

Cardiac Rehabilitation Availability and Delivery in Europe:

How does it Differ by Region and Compare to other High-Income Countries?

Endorsed by: European Association of Preventive Cardiology

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Abstract

Aims

To establish: (1a) CR availability and density, as well as (1b2) the nature of programs, and (23) compare these (a) by European region (geoscheme) and (b) to other high-income countries (HICs).

Methods

A survey was administered to CR programs globally. Cardiac associations were engaged to facilitate program identification. Density was computed using Global Burden of Disease study ischemic heart disease (IHD) incidence estimates. Four HICs were selected for comparison (N=790 programs) to European data, and multi-level analyses performed.

Results

CR was available in 4039/444 (9088.96%) European countries. Data were collected in 37 (94.8% country response rate). 455/1538 (29.6% response rate) program respondents initiated the survey.

Program volumes (median=300) were greatest in Western European countries, but overall were higher than other HICs ($p < .001$). Across all ~~the European HICs~~, there was on average only 1 CR spot per 7 IHD patients, with an unmet regional need of 3,449,460 ~~1,882,956~~ spots annually.

Most programs were funded by social security ($n=25$, 59.5%; with significant regional variation, $p < 0.001$), but in 72 (16.0%) patients paid some or all of program costs (or ~ 18.5% of the ~€150.0/program) out-of-pocket. Guideline-indicated conditions were accepted in $\geq 70\%$ of programs (lower for stable coronary disease), with

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no regional variation. Programs had a multidisciplinary team of 6.56 ± 3.0 staff (number and type varied regionally; and European programs had more staff than other HICs), offering $8.5 \pm 1.5/10$ core components (consistent with other HICs) over 24.8 ± 26.0 hours (regional differences, $p < 0.05$).

Conclusion

European CR capacity must be augmented. Where available, services were consistent with guidelines, but varied regionally.

Keywords: Cardiac Rehabilitation; Europe; Survey

Introduction

Similar to other high-income countries (HICs), cardiovascular diseases (CVD) are among the leading burdens of disease and disability in Europe^{1,2}. Accordingly, it is the most expensive health condition to treat in terms of direct and indirect costs²; overall CVD is estimated to cost the EU economy €10 billion a year². CVD is a chronic condition, and hence secondary prevention is key to managing this massive burden on the healthcare system, as well as on patients and their families.

Cardiac rehabilitation (CR) is an established model of care for secondary prevention, which is cost-effective, affordable, and averts costly downstream healthcare utilization³. Based on substantive evidence that participation is associated also with 20% reductions in cardiovascular mortality and morbidity^{4,5}, clinical practice guidelines⁶ for CVD revascularization and heart failure patients, among others, recommend referral to CR. Many European countries have CR guidelines⁷⁻¹⁶, as does the European Association of Preventive Cardiology⁶, a branch of the European Society of Cardiology, which specify the core components (e.g., initial assessment, structured exercise training, and risk factor management, including stress) which are to be delivered by a multi-disciplinary team of healthcare professionals with expertise in all the secondary prevention recommendations¹⁷. It is recommended programs offer a minimum dose of 12 sessions, although greater benefits could be achieved with more¹⁸, and these sessions can be delivered in an unsupervised setting if patients have barriers to participation¹⁹.

The availability and nature of CR in European countries has been described following 2 previous surveys of national coordinators^{20,21}. There have also been surveys of individual programs in Denmark²², Italy²³, Portugal²⁴⁻²⁶, Spain²⁷ and the United

Kingdom²⁸⁻³³, but this is only 5 of the approximately 44 countries in Europe. These surveys did characterize funding sources, volumes, CR dose, healthcare providers on CR teams, accepted indications, core components delivered, and delivery of alternative models (for a summary see Pesah et al.³⁴). However, little is known about the capacity and density of CR. Moreover, assessment of individual programs across European countries with the same assessment tool has never been undertaken to enable comparison against the above guideline recommendations across the region, nor has there been any assessment and comparison of services with any other region in the world³⁴.

