ethic Committee \(Comité de Protection des Personnes Île-de-France V, Hôpital Saint-Antoine 184, rue du Faubourg Saint-Antoine 75012 Paris; Germany: Ethics committee University Hospital: "Medizinische Fakultät Heidelberg", Alte Glockengießerei 11/1, D-69115 Heidelberg \(S-413/2007\); The Netherlands: Ethics committee CMO Region Arnhem-Nijmegen; Slovenia: Slovenian national committee on medical ethics \(No 87/11/07\); Spain: Scientific committee of IDIAP Jordi Gol \(Catalan Primary Care Research Institute Jordi Gol\), Barcelona, Catalonia, Spain; Switzerland: KEK - Kantonale Ethikkommission, Bern; The United Kingdom: North West Research Ethics Committee: 07/H1010/83](#)

Data sharing:

No additional data available.

References

- 1 Improving chronic illness care. <http://www.improvingchroniccare.org/>. Accessed 24 February 2012.
- 2 Bodenheimer T, Wagner EH, Grumbach K. Improving Primary Care for Patients With Chronic Illness. *JAMA*. 2002;288(14):1775-1779.
- 3 ACEP Board of Directors. The Patient-Centered Medical Home Model. *Ann Emerg Med*. 2009;53(2):289-291.
- 4 Tsai AC, Morton SC, Mangione CM, et al. A meta-analysis of interventions to improve care for chronic illnesses. *Am J Manag Care*. 2005;11(8):478-488.
- 5 Friedberg MW, Coltin KL, Safran DG, et al. Associations between structural capabilities of primary care practices and performance on selected quality measures. *Ann Intern Med*. 2009;151(7):456-463.
- 6 Sperl-Hillen JM, Solberg LI, Hroschikoski MC, et al. Do all components of the chronic care model contribute equally to quality improvement? *Jt Comm J Qual Saf*. 2004;30(6):303-309.
- 7 Koelling TM, Johnson ML, Cody RJ, Aaronson KD. Discharge education improves clinical outcomes in patients with chronic heart failure. *Circulation*. 2005;111(2):179-185.
- 8 Bosworth HB, Olsen MK, Grubber JM, et al. Two self-management interventions to improve hypertension control: a randomized trial. *Ann Intern Med*. 2009;151(10):687-695.
- 9 Demiris G, Afrin LB, Speedie S, et al. Patient-centered applications: use of information technology to promote disease management and wellness. A white paper by the AMIA knowledge in motion working group. *J Am Med Inform Assoc*. 2008;15(1):8-13.

1
2
3 10 Chaudhry B, Wang J, Wu S, et al. Systematic review: impact of health information technology on
4 quality, efficiency, and costs of medical care. *Ann Intern Med.* 2006;144(10):742-752.
5
6

7
8
9 11 Bernstein J. The elusive benefits of chronic care management. *Arch Intern Med* 2011; 171 (5), 466-
10 467.
11

12 12 World Health Organization. Cardiovascular diseases (CVDs). WHO, 2011.
13
14
15 <http://www.who.int/mediacentre/factsheets/fs317/en/index.html>. Accessed July 29, 2011.
16
17

18
19
20
21 13 Graham I, Atar D, Borch-Johnsen K, et al; European Society of Cardiology (ESC); European
22 Association for Cardiovascular Prevention and Rehabilitation (EACPR); Council on Cardiovascular
23 Nursing; European Association for Study of Diabetes (EASD); International Diabetes Federation
24 Europe (IDF-Europe); European Stroke Initiative (EUSI); Society of Behavioural Medicine (ISBM);
25 European Society of Hypertension (ESH); WONCA Europe (European Society of General
26 Practice/Family Medicine); European Heart Network (EHN); European Atherosclerosis Society
27 (EAS). European guidelines on cardiovascular disease prevention in clinical practice: full text. Fourth
28 Joint Task Force of the European Society of Cardiology and other societies on cardiovascular disease
29 prevention in clinical practice (constituted by representatives of nine societies and by invited experts).
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
Eur J Cardiovasc Prev Rehabil. 2007;14 (Suppl 2):S1-113.

