EXPLORING QUALITY AND OUTCOMES OF CARDIOVASCULAR PRIMARY CARE IN CATALONIA

EVA FRIGOLA CAPELL
Exploring quality and outcomes of cardiovascular primary care in Catalonia
For reasons of consistency within this thesis, some terms have been standardized throughout the text. As a consequence the text may differ in this respect from the articles that have been published.

The studies presented in this thesis have been performed at the Scientific Institute for Quality of Healthcare (IQ healthcare). This institute is part of the Nijmegen Centre of Evidence Based Practice (NCEBP), one of the approved research institutes of the Radboud University Nijmegen Medical Centre.

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Chapter 1

Introduction
This thesis addresses the management of patients with cardiovascular diseases in primary care, particularly coronary heart disease and chronic heart failure. Despite extensive research on the adoption of evidence based recommendations by family physicians, a better understanding remains warranted of the factors associated with quality and outcomes of cardiovascular primary care.

**Cardiovascular disease**

Cardiovascular disease (CVD) is the leading cause of death worldwide and has a major impact on both developed and developing nations, being responsible for nearly 30% of all deaths\(^1\). The two most prevalent CVDs are ischemic (coronary heart disease – CHD) and cerebrovascular diseases, which together are responsible of the 60% overall cardiovascular mortality\(^2\). Chronic Heart Failure (CHF) is a related, but different condition with high impact on mortality, quality of life and costs.

Mediterranean countries are characterized by substantially lower CHD mortality rates compared with Northern European countries\(^3\) and the United States\(^4\) given similar levels of the main cardiovascular risk factors in the population (the "Mediterranean paradox")\(^5\). It has been hypothesized that regional factors may confer protection\(^6\), such as the Mediterranean diet\(^7\). Nevertheless, cardiovascular disease remains highly prevalent and important cause of death in Mediterranean countries. In Spain CVDs account for 32% of all deaths\(^2\) (28% male, 36% female). CHD is the most frequent cause of death (30%) and it is higher among male (37%) than in female (24%). In women fatalities due to cerebrovascular disease are more frequent (28% in female and 25% in male). Particularly in Catalonia, in 2008, CHF accounted for the third cause of death (total 5.13%, women 6.75%, men 3.55%), after ischemic diseases (total 7.94%, women 6.93%, men 8.94%) and lung cancer\(^8\). In Spain, as in other developed countries, there is a reduction in overall cardiovascular disease mortality. In Spain this reduction has been observed since the seventies and is higher for cerebrovascular disease (4%) than CHD (1.2%)\(^9\). It has been estimated that half of this decrease can be attribute to evidence-based medical therapies and half to reductions in major risk factors\(^10\).

Despite this reduction in mortality, the burden of CHD remains an important public health issue and also causes substantial disability, long-term dependence on health services and medications and loss of quality of life\(^11\). For instance, the hospitalization rate for CHD in Spain in 2007 was overall 317/100,000 inhabitants (447 in male and 189 in female)\(^2\). It is expected to become a heavier burden in the future due to an increase in life expectancy and improvement of survival rates
mainly due to implementation of evidence based therapies and risk factors management.

The prevalence of CHF is between 1 and 3% in developed countries and increasing with age\textsuperscript{12-15}. It is also a highly prevalent cause of hospitalization\textsuperscript{16,17}, accounting for 5% of acute hospital admissions and rises in patients older than 65 years\textsuperscript{12,18}.

CHF is a complex clinical syndrome which arises as a consequence of an abnormality in cardiac structure, function, rhythm or conduction\textsuperscript{19}. It is characterized by symptoms such as exertional breathlessness and fatigue, and signs of fluid retention as well as signs associated with the underlying cardiac disorder\textsuperscript{20} of which in developed countries ventricular dysfunction is the commonest.

CHF has many causes, of which CHD (systolic dysfunction) and hypertension (diastolic and systolic dysfunction) are the most prevalent. Consequently CHF does not occur in isolation. It is caused by an underlying cardiac defect or its cause, generally in elderly individuals, many of whom are being treated for other medical problems. The existence of many co-morbidities creates the potential for drug intolerance and interactions and poses major difficulties for their treatment. Furthermore most of the cardinal symptoms (dyspnoea and fatigue) and signs of CHF are non-specific, especially in elderly patients, and could be due to other co-existing health problems. Therefore this complicates the diagnosis of CHF, which initially takes place usually in the primary care to a family physician (FP).

Many health problems such as hypertension, hypercholesterolemia, diabetes mellitus and renal failure have been described to contribute to cardiovascular diseases. Also other risk factors related to lifestyle such as weight, diet, smoking and physical activity can also contribute to their prognosis.

Management of CVD and prevention of further cardiovascular events usually takes place in primary care. FPs usually face complex patients who are often elderly and frail due to co-morbidity and polypharmacy.

Evidence based recommendations for the management of patients with cardiovascular diseases are available in international clinical guidelines. Particular emphasis has been given to improving lifestyle (smoking cessation, physical exercise, diet and alcohol intake) and pharmaceutical treatment (statins, antihypertensive therapy and antiplatelet therapy).
Spanish National Health System (Spanish NHS)
The Spanish NHS provides universal coverage and is state funded through
general taxes. The system is divided into primary and secondary care. The
Spanish NHS has been decentralized into 17 Autonomous Communities or
regions that configure the Spanish State, each are in charge of health planning,
public health and healthcare services management\(^\text{21}\). There are minor differences
between these regions with respect of structure and administration across the
region\(^\text{22}\). For instance, in Aragon and Navarra all services are provided by the
state-funded regional service while in Catalonia, the provision of primary care
services is offered by different providers (state and non-state funded) among
which the Catalan Health Institute (ICS) is responsible for the provision of primary
care services to the 80\% of the Catalan population (7,210,508)\(^\text{23}\). In Spain, the
health promotion and preventive activities programme (PAPPS) developed by the
Spanish Society of Family Medicine (SemFYC) and adopted by the Spanish NHS
has integrated the international guidelines on cardiovascular prevention activities.
The "EUROPREV" (European Network for Prevention and Health Promotion in
Family Medicine and General Practice) was created to extend and coordinate the
experiences from the PAPPS program and to promote preventive services at
European level\(^\text{22}\).

Cardiovascular primary care in Catalonia
Primary care is organized as a network of large practices that behave as
geographical and administrative units and family physicians (from 4 to 36
physicians per practice depending on the number of patients listed at the practice)
are part of the staff, together with nurses, paediatricians, social workers, dentists
and ancillary staff\(^\text{22}\). Every citizen is registered with a family physician who acts as
a gatekeeper to specialized care. In 1990\(^\text{24}\) Catalonia initiated the implementation
of an integrated care program which consisted of medical specialists, such as
cardiologists, providing support on patient management (diagnosis, prescription,
follow up, continuum educational programs) to FPs in primary care practices
(PCPs). In PCPs, components of the six dimensions of the chronic care model\(^\text{25}\),
for chronic disease management, are implemented, particularly in ICS, the main
data source of this thesis. (1) In relation to healthcare organization, chronic care is
seen as a priority with procedures for the management of patient information in
relation to examination results, alerts in the electronic medical records for
reviewing medication prescribed, monthly and annual production of quality reports
among others. (2) In delivery system design, management of chronic conditions
are planned separated from acute care (i.e. case finding methods, recall of patients at risk, screening programs, prevention procedures). (3) Access to decision support systems such as electronic clinical guidelines are embedded into the electronic medical records. There is also access to peer-reviewed medical journals and to specialist expertise (either at the practice, by email or telephone). (4) Clinical information systems are implemented for medical records, prescription, referrals, examination requests and quality and safety management. (5) The organization encourages PCPs to implement self-management support activities (i.e. availability of leaflets about cardiovascular disease, directory of prevention activities available locally) as well as (6) participation of primary care professionals in the community (offering public health and risk reduction programs in the community for several conditions and age groups).

The Catalan Health Department, in partnership with health providers, patient representatives, professional bodies (primary care physicians and nurses), and other relevant associations (e.g. education and community) developed the National Health Care Plan. Particularly in the Health Plan 2002-2005, applicable to this thesis, several targets related to CVD and risk factors management were set up, also adopting the PAPPS developed by SemFYC. For instance reduction of mortality rates due to cardiovascular diseases, increase of appropriate prescription, better control of levels of cholesterol and systolic and diastolic blood pressure. Intervention programs to promote healthier life style were also set up, including smoking cessation, overweight and obesity and physical exercise targets. To ensure implementation of these standards to the whole of Catalonia, the health department created a new directorate for circulatory diseases in 2006. This directorate also included CVD management and prevention in primary care. This was a permanent structure managed by two cardiologists who were supported by an adviser committee formed by stakeholders representing health providers, patient representatives, professional bodies (primary care physicians and nurses) and other relevant associations across Catalonia. The added value of this directorate was its role in encouraging and supporting standards implementation across Catalonia.

The ICS adopted these recommendations by developing a wide continuum educational program for FPs, developing specific devises for their use in their electronic medical record system and as standards in their pay for performance outcomes framework policy for primary care.
Chapter 1

Current practice
Cardiovascular diseases, such as CHD and CHF constitute an important challenge for the health system. These are chronic conditions of complex patients, who tend to be old, have co-morbidities and polypharmacy. Although international clinical guidelines have been published the diagnosis and treatment of many of these patients remains suboptimal\textsuperscript{26,27}. For instance, in patients with CHF, international guidelines recommend widespread use of both angiotensin-converting enzyme inhibitors (ACEI) and beta-blockers (BB) to improve symptoms and survival unless a specific contraindication exists\textsuperscript{28,29}. However European research showed that although 60\% of patients were receiving an ACEI, only 20\% did so in combination with BB suggesting a substantial short-fall in treatment.

In many European countries the FP plays an important role in the detection, treatment and monitoring of patients with established CVD. Particularly, Catalonia has a strong primary care-orientated health care system\textsuperscript{30} acting as a first point of contact for patients and gatekeeper to specialist care; also it has a strong interface with specialist care. Primary care is conceived to be in a very good position to improve care delivery and outcomes of patients with an established CVD and service redesign such as implementation of the Chronic Care Model accounts for that. However there is a lack of epidemiological studies in CVD, community based, reporting on patient outcomes and professionals' performance and how these can be influenced by the implementation of chronic care management.

This thesis addresses current practice in the management of cardiovascular disease in primary care and has been divided in two sections. Section I explores the role of a number of organizational components in the management of patients with an established cardiovascular disease (CHD) in Europe and particularly in Catalonia. Section II describes patient outcomes (survival, hospitalizations) and professionals performance in patients with an established cardiovascular disease (CHF) managed in primary care in Catalonia.

Section I Analysis of organization of coronary heart disease primary care

Evidence based recommendations for improving lifestyle and pharmaceutical treatment have been incorporated as performance measures in several health quality frameworks.

Healthcare quality management also focused not just in the content but also in the delivery of such recommendations\textsuperscript{31}. Effectiveness of different strategies to improve delivery of care have been largely investigated\textsuperscript{32,33}. Evidence that
interventions with multiple strategies do better than single interventions is inconclusive. The right choice of interventions and measures probably depends on the topic, the setting, the target group and the problems encountered\textsuperscript{34}. Sometimes single interventions can be effective\textsuperscript{35} and in other cases a more complex intervention is needed\textsuperscript{36,37}. Chronic conditions treated in primary care requires an organizational structure allowing for population-based management. In this thesis we focus on several aspects of practice organization: the practice size and a range of organizational components that have been specified in the Chronic Care Model (CCM). We participated in an international research project on cardiovascular management, called the European Practice Assessment Cardio Project (EPA Cardio)\textsuperscript{38}. This international study allowed us to collect data on several practice organization factors implemented in different primary healthcare systems in Europe.

Practice size is an organizational characteristic that has been found to influence the delivery of services in primary care\textsuperscript{39-41}. However, we did not know how this could apply to the management of patients with chronic conditions such as cardiovascular diseases in terms of variation of care provided depending on practice size.

The CCM is a specific primary care orientated framework designed to organize and improve healthcare delivery for patients with chronic diseases. The CCM has been promoted as a unified package with six organizational components to be crucial to achieve high-quality healthcare for patients with chronic diseases: 'healthcare organization', 'delivery system design', 'decision support', 'clinical information systems', 'self-management support' and 'community resources and policies'\textsuperscript{25}. Although this framework is based on some research, its positive impact on clinical performance needs further investigation. We draw specific attention to the implementation of community resources as few studies have been found to judge its relative effectiveness on clinical performance\textsuperscript{42}.

Section II Analysis of current practice in chronic heart failure primary care

Primary care has an important role on the management of patients with CHF at population-based level. However, community epidemiological data reporting on the quality of CHF management in primary care at the level of patient outcomes (survival, hospitalizations and care received) were lacking when we initiated our research in 2007 in Catalonia. Most studies are clinical trials or studies including
patients after hospital discharge\textsuperscript{43} that do not represent the complexity of the management of patients with CHF in the primary care setting.

We conducted a population-based retrospective cohort study using the data collected in a project published in \textit{Clinical Trials database (NCT00792402)}. Briefly, this project used a non-equivalent controlled before and after quasi-experimental design with a population based approach to evaluate the impact of a clinical practice guideline on CHF in two regions of Catalonia. For the purpose of this thesis, we combined data from both study arms, the intervention (urban) and control (rural) regions. Despite urbanization differences, both regions shared same organizational features\textsuperscript{22}. This study offered the possibility to have access to a large dataset from two different settings (urban and rural) containing information from three regional (Catalonia) data sources: hospital admissions, mortality register and primary care electronic medical records. This dataset allowed a comprehensive evaluation of current practice in CHF management in primary care in our region which we present in this section.

We collected data from 2005 to 2007 on newly diagnosed patients over 30 years old, registered with the diagnosis code of CHF according to the International Classification of Diseases Tenth Revision used in primary care.

In this section, we describe trends on survival, hospitalization and determine the association of prescription of recommended treatment in patients with CHF and concomitant comorbidities with and without hospitalization. We also describe the impact of the following prognostic factors: patients' age, gender, hypercholesterolemia, hypertension, diabetes mellitus, ischemic heart disease, chronic obstructive pulmonary disease (COPD), and chronic kidney disease (CKD).
Table 1. Overview of research questions, methods and measures of the studies presented in this thesis

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<th>Research methods</th>
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<td>What is the actual quality of care of patients with coronary heart disease in primary care practices across countries? Is it associated to practice size?</td>
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<td>Do complex patients (according to the number of co-morbidities) with CHF receive equivalent care (prescription of recommended treatment) than patients with less complex diseases when managed in primary care?</td>
<td>Population-based retrospective cohort study</td>
<td>Medical record audit</td>
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Section I

Analysis of organization of coronary heart disease primary care
Chapter 2

Cardiovascular risk management in patients with coronary heart disease in primary care: variation across countries and practices. An observational study based on quality indicators

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Abstract

Background: Primary care has an important role in cardiovascular risk management (CVRM) and a minimum size of scale of primary care practices may be needed for efficient delivery of CVRM. We examined CVRM in patients with coronary heart disease (CHD) in primary care and explored the impact of practice size.

Methods: In an observational study in 8 countries we sampled CHD patients in primary care practices and collected data from electronic patient records. Practice samples were stratified according to practice size and urbanization; patients were selected using coded diagnoses when available. CVRM was measured on the basis of internationally validated quality indicators. In the analyses practice size was defined in terms of number of patients registered of visiting the practice. We performed multilevel regression analyses controlling for patient age and sex.

Results: We included 181 practices (63% of the number targeted). Two countries included a convenience sample of practices. Data from 2960 CHD patients were available. Some countries used methods supplemental to coded diagnoses or other inclusion methods introducing potential inclusion bias. We found substantial variation on all CVRM indicators across practices and countries. We computed aggregated practice scores as percentage of patients with a positive outcome. Rates of risk factor recording varied from 55% for physical activity as the mean practice score across all practices (SD 32%) to 94% (SD 10%) for blood pressure. Rates for reaching treatment targets for systolic blood pressure, diastolic blood pressure and LDL cholesterol were 46% (SD 21%), 86% (SD 12%) and 48% (SD 22%) respectively. Rates for providing recommended cholesterol lowering and antiplatelet drugs were around 80%, and 70% received influenza vaccination. Practice size was not associated to indicator scores with one exception: in Slovenia larger practices performed better. Variation was more related to differences between practices than between countries.

Conclusions: CVRM measured by quality indicators showed wide variation within and between countries and possibly leaves room for improvement in all countries involved. Few associations of performance scores with practice size were found.
Cardiovascular risk management in patients with coronary heart disease

Background
Many patients with chronic conditions are treated in primary care. This is challenging as high quality chronic care asks for an organizational structure allowing for population-based management. In previous research larger practice size tended to be related to higher quality of care considering various conditions with greater diversity of services\textsuperscript{1-5}. Furthermore, larger practices tended to show more features consistent with the delivery of chronic care\textsuperscript{6,7}. In many countries there is a tendency to develop larger practices\textsuperscript{8}. Increasing size of scale and scope may be, up to a certain point, associated with decreasing average costs of a service as fixed costs like participation in continued education and hiring additional staff are divided by a larger number of patients. From an educational perspective, a larger size of scale with more patients may be associated with larger opportunity to practice specific procedures, thus steeper learning curves and higher quality of performance. On the other hand, a smaller practice size may have advantages in terms of more personal care and continuity\textsuperscript{9}.

Cardiovascular diseases (CVD) have major impact on the mortality and health-related quality of life of people in both developed and developing countries. Despite a declining cardiovascular mortality, improvements in the preventive, medical and surgical treatment in previous decades, and widely accepted practice guidelines\textsuperscript{10-12}, CVD are still one of the major causes of death and illness. Primary care can play an important role in delivering cardiovascular risk management (CVRM) to populations, but previous research showed that not all eligible patients receive optimal prevention of atherosclerosis-related CVD\textsuperscript{13,14}. Many European countries therefore have adopted large scale programs for improving cardiovascular risk management, including pay-for-performance in the United Kingdom, disease management in Germany and practice accreditation in the Netherlands\textsuperscript{15}.

While data on CVRM are collected in a number of countries, mostly in specialized care settings\textsuperscript{13,14}, comparable data from primary care where many patients are treated and counselled, was lacking. We conducted an observational study of current CVRM in primary care in eight European countries, focused on patients with established coronary heart diseases (CHD)\textsuperscript{16}. In this paper we aimed to describe current practice across countries and to explore associations of practice size with CVRM measured by quality indicators.
Methods
Data were derived from the EPA Cardio study\textsuperscript{16}. In this cross-sectional observational study eight countries provided data on CVRM in primary care practices: Austria, Belgium, England, France, Germany, Netherlands, Slovenia and Switzerland. The country sample was a convenience sample from the countries participating within the EQuIP framework and included countries with a strong and with a weak position of primary care within the national health care system, and both small and large countries\textsuperscript{17}. Countries with a strong primary care orientation were England, the Netherlands, and Slovenia; in the other countries primary care held a weaker position within the health care organization\textsuperscript{15,18}. Data from patient records were gathered in 2008 and 2009. Ethical approval for the study has been obtained in each of the participating countries, according to national laws and regulations. A detailed study protocol has been published\textsuperscript{16}. Stratified random sampling of 36 practices per country was planned, involving two factors: practice location (up to versus more than 100,000 inhabitants) and practice size (up to two versus two or more full time equivalent physicians working in the practice). The relative contribution of each stratum should mirror the national situation and each country had the option to add strata in order to better reflect the national context. Four countries used this possibility: in England large practices were split in up to and more than five GPs; in the Netherlands small practices were split in single handed and duo; and in Germany and Slovenia the stratum up to 100,000 inhabitants was split in up to and more than 40,000 inhabitants. The number of practices – in relation to the patient numbers – was based on calculations of statistical accuracy, as described in the study protocol based on the detection of significant differences between indicator scores between two countries\textsuperscript{16}. It was calculated that 36 practices per country with data on 15 patients per practice would suffice for this goal. Furthermore, earlier experiences with international comparative data showed that 30-40 practices can provide a reasonably good representation of the national situation\textsuperscript{19}.

Patient population
We aimed at including 15 patients with established CHD per practice, including patients with myocardial infarction, angina pectoris or coronary interventions. Patients with diabetes were excluded because diabetes care and care for CHD patients are largely congruent. With diabetes patients included our results in part would be determined by diabetes care. In each practice a list of eligible patients was made, preferably based on coded diagnoses in the data files of patients
Cardiovascular risk management in patients with coronary heart disease registered with the practice. Then a random sample of 30 patients was taken from this list of CHD patients anticipating a 50% response rate. As variation across countries was anticipated related to the possibilities to generate patient lists, as second choice, other methods were allowed, for instance going through patient lists or simply by recalling patients. In Belgium, England, the Netherlands and Slovenia patient selection was exclusively based on recorded diagnoses. Apart from coded diagnoses, in Germany and Switzerland, the GP selected extra patients by recalling CHD patients in practices with less than 30 patients with a coded diagnosis of CHD. In two countries it appeared impossible to select patients based on coded diagnoses. In Austria, patient selection was based on going through prescription lists. In France, primary care physicians included eligible patients when they visited the practice. For this study we excluded practices with data on less than 8 CHD patients.

**Measures**

Measures were linked to a set of rigorously developed performance indicators for CVRM\(^20\). To develop these indicators we used a RAND Modified Delphi procedure with two rounds of consensus, with 101 general practitioners from nine countries involved in the consensus process. From an original list of 650 indicators derived from the scientific literature, we first identified and edited 186 unique indicators. After two rounds of consensus 17 indicators relevant for patients with established CHD were selected; for 11 out of these 17 indicators data could be collected by extraction from medical records. These indicators comprised the registration of risk factors (smoking status, physical activity capacity, weight or body mass index, blood pressure, and serum cholesterol), advice on physical activity, influenza vaccination, antiplatelet and statin drug therapy prescribed or offered, systolic and diastolic blood pressure below threshold (140 and 90 mmHG respectively). Though not identified as a key-indicator we also present data on LDL-cholesterol levels because these data are widely seen as an important treatment goal\(^{10-12}\). All measures were systematically translated into the different countries’ languages, with established procedures of forward and backward translation and a pilot testing. The final instrument to collect the data from the patient records was tested and adapted in a pilot project in five countries including two practices\(^21\).

**Analysis**

We calculated descriptive figures per practice providing data on practice size and CVRM. For each practice the percentages of patients with a positive score on
indicators were assessed; patients with a missing value were excluded for this outcome measure. We determined the mean scores across practices per country with standard deviations, implying that each practice had equal weight irrespective of the number of patients included. We tested whether the country means deviated significantly from the grand mean, using two-sided t-tests considering Levine's test results. As the analyses of country differences are explorative a threshold value of p<0.01 was chosen to reduce the possibility of chance capitalization.

Based on the reported practice size – patient list size when available, otherwise yearly attending patient numbers – using a logistic multilevel regression analysis we assessed the association between indicator scores and practice size per country with two levels: a patient and a practice level. Age and gender were independent variables in the first level (patient level). In these analyses practice size was based on patient number as a continuous factor and not on the number of GPs in the practice what was used only for easy definition of stratification groups.

Furthermore, we performed a three level logistic regression analysis with country as a fixed factor in the third level. For this analysis we standardized practice size per country. With this methodology we corrected for the differences in practices sizes between the countries as we were not interested in country differences but in the effect of practices size across countries. Furthermore, this transformed patient numbers to comparable data in all countries, even comparing countries with numbers from patients lists and countries with numbers of attending patients. We assessed the association between practice size and indicator scores across all countries and across the countries with a strong and a weak primary care system apart. Related to practice size we hypothesized that larger practices would perform better; for these hypothesis driven analyses we used p<0.05 as threshold for significance.

We assessed the contribution of practices and of countries to the variance in scores on the performance indicators. The Intra Class Coefficients were computed based on the methodology described by Twisk\textsuperscript{22}. SPSS 16 was used for descriptive analysis and t-tests, SAS for random coefficient regression modelling.
Results
In several countries it appeared impossible to include 36 practices. Finally 232 practices participated (81% of the number aimed at). We excluded 51 practices because they did not provide data on practice size (n=14), included less than eight CHD patients (n=33), or both (n=4). In this study we included 181 practices. In Austria and Switzerland a convenience sample of practices participated; in Belgium, additional to practices from a list, four practices were included after they were personally contacted by the researchers. All other countries worked with national or regional practice lists. Practices in Austria, Germany, and Switzerland reported on the yearly attending population; in the other countries practice size was based on the number of patients listed.