Accordingly, the objectives of this investigation were to: (1) characterize the availability, volumes, capacity and density of CR (a) by European country, (c) region, and (c) in relation to other HICs; (2) characterize the following aspects of CR: (a) who pays for services and costs, (b) type of patients served, (c) number and types of healthcare professionals on the CR team, (d) number of program sessions / dose, (e) core components delivered, and (f) delivery of alternative models, again by European country, region, and in comparison to other HICs.

Methodology

Design & Procedure

This research was cross-sectional in design; detailed methods are reported elsewhere (Supervia et al., under review). In brief, countries where CR services were available were identified first through previous reviews^{35,36}. In countries where CR services were not suspected to be available, the internet was searched and major CR and cardiology societies were contacted to identify any programs or verify lack thereof.

For each country identified to offer CR, first available CR or cardiac society leadership were contacted (e.g., European Association of Preventive Cardiology). If

there was no society available or response, “champions” were identified, and in the case of European countries, the European Society of Cardiology national CVD coordinators were contacted. Identified leaders were sent an e-mail requesting their collaboration to: (a) determine the number of programs in their country, and (b) assist with administration of the survey to each program in their country.

Each identified program was emailed with the request to complete the survey. Informed consent was secured through an online form. The survey was administered through REDCap, with data collection occurring from June 2016 to December 2017.

Sample

For the global study, the sample consisted of all CR programs identified in the world that offer services to patients following an acute cardiac event or hospitalization (i.e., Phase II). The inclusion criteria were CR programs that offered: (1) initial assessment, (2) structured exercise, and (3) at least one other strategy to control CV risk factors.

For the purposes of this study, CR programs in European countries (according to the geoscheme regions³⁷; small islands and jurisdictions were excluded, e.g., Aland islands, Vatican City) as well as in 4 other HICs (United States, Canada, Australia and New Zealand; i.e., countries most comparable to European HICs) were selected.

Measures

With regard to the first objective, CR availability referred to existence of ≥ 1 program in a country. Program volume was defined as the median number of patients served by a program annually (program-reported in survey, described below). National and regional CR capacity were computed by multiplying the median number of patients a program could serve annually (program-reported in survey) among the responding programs in a given country or region respectively, multiplied by the total number of programs in that jurisdiction (ascertained from literature and/or champion). Please note

for countries where no surveys were completed, capacity was computed by multiplying the number of programs by median regional program volumes. Lastly, to compute density, ischemic heart disease (IHD) incidence was pulled from the Global Burden of Disease study³⁸. Then, the ratio of capacity (as computed above) per annual incident IHD case was computed. Unmet need was computed as IHD incidence minus national capacity.

Development of the survey is described in detail elsewhere³⁹. In short, items were based on previous national/regional CR programs surveys^{20,40}. Most items had forced-choice response options, and skip-logic was used to obtain more detail where applicable. The survey is available elsewhere (Supervia et al., under review).

The following variables were assessed: (i) who funds the program (i.e., private sources such as healthcare insurance, public sources such as government, or a combination of these sources [i.e., hybrid]), (ii) the type (e.g., myocardial infarction, as well as non-cardiac indications) and number of patients served per session (as well as staff-to-patient ratio), (iii) the number and types of healthcare professionals on the CR team (part-time staff were counted as 0.5), (iv) dose of CR (in hours; i.e., sessions per week x duration in weeks x duration of exercise sessions in minutes/60); (v) the type and number of core components delivered (of 10; i.e., initial assessment [including risk factors assessed and type of functional capacity test], risk stratification, structured exercise, patient education, risk factor management, nutrition counselling, stress management, smoking cessation interventions, prescription or titration of medication, and communication with a primary healthcare provider), and (vi) whether the program offers alternative CR models (i.e., home or community-based programs, or hybrid models where patients transition from supervised to unsupervised settings).

Data analysis

SPSS version 24 was used for analysis⁴¹. All initiated surveys were included. The number of responses for each question varied due to missing data (e.g., respondent did not answer a question due to lack of willingness or potential inapplicability, use of skip logic); for descriptive analyses, percentages were computed with the denominator being the number of responses for a specific item. Descriptive statistics were used to characterize availability, volume, capacity, density, as well other closed-ended items in the survey (e.g., funding sources, healthcare professionals on the CR team, and core components delivered).