14 Fraker TD Jr, Fihn SD, Gibbons RJ, et al; American College of Cardiology; American Heart
Association; American College of Cardiology/American Heart Association Task Force on Practice
Guidelines Writing Group. 2007 chronic angina focused update of the ACC/AHA 2002 Guidelines for
the management of patients with chronic stable angina: a report of the American College of
Cardiology/American Heart Association Task Force on Practice Guidelines Writing Group to develop
the focused update of the 2002 Guidelines for the management of patients with chronic stable angina.
Circulation. 2007;116(23):2762-2772.

1
2
3 15 Kotseva K, Wood D, De Backer G, et al; EUROASPIRE Study Group. EUROASPIRE III: a survey
4 on the lifestyle, risk factors and use of cardioprotective drug therapies in coronary patients from 22
5 European countries. *Eur J Cardiovasc Prev Rehabil*. 2009;16(2):121-137.
6
7

8
9
10
11 16 Chan PS, Oetgen WJ, Buchanan D, et al. Cardiac performance measure compliance in outpatients:
12 the American College of Cardiology and National Cardiovascular Data Registry's PINNACLE
13 (Practice Innovation And Clinical Excellence) program. *J Am Coll Cardiol*. 2010;56(1):8-14.
14
15

16
17
18
19 17 Wensing M, Ludt S, Campbell S, et al; EPA Cardio Project Group.
20 European Practice Assessment of Cardiovascular risk management (EPA Cardio): protocol of an
21 international observational study in primary care. *Implement Sci*. 2009;4:3.
22
23

24
25
26
27 18 Campbell SM, Ludt S, Van Lieshout J, et al. Quality indicators for the prevention and management
28 of cardiovascular disease in primary care in nine European countries. *Eur J Cardiovasc Prev Rehabil*.
29 2008;15(5):509-515.
30
31

32
33
34
35 19 Ludt S, Campbell S, Van Lieshout J, et al. Development and pilot of an internationally standardized
36 measure of cardiovascular risk management in European primary care. *BMC Health Services*
37 *Research*. 2011; 11(1):70.
38
39

40
41
42
43 20 Engels Y, Dautzenberg M, Campbell S, et al. Testing a European set of indicators for the
44 evaluation of the management of primary care practices. *Fam Pract*. 2006;23(1):137-147.
45
46

47
48
49 21 Van Lieshout J, Goldfracht M, Campbell S, et al. Characteristics of primary care in Europe which
50 contribute to chronic disease management: an observational study. *Br J Gen Pract*. 2011;61:25-31
51
52

1
2
3 22 Antithrombotic Trialists' Collaboration. Collaborative meta-analysis of randomised trials of
4 antiplatelet therapy for prevention of death, myocardial infarction, and stroke in high risk patients.
5
6 *BMJ*. 2002;324(7329):71-86.
7
8

9
10
11 23 Keller T, Weeda VB, van Dongen CJ, et al. Influenza vaccines for preventing coronary heart
12 disease. *Cochrane Database of Systematic Reviews* 2008, Issue 3. Art. No.: CD005050. DOI:
13 10.1002/14651858.CD005050.pub2.
14
15

16
17
18 24 Vargas RB, Mangione CM, Asch S, et al. Can a chronic care model collaborative reduce heart
19 disease risk in patients with diabetes? *J Gen Intern Med*. 2007;22(2):215-222.
20
21

22
23
24 25 Asch SM, Baker DW, Keeseey JW, et al. Does the collaborative model improve care for chronic
25 heart failure? *Med Care*. 2005;43(7):667-675.
26
27

28
29
30 26 Buckley BS, Byrne MC, Smith SM. Service organisation for the secondary prevention of ischaemic
31 heart disease in primary care. *Cochrane Database of Systematic Reviews* 2010, Issue 3. Art. No.:
32 CD006772. DOI: 10.1002/14651858.CD006772.pub2.
33
34

35
36
37 27 P Scarborough, P Bhatnagar, K Whickramasinge, et al. Coronary heart disease statistics 2010
38 edition. <http://www.bhf.org.uk/publications/view-publication.aspx?ps=1001546>. Accessed 24
39 February 2012.
40
41