The 181 practices included provided data on 2960 patients, on average 16.4 per practice. Overall 33% of the patients included were female and the overall mean age was 68.7 years (see Table 1).

Table 1. Practice sample and demographic data

<table>
<thead>
<tr>
<th>Practice</th>
<th>Practices (n)</th>
<th>Mean practice size (SD)</th>
<th>Patients (n)</th>
<th>% female</th>
<th>Mean age (years)</th>
</tr>
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<tbody>
<tr>
<td>Austria</td>
<td>23</td>
<td>2878* (1369)</td>
<td>293</td>
<td>36</td>
<td>71.6</td>
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<td>Belgium</td>
<td>18</td>
<td>3035 (2363)</td>
<td>232</td>
<td>25</td>
<td>66.7</td>
</tr>
<tr>
<td>England</td>
<td>32</td>
<td>6573 (3655)</td>
<td>479</td>
<td>39</td>
<td>68.2</td>
</tr>
<tr>
<td>France</td>
<td>9</td>
<td>1417 (754)</td>
<td>133</td>
<td>26</td>
<td>67.8</td>
</tr>
<tr>
<td>Germany</td>
<td>13</td>
<td>4423* (1608)</td>
<td>248</td>
<td>35</td>
<td>70.0</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>34</td>
<td>3183 (1215)</td>
<td>495</td>
<td>29</td>
<td>69.3</td>
</tr>
<tr>
<td>Slovenia</td>
<td>35</td>
<td>2059 (804)</td>
<td>805</td>
<td>36</td>
<td>68.3</td>
</tr>
<tr>
<td>Switzerland</td>
<td>17</td>
<td>3449* (2537)</td>
<td>275</td>
<td>24</td>
<td>68.2</td>
</tr>
<tr>
<td>total</td>
<td>181</td>
<td>3538 (2582)</td>
<td>2960</td>
<td>33</td>
<td>68.7</td>
</tr>
</tbody>
</table>

* Practices size provided by practices as number of yearly attending patients; in all other countries as number of patients listed.

Cardiovascular risk management
Regarding cardiovascular risk factor recording, the percentage of missing values was consistently 3 to 4%. The mean practice score of recording physical activity capacity was, on average, about 50% (see Table 2). Overall, blood pressure recording had the highest score (94%), followed by cholesterol levels (87%). Standard deviations are indicative of the differences between practices.

Indicators concerning achievement of target values for SBP, DBP and LDL, considering the most recent measurements, are displayed in Table 3. We had data of about 90% of the patients. Overall, the mean practice score on the indicator DBP below 90 mmHg was 85%, and on SBP and LDL cholesterol about 45%. On average the scores on the recommended cholesterol lowering and anti-platelet
drug treatment were 80%. The practice mean score on influenza vaccination was less than 70%.

Risk factor recording in general was below the mean in the Netherlands; in England most factors were recorded significantly more often. The other countries showed less deviations from the grand mean scores (see Table 2).

Table 2. Indicator scores: risk factor recording

<table>
<thead>
<tr>
<th>Smoking status</th>
<th>Physical activity</th>
<th>Weight / BMI</th>
<th>Blood pressure</th>
<th>Serum cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>Mean 100↑</td>
<td>50.6</td>
<td>61.4</td>
<td>94.2</td>
</tr>
<tr>
<td></td>
<td>SD 0</td>
<td>31.2</td>
<td>33.0</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>p .000</td>
<td>.566</td>
<td>.311</td>
<td>.957</td>
</tr>
<tr>
<td>Belgium</td>
<td>Mean 76.7</td>
<td>52.6</td>
<td>84.4↑</td>
<td>98.0↑</td>
</tr>
<tr>
<td></td>
<td>SD 29.0</td>
<td>34.5</td>
<td>15.1</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>p .708</td>
<td>.805</td>
<td>.001</td>
<td>.004</td>
</tr>
<tr>
<td>England</td>
<td>Mean 94.8↑</td>
<td>64.1</td>
<td>82.9↑</td>
<td>98.3↑</td>
</tr>
<tr>
<td></td>
<td>SD 10.0</td>
<td>29.4</td>
<td>22.1</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>p .000</td>
<td>.121</td>
<td>.003</td>
<td>.000</td>
</tr>
<tr>
<td>France</td>
<td>Mean 79.4</td>
<td>46.0</td>
<td>90.9↑</td>
<td>96.2</td>
</tr>
<tr>
<td></td>
<td>SD 21.5</td>
<td>39.6</td>
<td>11.0</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>p .983</td>
<td>.439</td>
<td>.000</td>
<td>.555</td>
</tr>
<tr>
<td>Germany</td>
<td>Mean 92.5↑</td>
<td>55.6</td>
<td>65.2</td>
<td>96.3</td>
</tr>
<tr>
<td></td>
<td>SD 9.9</td>
<td>41.5</td>
<td>33.3</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>p .001</td>
<td>.933</td>
<td>.662</td>
<td>.462</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Mean 57.2↓</td>
<td>41.7↓</td>
<td>44.6↓</td>
<td>82.0↓</td>
</tr>
<tr>
<td></td>
<td>SD 28.3</td>
<td>27.7</td>
<td>27.3</td>
<td>15.8</td>
</tr>
<tr>
<td></td>
<td>p .000</td>
<td>.030</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Slovenia</td>
<td>Mean 76.5</td>
<td>60.0</td>
<td>70.8</td>
<td>97.4↑</td>
</tr>
<tr>
<td></td>
<td>SD 26.2</td>
<td>29.0</td>
<td>25.0</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>p .580</td>
<td>.358</td>
<td>.705</td>
<td>.021</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Mean 65.4</td>
<td>62.8</td>
<td>71.4</td>
<td>96.6</td>
</tr>
<tr>
<td></td>
<td>SD 38.1</td>
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<td>24.4</td>
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<td></td>
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<tr>
<td>Total</td>
<td>Mean 79.3</td>
<td>54.6</td>
<td>68.8</td>
<td>94.1</td>
</tr>
<tr>
<td></td>
<td>SD 27.5</td>
<td>32.2</td>
<td>28.8</td>
<td>10.4</td>
</tr>
</tbody>
</table>

Mean practice scores (%) per country and across countries with standardized variation. Scores significantly deviating from the mean of all countries are marked, with p values displayed.

Considering the outcomes advice on physical activity, influenza vaccination, antiplatelet and statin drug therapy, blood pressure and cholesterol levels (see Table 3) England again scored above the mean in 4 of the 7 outcomes. Here the Netherlands and Slovenia outperformed on one outcome, respectively influenza vaccination and antiplatelet drug therapy.
## Table 3. Indicator scores

<table>
<thead>
<tr>
<th>Advice/ contraindication physical activity</th>
<th>Influenza vaccination</th>
<th>Antiplatelet therapy if not contra-indicated</th>
<th>Statin recorded/offered</th>
<th>SBP below threshold(^1)</th>
<th>DBP below threshold(^2)</th>
<th>LDL below threshold(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Austria</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>61.1</td>
<td>49.9 ‡</td>
<td>86.4</td>
<td>78.8</td>
<td>46.7</td>
<td>86.0</td>
</tr>
<tr>
<td>SD</td>
<td>30.8</td>
<td>29.2</td>
<td>25.1</td>
<td>22.5</td>
<td>20.9</td>
<td>9.5</td>
</tr>
<tr>
<td>p</td>
<td>.062</td>
<td>.012</td>
<td>.739</td>
<td>.317</td>
<td>.850</td>
<td>.871</td>
</tr>
<tr>
<td><strong>Belgium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>39.3</td>
<td>90.7 ‡</td>
<td>90.1</td>
<td>85.8</td>
<td>55.4</td>
<td>85.0</td>
</tr>
<tr>
<td>SD</td>
<td>32.1</td>
<td>12.2</td>
<td>12.3</td>
<td>12.2</td>
<td>21.3</td>
<td>12.6</td>
</tr>
<tr>
<td>p</td>
<td>.317</td>
<td>.000</td>
<td>.553</td>
<td>.427</td>
<td>.065</td>
<td>.870</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>48.1</td>
<td>87.3 ‡</td>
<td>90.8</td>
<td>90.2 ‡</td>
<td>43.3</td>
<td>95.7 ‡</td>
</tr>
<tr>
<td>SD</td>
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<td>10.5</td>
<td>10.8</td>
<td>14.8</td>
<td>5.1</td>
</tr>
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<td>.000</td>
<td>.171</td>
<td>.002</td>
<td>.404</td>
<td>.000</td>
</tr>
<tr>
<td><strong>France</strong></td>
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<tr>
<td>Mean</td>
<td>45.7</td>
<td>50.7</td>
<td>88.0</td>
<td>86.4</td>
<td>61.4 ‡</td>
<td>90.2</td>
</tr>
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<td>SD</td>
<td>39.0</td>
<td>31.9</td>
<td>15.3</td>
<td>21.4</td>
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<tr>
<td>p</td>
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<td>.260</td>
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<td></td>
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<tr>
<td>Mean</td>
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<td>74.9</td>
<td>69.3 ‡</td>
<td>69.5 ‡</td>
<td>52.3</td>
<td>81.2</td>
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<tr>
<td>SD</td>
<td>45.0</td>
<td>31.4</td>
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<td>10.8</td>
</tr>
<tr>
<td>p</td>
<td>.497</td>
<td>.520</td>
<td>.023</td>
<td>.006</td>
<td>.282</td>
<td>.204</td>
</tr>
<tr>
<td><strong>Netherlands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>28.8 ↓</td>
<td>96.8 ‡</td>
<td>82.8</td>
<td>77.9</td>
<td>28.9 ↓</td>
<td>81.0 ↓</td>
</tr>
<tr>
<td>SD</td>
<td>22.9</td>
<td>5.8</td>
<td>18.2</td>
<td>15.9</td>
<td>15.6</td>
<td>12.7</td>
</tr>
<tr>
<td>p</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.046</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
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<td>33.3 ↓</td>
<td>92.9 ‡</td>
<td>84.2</td>
<td>46.0</td>
<td>80.2 ↓</td>
</tr>
<tr>
<td>SD</td>
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<tr>
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<td>.129</td>
<td>.120</td>
<td>.000</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>52.3</td>
<td>56.9</td>
<td>94.1</td>
<td>84.7</td>
<td>59.8 ‡</td>
<td>87.3</td>
</tr>
<tr>
<td>SD</td>
<td>38.9</td>
<td>28.1</td>
<td>9.9</td>
<td>15.2</td>
<td>23.4</td>
<td>11.5</td>
</tr>
<tr>
<td>p</td>
<td>.567</td>
<td>.159</td>
<td>.128</td>
<td>.625</td>
<td>.010</td>
<td>.570</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>47.4</td>
<td>68.8</td>
<td>87.7</td>
<td>82.7</td>
<td>45.8</td>
<td>85.5</td>
</tr>
<tr>
<td>SD</td>
<td>33.0</td>
<td>33.5</td>
<td>16.9</td>
<td>16.3</td>
<td>20.9</td>
<td>12.1</td>
</tr>
</tbody>
</table>

Mean practice scores (%) per country and across countries with standardized variation. Scores significantly deviating from the mean of all countries are marked, with p values displayed.

1. SBP below threshold: SBP<140 mmHg
2. DBP below threshold: DBP<90 mmHg
3. LDL below threshold: LDL<2.5 mmol/l

### Practice size

In the analyses per country practice size did not consistently correlate to the outcomes (data not shown). In Slovenia 4 of the 12 outcomes (recording of physical activity capacity and BMI or weight, advice or contraindication for physical activity, influenza vaccination) had a significant positive association with practice size; 7 outcomes were non-significant positive and one was non-significant.
negative. We found one other significant association: In England practice size and the indicator score related to influenza vaccination were negatively associated. For the outcome measure recording of physical activity capacity all countries showed a positive association, though significant only in Slovenia. Across all 8 countries we found no association between practice size and indicator scores. In countries with a strong primary care system practice size was positively associated with the score on influenza vaccination (OR 1.28, 95%CI 1.01–1.61) and negatively with the LDL cholesterol level score (OR 0.86, 95%CI 0.74–0.99). In countries with a weak primary care system we could not detect associations between practice size and outcomes. We assessed the relative contribution of practices and countries to the variance in indicator scores, the ICC scores (see Table 4). Of the indicator scores on SBP, DBP and LDL about 10% of the variance could be explained at the practice and country level together. In all other indicators more of the variance could be explained, about 15-30% at the practice level and up to 18% at the country level.

Table 4. Intra Class Coefficients

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Country level</th>
<th>Practice level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke status recorded</td>
<td>11.6</td>
<td>31.7</td>
</tr>
<tr>
<td>Physical activity capacity recorded</td>
<td>0.9</td>
<td>29.1</td>
</tr>
<tr>
<td>Weight or BMI recorded</td>
<td>7.6</td>
<td>24.7</td>
</tr>
<tr>
<td>Blood pressure recorded</td>
<td>16.4</td>
<td>28.4</td>
</tr>
<tr>
<td>Cholesterol recorded</td>
<td>17.0</td>
<td>19.3</td>
</tr>
<tr>
<td>Advice or contraindication for physical activity</td>
<td>2.1</td>
<td>28.6</td>
</tr>
<tr>
<td>Influenza vaccination</td>
<td>18.2</td>
<td>17.9</td>
</tr>
<tr>
<td>Antiplatelet therapy</td>
<td>6.1</td>
<td>26.1</td>
</tr>
<tr>
<td>Statin advised or prescribed</td>
<td>2.5</td>
<td>15.2</td>
</tr>
<tr>
<td>SBP below threshold</td>
<td>3.4</td>
<td>7.9</td>
</tr>
<tr>
<td>DBP below threshold</td>
<td>3.8</td>
<td>7.4</td>
</tr>
<tr>
<td>LDL below threshold</td>
<td>3.6</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Discussion
This is, to our knowledge, the first large scale study on CVRM in European primary care at a larger scale. We found that scores on quality indicators in general vary from 45% (a record of advice on physical activity; SBP and LDL below treatment targets) up to about 95% (blood pressure recording) of the maximum score, which indicates optimal policy. As opposed to our expectation, we found little evidence for better performance in large practices. In Slovenia larger practices tended to perform better. Our study did not explicitly assess the efficiency of delivering CVRM.
Similar to our research, the three EUROASPIRE surveys provide data from international research with uniform data collection across countries. But in EUROASPIRE a specialist care starting point guided CHD patient selection. Raised blood pressure, defined as SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg or in diabetics respectively ≥ 130 mmHg and ≥ 80 mmHg, was prevalent in 58-61% of these survey samples. Raised cholesterol was defined as ≥ 4.5 mmol/l and diminished from 94.5% in EUROASPIRE I, to 76.7% in the second survey and finally to 46.2% in the third. Data collected in the most recent EUROASPIRE survey in 2006 and 2007 are comparable to our results. In the Pinnacle program, data regarding outpatients from cardiology offices, too, show comparable results with for instance antiplatelet and statin therapy in 84.9 and 84.3%, respectively.

Previous data on CVRM in primary care can be found in various national studies. In a Cochrane review the effects of interventions on the organization of the treatment considering ischemic heart disease patients in primary care are studied. Data from the control groups could be considered comparable to our audit data. Direct comparable outcomes are statin prescription and antiplatelet therapy. In the review 50.1% of the control patients received statin therapy, but studies dated back till the 1990's. The most recent study, SPHERE, had with 80.3% a result comparable to 82.7% in our study. Relating to antiplatelet therapy the review result was 72.5% compared to 87.7 in our study sample. Again, the more recent data were the best, up to 87.0 In the SPHERE study SBP was < 140 mmHg in 66.2% (versus 47.5% in our data) and DBP < 90 mmHg in 88.6% of the patients (comparable to 85.5% in our data). In drug trials efficacy of statins varies from 60 to 90% in achieving LDL < 2.5 mmol/l. In our observational study, the real life results are on the lower end of this range. In contrast to the optimum situation in these drug studies physicians could include every patient known to have a CHD, patients without further medical attention, too. The indicator on LDL cholesterol treatment target surprisingly was not validated in the Delphi indicator development procedure. We can only speculate about the reasons; setting strict norms irrespective of the patient’s age might be argued by some or the fact that this outcome measure very much depends on the patient in contrast to process measures as offering a statin. In view of the strong evidence base for the relationship between LDL cholesterol and coronary heart disease we anyhow decided to include the LDL cholesterol results in our study.

Since most patients with increased cardiovascular risk are treated in primary care, the findings are extremely relevant for improving care in the different countries despite study limitations. They show that specific countries scored high on some
indicators and low on others. Improvements in CVRM are possible in all countries. Our study allowed to include all patients with a known diagnosis of CHD. Inevitably, patients treated in secondary care could be included, too. Our results give an overview of the performance of CVRM related to all patients known in the primary care practice.

In England high scores on performance indicators were observed, particularly for indicators incentivized as part of the Quality and Outcomes Framework (QOF). Physicians in England are forced, by their electronic patient records, to tick boxes for QOF-indicators, which might be a strong driver for change in registration, enhancing good risk factor registration in England. On the other hand, we found relatively low performance scores for some indicators of CVRM, especially risk factor recording, in the Netherlands. The only indicator related to a financial incentive (influenza vaccination) and supported by a national organizational program had very high scores in this country (in 2009 a fee of 9.88 euro was provided for every vaccinated patient). The system parameter incentives on a national level and as such as a country characteristic may have an important influence relative to practice size as a practice characteristic.

The DBP indicator scores were much higher than scores for SBP, though the importance of the latter is stressed by its role in risk classification schemes. Advice on physical activity had low scores, too, although it remains uncertain whether such advice had been provided but not recorded.

Differences between countries may be partly explained by differences in the quality of recording as stated above. Medication and blood pressure or cholesterol levels are probably well recorded, but this is less the case for smoking status or exercise advice. It might be argued that recorded care does not mirror care provided. But in chronic care recording is thought to be essential. Risk factor recording is a prerequisite to select patients for treatment and chronic care means collaboration between various health care professionals, who will need to rely on the data in the patient records.

In our study practice size seems to have little relation to performance as measured by quality indicators. Though in previous research on practice size no consistent results were found, in general larger practices tend to show better performances and provide more extensive services, for instance more preventive activities. All these studies were based on national data. We took into account the fact that we had practices from eight countries by entering country as a level in our multilevel analysis. This procedure effected chance on significant findings. Taking into account the strength of the primary care did not provide relevant findings.
A larger practice offers opportunities to develop skills by experience and gives managerial advantages, especially when specialized staff is required. Structured care will be more cost effective with larger patient groups included in a program. On the other hand, there seems to be a trade of between high quality clinical care and interpersonal care, and access might be better in smaller practices\textsuperscript{2,9}. In our sample across countries small practices were able to deliver a performance on cardiovascular risk management as good as larger practices.

Only in Slovenia larger practices showed a tendency towards better performance in general. We can only speculate regarding this finding. It may be the resultant of recent implementation strategies with first effects in larger settings. This would be in line with the general concept of larger practices being in a good position for providing structured care to larger groups of patients.

The proportion of variance explained at the practice level was larger than that related to the country level, indicating that the practice has more influence on that variation than the country. This could stimulate practices to invest in quality improvement in their practices as there is little argument that much is determined at a higher level out of their reach. A remarkable small part of the variation in outcomes is explained at both the practice and the country level considering the blood pressure and cholesterol levels. These biological outcomes will be determined at the patient level to a greater extend.

**Strengths and limitations of the study**

Within the context of our international survey we had to face inclusion bias both at the practice level and at the patient level as a result of differences in the organization of the health care system within the various countries at different levels. Practice selection was random in most countries but a convenience sample in two countries (Austria and Switzerland). The procedure for sampling patients, too, showed some variation. In Belgium, England, the Netherlands and Slovenia patient selection was exclusively based on recorded diagnoses, enabling inclusion of patients registered but not controlled in primary care or not at all. Less strict methods were used in the other countries (remembering patients, prescription lists, attending patients) providing patient inclusion bias. Patients on a prescription list by definition have some drug treatment and frequent attenders and treated patients are more likely to be remembered. Our practice sample appeared the best feasible given the limitations of our international survey. The sample size of 181 practices forms a limitation to detect small effects of practice size on outcomes,
among other due to clustering within countries and differences of possible effects between countries.

Data on practice size were not directly comparable between countries because of the differences in health care systems. In some but not all countries patients are listed with one GP or practice. Countries without these clear patients' lists had to report on numbers of attenders as a measure for practices size. By standardizing practice size data per country we solved this potential problem.

We included patients with CHD to have a patient group more homogeneous than the group of CVD patients in general. This did not completely prevent heterogeneity within our study population. The CHD group comprised on the one hand patients who had a myocardial infarction or vascular surgery and have been treated in secondary care and on the other hand patients with stable angina pectoris who might have been treated in primary care exclusively.

**Conclusions**

The variation between practices within each country is unwanted and proves potential for improvement. The presence of highly performing practices within each country proves that in each national context good CVRM is possible. Differences found between countries and especially best practices can form lessons for all countries. For instance the Quality and Outcomes Framework from the UK can be an example to other countries but focus may differ according to the national situation as the position of primary care within the larger context of the health care system.

In contrast to most previous research our analysis did not indicate significant influence of practice size on the quality indicator scores. In various studies larger practices tend to perform better, supporting the development of practice collaboration with consequently larger groups of CHD patients to organize care. This may enhance expertise and logistics. We could not confirm this tendency. Here, further research is needed.
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Chapter 3

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

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

Abstract

Objectives: Cardiovascular risk management (CVRM) received by patients shows large variation across countries. In this study we explored the aspects of primary care organization 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, antiplatelet therapy, influenza vaccination, blood pressure levels (systolic <140 and diastolic <90 mm Hg), and low-density lipoprotein cholesterol <2.5 mmol/l. Data from structured questionnaires were used to construct an overall measure and six 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), antiplatelet 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 organizational domains 'self-management support' and 'use of clinical information systems' were linked to three CVRM indicators.

Conclusions: A better organization of a primary care practice was associated with better scores on process indicators of CVRM in CHD patients, but not on intermediate patient outcome measures. Direct support for patients and clinicians seemed most influential.
Introduction
Providing high-quality healthcare for patients with chronic diseases poses major challenges for healthcare 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: 'healthcare organization', 'delivery system design', 'decision support', 'clinical information systems', 'self-management support', and 'community resources and policies'\textsuperscript{1,2}. Box 1 shows a brief description of the six domains. Other organizational models, such as the Patient-Centered Medical Home\textsuperscript{3}, specified similar components. Although these models are based on some research\textsuperscript{4–10}, their positive impact on clinical and preventive performance needs further research as implementing best practices for chronic illness management shows little success\textsuperscript{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\textsuperscript{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\textsuperscript{12}. Practice guidelines with recommendations for effective secondary preventive therapy are widely available\textsuperscript{13,14}. Although the effects of antiplatelet 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 USA\textsuperscript{15,16}. Preventive treatment for patients with established CHD is mostly delivered in primary care, especially in countries with a strong primary care-oriented healthcare system. Substantial variation is observed regarding CVRM received by patients. We expect better healthcare organisation 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
This study was part of the EPA Cardio project, an international observational study on cardiovascular risk management in 10 European countries\textsuperscript{17}. The participating countries comprised a convenience sample: Austria, Belgium, England, Finland,
France, Germany, The Netherlands, Slovenia, Switzerland and Spain. In stratified samples of primary care practices in each of these countries randomly sampled medical records were reviewed to provide data on cardiovascular risk management and structured questionnaires among participating general practitioners were used to provide data on practice organization. Practices were stratified according to urbanization and size sampling based on regional or national lists of practices; in Austria and Switzerland a convenience sample was included. Patients were included based on coded diagnoses in most countries; in Austria prescription lists were used to include patients and in France patients visiting the practice were included when eligible. Data collection took place in 2008–2009.