All open-ended responses were coded / categorized. Aspects of CR were then compared by nationally, regionally and versus other HICs using generalized linear mixed models to take into consideration the hierarchical nature of data (e.g., CR programs nested within countries) where applicable and there were sufficient data in each country for estimates to be generated. Otherwise ANOVA or chi-square tests were applied.

Results

As shown in Table 1, CR is available in 4039 (9088.96%) of the 44 European countries.

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Data were collected in 37 (92.5%) countries. Of these, 8 (Belarus, Bosnia and Herzegovina, Bulgaria Romania, Russia, Moldova, Republic of Northern Macedonia and Serbia) were not considered high-income as per the World Bank⁴². No response was obtained from: Montenegro, Norway and Luxembourg (Figure 1).

In terms of programs, 455/1538 responded in Europe (29.6%; Table 1). Please note a subsample of programs only was surveyed in Austria and Scotland (1-2 programs per health board/region for the latter) due to champion preference. Of the 4 HICs selected for comparison that had CR, 234 surveys were initiated (30.1% response rate).

Volumes, Capacity and Density

The number of programs per country and region is shown in Table 1. Of responding programs, 287 (65.9%) reported being situated in an urban area, and 83 (19.1%) in a suburban area. Overall, 337 (78.9%) were in a hospital (academic, community or rehabilitation); of which 155 (45.9%) were academic or tertiary centres. Two hundred and four (51.1%) programs reported that there was another CR program within a 20km radius (vs. 87 [38.7%] in other HICs).

Volumes, capacity and density are shown in Supplemental Table 1. Volumes per program (median=300) were greatest in Western Europe (median=515). Program volumes were significantly higher than in other HICs ($p<0.001$). Median national capacity was 4170 CR spots/country (7563 for Northern, 3000 for Eastern, 2300 for Southern and 27450 for Western). It was significantly higher than the other HICs.

Overall European density was 1 spot per a median of 7 IHD patients / year / country (per 2 for Northern countries, 21 for Eastern, 13 for Southern and per 4 patients for Western region; Supplemental Table 1). In other HICs, the density was on average 1 spot for 2 patients. As shown in Table 1, unmet CR need was substantially higher in Eastern Europe, particularly due to the dearth of CR in Russia.

Nature of CR Services

Program responders were asked to report who pays for their services, and could check all applicable sources ($n=112$, 25.7% reported >1 source; Table 2). Overall, 312 (69.5%) programs reported government funding ($p=0.11$ for regional variation), 115 (25.6%) reported hospital / clinical centre funding (with significant regional variation, $p=0.001$), 77 (17.1%) reported private health insurance ($p<0.01$), and 72 (16.0%) reported the patient pays ($p=0.15$). Funding source in Europe was not different than other HICs ($p=0.50$).

In 15 (3.3%) programs, the sole source of funding was the patient ($p < 0.001$; data shown by country elsewhere⁴³). Table 2 also displays the proportion of the total program cost patients pay when they are a source of CR financing, and the associated estimated cost to them (purchasing power parity values by country shown elsewhere⁴³). Direct cost to patient differed between regions where they paid ($p < 0.05$), with the Southern region having the highest cost (€809.21). The estimated cost to deliver a full course of CR (as per dose shown in Figure 2) is also shown; cost differed between regions ($p < 0.001$), with the Western and Southern region having the highest cost (€2,163 and €3,090). There was also no difference from other HICs for cost to deliver a full course of CR ($p > .05$).

The most common type of patients accepted in CR programs are shown in Table 3 (shown by country in Supervia, M. et al., under review). There was significant regional variation for heart failure (accepted less often in Southern Europe), and the only significant difference between European HICs and other HICs was for valve procedures (accepted more often in European HICs). Other accepted indications included: heart transplant ($n=282$, 63.8%), congenital heart disease ($n=266$, 60.2%), patients with mechanical circulatory support devices ($n=188$, 42.5%) and implanted devices for rhythm control ($n=187$, 42.3%). Many programs also accepted patients with non-cardiac indications, namely: intermittent claudication / peripheral vascular disease ($n=149$, 33.7%), diabetes ($n=122$, 27.6%), lung disease ($n=103$, 23.3%), stroke ($n=74$, 16.7%) and cancer ($n=50$, 11.3%).