42
43
44 28 Gommer AM, Poos MJJC. Prevalentie, incidentie en sterfte naar leeftijd en geslacht. In:
45 Volksgezondheid Toekomst Verkenning, Nationaal Kompas Volksgezondheid. Bilthoven: RIVM,
46 <<http://www.nationaalkompas.nl>> Nationaal Kompas Volksgezondheid\Gezondheid en ziekte\Ziekten
47 en aandoeningen\Hartvaatstelsel\Coronaire hartziekten, 7 december 2010.
48
49
50
51
52
53
54
55
56 <http://www.nationaalkompas.nl/gezondheid-en-ziekte/ziekten-en->
57
58
59
60

1
2
3 [aandoeningen/hartvaatstelsel/coronaire-hartziekten/cijfers-coronaire-hartziekten-prevalentie-](#)
4 [incidentie-en-sterfte-uit-de-vtv-2010/](#). Accessed 24 February 2012.
5
6
7

8
9 29 Robert Koch-Institut, Berlin 2011. Daten und Fakten: Ergebnisse der Studie "Gesundheit in
10
11 Deutschland aktuell 2009". <http://www.gbe-bund.de/>. Accessed 24 February 2012.
12
13

14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

Table 1

Countries, practices and patients included

Country	Number of practices	Number of patients	% female	Mean age
Austria	23	307	36.1	71.5
Belgium	23	269	23.6	66.8
England	36	540	38.0	67.9
Finland	12	245	38.4	72.1
France	25	346	27.9	68.5
Germany	26	463	36.9	69.0
Netherlands	35	507	29.1	69.4
Slovenia	35	822	35.8	68.2
Spain	36	722	37.0	73.3
Switzerland	22	342	22.4	67.8
Total	273	4563	33.4	69.5

Table 2

Indicators for cardiovascular risk management. Percentage of maximum score in risk factor registration (with standard deviation) and percentage of the patients with positive scores for the binary outcomes is shown (n= 4563 patients with [CHD](#)coronary heart disease).

	Risk factor registration (std. deviation)	Anti-platelet therapy	Influenza vaccination	SBP Systolic blood pressure <140 mmHg	DBP Diastolic blood pressure <90 mmHg	LDL cholesterol < 2.5 mmol/l
Austria	80.6 (18.6)	86.4	52.8	61.4	85.9	56.1
Belgium	80.8 (21.2)	90.7	89.2	55.9	85.2	44.8
England	87.5 (16.6)	92.0	86.7	69.7	95.9	65.5
Finland	70.1 (24.4)	93.2	72.5	50.2	84.4	65.8
France	81.4 (16.5)	90.4	59.1	58.9	89.5	38.2
Germany	80.4 (19.2)	67.5	71.5	58.0	81.3	30.4
Netherlands	59.8 (31.7)	85.2	96.4	43.6	85.7	45.1
Slovenia	77.4 (24.8)	93.9	31.8	56.8	79.8	38.2
Spain	58.1 (32.9)	80.2	67.5	72.8	96.1	45.9
Switzerland	76.8 (24.2)	95.3	55.2	65.4	87.2	46.3
Total	74.0 (26.8)	87.0	66.1	60.1	87.1	46.3

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

Table 3a Primary analyses of effects of practice organization characteristics on indicators of cardiovascular risk management

	Linear regression		Logistic regression									
	Risk factor registration		Antiplatelet therapy		Influenza vaccination		SBD<140 mmHg		DBD<90 mmHg		LDL<2.5 mmol/l	
	B	p	OR	p	OR	p	OR	p	OR	p	OR	p
Age	-0.0042	0.0207	1.0040	N.S.	1.0688	<.0001	1.0230	<.0001	0.9858	0.0036	0.9886	0.0035
Gender												
1 = female	0.0200	N.S.	1.7695	<.0001	1.0619	N.S.	0.9601	N.S.	0.9954	N.S.	0.7192	0.0001
2 = male												
<u>Chronic Care Model-</u> composite (score from 0 to 5)	0.0307	<.0001	1,0533	0.0245	1.1246	<.0001	1.0028	N.S.	1.0091	N.S.	1.0037	N.S.
Community resources and policies (n=4)	0.0084	N.S.	0,9049	N.S.	0.8513	N.S.	1,0078	N.S.	1.1556	0.0283	1.1035	N.S.