**Indicators for cardiovascular risk management**

Data from medical records were linked to internationally validated indicators on cardiovascular risk management, which were developed in a structured Delphi procedure\(^{18}\). Primary care physician panels from nine countries initially evaluated 650 indicators for cardiovascular risk management. This resulted in a core set of 44 indicators, which were then operationalized in specific measures and tested in a pilot study\(^ {19}\). This study is based on performance indicators related to preventive treatments in CHD patients. Data were obtained from patient medical records. The first indicator was an aggregate score which indicated the number of risk factors recorded per patient. Risk factors considered were: smoking behaviour, body mass index, physical activity, blood pressure, and cholesterol levels (range 0-5). Five other indicators, all dichotomous, were: a record of antiplatelet therapy unless contraindicated, influenza vaccination offered, systolic blood pressure <140 mmHg, diastolic blood pressure <90 mmHg, and low-density lipoprotein (LDL) cholesterol <2.5 mmol/l.

**Organization of primary practice**

A large set of questions on practice organization was included in structured questionnaires, which were partly administered in written form and partly in interviews with the general practitioner in the participating practices who was the research participating contact person. These questions mainly comprised items from the European Practice Assessment (EPA) instrument. This EPA instrument was previously validated in an international project\(^ {20}\). We constructed post hoc measures by linking items to one of the six domains of the Chronic Care Model as published before\(^ {21}\). All items were formulated positively, with 'yes' indicating the
What components of chronic care organization relate to better primary care? 41

presence of a characteristic. We dichotomized all answers as either 'yes' or 'no', the latter consisting of 'no', 'missing value', or 'not applicable'. The aggregated scores of the following five CCM domains were positively correlated: 'healthcare organization' (7 items), 'delivery system design' (15 items), 'decision support' (3 items), 'clinical information systems' (6 items) and 'self-management support' (4 items). These correlations were highly significant with Spearman's rho values varying from 0.2 to over 0.6. For that reason, an overall measure of structured chronic care was defined with a scale from 0 to 5, with equal weight for each CCM domain. Factor analysis showed a Cronbach's \( \alpha \) of 0.74. One CCM domain, 'community resources and policies' (4 items), was left out of the overall score due to difference in focus and lower correlation with other domains.

**Data analysis**

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

**Results**

From the 284 practices in the EPA Cardio study 11 practices were excluded because of 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 were 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 1. Countries, practices and patients included

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

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

<table>
<thead>
<tr>
<th>Risk factor recording (SD)</th>
<th>Anti-platelet therapy</th>
<th>Influenza vaccination</th>
<th>SBP &lt;140 mmHg</th>
<th>DBP &lt;90 mmHg</th>
<th>LDL &lt; 2.5 mmol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>80.6 (18.6)</td>
<td>86.4</td>
<td>52.8</td>
<td>61.4</td>
<td>85.9</td>
</tr>
<tr>
<td>Belgium</td>
<td>80.8 (21.2)</td>
<td>90.7</td>
<td>89.2</td>
<td>55.9</td>
<td>85.2</td>
</tr>
<tr>
<td>England</td>
<td>87.5 (16.6)</td>
<td>92.0</td>
<td>86.7</td>
<td>69.7</td>
<td>95.9</td>
</tr>
<tr>
<td>Finland</td>
<td>70.1 (24.4)</td>
<td>93.2</td>
<td>72.5</td>
<td>50.2</td>
<td>84.4</td>
</tr>
<tr>
<td>France</td>
<td>81.4 (16.5)</td>
<td>90.4</td>
<td>59.1</td>
<td>58.9</td>
<td>89.5</td>
</tr>
<tr>
<td>Germany</td>
<td>80.4 (19.2)</td>
<td>67.5</td>
<td>71.5</td>
<td>58.0</td>
<td>81.3</td>
</tr>
<tr>
<td>Netherlands</td>
<td>59.8 (31.7)</td>
<td>85.2</td>
<td>96.4</td>
<td>43.6</td>
<td>85.7</td>
</tr>
<tr>
<td>Slovenia</td>
<td>77.4 (24.8)</td>
<td>93.9</td>
<td>31.8</td>
<td>56.8</td>
<td>79.8</td>
</tr>
<tr>
<td>Spain</td>
<td>58.1 (32.9)</td>
<td>80.2</td>
<td>67.5</td>
<td>72.8</td>
<td>96.1</td>
</tr>
<tr>
<td>Switzerland</td>
<td>76.8 (24.2)</td>
<td>95.3</td>
<td>55.2</td>
<td>65.4</td>
<td>87.2</td>
</tr>
<tr>
<td>Total</td>
<td>74.0 (26.8)</td>
<td>87.0</td>
<td>66.1</td>
<td>60.1</td>
<td>87.1</td>
</tr>
</tbody>
</table>

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).
### Table 3. Effects of practice organization characteristics on indicators of cardiovascular risk management

<table>
<thead>
<tr>
<th></th>
<th>Linear regression</th>
<th>Logistic regression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk factor</td>
<td>Antiplatelet</td>
</tr>
<tr>
<td></td>
<td>registration</td>
<td>therapy</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>p</td>
</tr>
<tr>
<td><strong>Primary analyses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.0042</td>
<td>0.0207</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 = female</td>
<td>0.0200</td>
<td>N.S.</td>
</tr>
<tr>
<td>2 = male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic Care Model-composite (score from 0 to 5)</td>
<td>0.0307</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Community resources and policies (n=4)</td>
<td>0.0084</td>
<td>N.S.</td>
</tr>
<tr>
<td><strong>Secondary analyses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health care organization (n=7)</td>
<td>0.0280</td>
<td>N.S.</td>
</tr>
<tr>
<td>Clinical information systems (n=6)</td>
<td>0.0498</td>
<td>0.0236</td>
</tr>
<tr>
<td>Self-management support (n=4)</td>
<td>0.1676</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Decision support (n=3)</td>
<td>0.0685</td>
<td>N.S.</td>
</tr>
<tr>
<td>Delivery system design (n=15)</td>
<td>0.0352</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

*Analysis found no estimate.

DBP, diastolic blood pressure; B, effect estimate in regression analysis; LDL, low-density lipoprotein cholesterol level; NS, not significant, significance level at p<0.05; SBP, systolic blood pressure
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 diastolic blood pressure < 90 mmHG.

Discussion

Main results

A primary care practice with better practice organization showed better performance for risk factor registration, antiplatelet prescription and influenza vaccination in CHD patients. These findings support the belief that practice organization has impact on quality of CVRM in CHD patients across different healthcare systems although the observational design does not allow causal inferences.

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

Table 4. Estimates of intra class coefficients (ICC), signifying the portion of variance explained by country, by practice, or unexplained

<table>
<thead>
<tr>
<th>Sum score risk factor registration</th>
<th>Antiplatelet therapy</th>
<th>Influenza vaccination</th>
<th>SBD &lt;140 mmHg</th>
<th>DBD &lt;90 mmHg</th>
<th>LDL &lt;2.5 mmol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICC countries</td>
<td>0.10433</td>
<td>0.08961</td>
<td>0.23663</td>
<td>0.03026</td>
<td>0.08882</td>
</tr>
<tr>
<td>ICC practices</td>
<td>0.25582</td>
<td>0.21132</td>
<td>0.26614</td>
<td>0.06560</td>
<td>0.07269</td>
</tr>
<tr>
<td>unexplained</td>
<td>0.63986</td>
<td>0.69908</td>
<td>0.49723</td>
<td>0.90414</td>
<td>0.83849</td>
</tr>
</tbody>
</table>

The findings related to 'self-management support' were of particular interest, given the current focus on self-management in the health policies of many countries. In our study the domain related to having information leaflets available in the practice concerning cardiovascular diseases (e.g., CHD, stroke, hypertension, stop smoking, etc); presence of a directory of prevention activities/organizations locally
available (e.g., gyms, walking group and weight-watchers); offering written information on lifestyle regularly; and offering advice about websites for education on health risks or healthy lifestyle regularly. It is encouraging that such practical items are indeed associated with better clinical processes, although the causality remains unknown.

The organizational domain 'clinical information system' referred to access to internet and email in the practice, virus protection, use of a password, 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 performance and also quality of recording. Optimal use of computerized medical record systems leads to better scores for practice organization and clinical performance. But as CVRM mainly is a collaborative task, healthcare professionals need to be able to rely on the data recorded.

The relevance of a well organized practice mainly concerned preventive procedures (risk factor registration, drug prescription and vaccination) rather than intermediate outcomes of healthcare (blood pressure and cholesterol levels). However, it should be noted that better prescribing of antiplatelet therapy has a well-assessed effect on cardiovascular events and mortality\(^22\). Likewise, the benefits of influenza vaccination in preventing complications are well-documented and guidelines recommend vaccination to patients with cardiovascular diseases\(^{13,14,23}\). This suggests that better organization of primary care was indeed associated with improved survival and fewer cardiovascular events in patients with CHD.

Previous research found associations between practice organization and clinical performance\(^4-10,24,25\), and a systematic review of trials of organizational interventions in CHD patients in primary care found limited evidence for effects on outcomes such as blood pressure and serum cholesterol levels\(^26\).

In our explorative analysis of the relevance of various organizational domains, we found differential effects on performance. The components ‘self-management support’ and ‘clinical information system’ were found to be most consistently related to cardiovascular risk management. We cannot rule out the possibility that our measures of these domains may have been more accurate than those of other domains or that the participating primary care practices had specific characteristics explaining the findings. On the contrary, both clinical information system and self-management are directly linked to decisions and behaviours of clinicians and patients, which have known impact on cardiovascular risk. Clinical information
systems may be crucial because it is a well-known contribution to the other domains. Self-management support is the one domain targeting the patient, offering another aspect than the care and practice-related domains. The question is how the impact of organization of healthcare on (intermediate) patient outcomes can be optimized. Our study may have missed the power to detect small effects. Further down the line (system, process and patient outcomes), more factors become relevant and influential and to prove the effect of care domains subsequently becomes more difficult.

**Strengths and weaknesses**
The EPA Cardio study was based on random sampling of patients using well-developed measures of cardiovascular risk management and practice organization, although the measures of the CCM were post hoc constructed. The international character of our study contributed to its generalizability and provided control for contextual confounders, such as specific reimbursement system or national policies. The sampling of countries and practices had limitations with respect to representativeness, but provided arguably more generalizable evidence than many trials of organizational changes in healthcare. In the patient samples women seemed underrepresented. In various national databases male CHD prevalence is 1.5–2 times the female prevalence.\textsuperscript{27–29} Particularly in Belgium and Switzerland low numbers of females were included which cannot be accounted for. We suggest that the impact of this on our result was limited, because sex and age were controlled for in the analyses.

**Conclusion**
Our observational study provided data from a real-life situation in contrast with many trials of organizational changes in primary care. We found that a better organized practice, measured in terms of implementation of the Chronic Care Model, had better clinical processes in the targeted cardiovascular domain. Most notably, we found that 'clinical information systems' and 'self-management support' were relevant. The impact on cardiovascular outcomes was less obvious, which may be due to a range of factors. Nevertheless, this study reinforces the importance of strengthening the organization of primary care practices for improving their clinical performance.
What components of chronic care organization relate to better primary care?

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Chapter 4

Community programs for coronary heart disease in Spanish primary care

Eva Frigola-Capell
Jan van Lieshout
Miguel A. Muñoz
Jose M. Verdú-Rotellar
Francesc Orfila
Rosa Suñol
Michel Wensing
Abstract

Objective: In this study we explored the add on value of community orientated programs to enhance healthy life style associated with key components of cardiovascular risk management (CVRM) in patients with coronary heart disease.

Methods: Observational study in Catalonia (Spain), including 36 practices, 36 professionals and 722 patients with coronary heart disease (37% female: mean age 72 (SD 11.73)). Our predictor variable of interest was reported delivery by primary care practices (PCPs) of community orientated programs such as physical exercise groups and stop smoking, which was collected through structured questionnaires administered to professionals of PCPs. Our CVRM outcome measures were: recorded risk factors, drug prescription and intermediate patient outcomes (blood pressure levels, low-density lipoprotein cholesterol, body mass index).

Results: Thirty practices delivered community programs. Most delivered one [17 (47.2%) practices] or two programs [11 (30.5%) practices]. The content of these programs was orientated to education and motivation to enhance healthy life styles, using group counselling sessions, mailed print material and one-to-one counselling. In practices delivering community programs more patients received anti-hypertensives (89.7%), antiplatelet therapy (80.5%) and statins (70.8%). However, none of the differences with the other practices were statistically significant.

Conclusions: No evidence was found for the added value of community orientated programs on cardiovascular risk in patients with coronary heart disease, which can help clinicians and managers to refine criteria when including patients in preventive programs.
Introduction

While progress has been made in reducing mortality, coronary heart disease (CHD) still remains one of the main causes of death worldwide. Evidence based recommendations on improving lifestyle (smoking cessation, physical exercise, diet, and alcohol intake) and drug treatment (statins, antihypertensive therapy and antiplatelet therapy) have been incorporated as performance measures in several health quality frameworks; particularly in primary care, where patients with high cardiovascular risk or established cardiovascular disease receive preventive treatment. The management of patients with existing cardiovascular disease in the community can be cost-effective, for instance by preventing hospital events. Nonetheless how best deliver and achieve prevention targets in this setting is still unclear. Several interventions for enhancing healthy life styles in the community have been undertaken, either primary care based or by other community providers, reporting mixed results. The profile of patients which can benefit of referral to these interventions is yet to be elucidated. Despite so, complementary community interventions to usual care contacts are used in our setting to implement preventive activities. In our context, primary care is organized as a network of large practices that behave as geographical and administrative units and family physicians (from 4 to 36 full time equivalent FPs) are part of the staff, together with nurses, paediatricians, social workers, dentists and ancillary staff; patients are listed in a practice, FPs are allowed to recall patients and are gatekeepers to other care providers. In Spain, PCPs are responsible to deliver the health promotion and preventive activities program (PAPPS) developed by the Spanish Society of Family Medicine (SemFYC) which integrates the international guidelines on cardiovascular prevention. Nonetheless variability exist among PCPs on strategies (individual contacts with FPs/nurses and complementary community interventions) used to implement preventive activities in patients with cardiovascular disease in the community.

The community approach has been included in theoretical frameworks for quality improvement in chronic diseases, such as in the Chronic Care Model (CCM). This framework emphasizes that chronic diseases require of an integration of several aspects in a health system and identifies six essential elements: 'healthcare organization', 'delivery system design', 'decision support', 'clinical information systems', 'self-management support' and 'community resources and policies'. Evidence reports mixed results on the contribution of each domain to patient outcomes. For instance self-management support, clinical information systems and decision support have been found to be associated with better outcomes and
processes\textsuperscript{19,20}, nonetheless less research has been performed implementing community resources elements to judge their relative effectiveness\textsuperscript{19}. Reporting evidence on how delivering community interventions for selected patients by PCPs relate to their performance can contribute to a better understanding of primary healthcare competences and their convergence with primary care management. Our aim was to examine whether delivery of community orientated programs to enhance healthy life styles was associated to quality of cardiovascular risk management (CVRM) in patients with CHD.

**Methods**

*Study design and participants*

This study was part of the EPA Cardio project, an international observational study on cardiovascular risk management conducted in 10 European countries\textsuperscript{21}. Study design, participants selection and measures have extensively been described previously\textsuperscript{20,22}. Briefly we conducted an exploratory and pragmatic cross-sectional study and included a random sample of 36 practices representing rural and urban setting (100,000 inhabitants as a cut of point) in Catalonia (Spanish region with a population of 7,210,508 inhabitants)\textsuperscript{23}. Each practice provided data for patients with prevalent CHD (I20-I25) listed with one of their FPs. Patients with diabetes were excluded. Based on a calculation of the statistical accuracy of the estimates per each participating country in the EPA Cardio project\textsuperscript{21}, we aimed at least at 15 patients randomly selected with established CHD per practice. Ethics approval for this study was obtained from The Catalan Primary Care Research Institute "IDIAP Jordi Gol" ethics committee, over sighted by the Spanish Ministry of Health.

Our outcome measures were based on European guidelines\textsuperscript{10} on prevention and management of CHD and the validated European Practice Assessment (EPA) instrument\textsuperscript{24}, which comprises a list of indicators to measure quality performance in primary care. We collected data on prescription of statins, antihypertensive therapy and antiplatelet therapy according to the "Anatomical Therapeutic Chemical (ATC) Classification System". Patient intermediate outcomes included were systolic and diastolic blood pressure, total cholesterol and low-density lipoprotein cholesterol (LDL), weight and body mass index (BMI). At patient level we also collected information on age, gender, region (rural/urban) and diagnosis of hypercholesterolemia (E78) and hypertension (I10) according to the International Classification of Diseases Tenth Revision used in primary care.
Data described above was provided by PCPs involved in the study, extracted from their electronic medical records. None of the officers responsible for data collection were involved in the subsequent data analysis.

As a predictor variable, we selected in a post hoc analysis items from the validated EPA instrument, to collect information on PCPs participation in community programs to enhance healthy life styles. In structured questionnaires we asked the research contact person at the practice (FP or nurse practitioner), the following questions: (1) Was there a public health project concerning cardiovascular risk in your practice the last 2 years? (i.e. physical exercise, stop smoking)? (2) did nurses take part in education about cardiovascular disease risk factors (for example, diet, exercise, smoking) in schools?, (3) did GPs take part in local/community campaigns or actions on cardiovascular disease risk prevention (for example, stop smoking campaigns and fun-runs)?, (4) did nurses take part in local/community campaigns or actions on cardiovascular disease risk prevention (for example, stop smoking campaigns and fun-runs)?

We provided descriptive data for age, gender and prevalence of relevant variables were calculated for all patients. Chi Square and Student test for categorical and continuous variables, respectively were used at bivariate analysis to compare patients listed in PCPs with and without delivery of cardiovascular risk reduction programs. Question (1) of the structured questionnaire reported us information on programs to enhance healthy life styles delivered at the PCPs. Questions (2), (3) and (4) reported us descriptive information of professionals involvement in community activities related to cardiovascular disease. Multilevel analysis was performed establishing PCPs as random units to control the variability associated to clinical practice in primary care. Descriptive and bivariate analysis were undertaken with the use of SPSS Inc v18 software. Multilevel analysis was performed with Stata/IC 11.0.

**Results**

Initially we identified 66 potentially eligible PCPs in the urban setting covering a population of 558,515 and 37 in the rural setting covering a population of 480,827. We randomly included 36 PCP (with 490 FTE GPs), 21 from rural (269.35 FTE GPs) and 15 from urban (220.7 FTE GPs) mirroring the situation in our region. Each PCP provided a FP as a research contact person.
Community programs to enhance healthy life styles

Overall about 90% of PCPs usually participate in public health care programs on lifestyle and in local/community campaigns or actions on cardiovascular disease risk prevention. Participation of nurse practitioners was higher (88.8%) than family physicians (66.7%). Thirty (83%) practices delivered community programs to enhance healthy life styles. Most practices implemented one [17 (47.2%) practices] or two [11 (30.5%) practices] programs at the same time (Table 1). These programs were educational programs on risk factors management offered in group counselling sessions; mailed print material was also given. Motivation for an active lifestyle was promoted through exercise programs consisting of walks adapted to recruited patients. These programs were offered by professionals working at the PCP, usually nurse practitioners or allied health professionals. Any patient from the community listed at the practice could be referred to these programs by FPs or nurse practitioners if fulfilling the inclusion criteria.

Table 1. Description of programs to enhance healthy life styles

<table>
<thead>
<tr>
<th>Name of intervention</th>
<th>Goal</th>
<th>Type of intervention</th>
<th>Practices (n=36)</th>
<th>Patients (n=722)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Blood Pressure reduction program</td>
<td>education/ motivation to reduce blood pressure</td>
<td>group counselling sessions; mailed print</td>
<td>8 (22.2%)</td>
<td>159</td>
</tr>
<tr>
<td>Obesity reduction program</td>
<td>education/ motivation to reduce weight</td>
<td>group counselling sessions; mailed print</td>
<td>2 (5.6%)</td>
<td>30</td>
</tr>
<tr>
<td>Exercise promotion program</td>
<td>education/ motivation to an active lifestyle</td>
<td>group counselling sessions; mailed print</td>
<td>22 (61.1%)</td>
<td>435</td>
</tr>
<tr>
<td>Diet education program</td>
<td>education/ motivation to change diet habits.</td>
<td>group counselling sessions; mailed print</td>
<td>4 (11.1%)</td>
<td>118</td>
</tr>
<tr>
<td>Smoking cessation program</td>
<td>education/ motivation to stop smoking</td>
<td>group counselling sessions; mailed print</td>
<td>9 (25%)</td>
<td>218</td>
</tr>
</tbody>
</table>

Cardiovascular risk management provided to patients

We collected data from 722 patients listed at the participating PCPs, 282 from rural setting and 440 from urban. PCPs from urban setting delivered significantly (P<0.001 ) more programs to enhance healthy life styles than rural areas (Table 2). Mean age for our sample was 72 years (SD 12) with 50.7% of patients ≥ 60 years and 37% women (Table 2). Overall patients listed in PCPs delivering programs to enhance healthy life styles did not significantly differ from those without in age, gender and prevalence of hypercholesterolemia, smoking and hypertension. In the overall sample, drug prescription was high for anti-hypertensive therapy (88.9%), antiplatelet therapy (80.2%) and lower for statins (69.5%).
Table 2. Patient characteristics

<table>
<thead>
<tr>
<th></th>
<th>n=722 patients, n=36 practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Mean, SD)</td>
<td>72 (12)</td>
</tr>
<tr>
<td>Gender (female, %)</td>
<td>267 (37)</td>
</tr>
<tr>
<td>Smoking n (%)</td>
<td>54 (7.5)</td>
</tr>
<tr>
<td>Men over 60 years old (%)</td>
<td>366 (50.7)</td>
</tr>
<tr>
<td>Hypercholesterolemia (%)</td>
<td>230 (31.9)</td>
</tr>
<tr>
<td>High Blood Pressure (%)</td>
<td>442 (61.2)</td>
</tr>
<tr>
<td>Patients from Urban/Rural setting</td>
<td>440 (60.9) / 282 (39.1)*</td>
</tr>
<tr>
<td>Systolic Blood Pressure (Mean, SD)</td>
<td>131.09 (16.14)</td>
</tr>
<tr>
<td>Diastolic Blood Pressure (Mean, SD)</td>
<td>72.56 (10.05)</td>
</tr>
<tr>
<td>Total Cholesterol (Mean, SD)</td>
<td>182.69 (36.51)</td>
</tr>
<tr>
<td>LDL (Mean, SD)</td>
<td>104.04 (28.64)</td>
</tr>
<tr>
<td>Weight (Mean, SD in Kg)</td>
<td>74.06 (14.47)</td>
</tr>
<tr>
<td>BMI (Mean, SD )</td>
<td>28.38 (4.6)</td>
</tr>
<tr>
<td>Prescription of statins (%)</td>
<td>502 (69.5)</td>
</tr>
<tr>
<td>Anti-hypertensive therapy (%)</td>
<td>642 (88.9)</td>
</tr>
<tr>
<td>Antiplatelet therapy (%)</td>
<td>579 (80.2)</td>
</tr>
</tbody>
</table>

*Primary care practices from urban setting significantly (P<0.001) implement more risk reduction programs.

In practices delivering programs to enhance healthy life styles patients received more anti-hypertensive therapy (89.7%), antiplatelet therapy (80.5%) and statins (70.8%) versus the other practices (Table 3); nonetheless the bivariate analysis showed no significant differences neither for drug prescription, risk factors registration and intermediate patient outcomes. Differences were found for prescriptions of statins, but after adjusting for random differences between PCPs this effect was no longer significant. Registration of BMI was low in both groups.