The number and nature of healthcare professionals on CR teams is shown in Table 4 (shown by country in Supervia, M. et al., under review); programs on average had 6.5 staff members, most commonly a nurse, physiotherapist, cardiologist, dietitian and administrative assistant. There was significant regional variation in total number

(higher in west than north), and type (i.e., fewer cardiologists [among other physicians], psychologists and administrative assistants in north) of providers. When compared to other HICs, Europe had significantly more staff overall, with more physiotherapists, cardiologists, physiatrists, and sports medicine physicians as well as psychologists and psychiatrists on their CR teams.

During exercise sessions, there was most commonly a physiotherapist (n=248, 82.7%) and a nurse (n=184, 63.2%) present. The median number of patients per supervised exercise session was 9 (Q25-Q75=6-12). The overall dose of CR was 24.8 ± 26.0 hours (median=16.0; Figure 2; median frequency was 2.5 sessions per week, and program duration was 8.0 weeks). There was significant variation by region ($p < 0.05$), with higher doses in the Southern and Western regions. Dose was not significantly different in Europe than other HICs.

Programs offered 8.5/11 “core” components on average (Table 5; shown by country in Supervia, M. et al., under review), this did not vary significantly by region. There was some significant regional variation in provision of return-to-work counselling (higher in west), among some other elements. There were some significant differences in delivery of components in European versus other HICs (but the same number offered overall), namely counselling for return-to-work, prescription and /or titration of medications and functional capacity testing (by multiple means) were more frequently delivered in European HICs. Risk factors assessed pre-program, and equipment to deliver components are reported elsewhere by country (Supervia, M. et al., under review).

Finally, alternative CR model delivery is shown in Figure 1; 119 (33.5%) programs reported delivery of any alternative model (more detail on type is shown in Ghisi, G. et al.⁴⁴). Twenty-five (21.0% of programs that offered alternative models, or

5.5% of all programs) programs reported using smartphones, an “app”, or text messaging with patients (i.e., some form of eCR). There was significant variation by region ($p < .05$), but there was not significantly different alternative model implementation when compared to other HICs ($p > .05$).

Discussion

For the first time, the unmet need for CR has been estimated in Europe, with well over 3 million more spots needed per year to treat IHD patients alone, and the grossest unmet need in Eastern Europe. Where available, countries have a median of 16 programs each treating 300 patients (with guideline-indicated conditions accepted in $\geq 85\%$ of programs, but stable coronary disease less so) per year. Government is the most common CR funding source for programs that cost a mean of $\sim \text{€}1850$, but in approximately 40% of programs patients are paying out-of-pocket (for 35% of the program cost or $\sim \text{€}500/\text{patient}/\text{program}$). Patients are prescribed a median of 167 hours of CR ([which is considered sufficient to achieve the benefits](#))¹⁸, covering a median of 8.5 core components (with significant variation in delivery of return-to-work counselling needing to be addressed, and more consistent delivery of tobacco cessation interventions needed as well) delivered by 6.5 staff (with the type differing by region and varying from the composition in other HICs).

No study has ever attempted to quantify density and unmet need in Europe, so this is a first and best attempt. The overall value for unmet need does not take into consideration patients who may have contraindications to participation (not to exercise as patients should receive the other core components), or heart failure patients who are also indicated, so more research is needed. While we did not compute unmet need in all global regions, when comparing density of CR in other regions (only considering

countries with CR) of the globe, Europe and the Western Pacific have the best and quite comparable density, with Africa the worst.

Moreover, this is the first ever survey of all CR programs in Europe (although the European Society of Preventive Cardiology has recently re-surveyed national coordinators [but not individual programs]⁴⁵, and so we look forward to those results becoming available). Results are fairly consistent with the previous surveys of programs in Europe³⁴, with regard to funding source, accepted indications, most common healthcare providers, dose, as well as the low availability of CR in alternative settings.