Table 3b Secondary analyses of effects of practice organization characteristics on indicators of cardiovascular risk management

	Linear regression		Logistic regression									
	Risk factor registration		Antiplatelet therapy		Influenza vaccination		SBD<140 mmHg		DBD<90 mmHg		LDL<2.5 mmol/l	
	B	p	OR	p	OR	p	OR	p	OR	p	OR	p
Health care organization (n=7)	0.0280	N.S.	1.0371	N.S.	1.1928	0.0243	0.9938	N.S.	0.9807	N.S.	0.9802	N.S.
Clinical information systems (n=6)	0.0498	0.0236	1.3192	0.0016	1.4768	0.0002	1.0575	N.S.	1.0558	N.S.	0.9627	N.S.
Self-management support (n=4)	0.1676	<.0001	1.0539	N.S.	1.5477	0.0004	0.9685	N.S.	- ¹		1.1469	0.0252
Decision support (n=3)	0.0685	N.S.	1.1954	N.S.	1.4338	0.0411	1.0767	N.S.	1.0664	N.S.	1.1165	N.S.
Delivery system design (n=15)	0.0352	0.0002	1.0597	N.S.	1.1342	0.0036	1.0022	N.S.	0.9763	N.S.	1.0033	N.S.

1
2
3
4
5 Legend. Results of regression analyses (B values and OR) with $p < 0.05$ as significance level, a three level model.

6
7 Three level model: outcomes on patient level with age and gender as covariates; practice characteristics was the next level and country the third level. Country
8 proved to be a significant factor in all analyses ($p < 0.0001$, data not shown).

9
10
11 3a practice level with two variables: 1. community resources and policies; and 2. the Chronic Care Model composite score of the other five domains,
12 comprising health care organization, clinical information systems, self-management support, decision support, and delivery system design.

13
14
15 3b practice level with two variables: 1. community resources and policies; and 2. one of the other five domains: health care organization, clinical information
16 systems, self-management support, decision support, or delivery system design. Only the estimates of these last domains are displayed in table 3b.

17
18
19 ¹ Analysis found no estimate.

20
21 [N.S. = not significant, significance level at \$p < .05\$](#)

22
23 [SBP = Systolic blood pressure](#)

24
25 [DBP = Diastolic blood pressure](#)

26
27 [LDL = LDL cholesterol level](#)

28
29 [B = Effect estimate in regression analysis](#)

30
31 [OR = Odds ratio](#)
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

Table 4

Estimated cardiovascular performance for practices with low or high scores on measures of practice organization .

	Performance indicators	Practice with low scores	Practice with high scores
CCM-composite	Risk factor registration	0.74	0.76
	Antiplatelet therapy	0.86	0.88
	Influenza vaccination	0.63	0.69
Clinical information systems	Risk factor registration	0.72	0.75
	Antiplatelet therapy	0.78	0.89
	Influenza vaccination	0.45	0.72
Self-management support	Risk factor registration	0.69	0.79
	Influenza vaccination	0.50	0.79
	LDL<2.5 mmol/l	0.44	0.48

Legend. Performance scores have a range from 0-1 (0=poor, 1= perfect). Low and /high scores on practice organization variables were defined as P10th and P90th percentile scores-values on the variable.

Box 1. Features of the Chronic Care Model

Community Resources and Policies	Provider organizations are linked to community-based resources, eg, exercise programs, senior centres, and self help groups.
Health Care Organization	Chronic care is seen as a priority with adequate reimbursement.
Self-management Support	Patients themselves become the principal caregivers, taught to manage their illnesses, with lifestyle issues under the direct control of the patient. Self-management support involves collaboratively helping patients and their families acquire the skills and confidence to manage their chronic illness, providing self-management tools, and routinely assessing problems and accomplishments.
Delivery System Design	Planned management of chronic conditions is separated from acute care. Non physicians support patient self-management, arrange for routine periodic tasks and ensure appropriate follow up.
Decision Support	Evidence-based clinical practice guidelines provide standards for optimal chronic care integrated into daily practice. Specialist expertise is available without full specialty referral. Guidelines are reinforced by educational sessions for practice teams.
Clinical Information Systems	Registries, a central feature of the chronic care model, are lists of all patients with a particular chronic condition in a health care organisation. Reminder systems help teams comply with practice guidelines. The system provides feedback showing how each professional is performing on chronic illness measures. Registries are used to plan both the individual patient care and the population-based care.