Table 3. Management of patients listed in practices with and without delivery of programs to enhance healthy life styles

<table>
<thead>
<tr>
<th></th>
<th>Delivery of programs to enhance healthy life styles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WITH n=650 patients n=30 practices</td>
</tr>
<tr>
<td><strong>Risk factors registration</strong></td>
<td></td>
</tr>
<tr>
<td>BP</td>
<td>484 (74.5)</td>
</tr>
<tr>
<td>Total col. n (%)</td>
<td>394 (60.6)</td>
</tr>
<tr>
<td>BMI n (%)</td>
<td>212 (32.6)</td>
</tr>
<tr>
<td><strong>Risk factors management</strong></td>
<td></td>
</tr>
<tr>
<td>Systolic Blood Pressure mmHg (Mean, SD)</td>
<td>130.77 (15.77)</td>
</tr>
<tr>
<td>Diastolic Blood Pressure mmHg (Mean, SD)</td>
<td>72.64 (9.85)</td>
</tr>
<tr>
<td>Total Cholesterol mg/dl (Mean, SD)</td>
<td>183.20 (37.18)</td>
</tr>
<tr>
<td>LDL (Mean, SD)</td>
<td>104.28 (29.48)</td>
</tr>
<tr>
<td>Weight Kg (Mean, SD)</td>
<td>73.79 (14.32)</td>
</tr>
<tr>
<td>BMI (Mean, SD )</td>
<td>28.33 (4.61)</td>
</tr>
</tbody>
</table>
### Delivery of programs to enhance healthy lifestyles

<table>
<thead>
<tr>
<th>Risk factors control</th>
<th>WITH n=650 patients n=30 practices</th>
<th>WITHOUT n=72 patients n=6 practices</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blood pressure:</strong> Blood pressure: % patients with BPSYS and BPDIAS &lt; 140/90 mmHg</td>
<td>352 (54.2)</td>
<td>37 (51.4)</td>
<td>P=0.71</td>
</tr>
<tr>
<td><strong>BMI:</strong> % patients with BMI &lt;25kg/m2</td>
<td>45 (6.9)</td>
<td>4 (5.6)</td>
<td>P=0.81</td>
</tr>
<tr>
<td>% patients with total cholesterol &lt; 175mg/dl</td>
<td>170 (26.2)</td>
<td>20 (27.8)</td>
<td>P=0.78</td>
</tr>
<tr>
<td><strong>LDL:</strong> % patients with LDL&lt;100mg/dl</td>
<td>151 (23.2)</td>
<td>19 (26.4)</td>
<td>P=0.56</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drug prescription</th>
<th>WITH n=650 patients n=30 practices</th>
<th>WITHOUT n=72 patients n=6 practices</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statins (%)</td>
<td>460 (70.8)</td>
<td>42 (58.3)</td>
<td>P=0.04*</td>
</tr>
<tr>
<td>Anti-hypertensive therapy (%)</td>
<td>583 (89.7)</td>
<td>59 (81.9)</td>
<td>P=0.07</td>
</tr>
<tr>
<td>Antiplatelet therapy (%)</td>
<td>523 (80.5)</td>
<td>56 (77.8)</td>
<td>P=0.64</td>
</tr>
</tbody>
</table>

*Multilevel analysis showed no significant difference on statins prescription (p=0.084)

### Discussion

In our sample of primary care practices the delivery of community orientated programs to enhance healthy lifestyles was not associated to better cardiovascular risk management in patients with CHD, although prescription of preventive medication tended to be better.

The implementation of the six components of The Chronic Care Model has been emphasized to achieve high-quality healthcare for patients with chronic diseases in a health system, because of the supporting synergistic effects; nonetheless advantages to implement multiple components rather than single have yet to be elucidated. Self-management support, clinical information systems and decision support have been found to be associated with better outcomes and processes in the literature. On the other hand, less research has focused on the linkage with community resources for people with chronic illness. Our results seemed to suggest that the linkage with community resources did not relate with quality of clinical process and outcomes in patients with CHD. This may be related to the wide implementation of most of the CCM elements in Spain. There might have been little room for added value of community programs for enhancing healthy lifestyles at least in patients with established cardiovascular disease, who probably received a relatively high amount of support and counselling.

Community programs for enhancing healthy lifestyles in community primary care has not been uniformly successful. For instance in Europe, two primary care-based community interventions aimed at lifestyle improvement to patients at cardiovascular risk found opposite results. A Dutch study reported no effects on determinants of behavioural change. On the other hand, positive effects (decreased body weight, waist and hip circumference, body mass index, waist–hip ratio, systolic and diastolic blood pressure, triglycerides, and glycosylated...
haemoglobin) were found in a Swedish trial. In an Australian study, no clear benefits were seen on blood lipids, diet or body mass from patients at cardiovascular risk participating in an intensive program requiring a heavy time commitment from nurse counsellors relative to routine care provided by interested family physicians. On the other hand, in United States, a community health worker-based program was successful on reducing 10-year CHD risk and improvements in dietary patterns, weight, blood pressure and cholesterol levels.

This variability of findings in the literature could be explained by a range of factors, including patient selection, targeted population, type of intervention (individual or group counselling, health policies...), service provider (primary care based or other community providers), and to the quality of the intervention itself (i.e. the quality of the counselling techniques used, targeted barriers, professionals' skills...). Several barriers to success on lifestyle behavioural changes have been associated to either primary care professionals such as lack of time, costs, patient compliance, lack of counselling skills and to patients such as dissatisfaction with the quality of counselling received by those working in primary care; lack of skills, lack of will power, reluctance to change culturally rooted behaviours and strong sense of fatalism regarding the course of their disease in terms of that no action would guarantee protection.

The role that family physicians have in achieving benefits to patients at cardiovascular risk can be crucial. There is some evidence that the behaviour of primary health care providers in offering lifestyle advise can be increased through a range of strategies. On the other hand, evidence also suggests that specialized community-based providers outside primary care settings can overcome patients' barriers focusing on enhancing education of patients and improving quality of care and health outcomes by also addressing community-level factors hindering the adoption of healthy behaviours.

In our Spanish environment, previous experiences show that when it fits with a national target or a research agenda, primary care practices are capable to deliver successful public health programs. For instance the ISTAPS smoking cessation program involved 176 PCPs across Spain in a 6 month intervention which consisted in implementing recommendations from an evidence-based clinical practice guideline on smoking cessation to targeted patients achieving positive results in patient outcomes. Nonetheless the patients’ profile who benefit from this intervention were younger (mean age 42 years) and without comorbidities compared to patients in our study. Our structural organisation of primary care allows population based prevention at community level. Despite so, resources
constraints may require to refine criteria to include patients in preventive programs or re-adapt these programs according to selected patients. On the other hand, when compared with international literature our professionals perform in the average. For instance, high levels of control for systolic and diastolic blood pressure when comparing to other European countries have been reported; but our level of risk factors registration was one of the lowest\textsuperscript{20}.

The best way to deliver prevention in the community is still unclear, and further research is required, particularly on cost-effectiveness. Despite which provider is responsible for delivering care at community level, evidence suggest that the role that motivated family physicians could have on changing patients behaviours plus addressing individual as well as community-level elements are key factors to consider, which may suggest that care needs to be seen as a continuum to achieve effective interventions.

The limitations of our study design, patient selection and measures may have an effect on our results. Particularly the lack of power of our sample due to the low variability of the predictor variable. The wide implementation of community programs at PCPs level, may be responsible for the fact that the trends we found did not reach significance, for instance the positive trends identified in prescription of preventive medicines in those practices delivering programs to enhance healthy life styles. We could not have access to detailed information of these programs delivered by PCPs such as inclusion criteria, quality of the counselling provided and patient attendance rate. Nevertheless we did not aim at evaluating effectiveness of these programs, rather we intended to examine the add on value of community interventions in quality CVRM in patients with an established cardiovascular disease.

Conclusions

The delivery of community orientated programs for enhancing healthy life styles by primary care was not associated with better cardiovascular risk management in patients with coronary heart disease. This can help service management to refine criteria when including patients in preventive programs.
References


Section II

Analysis of current practice in chronic heart failure primary care
Chapter 5

Survival in Mediterranean ambulatory patients with chronic heart failure. A population-based study

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Josep Comin-Colet
Josep Davins-Miralles
Ignasi J. Gich-Saladich
Michel Wensing
Jose M. Verdú-Rotellar

Abstract

Introduction and objectives: Scarce research has been performed in ambulatory patients with chronic heart failure in the Mediterranean area. Our aim was to describe survival trends in our target population and the impact of prognostic factors.

Methods: We carried out a population-based retrospective cohort study in Catalonia (north-east Spain) of 5659 ambulatory patients (60% women; mean age 77 [10] years) with incident chronic heart failure. Eligible patients were selected from the electronic patient records of primary care practices from 2005 and were followed-up until 2007.

Results: During the follow-up period deaths occurred in 950 patients (16.8%). Survival after the onset of chronic heart failure at 1, 2, and 3 years was 90%, 80%, 69%, respectively. No significant differences in survival were found between men and women (P=.13). Cox proportional hazard modelling confirmed an increased risk of death with older age (hazard ratio=1.06; 95% confidence interval, 1.06-1.07), diabetes mellitus (hazard ratio=1.53; 95% confidence interval, 1.33-1.76), chronic kidney disease (hazard ratio=1.73; 95% confidence interval, 1.45-2.05), and ischemic heart disease (hazard ratio=1.18; 95% confidence interval, 1.02-1.36). Hypertension (hazard ratio=0.73; 95% confidence interval, 0.64-0.84) had a protective effect.

Conclusions: Service planning and prevention programs should take into consideration the relatively high survival rates found in our area and the effect of prognostic factors that can help to identify high risk patients.
Introduction
The prevalence of chronic heart failure (CHF) in developed countries is between 1% and 3% and increases with age\textsuperscript{1–4}. The management of CHF represents an important economic burden for healthcare systems and accounts for 1% to 2% of the total health care expenditure\textsuperscript{5,6}.

CHF is also lethal, particularly after onset\textsuperscript{7,8}, and worsens after hospital admission\textsuperscript{9–11}. Other factors such as age, sex and comorbidities have been described to be determinants of prognosis\textsuperscript{12}. The interaction among these factors is complex\textsuperscript{13} and complicates management particularly in primary care where diagnosis is often initiated\textsuperscript{14} and patients are followed-up. However, little research has been performed in ambulatory patients managed in the community\textsuperscript{15}. Most studies performed to date have been clinical trials or studies that included patients after hospital discharge\textsuperscript{7}. Moreover, little is known on specific trends and prognostic factors for community CHF cohorts in the Mediterranean area; a lower incidence\textsuperscript{16} and lower risk of fatal coronary heart disease have been described\textsuperscript{17,18} even though cardiovascular risk factors are similar to those found in the rest of Europe\textsuperscript{19}. In Spain, trends in survival are mainly reported by the national data registry from hospital-based heart failure clinics\textsuperscript{20} and large community population-based studies representing the Mediterranean lifestyle are lacking.

The aim of this study was to document longitudinal survival trends in ambulatory patients with CHF in Catalonia (north-east Spain) and to assess the impact of comorbidity and hospitalization on survival.\textsuperscript{a}

Methods
Study design and setting
We designed a population-based retrospective cohort study using the resources of a project published in clinical trials database (NCT00792402), which evaluated the impact of a computerized clinical guideline on CHF in Catalonia (population of 7,210,508\textsuperscript{21}). Briefly, in this project, a pragmatic, nonequivalent, controlled, before-and-after quasi-experimental study was performed using a population-based approach. Patients from 2 regions (urban and rural) were included. This project was established to evaluate a complex intervention in the urban setting where primary care practices (PCPs) were randomized. Half the PCPs followed usual care management plus a computerized clinical guideline on CHF and half underwent a disease management intervention.

\textsuperscript{a} It should say: 'the impact of comorbidity on survival.'
For the purpose of this study, data from both regions were combined. Despite urbanization differences, both regions shared the same organizational features (Table 1). Ethical approval for this study was obtained from the Health Care Ethics Committee of the Institut d'Investigació en Atenció Primària Jordi Gol.

Table 1. Organizational features of participating primary care practices

<table>
<thead>
<tr>
<th>Features</th>
<th>Urban region/Rural region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care provider</td>
<td>Catalan Health Service for 80% of the population in the autonomous community of Catalonia (population of 7,210,508). This health care provider belongs to the Spanish National Health System</td>
</tr>
<tr>
<td>Coverage</td>
<td>Universal coverage for both primary and secondary care</td>
</tr>
<tr>
<td>Funding</td>
<td>State funded through general taxes. Co-existence with the private sector</td>
</tr>
<tr>
<td>Access to care</td>
<td>All citizens are registered with a family physician who acts as a gatekeeper to specialized care</td>
</tr>
<tr>
<td>Medical records</td>
<td>Electronic patient records system</td>
</tr>
<tr>
<td>Provision of care</td>
<td>Network of practices that behave as a geographical and administrative units where physicians are part of the staff (from 4 to 36 physicians per practice depending on the population attended)</td>
</tr>
<tr>
<td></td>
<td>Single health care centres(^a). Single health care centres and satellite offices(^b).</td>
</tr>
<tr>
<td>Diagnosis process / Integrated care</td>
<td>Cardiologists and other specialized services attending practices weekly since 1990 to support physicians on the diagnosis process, management and training</td>
</tr>
</tbody>
</table>

\(^a\) applies only to urban region

\(^b\) applies only to rural region

**Participants**

We included incident patients attending PCPs from 2005 to 2007. Patients aged more than 30 years old with a diagnostic code related to CHF, registered by their primary care physician (I11.0, I13.0, I13.2, I50, I50.0, I50.1, I50.9, P29.0, according to the International Classification of Diseases Tenth Revision used in primary care) were included. As a measure of diagnostic accuracy we only included patients prescribed diuretics. In the urban region, we included the randomized set of PCPs that followed usual care plus clinical practice guideline on CHF and excluded those PCPs that underwent the disease management intervention. We included all PCPs in the rural region.

**Measures**

We measured survival after the onset of CHF until death or the end of follow-up (31 December 2007). Onset of CHF referred to the recorded date of diagnosis of CHF, which we extracted from the primary care electronic patient records. Registration of the diagnosis was done by primary care physicians and in our context is usually done after cardiologist consultation or advice (Table 1) or after
the patient has been admitted to hospital. As a measure of the accuracy of the diagnosis, we only included patients prescribed diuretics. We also measured survival in patients with hospital admission for cardiovascular causes during the follow-up, as a primary discharge diagnosis (398-398.99, 402-402.91, 428-428.9, 997.1, 403.90-403.91, 404-404.93, 411-411.89, 414-414.9 according to the International Classification of Diseases Ninth Revision used by hospitals). We included mortality from any cause.

Potential comorbidities associated with survival were defined on the basis of the International Classification of Diseases Tenth Revision codes registered in the primary care electronic patient records either before or at the onset of CHF and were chosen according to a review of the literature, clinical relevance, and availability. We included patient age and sex, hypercholesterolemia, hypertension, diabetes mellitus, ischemic heart disease, chronic obstructive pulmonary disease, and chronic kidney disease (Table 2). We obtained age by calculating the difference between the date of inclusion in our study (1 January 2005) and date of birth and considered 2 categories: patients aged less than 65 years and patients aged 65 years or older. Setting was also considered as a covariate.

<table>
<thead>
<tr>
<th>Table 2. International Classification of Diseases Tenth Revision Codes related to comorbidity included in this study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypercholesterolemia (E78)</td>
</tr>
<tr>
<td>Hypertension (O10-O10.4; O11, O13, O14, O16; I10, I11, I11.9, I12, I12.0, I12.9; I13, I13.1, I13.9; I15-I15.2, I15.8, I15.9)</td>
</tr>
<tr>
<td>Diabetes Mellitus (E10-E10.9; E11-E11.9; E12-E12.9; E13-E13.9;E14-E14.9;P70.2;N08.3; O24-O24.4, O24.9).</td>
</tr>
<tr>
<td>Ischemic Heart Disease (I20-I20.1; I20.8, I20.9; I21-I21.4, I21.9, I21.11; I22-I22.1, I22.8; I23-I23.6, I23.8; I24.1, I24.8, I24.9; I25-I25.6, I25.8; I40-I40.1, I40.8, I40.9; I41-I41.2, I41.8; I42-I42.9; I43-I43.2, I43.8; I51-I51.9; I52-I52.1, I52.8).</td>
</tr>
<tr>
<td>Chronic kidney disease (N13.2; N15.8; N16, N16.0, N16.2-N16.4; N17-N17.2, N17.8, N17.9; N18, N18.0, N18.8, N18.9,N19; N20.1; N02.3-N02.5, N07-N07.9, O90.4; Q27.1, Q27.2; Q61.4; P96.0; N25, N25.0; N14.1-N14.4; N15-N15.1, N15.9;I70.1; I72.2; M10.3; A98.5; Y84.1; R39.2; I82.3; Z99.2; K76.7).</td>
</tr>
<tr>
<td>Chronic Obstructive Pulmonary Disease (J43-J43.2, J43.8, J43.9; J44-J44.1, J44.8, J44.9; J47).</td>
</tr>
</tbody>
</table>

**Data Sources**

From January 2005 to December 2007, we extracted data from 3 national database sources, which we were able to match because every Catalan citizen has a unique and anonymous identification number for health care use. The central database of the Catalan Health Service facilitated data abstraction from the electronic patient records of PCPs. Data from hospital admissions was gathered
from the Division of Demand and Activity Registries (Minimum Basic Data Set for
Acute-care Hospitals) of the Catalan Health Service, where all Catalan hospitals
are required to send in their data for reimbursement. Information on mortality was
gathered from the Mortality Register of Catalonia, where fatalities had to be
notified. We recorded as fatality cases patients codified as such in the primary
care electronic patient records register and those also identified in the Mortality
Register of Catalonia.
None of the officers responsible for data abstraction were involved in the
subsequent data analysis.

Statistical Methods
Descriptive data from our sample on age, sex and comorbidities are presented.
We calculated the entire cohort follow-up period and reported the median,
minimum and maximum values. Candidate variables significantly associated with
mortality in the bivariate analysis (P<.05) were included as potential covariates in
the multivariable model. In the bivariate model, the chi square text and Fisher's
exact test were used for categorical variables and Student's t test for continuous
variables. Kaplan Meier analysis was used to determine long-term survival. The
Cox proportional hazards model was used to examine the independent effect of
candidate variables. The forward and backward step technique with the likelihood
ratio test was used. Discrimination of the model was calculated with Harrell's C-
index, and calibration of the model was calculated with the Gronnesby and Borgan
test. Constant hazard was tested with the log (-log S[x]) vs Log(time) graphic. All
tests were 2-tailed and significance was set at the 5% level (a=0.05). Missing
values were calculated (0.2% of our final sample) and were found not relevant in
our analysis.
The statistical analysis was performed with SPSS v18 software and StataCorp12.

Results
Initially we identified 13,008 potentially eligible patients with a diagnosis of CHF
from 43 PCPs, covering a population of 1,039,342 listed citizens.
We excluded 2221 patients without registration of the date of diagnosis and 5128
patients with a prevalent diagnosis of CHF or without a prescription for diuretics.
Our final sample consisted of 5659 patients from 43 PCPs: 3641 (64.3%) from
urban areas (covering a population of 558,515 inhabitants) and 2018 (35.7%) from
rural settings (covering a population of 480,827 inhabitants). The median follow-up
period of the entire cohort was 3 years with a minimum of 0.08 years and a maximum of 3 years.

Patient characteristic in the sample did not differ substantially from those of the initial population (Table 3). The mean (standard deviation) age of our sample was 77 (10) years; 88.3% of the patients were aged 65 years or more and 60% were women. During the study period, 585 patients (10.3%) were hospitalized for cardiovascular causes. The median interval after the onset of CHF was 1.6 years. Regarding comorbidities, the bivariate analysis showed that in those patients who died during the follow-up, hypertension was more prevalent in women (P=.022) and in patients aged 65 years or more (P=.029), while chronic obstructive pulmonary disease (P<.001), ischemic heart disease (P<.001), and chronic kidney disease (P=.009) were more common in men. Diabetes mellitus was more frequent in patients aged less than 65 years (P=.041), while hypercholesterolemia was also more frequent, although this difference was not statistically significant (P=.771).

Table 3. Patient characteristics

<table>
<thead>
<tr>
<th></th>
<th>Study sample (n=5659)</th>
<th>Population (n=13,008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>77 ± 10 (available for 5654)</td>
<td>76 ± 11 (available for 12,963)</td>
</tr>
<tr>
<td>Age &lt; 65</td>
<td>656 (11.6)</td>
<td>1793 (13.8)</td>
</tr>
<tr>
<td>Age ≥ 65</td>
<td>4998 (88.3)</td>
<td>11170 (85.9)</td>
</tr>
<tr>
<td>Women</td>
<td>3402 (60)</td>
<td>7671 (59)</td>
</tr>
<tr>
<td>Hospitalization during follow up</td>
<td>585 (10.3)</td>
<td>1233 (9.5)</td>
</tr>
<tr>
<td>Time after the onset of CHF, years</td>
<td>1.6 (1.0, 2.2)</td>
<td>2.21 (1.23, 3.57) [available for 10,787 patients]</td>
</tr>
<tr>
<td>Patients on diuretics</td>
<td>5659 (100)</td>
<td>9391 (72.2)</td>
</tr>
<tr>
<td>Patients on ACE inhibitors/ARB</td>
<td>4537 (80.2)</td>
<td>9262 (71.2)</td>
</tr>
<tr>
<td>Patients on beta-blockers</td>
<td>2086 (36.9)</td>
<td>4137 (31.8)</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>444 (7.8)</td>
<td>1206 (9.3)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>3996 (70.6)</td>
<td>9134 (70.2)</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>1686 (29.8)</td>
<td>4105 (31.6)</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>1458 (25.8)</td>
<td>3540 (27.2)</td>
</tr>
<tr>
<td>CKD</td>
<td>624 (11.0)</td>
<td>2044 (15.7)</td>
</tr>
<tr>
<td>COPD</td>
<td>827 (14.6)</td>
<td>2060 (15.8)</td>
</tr>
</tbody>
</table>

ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blockers; CHF, chronic heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease.

Data are expressed as no. (%), mean ± standard deviation or median [interquartile range].

During the follow-up period, 950 patients died (16.8%).

Survival after the first, second and third year of follow-up was 90%, 80%, 69%, respectively (Figure); no significant differences (P=.13) in survival were found between men and women.
Cox proportional hazard modelling (Table 4) confirmed an increased risk of death for older age (hazard ratio \(\text{HR} = 1.06; 95\%\text{CI}, 1.06-1.07\)), diabetes mellitus (HR=1.53; 95%CI, 1.33-1.76), chronic kidney disease (HR=1.73; 95%CI, 1.45-2.05), and ischemic heart disease (HR=1.18; 95%CI, 1.02-1.36). Hypertension (HR=0.73; 95%CI, 0.64-0.84) had a protective effect. We did not find a significant effect according to the setting.

Figure. Overall survival in incident patients during the follow-up period. No statistically significant differences

The assumption of constant hazard was met. The discrimination of the model was 0.67. Calibration of the model (\(P=.03\)) was significant for the first decile only and was not significant for the remaining deciles, indicating that the model failed in patients with lower risk.
Table 4. Multivariable model reporting the effect of prognostic factors on survival (n=5647), Cox Proportional Hazards Model

<table>
<thead>
<tr>
<th></th>
<th>HR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>1.06 (1.06-1.07)</td>
</tr>
<tr>
<td>Diagnosis of chronic kidney disease</td>
<td>1.73 (1.45-2.05)</td>
</tr>
<tr>
<td>Diagnosis of diabetes mellitus</td>
<td>1.53 (1.33-1.76)</td>
</tr>
<tr>
<td>Diagnosis of ischemic heart disease</td>
<td>1.18 (1.02-1.36)</td>
</tr>
<tr>
<td>Diagnosis of hypertension</td>
<td>0.73 (0.64-0.84)</td>
</tr>
</tbody>
</table>

95%CI, 95% confidence interval; HR, hazard ratio

Discussion

In our study 90% of ambulatory patients with CHF survived 1 year after onset. Independent predictors of a worse outcome were older age, diabetes mellitus, chronic kidney disease, and ischemic heart disease. In contrast with previous studies carried out in hospital-based cohorts or selected patients from clinical trials, we evaluated mortality trends and predictors of mortality for ambulatory patients in a Mediterranean community-based cohort. Comparisons with other studies are hampered by differences in patient selection, patient characteristics, and follow-up periods. Nevertheless, our survival rates were higher than those reported in the literature, such as the Framingham\(^8\) (57% for men and 64% for women) and Rochester\(^23\) (77%) studies in the United States, and the Hillington\(^7\) (62%) study in the United Kingdom. All of these studies reported incident CHF. In our study, survival was also higher than that in a study in the Netherlands\(^24\) (74% survival at 1 year), which used a selection process similar to ours. In prevalent CHF, studies in central Europe reported a 1-year survival rate of 87.4%\(^25\) and 89%\(^26\).