The implications of this work are many. Policy recommendations include advocacy for better reimbursement of CR services by public sources and private healthcare insurance so patients are not paying out-of-pocket⁴⁶. Recommendations to augment capacity include initiating services in countries without CR, and expanding provision of eCR^{47,48}, particularly in Russia, Belarus and Greece where unmet need is greatest. Program-level innovations recommended on the basis of this work include more consistent provision of return-to-work counselling to optimize life functioning for patients and reduce the negative impacts of CVD on the economy. Moreover, given tobacco cessation is the most impactful change for secondary prevention⁴⁹, clearly universal delivery should be pursued. [Indeed, results from EUROASPIRE IV demonstrate that CR participants are not quitting tobacco at a rate greater than non-participants⁵⁰, bolstering our call for more focus on this component in European CR programs.](#)

In terms of directions for future research, there are several important avenues to be pursued. First, while the survey assessed structure and process indicators of CR programs, how these translate to patient outcomes cannot be ascertained. Field tests of CR programs, examining the “how” and what is delivered in each core component, and

in non-supervised settings is warranted, as well as actual dose received by patients (i.e., adherence to prescribed sessions). Europe did have a multinational registry⁵¹, and it would be ideal to link this structural program data to the patient-level data in a registry to determine the degree of quality of CR in Europe. Given there are other countries that also have registries⁵², again CR delivery in Europe could be benchmarked against these other countries.

This study has several limitations. First, there may be ascertainment bias or under-estimation of capacity due to failure to identify programs or differences in the nature of programs identified to those that may have not been identified. Second, response rates to online surveys are notoriously low. The country response rate was high, but the program rate was 30% in the current study, which is fair, but suggests there may be bias (potentially higher-quality programs are better-represented). Third, respondents may have been inclined to respond in a socially-desirable manner, such that results were skewed to reflect better provision of CR. However, participants were informed that their responses were confidential. [The recent data from EUROASPIRE IV does suggest that provision of some CR components is insufficient to achieve target risk reductions⁵⁰](#). Fourth, [CR in Europe was compared to only four other HICs; comparisons to other HICs in future could provide useful information](#). Finally, multiple comparisons were performed, and there were few respondents in some countries, and hence caution is necessary when interpreting the findings.

Conclusion

There are ~~≥150038~~ CR programs across Europe, existing in ~90% of countries. However, there is only one spot for every 7 patients in need (with particularly great need for capacity increases in Eastern Europe), although this density is quite good compared to other regions of the globe. Program delivery is highly consistent with

European CR guidelines, although there is significant regional variation in relation to funding sources, costs to patients, the nature of providers on CR teams, dose and alternative model delivery. Moreover, the nature of services is quite consistent with that in other comparable HICs, except in terms of program volumes, the number and nature of providers on CR teams and the type of core components offered.

Funding

This work was supported by a minor research grant provided by the York University Faculty of Health.

Acknowledgements

On behalf of the International Council of Cardiovascular Prevention and Rehabilitation through which this study was undertaken, we are grateful to others who collaborated with us to identify and reach programs in their European country, namely: Dr. Alexander Aleksiev, Dr. Josef Niebauer, Dr. Borut Jug, Dr. Henrik Schirmer, Dr. Charles Delagardelle, and Mr. Ricky Thomas. We also thank the following associations for assisting with program identification: the British Association of Cardiovascular Prevention and Rehabilitation, European Association of Preventive Cardiology (Secondary Prevention and Rehabilitation Section), the International Society of Physical Medicine and Rehabilitation and World Heart Federation (who also formally endorsed the study protocol).

Conflict of Interest

None declared

Authors' Contributions

MS, KTA, SLG, FLJ, BB-W contributed to the conception or design of the work. EP, MS, KTA, AA, MA, KA, VG, DV, EV, DG, JC, EK, IY, SA, AH, ET, HK, ZE, SF, JH, EP, SD, BP, AK, AND ES contributed to the acquisition, analysis, or interpretation of data for the work. AA, EP and SLG drafted the manuscript. AA critically revised the manuscript. All gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

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