On the other hand, our survival rates for incident CHF were in line with those reported by the Spanish national data registry from hospital-based heart failure clinics\(^20\) (survival rates at 1 and 2 years of 90% and 80%, respectively). Higher mortality (about 30% mortality at 1 year) was found in the south of Spain\(^27\), although this phenomenon has been described as a paradox\(^28\), as this mortality is the highest in Spain and is associated with ischemic heart disease mortality, illiteracy, and unemployment\(^29\). In contrast, we found a low rate of hypercholesterolemia and ischemic heart disease in our cohort, which could partly explain our positive results on survival. None of the above studies analyzed the effect of comorbidities on outcomes.

Our results show that Mediterranean countries may also have better outcomes for CHF in addition to the favorable trends reported in coronary heart disease\(^17,18\). It has been hypothesized that regional factors\(^30\), as well as the implementation of
evidence-based therapies and risk factor management\(^{19}\), may confer protection. At the organizational level, there may be differences in the role played by primary care in health care systems on risk factor control and in fast tracking to specialist care. To allow comparisons, these issues should be further investigated in epidemiological studies in other Mediterranean countries.

Despite differences in patient selection and patient characteristics, the predictors of worse prognosis in our study were similar to those found in previous community-based studies. There is common agreement on the effect of older age both in the United States and Europe, although disparities exist regarding sex and other prognostic factors. Although we found no effect of sex on survival, several studies have reported better survival in women\(^{8,24,25}\). Other factors that increase the risk of death are diabetes mellitus\(^{8,26,31}\), hospitalization\(^{25}\) and renal failure\(^{7,23,25,26}\).

Hypertension has been previously reported\(^{23}\) as a positive predictor for survival. In a multivariable analysis, we found better survival among patients with a diagnosis of hypertension registered in their electronic medical records. The higher survival was probably due to the negative effect of low systolic blood pressure on prognosis described elsewhere\(^{7,25,26}\) rather than to the diagnosis of hypertension itself, which is one of the causes of diastolic heart failure and is more prevalent in women and older patients, who usually have a longstanding history of hypertension\(^{24,32,33}\).

**Limitations**

Our study has some potential design limitations concerning the inclusion of participants and measures. Although we did not have access to the set of PCPs excluded in the urban region, we found no significant differences among the regions included in this study. We expected that any other ethnic or socioeconomic effect on outcomes would have been minimized by our selection process, which developed from a previous randomization performed for a concomitant disease management intervention.

We identified CHF patients through their primary care physician's electronic patient records but did not know how many of them had undergone echocardiography and therefore lacked information on the etiology of CHF, which would have aided interpretation of our results. As a measure of diagnostic accuracy, we only selected patients who had been prescribed diuretics to perform our data analysis and possibly missed patients with CHF not receiving diuretics.

Usually, in our setting, primary care physicians register the diagnosis of CHF after confirmation by a specialist. This specialist is also involved in the diagnostic
process and management of these patients in the community and provides support to primary care physicians in their setting, as this has been part of our integrated care program since 1990\textsuperscript{34} (Table 1). Although we could not exclude the possibility that diagnosis of CHF was made clinically by the primary care physician alone in some cases, our results on survival were consistent with those found in the Spanish national data registry.

Our predictive model had a modest predictive power (c=0.67) and also low goodness-of-fit (P=.03), particularly for the first decile, with higher goodness-of-fit for the remaining deciles, indicating that the model failed in patients at lower risk. These results could be explained by 2 reasons: a) comorbidities were identified through the primary care physicians' registration in electronic patient records and we were unable to capture how long patients had been exposed to the conditions or to obtain information on severity by using biomarkers, and b) the sample size was large (over 500 cases in each decile), increasing the possibility that every small difference would be significant. Nonetheless, our model was clinically relevant and in line with reports in the literature.

Because of the low registration on New York Heart Association classification and left ventricular ejection fraction, we could not present survival data according to these factors. Such information would have provided more detailed information on the severity of CHF. Primary care physicians do not usually record this information, nor do they do so as open access text, which also hampered access.

Finally, we considered the date of registration of CHF in the primary care physicians' electronic medical records, which did not necessary reflect the date when the diagnosis was made, although our survival rates matched those in national database registers.

**Conclusions**

Survival rates in our community cohort of patients with CHF were relatively high. Clinicians and managers need to consider this favorable prognosis in service planning, as well as the effect of prognostic factors, which could help to identify high-risk patients.
References


Survival in Mediterranean ambulatory patients with chronic heart failure


Chapter 6

Trends and predictors of hospitalization, readmissions and length of stay in ambulatory patients with heart failure

Eva Frigola-Capell
Josep Comin-Colet
Josep Davins-Miralles
Ignasi J. Gich-Saladich
Michel Wensing
Jose M. Verdú-Rotellar

Abstract

Objectives: Little is known on predictors of hospitalization in ambulatory patients with chronic heart failure, and known predictors may not apply to Mediterranean countries. Our aim was to document longitudinal trends in hospitalizations and identify patient-related predictors of hospital admission, re-admission and length of stay in the targeted population.

Methods: Population-based retrospective cohort study in Catalonia (North-East Spain), including 7196 ambulatory patients (58.6% women; mean age 76 years). Eligible patients were selected from the electronic patient records of primary care practices, and followed for 3 years.

Results: At 3 years of follow up overall 645 (9.0%) patients had cardiovascular hospitalization, 37% were readmitted, and median length of stay was 9 (interquartile range 5-17) days. Chronic kidney disease [odds ratio (OR)=1.98 (1.62-2.43)], IHD [OR=1.72 (1.45-2.04)], DM [OR=1.50 (1.27-1.78)] and chronic obstructive pulmonary disease [OR=1.43 (1.16-1.77)] increased the risk for hospitalization. DM [OR=1.70 (1.22-2.38)], IHD [OR=1.85 (1.33-2.58)] and HTA [OR=1.66 (1.11-2.46)] increased the risk for readmissions. Chronic kidney disease [OR of 2.21 (1.70-2.90)], IHD [OR of 2.19 (1.73-2.77)], DM [OR= 1.70 (1.34-2.15)], HTA [OR=1.51 (1.13-2.01)], chronic obstructive pulmonary disease [OR=1.37 (1.02-1.83)] increased the risk for long length of stay in hospital.

Conclusions: Our study identified predictors of hospitalization, readmissions and long length of stay which can help clinicians and managers to identify high risk patients which should be targeted on service planning and when designing preventive actions.
Introduction
Hospitalizations for chronic heart failure (CHF) have major impact on patient's quality of life and imply high costs for societies'. In many industrialized countries management of CHF represents 1-2% of total healthcare expenditure and up to two-third of this cost is in relation with hospitalizations\textsuperscript{1-4}. Although recent reports suggest that CHF has probably reached its peak, it remains a highly prevalent cause of hospitalization\textsuperscript{5,6}. CHF accounts for 5% of acute hospital admissions and rises in patients older than 65 years\textsuperscript{7,8}. Despite so, there is a surprising lack of epidemiological prospective studies identifying potential prognostic predictors\textsuperscript{6}. A better insight into these predictors may help to identify patients with increased risk at an early stage for preventive actions.

CHF is a condition mostly managed in primary care\textsuperscript{9,10}. Family physicians (FPs) play an important role in the early and accurate initial diagnosis, risk factors identification and disease monitoring\textsuperscript{11}. But this is a complex condition with patients who are often elderly and frail, with comorbidity and polypharmacy\textsuperscript{12}. This complexity is not always represented in clinical trials; thus, research with "real world patients" registered in primary care would be applicable to their everyday practice. Factors such as age, gender, diabetes, respiratory disease and renal failure have been associated by several studies to hospitalization\textsuperscript{13,14}, readmissions\textsuperscript{15} and length of stay\textsuperscript{5,16,17}. Nevertheless. These studies are mainly hospital based, and epidemiological studies with ambulatory patients are scarce\textsuperscript{6,13}. In addition, in Mediterranean countries, cardiovascular patients tend to have better outcomes than similar patients in other countries, so predictors of hospitalization may be different as well.

In Spain, Health Care System is strongly primary carebased\textsuperscript{18} acting as a first point of contact for patients and as a gatekeeper to specialist care. On the other side, it has a strong interface with specialist care. Nevertheless, hospitalization trends are mainly reported from National Hospital database registry\textsuperscript{8} and clinical trials\textsuperscript{19} and large prospective community-population based studies reporting on readmission, length of stay and prognostic factors are lacking. The aim of this study was to document longitudinal trends in hospitalizations and identify patient-related predictors of hospital admissions, re-admissions and length of stay among ambulatory CHF patients in Catalonia (north-eastern Spain).
Participants and methods

Study design and setting

We performed a population-based retrospective cohort study using the resources of a project published in Clinical Trials database (NCT00792402). Briefly, this project used a non-equivalent controlled, before and after, quasi-experimental design with a population based approach to evaluate the impact of a clinical practice guideline on CHF in Catalonia (population of 7,210,508)\textsuperscript{20}. Primary care practices (PCPs) from urban (intervention group) and rural (control group) setting were included. PCPs of the intervention group were randomized and half were exposed to usual care plus a clinical practice guideline on CHF and the other half to a disease management intervention (which did not participate in our project). For the purpose of this study, data from both regions were combined. Despite urbanization differences, both regions shared same organizational features\textsuperscript{21} (Table 1). The ethics committee of the Catalan Primary Care Research Institute "IDIAP Jordi Gol", overseen by the Spanish Ministry of Health approved this study.

Table 1. Organizational features of participating primary care practices

<table>
<thead>
<tr>
<th>Features</th>
<th>Urban region/rural region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care provider</td>
<td>&quot;Catalan Health Institute&quot; care provider for the 80% of the population in the Autonomous Community of Catalonia (population of 7,210,508). Belongs to the Spanish National Health System</td>
</tr>
<tr>
<td>Coverage</td>
<td>Universal coverage for both primary and secondary care</td>
</tr>
<tr>
<td>Funding</td>
<td>State funded through general taxes. Co-existence with private sector</td>
</tr>
<tr>
<td>Access to care</td>
<td>Every citizen is registered with a family physician who acts as a gatekeeper to specialized care</td>
</tr>
<tr>
<td>Medical records</td>
<td>Electronic patient records system</td>
</tr>
<tr>
<td>Provision of care</td>
<td>Network of practices that behave as geographical and administrative units where physicians are part of the staff (from 4 to 36 physicians per practice depending on population attended)</td>
</tr>
<tr>
<td></td>
<td>Single health care centres\textsuperscript{a} Single health care centres and satellite offices\textsuperscript{b}</td>
</tr>
<tr>
<td>Diagnosis process / Integrated care</td>
<td>Cardiologists and other specialized services attending practices weekly since 1990 to support physicians on the diagnosis process, management and training</td>
</tr>
</tbody>
</table>

\textsuperscript{a} applies to urban region
\textsuperscript{b} applies to rural region

Participants

We selected patients from PCPs and followed them for 3 years, from January 2005 to December 2007. PCPs of the rural area were all included. In the urban area we included those PCPs exposed to usual care plus a clinical practice guideline on CHF and excluded the rest of PCPs exposed to a disease management intervention which was not targeted by our project as described
above. At patient level, we included patients over 30 years old attending PCPs, with a diagnosis of CHF (I11.0, I13.0, I13.2, I50, I50.0, I50.0 I50.1, I50.9, P29.0 according to the International Classification of Diseases Tenth Revision used in primary care) registered by their FP during the period of our study (incident cases).

Measures
Our primary measures were hospitalization, readmissions, length of stay and long length of stay. We defined hospitalization as any cardiovascular admission between 2005 and 2007 as primary diagnosis at discharge (398-39899, 402-40291, 428-4289, 9971, 40390-40391, 404-40493, 411-41189, 414-4149 according to the International Classification of Diseases Ninth Revision used by hospitals); re-admissions as more than one cardiovascular admission between 2005 and 2007, length of stay as total number of days spent in hospital per year and long length of stay as days above the median spent in hospital over the follow up period. Potential comorbidity associated to primary measures were included according to the review of the literature, clinical relevance and availability and were defined on the basis of the International Classification of Diseases Tenth Revision codes registered in the primary care electronic patient records (Table 2).

Table 2. ICD10 Codes related to comorbidity included

<table>
<thead>
<tr>
<th>Condition</th>
<th>ICD10 Codes related to comorbidity included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypercholesterolemia</td>
<td>(E78)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>(O10-O10.4; O11, O13, O14, O16; I10, I11, I11.9, I12, I12.0, I12.9; I13, I13.1, I13.9; I15-I15.2, I15.8, I15.9)</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>(E10-E10.9; E11-E11.9; E12-E12.9; E13-E13.9;E14-E14.9;P70.2;N08.3; O24-O24.4, O24.9)</td>
</tr>
<tr>
<td>Ischemic Heart Disease</td>
<td>(I20-I20.1; I20.8, I20.9; I21-I21.4, I21.9, I21.11; I22-I22.1, I22.8; I23-I23.6, I23.8; I24.1, I24.8, I24.9; I25-I25.6, I25.8; I40-I40.1, I40.8, I40.9; I41-I41.2, I41.8; I42-I42.9; I43-I43.2, I43.8; I51-I51.9; I52-I52.1, I52.8)</td>
</tr>
<tr>
<td>Chronic kidney disease - CKD-</td>
<td>(N13.2; N15.8; N16, N16.0, N16.2-N16.4; N17-N17.2, N17.8, N17.9; N18, N18.0, N18.8, N18.9; N19; N20.1; N02.3-N02.5; N07-N07.9; O90.4; Q27.1, Q27.2; Q61.4; P96.0; N25, N25.0; N14.1-N14.4; N15-N15.1, N15.9;I70.1; I72.2; M10.3; A98.5; Y84.1; R39.2; I82.3; Z99.2; K76.7)</td>
</tr>
<tr>
<td>Chronic Obstructive Pulmonary Disease - COPD-</td>
<td>(J43-J43.2, J43.8, J43.9; J44-J44.1, J44.8, J44.9; J47)</td>
</tr>
</tbody>
</table>

We included hypercholesterolemia (HCL), arterial hypertension (HTA), diabetes mellitus (DM), ischaemic heart disease (IHD), chronic obstructive pulmonary disease (COPD), and chronic kidney disease (CKD). We also included age and gender. We obtained age by calculating the difference of initial date of our study (1 January 2005) and date of birth and considered two categories such as less than 65 and ≥ 65 years old. Also we considered region and time since onset of
CHF as covariate variables. Time since onset of CHF was calculated as the time (years) from date of diagnosis registration in primary care electronic clinical records to the final date of our study (31 December 2007) or dead. Mortality from any cause was included. Diagnosis of CHF was made after hospital confirmation, cardiologist advice or echocardiography (Table 1). We also collected patients on diuretics, angiotensin-converting enzyme, angiotensin II receptor blockers and beta-blockers.

Data sources
We obtained primary care information from the central database of 'Catalan Health Institute', by one of their informatics officer with access to electronic patient records. Data from hospital admissions were collected from the Division of Demand and Activity Registries (Minimum Basic Data Set for Acute-care Hospitals-MBDS), of the Catalan Health Service, where Catalan hospitals are committed to send in their data for reimbursement. Information on mortality was abstracted from the Mortality Register of Catalonia where fatalities must be notified and added to the information held by primary care electronic patient records on patient status. We were able to link all the information from the three database sources because every Catalan citizen has a unique and anonymous identification number for health care use. The informatics officers responsible for data abstraction were not involved in the subsequent data analysis.

Statistical methods
Descriptive data for age, gender and comorbidities are presented for all patients. For categorical variables frequencies were reported. For continuous variables, mean and standard deviation (SD) were calculated. Median and interquartile range (IQR) were calculated for the variables time since onset of CHF and length of hospital stay. Candidate variables (measures) significantly ($p < 0.05$) associated with primary measures in the bivariate analysis were included as potential covariates in logistic regression models. Chi-Square and Student-Fisher test for categorical and continuous variables, respectively, were used at bivariate analysis. Forward step technique with likelihood ratio test was used. Multivariate adjusted odds ratios and accompanying 95% confidence intervals were calculated. Discrimination of the model was assessed by the area under the receiver operating characteristic (ROC) curve. Hosmer and Lemershow goodness of fit test was used for calibration of the model. All tests were 2-tailed and significant at 5% level ($\alpha = 0.05$). Multivariable analyses were performed considering all
patients and also excluding fatalities. All analyses were undertaken with use of SPSS Inc v18 software.

Results

Study population
We initially identified 20,576 potentially eligible patients with the diagnosis of CHF from 68 PCPs, covering a population of 1,522,564 listed citizens. According to our inclusion criteria we excluded 25 PCPs from the urban setting and 5812 patients with prevalent CHF. Our final sample was 7196 patients with incident CHF from 43 PCPs: 4750 from urban (covering 558,515 inhabitants) and 2446 from rural (covering 480,827 inhabitants). The median follow up for the entire cohort was 1095 days with a minimum of 31 and a maximum of 1095 days. Patients' characteristics are presented in Table 3. In the bivariate analysis, we found that HTA was significantly more prevalent in patient's ≥ 65 years and women while CKD, COPD and IHD were more prevalent in men. HCL, HTA, CKD, IHD and COPD were significantly \( p < 0.001 \) more prevalent in the urban setting than in the rural although. No significant differences were found according to age, sex and DM.

Table 3. Patients' characteristics

<table>
<thead>
<tr>
<th></th>
<th>All (n=7196)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (available for 7173). Mean (SD).</td>
<td>76 (10)</td>
</tr>
<tr>
<td>Age &lt; 65 n (%)</td>
<td>973 (13.5)</td>
</tr>
<tr>
<td>Age ≥ 65 n (%)</td>
<td>6200 (86.2)</td>
</tr>
<tr>
<td>Sex –women n (%)</td>
<td>4214 (58.6)</td>
</tr>
<tr>
<td>Cardiovascular admissions during the follow up n (%)</td>
<td>645 (9.0)</td>
</tr>
<tr>
<td>Patients on diuretics n (%)</td>
<td>5659 (78.6)</td>
</tr>
<tr>
<td>Patients on ACE / ARB n (%)</td>
<td>5539 (77)</td>
</tr>
<tr>
<td>Patients on beta blockers n (%)</td>
<td>1638 (22.8)</td>
</tr>
<tr>
<td>Hypercholesterolemia n (%)</td>
<td>644 (8.9)</td>
</tr>
<tr>
<td>Hypertension n (%)</td>
<td>5061 (70.3)</td>
</tr>
<tr>
<td>Diabetes Mellitus n (%)</td>
<td>2184 (30.4)</td>
</tr>
<tr>
<td>Ischemic Heart Disease n (%)</td>
<td>1941 (27.0)</td>
</tr>
<tr>
<td>CKD n (%)</td>
<td>925 (12.9)</td>
</tr>
<tr>
<td>COPD n (%)</td>
<td>1067 (14.8)</td>
</tr>
</tbody>
</table>

n, number of patients; SD, Standard deviation; ACE, angiotensin-converting enzyme; ARB, Angiotensin II receptor blockers; CKD, Chronic Kidney Disease; COPD, Chronic Obstructive Pulmonary Disease.

Hospitalization trends
In three years of follow up overall 645 (9.0%) patients had an admission to hospital due to cardiovascular reasons. Along the follow up period the number of
hospitalizations decreased from 435 in 2005 to 153 in 2007 (Table 4). Multivariate modelling identified four predictors of hospitalization at three years of follow up (Table 5). CKD was the strongest predictor of hospitalization (OR=1.98; 95% confidence interval [95%CI] 1.62-2.43), followed by IHD with (OR=1.72; 95%CI 1.45-2.04), DM (OR=1.50; 95%CI 1.27-1.78) and COPD (OR=1.43; 95%CI 1.16-1.77). For this explanatory model the area under the ROC curve was 0.627, and the maximum difference between observed and predicted hospitalization was 2%.

Table 4. Hospitalization, readmission and length of stay trends over the follow up

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>Follow up period (2005-2007) n=7196</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients alive, n</td>
<td>7196</td>
<td>7143</td>
<td>6688</td>
<td>6055 n=7196</td>
</tr>
<tr>
<td>Deceased patients, n</td>
<td>53</td>
<td>455</td>
<td>623</td>
<td>1131 n=7196</td>
</tr>
<tr>
<td>Patients admitted to hospital, n</td>
<td>435</td>
<td>194</td>
<td>153</td>
<td>645 n=7196</td>
</tr>
<tr>
<td>&gt; 1 admission, n (%)</td>
<td>99 (22.8)</td>
<td>54 (27.8)</td>
<td>44 (28.8)</td>
<td>238 (37.0) n=7196</td>
</tr>
<tr>
<td>Length of stay (days), median (IQR: P25-P75)</td>
<td>8 (5-15)</td>
<td>7 (3-14)</td>
<td>8 (4-13)</td>
<td>9 (IQR 5-17)</td>
</tr>
</tbody>
</table>

n, – number of patients. IQR, InterQuartile Range: Percentile 25, Percentile 75.

Table 5. Multivariable models

<table>
<thead>
<tr>
<th>Variables</th>
<th>Hospitalizations n=7196</th>
<th>Re-admissions n=7196</th>
<th>Long length of stay n=7196</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR  95% CI</td>
<td>OR  95% CI</td>
<td>OR  95% CI</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>1.50 1.27-1.78</td>
<td>1.70 1.22-2.38</td>
<td>1.70 1.34-2.15</td>
</tr>
<tr>
<td>Ischemic Heart Disease</td>
<td>1.72 1.45-2.04</td>
<td>1.85 1.33-2.58</td>
<td>2.19 1.73-2.77</td>
</tr>
<tr>
<td>CKD</td>
<td>1.98 1.62-2.43</td>
<td>a</td>
<td>2.21 1.70-2.90</td>
</tr>
<tr>
<td>COPD</td>
<td>1.43 1.16-1.77</td>
<td>a</td>
<td>1.37 1.02-1.83</td>
</tr>
<tr>
<td>REGION (URBAN)</td>
<td>a</td>
<td>a</td>
<td>1.63 1.23-2.14</td>
</tr>
<tr>
<td>Diagnosis of Hypertension</td>
<td>a</td>
<td>1.66 1.11-2.46</td>
<td>1.51 1.13-2.01</td>
</tr>
</tbody>
</table>

* No association was found. CKD, Chronic Kidney Disease. COPD, Chronic Obstructive Pulmonary Disease.

Re-admissions

Among the 645 patients with any hospitalization due to cardiovascular reasons along the follow up period, 37% were readmitted. Percentage of readmissions increased from 22.8% in 2005 to 28.8% in 2007 (Table 4). Range of admissions for the follow up period was 1-9. After three years of follow up, multivariate modelling identified three predictors for readmissions (Table 5): DM (OR=1.70; 95%CI 1.22-2.38), IHD (OR=1.85; 95%CI 1.33-2.58) and HTA (OR=1.66; 95%CI 1.11-2.46). For this explanatory model the area under the ROC curve was 0.633. For this model the maximum difference between observed and predicted readmission was 14.5%.
**Length of stay**

Median length of stay per patient in hospital after the follow up period was nine days (IQR 5.17) (Table 4). Multivariate modelling for the whole follow up period (Table 5) identified five predictors for long length of stay (>9 days): CKD (OR=2.21; 95%CI 1.70-2.90), IHD (OR=2.19; 95%CI 1.73-2.77), DM (OR=1.70; 95%CI 1.34-2.15), HTA (OR=1.51; 95%CI 1.13-2.01) and COPD (OR=1.37; 95%CI 1.02-1.83). Patients from urban region were associated to longer length of stay (OR=1.63; 95%CI 1.23-2.14). For this explanatory model the area under the ROC curve was 0.675 and the maximum difference between observed and predicted long length of stay was 0.68%. Multivariable models did not provide substantially different results when excluding fatalities from the analysis, except for readmissions (ROC curve of 0.643) and long length of stay (ROC curve of 0.688), which became more discriminative.

**Discussion**

In our cohort of ambulatory patients with CHF only 9.0% of patients were admitted to hospital due to cardiovascular reasons during three years of follow up. During that period we found that while the number of admissions and length of stay decreased, the number of readmissions increased. We also provided a risk profile for each of our main measures, hospitalization, readmission and long length of stay in hospital, according to comorbidities that were found to be associated to increase such risk. We found that despite we had a low prevalence of IHD (27%), this still was associated with an increased risk of hospital events. In contrast with previous studies, that were done in hospital-based cohorts or selected patients from clinical trials, we evaluated trends and predictors of hospitalization, readmission and length of stay for ambulatory patients in a Mediterranean community-based cohort.

**Hospitalizations**

No previous data from a community perspective confirmed the decrease on hospitalization trends found also in national hospital surveys either from United States\textsuperscript{13}, North\textsuperscript{5} or Central Europe\textsuperscript{22}. Our admission rates due to cardiovascular reasons were lower compared to those previously reported from the United States\textsuperscript{23} or United Kingdom\textsuperscript{24}. Reasons for that may remain in the organization of provision of care. We have a strong primary care management of chronic conditions in the community, with specialists supporting FPs and home care that could explain this result. Our risk profile for admissions was in line with what is
reported by hospital-based studies\textsuperscript{13,14}. Also Dunlay et al.\textsuperscript{23} from a community perspective found DM and creatinine clearance as predictors for CHF hospitalization.

**Readmissions**
Little is known on studies analyzing high-risk profile for readmissions due to CHF from a wide pool of patients from primary care. Most of the studies are hospital-based or have used government administrative data\textsuperscript{25}. Despite that these results do not bring a unique risk model for readmissions which to compare to, we confirmed the effect of DM and IHD similarly to what some of them reported\textsuperscript{26}. Despite our hospitalization rate being low, we found a high readmission rate, increasing over the period of our study. A similar finding has also been reported in hospital-based studies\textsuperscript{5,15}. A reason for that may be that management of CHF in the community may delay patient hospitalization up to a more severe stage when hospitalizations are more frequent.

**Length of stay**
Understanding which patients managed in the community are at higher risk to increase their stay in hospital can be an aid to clinicians and managers on health care planning nevertheless this is yet to be elucidated. In our cohort, comorbidities associated to increase the risk to stay longer time than the median in hospital were CKD, IHD, DM, HTA and COPD. We observed a decrease over time in the median of length of stay in hospital as reported by hospital-based studies\textsuperscript{5,16}.

**Limitations of the study**
We did not capture admissions to private hospitals or outside of targeted setting. However, we included listed patients of PCPs with a hospital assigned. These patients rarely would go to private hospital or attend other PCPs or public hospital because of our continuum of care model. Data from the Catalan government show that about 90% of patients use their assigned hospital\textsuperscript{27}. We were not able to report on the New York Heart Association classification and the Left Ventricular Ejection Fraction that would provide clinically important information on the severity and type of CHF and might have clarified the effect of an earlier onset of CHF on hospitalizations and our higher readmission rates. We identified CHF patients through their FPs' electronic patient records and could not have access to the number and echocardiography results performed in each patient. However, in our setting, usually FPs register a CHF diagnosis or any other comorbidity diagnosis.
after specialist confirmation, who is involved in the diagnosis process and management of these patients in the community, providing support to FPs in their setting, as this is part of our integrated care program since 1990\textsuperscript{28} (Table 1). As a measure of accuracy of the diagnosis we reported a high percentage of patients on diuretics. We did not analyze variability between FPs; nonetheless, our objective was to report trends of hospitalization for the CHF disease rather than primary care professional's performance. Anyway, all FPs participating in this study belonged to the same primary care provider and had the same electronic patient record system, which makes easily available all the International Classification of Diseases Tenth Revision diagnosis codes when the FPs need to record a diagnosis. We did not analyze separately hospitalizations due to CHF or other cardiovascular conditions that could have provided more clinical information about the physiopathology of the CHF. In addition, we used the date of CHF onset registered by FPs which do not necessarily reflect the date when the diagnosis was made. The exclusion of some PCPs in the urban region may explain differences in hospitalization trends found in the two settings analyzed. Nonetheless, we expected that any other ethnic or socioeconomic effect on outcomes would have been minimized by our selection process that started off from a previous randomization done by a concomitant disease management intervention in the former setting.

\textbf{Conclusions}

Our study identified predictors of hospitalization, readmissions and long length of stay which can help clinicians and managers to identify high risk patients which should be targeted on service planning and when designing preventive actions. Nevertheless, future research should study more in depth how severity of associated comorbidity can have an effect on hospital events for CHF patients and so modify their risk profile.
References


Chapter 7

Prescription in patients with chronic heart failure and multimorbidity attended in primary care

Eva Frigola-Capell
Jose M. Verdú-Rotellar
Josep Comin-Colet
Josep Davins-Miralles
Eduard Hermosilla
Michel Wensing
Rosa Suñol
Abstract

**Background:** Multimorbidity and polypharmacy pose challenges to improving the quality of care.

**Objectives:** To determine the association between prescription of recommended treatment in ambulatory patients with chronic heart failure and multiple comorbidities and hospitalization events.

**Design** A population-based retrospective cohort study in Catalonia (north-east Spain).

**Participants:** We included 7173 newly registered patients with chronic heart failure (59% women; mean [SD] age 76.3 [10.7] years). Patients were selected from the electronic patient records of primary care practices and followed for three years.

**Outcome measures:** Prescription of angiotensin-converting enzyme inhibitors (ACEI), angiotensin II receptor blockers (ARBs) and beta-blockers (BB).

**Results:** Prescription of ACEI/ARBs in patients managed in primary care without a hospitalization event during the follow-up rose from 50.8 to 83.5% for 0 and ≥ 4 comorbidities, respectively, and for ACEI/ARBs and BB from 13.1 to 30.6% for 0 and ≥ 4 comorbidities respectively. Patients with a hospitalization event were treated more often (ACEI/ARBs or 1.47 [1.17-1.85]; ACEI/ARBs and BB or 1.41 [1.17-1.69]). Comorbid conditions receiving more treatment were hypertension (ACEI/ARBs, or 3.75 [3.33-4.22]; ACEI/ARBs and BB or 1.40 [1.23-1.59]), diabetes mellitus (ACEI/ARBs or 1.79 [1.57-2.04]; ACEI/ARBs and BB or 1.33 [1.18-1.49]) and ischaemic heart disease (ACEI/ARBs or 1.25 [1.10-1.42]; ACEI/ARBs and BB or 3.01 [2.68-3.38]).

**Conclusion:** Prescription of recommended treatment in patients with chronic heart failure increased as the number of comorbidities increased. Family physicians can provide equivalent care to more complex patients and those less complex, according to the number of comorbidities.
Introduction
Chronic heart failure (CHF) is a prevalent and costly condition. In many industrialised countries, costs represent between 1 and 2% of total healthcare expenditure, and up to two thirds of costs are related to hospitalizations. Because the prevalence of CHF increases with age and the elderly population is growing it is expected to be a heavier burden in future. Appropriate treatment of heart failure effectively improves survival and quality of life. International guidelines recommend widespread use of both angiotensin-converting enzyme inhibitors (ACEI) and beta-blockers (BB) to improve symptoms and survival unless a specific contraindication exists. Despite these recommendations treatment of patients with CHF remains suboptimal.

CHF is mostly managed in primary care, where the diagnosis is often initiated and the condition followed up. Several studies using qualitative methods have reported that the complexity of these patients, because of ageing, comorbidities and uncertainty about diagnosis, are self-reported by family physicians (FPs) to be barriers to the use of recommended treatments. Whether this is consistent with FPs' real clinical performance has not yet been reported in large community studies. Previous trials showed that specialist care increases the probability of receiving the recommended treatment for CHF when compared with usual care by FPs, but the complexity of these patients in terms of comorbidities was not considered. The aim of this study was to determine the association between prescription of recommended treatments in ambulatory patients with CHF and concomitant comorbidities, with or without hospitalization events, in Catalonia (north-east Spain).

Methods
Study design and setting
We conducted a population-based retrospective cohort study using the data collected in a project published in the Clinical Trials database (NCT00792402). Briefly, this project used a non-equivalent controlled before and after quasi-experimental design with a population-based approach to evaluate the impact of a clinical practice guideline on CHF in two regions of Catalonia (a Spanish region with a population of 7,210,508). For this study, we combined data from both arms, including intervention (urban) and control (rural) regions. Despite urbanization differences, both regions shared the same organizational features (Table 1).
Participants
We selected patients newly registered with a diagnosis of CHF (codes I11.0, I13.0, I13.2, I50, I50.0, I50.0 I50.1, I50.9 and P29.0 according to the International Classification of Diseases Tenth Revision used in primary care) during the study follow-up (January 2005 to December 2007). Registration of the diagnosis was done by FPs using electronic patient records. We included patients over 30 years old because we did not have younger patients fulfilling the inclusion criteria. We only included patients with information recorded in their electronic patient records for all measures that we analyzed. At practice level, we included all primary care practices (PCPs) in the rural area. In the urban area, we included just those PCPs participating in the project described above (half of all the PCPs in the urban area), which were selected from a previous randomisation process.

Measures
Our primary measures were patients with a prescription of ACEI or ARBs; or alternatively ACEI or ARBs with BB if a diagnosis of asthma was not present. We collected this information at the end of each year of the follow-up period. Our primary predictors were the total number of conditions affecting each patient and recorded hospital events due to cardiovascular causes. We selected those comorbidities recorded in the primary care electronic patient record associated with worsening CHF prognosis. We defined these on the basis of the International Classification of Diseases Tenth Revision codes used in our primary care setting including hypercholesterolemia, hypertension, diabetes mellitus, ischaemic heart disease, chronic obstructive pulmonary disease (COPD) and chronic kidney disease (CKD) codes recorded either before or during the period of our study. We considered any hospital events due to cardiovascular causes as a primary diagnosis at discharge during the period of follow-up (codes 398–39899, 402–40291, 428–4289, 9971, 40390–40391, 404–40493, 411–41189, 414–4149 and V173 according to the International Classification of Diseases Ninth Revision used in hospital databases). Other covariates considered were patient age, gender and region. We obtained age by calculating the difference between the initial date of our study (1 January 2005) and date of birth. CHF diagnosis was recorded by FPs, which in Catalonia is usually done after consultation with a cardiologist (Table 1) or after hospital admission, although the source of the diagnosis was not registered in the electronic patient record. We also collected patients with diuretics prescription in each group. We also considered mortality from any cause.
Table 1. Organizational features of participating primary care practices

<table>
<thead>
<tr>
<th>Features</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care provider</td>
<td>Catalan Health Institute care provider for the 80% of the population in the Autonomous Community of Catalonia (population of 7,210,508) and belongs to the Spanish National Health System</td>
</tr>
<tr>
<td>Coverage</td>
<td>Universal coverage for either primary and secondary care</td>
</tr>
<tr>
<td>Funding</td>
<td>State funded through general taxes. Coexistence with private sector</td>
</tr>
<tr>
<td>Access to care</td>
<td>Every citizen is registered with a family physician who acts as a gatekeeper to specialized care</td>
</tr>
<tr>
<td>Medical records</td>
<td>Electronic patient records system</td>
</tr>
<tr>
<td>Provision of care</td>
<td>Network of practices that behave as geographical and administrative units in which physicians are part of the staff (from 4 to 36 physicians per practice depending on population attended)</td>
</tr>
<tr>
<td></td>
<td>Single health care centres (urban regions); Single health care centres and satellite offices (rural regions)</td>
</tr>
<tr>
<td>Diagnosis process / Integrated care</td>
<td>Cardiologists and other specialized services attending practices weekly since 1990, to support physicians on the diagnosis process, management and training</td>
</tr>
</tbody>
</table>

Data sources

The central database of the Catalan Health Institute supplied us with all patient information required for this study, as recorded by FPs in electronic patient records. Patient information related to hospital admissions was collected from the Division of Demand and Activity Registries (Minimum Basic Data Set for Acute Care Hospitals; MBDS), of the Catalan Health Service, where Catalan hospitals are committed to send in their data for reimbursement. Information on mortality was provided by the Mortality Register of Catalonia and we combined this information with the FPs mortality register on patient status. We were able to link all data from the three database sources because every Catalan citizen has a unique and anonymous identification number for health care use. The informatics officers responsible for data abstraction did not participate in the subsequent data analysis.

Statistical methods

Descriptive data for age, gender and prevalence of relevant variables were calculated for all patients and according to hospitalization events. Chi-square and Pearson tests, for categorical and continuous variables, respectively, were used to conduct bivariate analysis comparing patients with and without a hospitalization event. The probability of the total number of comorbidities and hospitalization events associated with primary measures (ACEI/ARBs, ACEI/ARBs and BB) was reported using multivariable and multilevel logistic regression models. For this purpose, we merged the six comorbidities included in our study into four
categories (one, two, three and four or more comorbidities) to increase the power of the analysis because some of the categories did not have enough patients; we considered this variable as categorical. Primary measures were converted into two dichotomous variables for the whole follow-up period (prescription of ACEI or ARBs at any time during the follow-up; or ACEI/ARBs and BB at any time during the follow-up).

Because patients were selected from PCPs, we established those as random units to control for the variability associated with primary care clinical practice. Next, we established a conditional basal model with the covariates region and hospitalization. Using a step-forward method we introduced each candidate variable (the number of comorbidities and hospitalization) into the basal model and compared the two models using the likelihood ratio test. The final multivariate regression model included the basal model together with the significant candidate variables. All tests were two-tailed and significant at 5% level ($\alpha = 0.05$). Patients with missing values for any of the relevant variables were excluded from the analysis. We also calculated the probability of each comorbidity receiving treatment. All analyses included all patients (including deceased) and those who survived the study period; we did not find significant differences in prescriptions. Missing values were calculated (0.3% of our final sample) and found to be not relevant for the results of our analysis.

All analyses were undertaken with use of StataCorp. 2009 (Stata Statistical Software: Release 11, StataCorp LP, College Station, TX, USA).

**Results**

Initially, we identified 20,576 potentially eligible patients with a diagnosis of CHF from 68 PCPs, covering a population of 1,522,564 listed citizens. According to our sampling and inclusion criteria, we did not study cases from 25 urban PCPs, and we excluded patients diagnosed before our study period (3591), those with an unknown diagnosis registration date (2221), and 23 patients for whom there was no information on the relevant variables. Our final sample included 4735 patients from urban areas (covering 558,515 inhabitants) and 2438 patients from rural areas (covering 480,827 inhabitants).

Patient characteristics and comparison according to hospitalization event are presented in Table 2. Overall, patients without hospital events had a lower prevalence of comorbidities. The group with hospital events during the follow-up period had significantly more patients on diuretics ($P < 0.001$), ACEI/ARBs ($P <$
0.001) and ACEI/ARBs and BB (P < 0.001). We did not find significant differences related to age and gender.

Table 2. Patients’ characteristics

<table>
<thead>
<tr>
<th>Overall</th>
<th>No hospital event</th>
<th>Hospital event</th>
<th>P value (Pearson)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=7173</td>
<td>n=6528</td>
<td>n=645</td>
<td></td>
</tr>
<tr>
<td>Age (Mean, SD)</td>
<td>76.5 (10.5)</td>
<td>76.5 (10.5)</td>
<td>77.1 (10.4)</td>
</tr>
<tr>
<td>Gender [n (%) women]</td>
<td>4202 (58.6)</td>
<td>3835 (58.7)</td>
<td>367 (66.9)</td>
</tr>
<tr>
<td>Hypercholesterolemia n(%)</td>
<td>675 (9.4)</td>
<td>614 (9.4)</td>
<td>61 (9.5)</td>
</tr>
<tr>
<td>High blood pressure n(%)</td>
<td>5129 (71.5)</td>
<td>4646 (71.2)</td>
<td>483 (74.9)</td>
</tr>
<tr>
<td>Diabetes Mellitus n(%)</td>
<td>2275 (31.7)</td>
<td>2010 (30.8)</td>
<td>265 (41.1)</td>
</tr>
<tr>
<td>Ischemic heart disease n(%)</td>
<td>2023 (28.2)</td>
<td>1757 (26.9)</td>
<td>266 (41.2)</td>
</tr>
<tr>
<td>CKD n(%)</td>
<td>1132 (15.8)</td>
<td>972 (14.9)</td>
<td>160 (24.8)</td>
</tr>
<tr>
<td>COPD n(%)</td>
<td>1136 (15.8)</td>
<td>1004 (15.4)</td>
<td>132 (20.5)</td>
</tr>
<tr>
<td>Rural region n(%)</td>
<td>2438 (34)</td>
<td>2247 (34.4)</td>
<td>191 (29.6)</td>
</tr>
<tr>
<td>Urban region n(%)</td>
<td>4735 (66)</td>
<td>4281 (65.6)</td>
<td>454 (70.4)</td>
</tr>
<tr>
<td>Patients on diuretics n(%)</td>
<td>5654 (78.8)</td>
<td>5069 (77.6)</td>
<td>585 (90.7)</td>
</tr>
<tr>
<td>ACE/ARBs in 2005-2007 n(%)</td>
<td>5533 (77.1)</td>
<td>4990 (76.4)</td>
<td>543 (84.2)</td>
</tr>
<tr>
<td>ACE/ARBs + BB in 2005-2007 n(%)</td>
<td>1635 (22.8)</td>
<td>1438 (22)</td>
<td>197 (30.5)</td>
</tr>
<tr>
<td>Comorbidities per patient: Median (IQR)</td>
<td>2 (1,2)</td>
<td>2 (1,2)</td>
<td>2 (1,2)</td>
</tr>
</tbody>
</table>

As shown in table 3, the prescription of recommended treatment in CHF patients increased as the number of chronic conditions increased. For patients managed in primary care without attending hospital, prescription of ACEI/ARBs rose from 50.8 to 83.5% for 0 and ≥ 4 comorbidities, respectively, and for ACEI/ARBs and BB from 13.1 to 30.6% for 0 and ≥ 4 comorbidities, respectively. In patients with hospitalization events during the follow-up period, prescription of ACEI/ARBs rose from 66.0 to 86.9% for 0 and ≥ 4 comorbidities, respectively, and for ACEI/ARBs and BB from 19.1 to 39.4% for 0 and ≥ 4 comorbidities, respectively.

Table 3. Prescription according to the number of co-morbidities and hospitalization event

<table>
<thead>
<tr>
<th>Number of comorbidities</th>
<th>Outcome</th>
<th>Patients taking ACE/ARBs, n (%)</th>
<th>Patients taking ACE/ARBs and BB, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (n=820)</td>
<td>No hospital event (n=773)</td>
<td>393 (50.8)</td>
<td>101 (13.1)</td>
</tr>
<tr>
<td></td>
<td>Hospital event (n=47)</td>
<td>31 (66.0)</td>
<td>9 (19.1)</td>
</tr>
<tr>
<td>1 (n=2314)</td>
<td>No hospital event (n=2149)</td>
<td>1625 (75.6)</td>
<td>391 (18.2)</td>
</tr>
<tr>
<td></td>
<td>Hospital event (n=165)</td>
<td>131 (79.4)</td>
<td>43 (26.1)</td>
</tr>
<tr>
<td>2 (n=2299)</td>
<td>No hospital event (n=2122)</td>
<td>1725 (81.3)</td>
<td>509 (24.0)</td>
</tr>
<tr>
<td></td>
<td>Hospital event (n=177)</td>
<td>158 (89.3)</td>
<td>52 (29.4)</td>
</tr>
<tr>
<td>3 (n=1223)</td>
<td>No hospital event (n=1066)</td>
<td>898 (84.2)</td>
<td>309 (29.0)</td>
</tr>
<tr>
<td></td>
<td>Hospital event (n=157)</td>
<td>137 (87.3)</td>
<td>54 (34.4)</td>
</tr>
<tr>
<td>≥4 (n=517)</td>
<td>No hospital event (n=418)</td>
<td>349 (83.5)</td>
<td>128 (30.6)</td>
</tr>
<tr>
<td></td>
<td>Hospital event (n=59)</td>
<td>86 (86.9)</td>
<td>39 (39.4)</td>
</tr>
</tbody>
</table>

Table includes just patients with a drug prescription. Patients without a prescription are not included.
The multivariable analysis (Table 4) was performed for the total sample size (n=7173) and confirmed that patients receiving more treatments were patients with 3 comorbidities (odds ratio [OR] 5.10 [4.12–6.28] for ACEI/ARBs treatment and OR 2.67 [2.10–3.38]) for ACEI/ARBs and BB), and ≥ 4 comorbidities (OR 4.90 [3.72–6.47] for ACEI/ARBs treatment and OR 2.95 [2.24–3.89] for ACEI/ARBs and BB), and patients with a hospital event during the follow-up (OR 1.47 [1.17–1.85] for ACEI/ARBs treatment and OR 1.41 [1.17–1.69] for ACEI/ARBs and BB).

Table 4. Modelling analysis of the prescription of treatment

<table>
<thead>
<tr>
<th></th>
<th>ACE/ARBs in the overall sample</th>
<th>ACE/ARBs and BB in the overall sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 comorbidity</td>
<td>2.96 (2.50-3.50)</td>
<td>1.49 (1.18-1.86)</td>
</tr>
<tr>
<td>2 comorbidity</td>
<td>4.27 (3.58-5.08)</td>
<td>2.07 (1.66-2.59)</td>
</tr>
<tr>
<td>3 comorbidity</td>
<td>5.10 (4.12-6.28)</td>
<td>2.67 (2.10-3.38)</td>
</tr>
<tr>
<td>4 comorbidity</td>
<td>4.90 (3.72-6.47)</td>
<td>2.95 (2.24-3.89)</td>
</tr>
<tr>
<td>Hospital event</td>
<td>1.47 (1.17-1.85)</td>
<td>1.41 (1.17-1.69)</td>
</tr>
</tbody>
</table>

Table shows that the odds of receiving drug treatment in a multivariable analysis increase as the number of comorbidities increases. Having a hospitalization event also increase the odds.

The univariate analysis (Table 5) showed that comorbidities with higher numbers of ACEI/ARBs prescriptions were hypertension (OR 3.75 [3.33–4.22]), diabetes mellitus (OR 1.79 [1.57–2.04]), ischaemic heart disease (OR 1.25 [1.10–1.42]), hypercholesterolemia (OR 1.27 [1.04–1.56]) and CKD (OR 1.17 [1.00–1.37]). Those comorbidities with more ACEI/ARBs and BB prescriptions were ischaemic heart disease (OR 3.01 [2.68–3.38]), hypertension (OR 1.40 [1.23–1.59]), diabetes mellitus (OR 1.33 [1.18–1.49]) and hypercholesterolemia (OR 1.58 [1.32–1.89]). No significant changes were found when removing deceased patients from the analysis. Cluster analysis reported 0.5% (95% confidence interval [CI] 0.2–0.7) variability on prescription between PCPs.

Table 5. Prescription for each condition (univariate model)

<table>
<thead>
<tr>
<th></th>
<th>OR (95% CI)</th>
<th>P value (LR test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>0.99 (0.99-0.10)</td>
<td>0.003</td>
</tr>
<tr>
<td>Gender (men)</td>
<td>1.02 (0.91-1.14)</td>
<td>0.705</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>1.27 (1.04-1.56)</td>
<td>0.019</td>
</tr>
<tr>
<td>Hypertension</td>
<td>3.75 (3.33-4.22)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>1.79 (1.57-2.04)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>1.25 (1.10-1.42)</td>
<td>0.001</td>
</tr>
<tr>
<td>CKD</td>
<td>1.17 (1.00-1.37)</td>
<td>0.049</td>
</tr>
<tr>
<td>COPD</td>
<td>0.91 (0.78-1.06)</td>
<td>0.229</td>
</tr>
<tr>
<td>Region</td>
<td>0.94 (0.77-1.15)</td>
<td>0.528</td>
</tr>
<tr>
<td>Hospital event</td>
<td>1.65 (1.32-2.06)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Prescriptions in patients with chronic heart failure and multimorbidity

<table>
<thead>
<tr>
<th>Condition</th>
<th>OR (95% CI)</th>
<th>P value (LR test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE/ARBs + BB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGE</td>
<td>0.96 (0.95-0.96)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Gender (men)</td>
<td>1.62 (1.45-1.82)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>1.58 (1.32-1.89)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.40 (1.23-1.59)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>1.33 (1.18-1.49)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ischemic Heart Disease</td>
<td>3.01 (2.68-3.38)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CKD</td>
<td>1.12 (0.96-1.30)</td>
<td>0.139</td>
</tr>
<tr>
<td>COPD</td>
<td>0.63 (0.53-0.74)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Region</td>
<td>0.93 (0.81-1.06)</td>
<td>0.290</td>
</tr>
<tr>
<td>Hospital event</td>
<td>1.56 (1.30-1.86)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Gender, COPD, and region have no effect on the odds of receiving ACE/ARBs. CKD and region has no effect on the odds of receiving ACE/ARBs and BB. For the rest, in a univariate analysis, having a specific condition increased the odds of drug prescription.

**Discussion**

In our cohort of patients from PCPs registered with the diagnosis of CHF, we found that the prescription of ACEI/ARBs and ACE/ARBs with BB increased as the number of comorbidities increased. These prescriptions were also more prevalent in patients who had attended hospital. Hypertension, diabetes mellitus and ischaemic heart disease were comorbid conditions significantly more associated with higher rates of prescribing.

Previous studies which have compared the clinical performance of FPs against cardiologists have found that hospitalization and cardiologist care increased the odds of receiving ACEI and BB\(^8,9,13,14,18\). The justification self-reported by FPs includes difficulties with establishing a diagnosis and the lack of confidence in initiating treatment with ACEI, partly because of their adverse effects in patients who are often elderly and frail, with comorbidity and polypharmacy\(^11\). Nevertheless, our study showed that the relationship between FPs prescribing recommended treatments and the number of conditions remained positive, which suggests that FPs can provide equivalent care for more complex patients with greater comorbidities compared with less complex patients. Patients attending hospital had a higher probability of receiving treatment.

Similar trends were found in a previous study that focused on the quality of care for several chronic conditions rather than a single disease\(^19\). In this study, a positive relationship between quality of care and the number of chronic conditions was found, probably because these patients had more opportunities to receive care. Also, patients who had seen a relevant specialist received higher quality of care. Another trial focusing on patients with CHF managed in primary care reported no association between the number of comorbidities and the prescription of evidence-based pharmacotherapy\(^18\). These different results could be explained
by differences in the comorbid conditions analyzed and how these were measured.

Previous studies which have analysed the effect of comorbidities on prescribing have reported that a diagnosis of ischaemic heart disease increased the odds for prescription, whereas age and respiratory or pulmonary disease decreased it\textsuperscript{8,9,18}. Our results were in line with this. We also reported a positive effect for hypertension and diabetes mellitus.

Prescription rates achieved in our study were higher than previously reported. In 2002, a European study involving FPs reported that in Spain prescription of diuretics was 63%, ACEI/ARBs was 51% and combined therapy with BB was 7%. In our study, prescription rose to 78.8% for diuretics, 77.1% for ACEI/ARBs and 22.8% for combined therapy with BB\textsuperscript{8}. This showed that adherence to evidence-based pharmacotherapy had increased although there is still room for improvement.

Our study had some limitations. First, we used a simple count of comorbid conditions as one of our primary predictor variables. This method has been used previously with the disadvantage that it is a crude measure of complexity, because clinicians do not view all coexisting conditions as equivalent in complexity\textsuperscript{19}. We identified CHF patients through their FPs' electronic patient records and did not formally validate the diagnosis of CHF because of resource constraints. Furthermore, we did not have data to show how many patients had echocardiography performed, which would have confirmed the diagnosis and aetiology of CHF and helped in the interpretation of our results.

Therefore, those patients with no hospital event during study follow-up and without a prescription of diuretics (22.4%) may have had an uncertain diagnosis of CHF. Nevertheless our aim was to report on FPs' clinical performance when prescribing in patients with multiple comorbidities, including those with an uncertain diagnosis of CHF because this is what happens in real practice. Also, it is important to take into account our context in which FPs usually register a diagnosis of CHF after specialist confirmation. Specialists are also involved in the diagnosis and management of these patients in the community, and have provided support to FPs as part of an integrated care program since 1990 (Table 1)\textsuperscript{20}. Nevertheless, we could not identify the source of diagnosis and could not exclude that the diagnosis of CHF was made by FPs using clinical means alone. Furthermore, we could not report on the severity of the illness, either for the CHF diagnosis or comorbidities, so we may have underestimated the total disease burden.
Despite not having access to those PCPs excluded in the urban region, we assumed that other ethnic or socio-economic difference affecting outcomes (in the urban area) were minimized by our selection process which began from a randomization for a disease management intervention.

**Conclusions**

Prescription of recommended treatments in ambulatory patients with CHF increased as the number of comorbidities increased, regardless of hospitalization events. This study suggests that FPs can provide care to more complex patients which is equivalent to those that are less complex, as determined by the number of comorbidities. Further research should explore patient experiences with drugs, including intolerance, contraindications and overall patient willingness to adhere to treatment. This may highlight other barriers which can help physicians and managers on delivering care.
References

Chapter 8

Discussion
Main findings

Section I Analysis of organization of coronary heart disease primary care
The Epa Cardio project found substantial variation in the management of patients with coronary heart disease (CHD), in primary care, which was more related to differences between practices than between countries. Overall rates for the prescription of recommended preventive medicines (statins and antiplatelet therapy) were over 80%. Risk factors registration varied from 55% to over 90% for: physical activity, weight, smoking status, serum cholesterol and blood pressure (ordered from lowest minus to highest scores achieved). Intermediate patient outcomes, in terms of treatment targets for systolic blood pressure, diastolic blood pressure and LDL cholesterol were achieved in 46% (SD 21%), 86% (SD 12%) and 48% (SD 22%) of the patients respectively.
A number of organizational characteristics of primary care practices were associated with the management of patients with CHD. Implementation of aspects of the chronic care model such as clinical information systems, self-management support, health care organization, decision support and delivery system design were associated to better risk factor registration, antiplatelet therapy and/or influenza vaccination. The delivery of community interventions on cardiovascular risk management was not associated to better cardiovascular risk management in patients with CHD.

Section II Analysis of current practice in chronic heart failure primary care
The study on computerised clinical practices in the primary care management of patients with chronic heart failure (CHF) in Catalonia provided insight into the trends and predictors of mortality, hospitalization, readmission and length of stay for patients in a Mediterranean community-based cohort. In this cohort 90% of patients with CHF managed in primary care survived after 1 year of the onset. Only 9.0% of patients were admitted to hospital in this time period due to cardiovascular reasons. During the follow up period we found that while the number of admissions and length of stay decreased, the number of readmissions increased. Elderly patients with co-morbidities were at highest risk of worst outcome for survival (diabetes mellitus - DM-, chronic obstructive pulmonary disease –COPD-, chronic kidney disease -CKD-, and ischemic heart disease –IHD-), hospitalization (DM, COPD and CKD), readmissions (DM, IHD and hypertension) and long length of stay in hospital (CKD, IHD, DM, hypertension and COPD). Prescription of ACEI/ARBs and ACE/ARBs + BB increased as the number of co-morbidities increased. These prescriptions were more prevalent in patients
Discussion

Section I  Analysis of organization of coronary heart disease primary care

Our findings regarding the quality of care of cardiovascular risk management were comparable to what is reported by other European Studies such as EUROASPIRE\(^1\) and SPHERE\(^2\). It may be noted that patients in these projects were from specialist care, while the EPA Cardio was done in primary care. Our data also conciliates with findings in a Cochrane review\(^3\). We found that practice size was not associated to better performance in cardiovascular care. In our sample across countries small practices were able to deliver a performance on cardiovascular risk management as good as larger practices and variation existed in both types of practices. In previous research on practice size no consistent results has been found. In general, studies based on national data show that larger practices tended to show better performance and provide more extensive services, for instance more preventive activities\(^4\)\(-\)\(^8\); tended to be more cost-effective and offers opportunities to develop skills and gives managerial advantages. On the other hand, there seemed to be a trade off between high quality clinical care and interpersonal care, and access seemed better in smaller practices\(^5\)\(,9\).

While research evidence showed mixed results on the contribution of organizational components of chronic care model to patient outcomes, our research indicated that self-management support systems and clinical information systems were associated with better cardiovascular risk management but not with recorded intermediate patient outcomes. This is in line with what is previously published\(^10\). Although scarce research has been performed implementing community resources and health care organization elements to judge their relative effectiveness and to compare our results, we found that healthcare organization was associated to influenza vaccination while community interventions on cardiovascular risk reduction were associated neither to better cardiovascular risk management nor to intermediate patient outcomes. Reasons for that may remain in the organisation of provision of care. We evaluated community interventions in the Catalan health care system, which is characterised by broad implementation of most of the Chronic Care Model elements. Access to healthcare services could partly explain why community interventions for cardiovascular risk reduction to usual care did not show additional benefits. Implementing programs to enhance
healthy lifestyles in primary care has not been uniformly successful\textsuperscript{11}. Variability in the literature could be explained by several factors such as patient selection, targeted population, type of intervention (individual or group counselling, health policies ...), service provider (primary care based or other community providers), and to the quality of the intervention itself (i.e. the quality of the counselling techniques used, targeted barriers, professionals' skills...). Also several barriers associated to primary care professionals (lack of time, patient compliance, lack of counselling skills, costs...) and to patients (dissatisfaction with the quality of counselling received by those working in primary care, lack of skills, lack of will power, strong sense of fatalism regarding the course of their disease...) have been associated to lack of success of lifestyle interventions. Although it remains unclear from the literature which provider should deliver such interventions, for instance primary health care or other community base providers, evidence suggests that the role that motivated family physicians could have on changing patients behaviours\textsuperscript{12} plus addressing individual as well as community-level elements\textsuperscript{13} are key factors to consider, which may suggest that care needs to be seen by the patient as a continuum to achieve effective interventions.

\textit{Section II Analysis of current practice in chronic heart failure primary care}

In contrast with previous studies, that were done in hospital-based cohorts or selected patients from clinical trials, we included patients from a Mediterranean community-based cohort, taking into consideration the complexity in terms of patients' comorbidities that FPs face in primary care settings. Comparisons with other studies are difficult because of differences in patient selection, patient characteristics and periods of follow up. Nevertheless the data suggest that our survival rates were higher than those reported in the literature, either United States and Europe and in line with those reported by the Spanish national data registry from hospital-based heart failure clinics\textsuperscript{14}. For instance higher than the Framingham\textsuperscript{15} (57\% for men and 64\% for women) and Rochester\textsuperscript{16} (77\%) studies in United States, and the Hillington\textsuperscript{17} (62\%) study in Britain and in Netherlands (74\% survival at one year)\textsuperscript{18}. In contrast, in our cohort, we found a low rate of hypercholesterolemia and ischemic heart disease, which could partly explain our positive results on survival. Our hospitalisation rates due to cardiovascular reasons were lower compared to those previously reported in United States\textsuperscript{19} and England\textsuperscript{20}. Reasons for that may remain in the organisation of provision of care. In Catalonia, the emphasis is on primary care management of chronic conditions in the community, with specialists supporting FPs and home
care. Nonetheless we found a high readmissions rate suggesting that management of CHF in the community may delay patient hospitalization up to a more severe stage when hospitalizations are more frequent.

In relation to prescription of recommended treatment to patients with multimorbidity we found mixed results in the literature. Similar trends than us were reported by a previous study\textsuperscript{21} focussing not on a single disease but on several chronic conditions and quality of care. In this study a positive relationship between quality of care and the number of chronic conditions was found positive because these patients probably had more opportunities to receive care; also patients who had seen a relevant specialist received higher quality of care. Nevertheless another trial focussing on patients with CHF managed in primary care reported no association between the number of comorbidities and the prescription of evidence-based pharmacotherapy\textsuperscript{22}. These mix results could be explained by differences on the comorbid conditions analysed and how these were measured.

Prescription rates found in our study (with data collection from 2005-2007) were higher than in 2002. An European study\textsuperscript{23} involving FPs reported that in Spain prescription of diuretics was 63%, ACEI/ARBs was of 51% and combined therapy with BB was of 7%, in our study prescription has risen up to 78.8% for diuretics, 77.1% for ACEI/ARBs and 22.8% for combined therapy with BB. This implies that adherence to evidence based pharmacotherapy has increased although there is still room for improvement.

Despite our good results in current practice outcomes (survival, hospitalization and prescription) we found similar predictors of worse prognosis than previous community-based studies. For instance ageing\textsuperscript{24}, diabetes mellitus\textsuperscript{15,25,26}, hospitalization\textsuperscript{27} and renal failure\textsuperscript{16,17,25,27} have also been identified to increase the risk of death in the literature. Hypertension has been also previously reported\textsuperscript{16} as a positive predictor for survival, probably due to the negative effect of low systolic blood pressure on prognosis described elsewhere\textsuperscript{17,25,27} rather than to the diagnosis of hypertension itself which is one of the causes of diastolic heart failure and more prevalent in women and elderly who usually have antecedent of hypertension for many years\textsuperscript{16,28,29}.

Matching with our results, Dunlay et al\textsuperscript{19} from a community perspective found diabetes mellitus and creatinine clearance as predictors for CHF hospitalization. We could not find studies from a community perspective analysing high risk profile for readmissions due to CHF and long length of stay. Nonetheless a hospital-based study\textsuperscript{30} found also and effect of diabetes mellitus and ischemic heart disease on increasing readmissions. Previous studies which have analyzed the
effect of comorbidities on prescription reported that ischemic heart disease increased the odds for prescription\textsuperscript{31} while age\textsuperscript{22,23} and respiratory/pulmonary\textsuperscript{31} disease decreased it. Our results were in the same line and we also reported a positive effect for hypertension and diabetes mellitus.

**Methodological considerations**

We used data from an European project (EPA Cardio project) to analyze organizational factors influencing management of coronary heart disease in primary care. In this project, first joined Austria, Belgium, Finland, France, Germany, the Netherlands, Slovenia, Switzerland, the UK. Spain (Catalonia region) joined later. Israel also participated in major parts of this study. To reduce bias due to differences in the organization of the health care systems of the participating countries concerning to practice size, accessibility to patients and medical records system implemented, countries were instructed to sample practice in such way that they mirrored the situation of their countries as much as possible. Stratification procedures were required to include practices in the study, according to number of FPs working in the practices and urbanization. Nonetheless figures for a country should not be considered representative for the national situation. Patient inclusion varied depending on access to patients. While most countries included a random sample of patients listed at the practice, some did it from those visited (France) or after a recall process (Austria, Switzerland and German). In Spain, two provinces (Girona and Barcelona) of the Catalan region participated in the study. Although practice inclusion was similar in both, patient selection differed. While in Barcelona all patients listed with one FP of each participating practice were included, in Girona a randomized selection of 15 patients were included. In both, data was extracted electronically, limiting results to those data recorded in a coded way. In the rest of countries data collection was done with a paper-based audit form and performed uniformly. Our patient inclusion criteria did not completely prevent heterogeneity within the study population. The cohort included patients who had a myocardial infarction or vascular surgery and have been treated in secondary care as well as patients with stable angina pectoris who might have been treated in primary care exclusively. Although the measures of the Chronic Care Model were post hoc constructed, they were evidence based and abstracted from the validated EPA instrument, which had been developed through a rigorous indicator development process and extensive testing\textsuperscript{32,33}.
Differences across countries were considered in a multilevel analysis considering patients nested in practices, and practices nested in countries to allow valid conclusions. To some extent, the international focus of our study controlled variation across health care systems which allowed to achieve more robust conclusions.

The study on chronic heart failure (CHF) in Catalonia had a number of limitations. We included patients newly diagnosed with a diagnosis code of CHF in the primary care electronic medical records and measured survival after the onset, cardiovascular admissions as primary diagnosis at discharge, and patients with prescription of angiotensin-converting enzyme inhibitors (ACEI) / angiotensin II receptor blockers (ARBs) and ACEI / ARBs + beta-blockers (BB) if not diagnosis of asthma. We also analysed the effect of comorbidities as prognostic factors. In our cohort, we found low prevalence of ischemic heart disease (27%) which may influenced our positive findings particularly on survival. Because of the low registration in the electronic medical records, we failed to report on severity and aetiology of CHF which could have influenced prognostic profile for survival and hospitalizations. Also prescription rates of BB. On the other hand, these are inherent limitations of studies using electronic medical records. Comorbidities were also identified through primary care electronic medical records and we were not able to capture how long patients were exposed to these conditions neither about severity by using bio-markers. When we analysed the association between prescription and comorbidities we used a simple count of comorbid conditions as one of our primary predictor variable. This method has been used previously with the disadvantage that it is a crude measure of complexity, since clinicians do not view all coexisting conditions as equivalent. Diagnosis accuracy was particularly relevant for the survival analysis, in this case we included just those patients on prescription of diuretics therefore probably missed patients with CHF not receiving diuretics. Regarding hospitalizations, we did not capture admissions to private hospitals or outside of targeted setting. However we included listed patients of PCPs with a hospital assigned. These patients rarely would go to private hospital or attend other PCPs or public hospital because of our continuum of care model. Data from the Government of Catalonia show that about 90% of patients use their assigned hospital.

Our analysis exploring patient outcomes in cardiovascular primary care included various strong elements, among others the large sample size, community based patient selection process and medical record audit from three regional data bases (mortality register, hospital database and electronic primary care medical records).
Implications for practice and future research

In this thesis we focus on patients with established CVD, that is patients with CHF and patients with CHD. Our projects showed that patients managed in primary care obtained high quality of care, in terms of high survival rate, low hospitalisations rate and good rates of prescription of recommended treatment. Nevertheless there is still room for improvement, particularly on risk factors registration by FPs and patients' achievement of recommended levels of blood pressure and low density lipoprotein cholesterol (LDL). Our findings showed that some organizational components are associated to better cardiovascular care, which can help health planning and delivery and to orientate future research.

Implications for practice

• In our study **larger practices (over two full time equivalent FP) delivered performance on cardiovascular risk management as good as small practices.** In the Catalan primary healthcare system, size of primary care practices vary from 4 to 36 fte FP depending on a geographic definition of population attended. In our context, there is an increasing tendency to reduce the number of practices by enlarging existing ones. Certainly, larger primary care practices offer advantages for providing structured care to larger groups of patients, which may be cost effective and relevant for delivering preventive activities particularly in community orientated primary care systems delivering public health interventions. Also offer opportunities to develop skills by having chances of more experience and gives managerial advantages, especially when specialized staff is required. Nonetheless and extra effort might have to be done to deliver interpersonal care and ensure access to services provided, which have been reported to be better in smaller practices\(^5,9\).

• **Implementing some of the organizational components of the chronic care model can improve clinical performance on cardiovascular risk management in primary care.** Our research conducted in several primary care systems across Europe supports that "clinical information systems", "health care organization elements" and "self-management support" are associated to better process indicators in preventive procedures. In the Catalan health care system, most of the components of the CCM are widely implemented\(^35\). The Catalan Health Institute, the main primary care provider, has a powerful electronic medical records system with specific devices implemented allowing chronic care management. For instance "clinical information systems" are implemented including computerized medical
records, prescription, referrals, examination requests and quality and safety management. "Health care organization elements" includes procedures for the management of patient information in relation to examination results, alerts in the electronic medical records for reviewing medication prescribed, monthly and annual production of quality reports among others. Nonetheless availability of these devises do not imply their use by primary care practitioners. For instance European research has shown that Catalan primary care practices score higher on implementing CCM components, nonetheless when comparing to other European countries our professionals perform in the average and our level of registration of cardiovascular risk factors was one of the lowest. An in depth evaluation of the current use by primary care practices of the electronic medical records system (understanding barriers and facilitators) and its association to patients outcomes and clinicians' performance may contribute to better quality of cardiovascular risk management.

- **Self-management support is another component of the CCM which have been associated to better care for cardiovascular risk management.** It involves collaboratively helping patients and their families acquire the skills and confidence to manage their chronic illness. Overall, in Catalan primary care practices self-management support is routinely provided among FPs. For instance leaflets about cardiovascular disease (for example, CHD, stroke, hypertension, and stop smoking) usually are available for patients to take home or read at the practice. Practices usually also have an up-to-date directory of prevention activities/organizations available locally (for example, gyms, walking group, and weight-watchers), written information on lifestyle is usually given, and also advice about websites for education on health risks or healthy lifestyle. But this is an area not enough studied though well designed projects. Concomitantly, some practices also deliver complementary community interventions for lifestyle improvement which in our research have not been associated to additional benefits on cardiovascular risk management. A better understanding of how best lifestyle improvement for cardiovascular risk prevention should be delivered in our primary care orientated healthcare system could help to save duplications among providers. Evidence suggests that the role that motivated family physicians could have on changing patients behaviours plus addressing individual as well as community-level elements are key factors to consider.
• Our research shows that in Catalonia, primary care has proved to develop effective management of patients with existing cardiovascular disease (CHF) in terms of survival, low hospitalizations and medication of complex patients. Service planning and prevention programs should take into consideration that management of cardiovascular diseases in primary care can help to save costs of care delivery by reducing hospital admissions and decrease median of length of stay in hospital. On the other hand, it may delay hospitalizations up to a more severe stage when re-admissions are more frequent. The availability of tools to identify high risk patients for readmissions, considering predictors of worse prognosis for existing cardiovascular disease (CHF) and other co-morbidities would aid health planning.

Future research
• Further research is still needed to demonstrate effects of practice size on cost-effectiveness, also in patient outcomes and patient satisfaction, as well as achieving health targets, interpersonal care and access to family physicians.
• Advantages of implementing multiple components of the CCM has been interpreted as supporting synergistic effects10, for instance community resources – i.e. exercise programs – help patients acquire self-management skills36. Further research should demonstrate cost-effectiveness of implementing multiple CCM components rather than single one. For instance in the Catalan context, future research should be orientated to identify: (1) what CCM components are most used and which are not, (2) barriers and facilitators for their integration in clinical practice, and (3) the association of CCM component implementation with better cardiovascular risk management.
• Further research is required to understand how lifestyle improvement for cardiovascular risk management should be delivered to improve patients outcomes and save costs.
• Further research should develop tools to identify high risk patients for hospital readmissions either for existing cardiovascular diseases (CHF) and other comorbidities which could support professionals and health care management. Further developments in this field considering predictors of worse prognosis are required.
References


Summary
Chapter 1
In the first chapter we introduce the topics of this thesis. Studies presented focus in patient outcomes, professional performance and practice characteristics and organization related to quality of care of cardiovascular management and secondary prevention in primary care. Patients with established cardiovascular diseases, CHD and CHF are considered.

Chapter 2
Primary care has an important role in cardiovascular risk management (CVRM) and a minimum size of scale of primary care practices may be needed for efficient delivery of CVRM. We examined CVRM in patients with coronary heart disease (CHD) in primary care and explored the impact of practice size. In an observational study in 8 countries we sampled CHD patients in primary care practices and collected data from electronic patient records. Practice samples were stratified according to practice size and urbanization; patients were selected using coded diagnoses when available. CVRM was measured on the basis of internationally validated quality indicators. In the analyses practice size was defined in terms of number of patients registered of visiting the practice. We performed multilevel regression analyses controlling for patient age and sex. We included 181 practices (63% of the number targeted). Two countries included a convenience sample of practices. Data from 2960 CHD patients were available. Some countries used methods supplemental to coded diagnoses or other inclusion methods introducing potential inclusion bias. We found substantial variation on all CVRM indicators across practices and countries. We computed aggregated practice scores as percentage of patients with a positive outcome. Rates of risk factor recording varied from 55% for physical activity as the mean practice score across all practices (SD 32%) to 94% (SD 10%) for blood pressure. Rates for reaching treatment targets for systolic blood pressure, diastolic blood pressure and LDL cholesterol were 46% (SD 21%), 86% (SD 12%) and 48% (SD 22%) respectively. Rates for providing recommended cholesterol lowering and antiplatelet drugs were around 80%, and 70% received influenza vaccination. Practice size was not associated to indicator scores with one exception: in Slovenia larger practices performed better. Variation was more related to differences between practices than between countries. We concluded that CVRM measured by quality indicators showed wide variation within and between countries and possibly leaves room for improvement in all countries involved. Few associations of performance scores with practice size were found.
Chapter 3
Cardiovascular risk management (CVRM) received by patients shows large variation across countries. In this study we explored the aspects of primary care organization associated with key components of CVRM in coronary heart disease (CHD) patients. We designed an observational study including 273 primary care practices and a random sample of 4563 CHD patients from Austria, Belgium, England, Finland, France, Germany, The Netherlands, Slovenia, Switzerland and Spain. We performed an audit in primary care practices in 10 European countries and used six indicators to measure key components of CVRM: risk factor recording, antiplatelet therapy, influenza vaccination, blood pressure levels (systolic <140 and diastolic <90 mm Hg), and low-density lipoprotein cholesterol <2.5 mmol/l. Data from structured questionnaires were used to construct an overall measure and six 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. We found that 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), antiplatelet 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 organizational domains 'self-management support' and 'use of clinical information systems' were linked to three CVRM indicators. We concluded that a better organization of a primary care practice was associated with better scores on process indicators of CVRM in CHD patients, but not on intermediate patient outcome measures. Direct support for patients and clinicians seemed most influential.

Chapter 4
Linkage to community resources has been re-emphasized recently, but little is known about its impact on the quality and outcomes of prevention in primary care. In this study we aimed to assess whether primary care practices delivering community orientated programs to enhance healthy life styles had better scores on indicators of cardiovascular risk management in patients with coronary heart disease. We conducted an observational study in Catalonia (Spain), including 36 practices, 36 professionals and 722 patients with coronary heart disease (37% female: mean age 72 (SD 11.73)). We used a structured questionnaire administered to professionals in these practices. The predictor variable of interest was reported participation in community orientated programs to enhance healthy
life styles such as physical exercise groups and stop smoking. We extracted patient data from electronic medical records regarding recorded risk factors, drug prescription and intermediate patient outcomes (blood pressure levels, low-density lipoprotein cholesterol, body mass index). We found that thirty practices delivered community programs. Most delivered one [17 (47.2%) practices] or two programs [11 (30.5%) practices]. The content of these programs was orientated to education and motivation to enhance healthy life styles, using group counselling sessions, mailed print material and one-to-one counselling. In practices delivering community programs more patients received anti-hypertensives (89.7%), antiplatelet therapy (80.5%) and statins (70.8%). However, none of the differences with the other practices were statistically significant. We concluded that in our setting, no evidence was found for the added value of community orientated programs on cardiovascular risk in patients with coronary heart disease.

**Chapter 5**
Scarce research has been performed in ambulatory patients with chronic heart failure in the Mediterranean area. In this study, we aimed to describe survival trends in our target population and the impact of prognostic factors. To achieve so, we carried out a population-based retrospective cohort study in Catalonia (north-east Spain) of 5659 ambulatory patients [60% women; mean age 77 (10) years] with incident chronic heart failure. Eligible patients were selected from the electronic patient records of primary care practices from 2005 and were followed-up until 2007. We found that during the follow-up period deaths occurred in 950 patients (16.8%). Survival after the onset of chronic heart failure at 1, 2, and 3 years was 90%, 80%, 69%, respectively. No significant differences in survival were found between men and women (P=.13). Cox proportional hazard modelling confirmed an increased risk of death with older age (hazard ratio=1.06; 95% CI, 1.06-1.07), diabetes mellitus (hazard ratio=1.53; 95% CI, 1.33-1.76), chronic kidney disease (hazard ratio=1.73; 95% CI, 1.45-2.05), and ischemic heart disease (hazard ratio=1.18; 95% CI, 1.02-1.36). Hypertension (hazard ratio=0.73; 95% CI, 0.64-0.84) had a protective effect. Our results suggested that service planning and prevention programs should take into consideration the relatively high survival rates found in our area and the effect of prognostic factors that can help to identify high risk patients.
Chapter 6
Little is known on predictors of hospitalization in ambulatory patients with chronic heart failure, and known predictors may not apply to Mediterranean countries. In this study we aimed to document longitudinal trends in hospitalizations and identify patient-related predictors of hospital admission, re-admission and length of stay in the targeted population. We conducted a population-based retrospective cohort study in Catalonia (North-East Spain), including 7196 ambulatory patients (58.6% women; mean age 76 years). Eligible patients were selected from the electronic patient records of primary care practices, and followed for 3 years. We found that at 3 years of follow up overall 645 (9.0%) patients had cardiovascular hospitalization, 37% were readmitted, and median length of stay was 9 (interquartile range 5-17) days. Chronic kidney disease [odds ratio (OR)=1.98 (1.62-2.43)], IHD [OR=1.72 (1.45-2.04)], DM [OR=1.50 (1.27-1.78)] and chronic obstructive pulmonary disease [OR=1.43 (1.16-1.77)] increased the risk for hospitalisation. DM [OR=1.70 (1.22-2.38)], IHD [OR=1.85 (1.33-2.58)] and HTA [OR=1.66 (1.11-2.46)] increased the risk for readmissions. Chronic kidney disease [OR of 2.21 (1.70-2.90)], IHD [OR of 2.19 (1.73-2.77)], DM [OR=1.70 (1.34-2.15)], HTA [OR=1.51 (1.13-2.01)], chronic obstructive pulmonary disease [OR=1.37 (1.02-1.83)] increased the risk for long length of stay in hospital. This study identified predictors of hospitalization, readmissions and long length of stay which can help clinicians and managers to identify high risk patients which should be targeted on service planning and when designing preventive actions.

Chapter 7
Multimorbidity and polypharmacy pose challenges to the improvement of the quality of care. In this study we aimed to determine the association between prescription of recommended treatment in ambulatory patients with chronic heart failure and multiple comorbidities and hospitalization events. We conducted a population-based retrospective cohort study in Catalonia (North-East Spain), including 7173 newly registered patients with chronic heart failure [59% women; mean age 76.3 (SD 10.7) years]. Patients were selected from the electronic patient records of primary care practices and followed for three years. Our main measures were prescription of angiotensin-converting enzyme inhibitors (ACEI) / angiotensin II receptor blockers (ARBs) and beta-blockers (BB). We found that prescription of ACEI/ARBs in patients managed in primary care without hospitalization event during the follow up rose from 50.8% to 83.5% for 0 and ≥4 comorbidities respectively and for ACE/ARBs + BB from 13.1% to 30.6% for 0 and ≥ 4
comorbidities respectively. Patients with a hospitalization event were more often treated (ACEI/ARBs, OR 1.47; [1.17-1.85]; ACEI/ARBs + BB, OR 1.41; [1.17-1.69]). Comorbid conditions receiving more treatment were hypertension (ACEI/ARBs, OR 3.75 [3.33-4.22]; ACEI/ARBs + BB, OR 1.40 [1.23-1.59]), diabetes mellitus (ACEI/ARBs, OR 1.79 [1.57-2.04]; ACEI/ARBs + BB, OR 1.33 [1.18-1.49]) and ischemic heart disease (ACEI/ARBs, OR 1.25 [1.10-1.42]; ACEI/ARBs + BB, OR 3.01 [2.68-3.38]). Our results reported that prescription of recommended treatment in patients with chronic heart failure increased as the number of comorbidities increase; and suggested that family physicians can provide equivalent care to more complex patients and to those less complex, according to the number of comorbidities.
Samenvatting
Hoofdstuk 1
In het eerste hoofdstuk introduceren we de onderwerpen die behandeld worden in dit proefschrift. De gepresenteerde studies zijn gericht op patiëntuitkomsten, professioneel handelen alsook de eigenschappen en de organisatie van de praktijken gerelateerd aan kwaliteit van zorg van cardiovascular management en secundaire preventie in de eerstelijnszorg. We keken daarbij naar patiënten bij wie cardiovasculaire aandoeningen, CHD en CHF zijn vastgesteld.

Hoofdstuk 2
De eerstelijnszorg speelt een belangrijke rol in cardiovascular risicomanagement (CVRM), waarbij een minimale grootte van de schaal van eerstelijnspraktijken nodig kan zijn om doelmatige CVRM zorg te leveren. We onderzochten CVRM bij patiënten met coronaire hartziekten (CHD) in de eerstelijnszorg en keken daarbij naar het effect van de grootte van de praktijk. Voor een observatiestudie in acht landen kozen we steekproefsgewijs CHD-patiënten uit in eerstelijnspraktijken en verzamelden data uit elektronische patiëntendossiers. De steekproeven werden vervolgens gestratificeerd met inachtneming van de grootte van de praktijk en de mate van verstedelijking; bij het selecteren van de patiënten werden waar mogelijk gecodeerde diagnoses gebruikt. CVRM werd gemeten op basis van internationaal gevalideerde kwaliteitsindicatoren. In de analyses werd de grootte van de praktijk gedefinieerd op basis van het aantal geregistreerde patiënten dat de praktijk bezoekt. We voerden multilevel regression analyses uit, waarbij we corrigeerden voor leeftijd en geslacht van de patiënten bij 181 praktijken (63% van het aantal dat we als doel hadden). In twee landen hebben we een steekproef op basis van een gemakkelijke bereikbaarheid van praktijken geïncludeerd. We hadden de beschikking over data van 2.960 CHD-patiënten. In enkele landen werden methodes gebruikt die een aanvulling vormden op de gecodeerde diagnoses of werden andere inclusiemethoden gebruikt, waardoor potentiële inclusiebias mogelijk was. Bij alle CVRM-indicatoren vonden we een substantiële variatie in de verschillende praktijken en landen. We berekenden de gezamenlijke praktijkscores als percentage patiënten met een positief resultaat. Scores voor het registreren van risicofactoren varieerden van 55% voor fysieke activiteiten als gemiddelde praktijkscore in alle praktijken (SD 32%) tot 94% (SD 10%) voor bloeddruk. Cijfers voor het behalen van behandelingsdoelen voor systolische bloeddruk, diastolische bloeddruk en LDL cholesterol waren respectievelijk 46% (sd 21%), 86% (SD 12%) en 48% (SD 22%). Cijfers voor het leveren van aanbevolen vermindering van het cholesterol en antiplatelet medicijnen lagen rond de 80%, en 70% ontving een
antigriepprik. De grootte van de praktijk hield geen verband met de indicatorscores, met een uitzondering: in Slovenië presteerden grotere praktijken beter. De variatie had meer betrekking op verschillen tussen de praktijken onderling dan tussen landen. Onze conclusie was dat CVRM gemeten met kwaliteitsindicatoren veel variatie liet zien in en tussen landen, en dat het mogelijk gelegenheid biedt voor verbetering in alle betrokken landen. We vonden weinig verband tussen prestatiescores en grootte van de praktijken.

Hoofdstuk 3
Cardiovasculair risicomanagement (CVRM), zoals dat gegeven wordt aan patiënten, laat een grote variatie zien in landen. In deze studie hebben we aspecten van de eerstelijnszorg onderzocht die geassocieerd worden met belangrijke componenten van CVRM bij patiënten met coronare hartziekten (CHD). We hebben daartoe een observatiestuidentie opgezet met daarin 273 eerstelijnspraktijken en een willekeurige steekproef van 4.563 CHD-patiënten uit Oostenrijk, België, Engeland, Finland, Frankrijk, Duitsland, Nederland, Slovenië, Zwitserland en Spanje. In eerstelijnspraktijken in tien Europese landen hebben we een audit uitgevoerd, waarbij we zes indicatoren gebruikten om belangrijke componenten van CVRM te meten: vastleggen van risicofactoren, behandeling met antiplatelet medicijnen, griepvaccinaties, hoogte van de bloeddruk (systolisch <140 en diastolisch <90 mm Hg), en lipoproteïne cholesterol met lage dichtheid <2.5 mmol/l. Data uit gestructureerde vragenlijsten werden gebruikt om een totaalmeting te maken, alsook om zes domeinmetingen van de praktijkorganisatie te maken op basis van 39 items. Door multilevel regressieanalyses toe te passen konden we de resultaten van de praktijkorganisaties met betrekking tot CVRM onderzoeken, daarbij corrigerend voor patiëntkarakteristieken. We ontdekten dat een betere algehele organisatie van de eerstelijnspraktijk verband hield met hogere scores voor drie indicatoren: registratie van risicofactoren (B=0.0307, p<0.0001), behandeling met antiplatelet medicijnen (OR 1.05, p=0.0245) en griepvaccinaties (OR 1.12, p<0.0001). De algehele praktijkorganisatie werd niet in verband gebracht met de geregistreerde hoogte van de bloeddruk of het cholesterol. Alleen de organisatorische domeinen 'zelfmanagement ondersteuning' en 'gebruik van klinische informatiesystemen' waren gelinkt aan drie CVRM indicatoren. Onze conclusie was dat een betere organisatie van de eerstelijnspraktijk in verband gebracht werd met betere scores bij procesindicatoren van CVRM bij CHD-patiënten, maar niet bij tussentijdse
resultaten van patiëntuitkomsten. Rechtstreekse ondersteuning van patiënten en clinici lijkt de meeste invloed te hebben.

**Hoofdstuk 4**
Recentelijk is het belang van een koppeling met gemeenschapsbronnen benadrukt, maar er is nog weinig bekend over de impact op de kwaliteit en de uitkomsten van preventie in de eerstelijnszorg. In deze studie probeerden we vast te stellen of eerstelijnspraktijken die gemeenschapsprogramma's organiseren gericht op het verhogen van een gezonde leefstijl, betere scores behaalden op de indicatoren voor cardiovasculair risicomanagement bij patiënten met coronaire hartziekten. Daartoe voerden we een observatiestudie uit in Catalonië (Spanje), bij 36 praktijken, 36 zorgverleners en 722 patiënten met een coronaire hartziekte (37% vrouwelijk: gemiddelde leeftijd 72 (SD 11.73)). De zorgverleners in deze praktijken ontvingen een gestructureerde vragenlijst. De voorspellende variabele van belang hierbij was deelname aan gemeenschapsgeoriënteerde programma's, gericht op het verhogen van een gezonde leefstijl, zoals fysieke inspanningsgroepen en stoppen-met-rokengroepen. Uit patiëntendata haalden we elektronische medische gegevens die betrekking hadden op vastgelegde risicofactoren, voorgeschreven medicijnen en tussentijdse patiëntuitkomsten (hoogte van de bloeddruk, lipoproteïne cholesterol met lage dichtheid, body mass index). Dertig praktijken bleken gemeenschapsprogramma's te leveren. De meerderheid daarvan leverde een [17 (47.2%) praktijken] of twee programma's [11 (30.5%) praktijken]. De inhoud van deze programma's richtte zich op onderwijs en motivatie om een gezonde leefstijl na te streven, daarbij gebruik makend van counseling sessies in groepen, geprinte materialen die met de post verstuurd werden en een-op-een counseling. Bij praktijken die gemeenschapsprogramma's boden ontvingen meer patiënten bloeddrukverlagende middelen (89,7%), behandeling met antiplateletmedicijnen (80,5%) en statines (70,8%). Echter, de verschillen met de andere praktijken waren statistisch gezien niet significant. Onze conclusie was dan ook dat er in onze setting geen bewijs was gevonden voor de toegevoegde waarde van gemeenschapsgeoriënteerde programma's over cardiovasculaire risico's bij patiënten met coronaire hartziekten.

**Hoofdstuk 5**
Er is amper onderzoek gedaan bij niet-bedlegerige patiënten met chronisch hartfalen in het gebied rond de Middellandse Zee. In deze studie richtten we ons op het beschrijven van overlevingstendensen in onze doelgroep, alsook op de
impact van voorspellende factoren. Om dit te bereiken voerden we een retrospectieve cohort studie uit op basis van populatie in Catalonië (noordoost Spanje) met 5.659 niet-bedlegerige patiënten (60% vrouwen; gemiddelde leeftijd 77 [10] jaar) met inherent chronisch hartfalen. Geschikte patiënten werden geselecteerd uit de elektronische patiëntendossiers van de eerstelijnspraktijken vanaf 2005 en werden gevolgd tot 2007. We ontdekten dat er zich gedurende de follow-up periode 950 sterkgevallen voordeden (16,8%). Overleven na het begin van chronisch hartfalen bij 1, 2 en 3 jaar was respectievelijk 90%, 80% en 69%. Er werden geen significante verschillen in overleving gevonden tussen mannen en vrouwen (P=.13). Cox proportional hazard modelling bevestigde een toegenomen risico op sterven bij toegenomen leeftijd (hazard ratio=1,06; 95% betrouwbaarheidsinterval, 1,06-1,07), diabetes mellitus (hazard ratio=1,53; 95% BI, 1,33-1,76), chronische nierziekte (hazard ratio=1,73; 95% BI, 1,45-2,05), en ischemische hartaandoening (hazard ratio=1,18; 95% BI, 1,02-1,36). Hoge bloeddruk (hazard ratio=0,73; 95% BI, 0,64-0,84) bleek een beschermend effect te hebben. Onze uitkomsten suggereren dat er bij het plannen van diensten en preventieprogramma's rekening moet worden gehouden met de relatief hoge overlevingscijfers die in ons gebied gevonden worden en het effect van voorspellende factoren die kunnen helpen bij het identificeren van hoogrisicopatiënten.

**Hoofdstuk 6**
Er is weinig bekend over de voorspellers van ziekenhuisopname bij niet-bedlegerige patiënten met chronisch hartfalen, en bestaande voorspellers zijn wellicht niet van toepassing op de landen rond de Middellandse Zee. Ons doel in dit onderzoek was het vastleggen van longitudinale trends in ziekenhuisopnames. Tevens probeerden we de patiëntgerelateerde voorspellers van ziekenhuisopnames, heropnames en duur van de opname in de beoogde populatie te identificeren. Daartoe voerden we een bevolkingsonderzoek uit door middel van een retrospectieve cohort studie in Catalonië (noordoost Spanje), inclusief 7.196 niet-bedlegerige patiënten (58,6% vrouwen; gemiddelde leeftijd 76 jaar). Uit de elektronische patiëntgegevens van de huisartsenpraktijken werden geschikte patiënten geselecteerd, die vervolgens gevolgd werden voor een periode van drie jaar. We ontdekten dat er na drie jaar follow-up bij in totaal 645 (9,0%) patiënten sprake was van cardiovasculaire ziekenhuisopname, 37% werd opnieuw opgenomen, en de gemiddelde lengte van de opname was 9 (interkwartielafstand 5-17) dagen. Toegenomen risico op ziekenhuisopname werd
veroorzaakt door chronische nierziekten [odds ratio (OR)=1,98 (1,62-2,43)], IHD [OR=1,72 (1,45-2,04)], DM [OR=1,50 (1,27-1,78)] en chronische obstructieve longziekten (COPD) [OR=1,43 (1,16-1,77)]. DM [OR=1,70 (1,22-2,38)], IHD [OR=1,85 (1,33-2,58)] en HTA [OR=1,66 (1,11-2,46)]. Chronische nierziekten [OR van 2,21 (1,70-2,90)], IHD [OR van 2,19 (1,73-2,77)], DM [OR=1,70 (1,34-2,15)], HTA [OR=1,51 (1,13-2,01)] en chronische obstructieve longziekten [OR=1,37 (1,02-1,83)] zorgden voor een toename in het risico van een langdurige ziekenhuisopname. In dit onderzoek identificeerden we voorspellers van ziekenhuisopnames, heropnames en lange verblijfsduur, die clinici en managers kunnen helpen in het vaststellen van hoogrisicopatiënten. Deze patiënten kunnen dan gericht benaderd worden voor service planning en bij het opstellen van preventieve handelingen.

Hoofdstuk 7
Multimorbiditeit en polyfarmacie vormen een uitdaging voor het verbeteren van de kwaliteit van zorg. In deze studie hebben we geprobeerd om het verband vast te stellen tussen het voorschrijven van de aanbevolen behandeling bij niet-bedlegerige patiënten met chronisch hartfalen en multiple comorbiditeit en ziekenhuisopnames. Daartoe voerden we een bevolkingsonderzoek uit door middel van een retrospectieve cohort studie in Catalonië (noordoost Spanje), inclusief 7.173 nieuw geregistreerde patiënten met chronisch hartfalen (59% vrouwen; gemiddelde [SD] leeftijd 76,3 [10,7] jaar). De patiënten werden uit de elektronische patiëntgegevens van de huisartspraktijken geselecteerd en gedurende drie jaar gevolgd. We gebruikten de voorgeschreven ACE-remmers angiotensin-converting enzyme inhibitors (ACEI) / angiotensin II receptor blockers (ARBs) en beta-blockers (BB) als uitgangspunt in onze metingen. We ontdekten dat het voorschrijven van ACEI/ARBs bij patiënten in de eerstelijnszorg zonder ziekenhuisopname gedurende follow-up steeg van respectievelijk 50,8% naar 83,5% voor 0 en ≥ 4 comorbiditeiten, en voor ACE/ARBs + BB van respectievelijk 13,1% naar 30,6% voor 0 en ≥4 comorbiditeiten. Patiënten die opgenomen waren in het ziekenhuis werden vaker behandeld (ACEI/ARBs, OR 1,47; [1,17-1,85]; ACEI/ARBs + BB, OR 1,41; [1,17-1,69]). Comorbide aandoeningen die vaker behandeld werden waren hoge bloeddruk (ACEI/ARBs, OR 3,75 [3,33-4,22]; ACEI/ARBs + BB, OR 1,40 [1,23-1,59]), diabetes mellitus (ACEI/ARBs, OR 1,79 [1,57-2,04]; ACEI/ARBs + BB, OR 1,33 [1,18-1,49]) en ischemische hartaandoeningen (ACEI/ARBs, OR 1,25 [1,10-1,42]; ACEI/ARBs + BB, OR 3,01 [2,68-3,38]). Onze resultaten laten een toename zien in het
voorschrijven van de aanbevolen behandeling bij patiënten met chronisch hartfalen, tegelijk met een toename van het aantal comorbiditeiten. We stellen daarom voor dat huisartsen gelijke zorg leveren aan zowel complexe als minder complexe patiënten, al naargelang het aantal comorbiditeiten.
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Curriculum Vitae

Eva Frigola Capell was born in La Bisbal d’Empordà (Catalonia-Spain) in 1972, where she grew up and completed her pre-university studies. From 1990 to 1995 she conducted a postgraduate degree in psychology at the Universitat Autònoma de Barcelona, and in 1998 she completed her masters in clinical psychology at the Hospital Clínic de Barcelona. Also in 1997 she completed a three years program and graduated in Criminology at the Universitat de Barcelona. From 1998 to 2002 she worked at Consell Comarcal del Baix Empordà (local institution of Catalan government) as a consultant in clinical psychology providing support to patients with dementia and their families in the community. As a psychologist she assessed and treated around 250 patients with dementia and offered advice and support to their families and carers. She also trained district nurses in the care of patients with dementia.

In 2002, she went to Scotland, initially to improve her English and to know the country. There she got in contact with the Scottish Intercollegiate Guidelines Network (SIGN), and worked for a year as a visiting fellow developing the dementia clinical guideline. In 2004 she was appointed as a project leader at the Centre for Change & Innovation, Scottish Executive, Health department developing patient pathways from primary care to specialist services for several medical conditions. During this period working in Scotland she gained experience in identifying, appraising and summarizing published research and other relevant information to aid development and implementation of evidence-based guideline development, patient pathways and planning and redesigning of health services to improve quality of healthcare. Liaising with internal and external agencies (such as
NHS Education for Scotland, the e-Health Program, Professional Organisations and the Health Department) to promote integration with other work in same field and to ensure wide consultation and dissemination of the final product. Also recruiting and liaising with stakeholders and clinicians either from primary and secondary care. In 2006 she was appointed as a researcher and project leader at the Catalan Health Institute – ICS – where she worked for four years. During this period she managed several research and quality improvement projects at regional and also at European level collaborating with the Jordi Gol i Gurina Primary Care Research Institute.

It was during this period, in 2007 when she initiated her PhD program at the Radboud University Nijmegen Medical Centre as international student. One of the research projects of her thesis was the European Practice Assessment Cardio Project (EPA Cardio) lead by the Scientific Institute for Quality of Healthcare (IQ healthcare) at the Nijmegen Centre of Evidence Based Practice (NCEBP). She was responsible for fundraising, recruitment of stakeholders, field work, data analysis and dissemination of the results at national level in Spain. Another of her research projects was conducted entirely in Catalonia and was the evaluation of implementation of Chronic Heart Failure computerised clinical guideline, which was granted by the Ministry of Health of Spain in a high competitive research call.

In 2010 she was appointed as a researcher at the Centre Cochrane Iberoamericano in Barcelona and in 2012 at the Ministry of Health of the Catalan Government leading one of the work packages of an European project on patient safety (Linneaus Euro-PC project). Since 2007 she worked part time on her thesis. In 2012 she obtained the Certificate of Research Proficiency in Public Health and Research Methods in the Universitat Autònoma de Barcelona where she gained skills on qualitative and quantitative methods and statistics (descriptive, bivariate, multivariant and survival analysis), systematic review and meta-analysis, and quality and safety healthcare.

Eva is happily joined to Pedro and a proud mother of their son Francesc (2010).