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Review

Cardiac rehabilitation costs

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ABSTRACT

Background: Despite the clinical benefits of cardiac rehabilitation (CR) and its cost-effectiveness, it is not widely received. Arguably, capacity could be greatly increased if lower-cost models were implemented. The aims of this review were to describe: the costs associated with CR delivery, approaches to reduce these costs, and associated implications.

Methods: Upon finalizing the PICO statement, information scientists were enlisted to develop the search strategy of MEDLINE, Embase, CDSR, Google Scholar and Scopus. Citations identified were considered for inclusion by the first author. Extracted cost data were summarized in tabular format and qualitatively synthesized.

Results: There is wide variability in the cost of CR delivery around the world, and patients pay out-of-pocket for some or all of services in 55% of countries. Supervised CR costs in high-income countries ranged from PPP$294 (Purchasing Power Parity; 2016 United States Dollars) in the United Kingdom to PPP$12,409 in Italy, and in middle-income countries ranged from PPP$146 in Venezuela to PPP$1095 in Brazil. Costs relate to facilities, personnel, and session dose. Delivering CR using information and communication technology (mean cost PPP$753/patient/program), lowering the dose and using lower-cost personnel and equipment are important strategies to consider in containing costs, however few explicitly low-cost models are available in the literature.

Conclusion: More research is needed regarding the costs to deliver CR in community settings, the cost-effectiveness of CR in most countries, and the economic impact of return-to-work with CR participation. A low-cost model of CR should be standardized and tested for efficacy across multiple healthcare systems.

1. Introduction

Cardiovascular disease (CVD) is one of the most prevalent health conditions worldwide [1]. This burden is particularly problematic in low and middle-income countries (LMICs), where more than 80% of CVD deaths occur [2].CVD is also among the leading causes of disability [3]; The percentage of years lived with disability has increased by 25% globally since 2005 [4].

Individuals with CVD are at high risk for subsequent major cardiac events and death [5], thus secondary prevention is paramount. Cardiovascular rehabilitation (CR) is an effective and low-cost model of care for secondary prevention of CVD. It is an outpatient chronic disease management program [6], delivering the core components of assessment, medical risk factor management, structured exercise training, patient education as well as psychosocial and behavioral counselling (e.g., diet, tobacco) [7,8]. CR is generally delivered in a clinical setting such as a hospital, and patients come on-site on average 3 times/week for 5 months [9]. CR participation results in a 26% reduction in cardiovascular mortality and 18% reduction in costly re-hospitalization compared to usual care [10].

The cost-effectiveness of CR has been demonstrated across many contexts and perspectives (e.g. [11–14].). In a systematic review of 9 cost-effectiveness studies by Wong et al. [15], it was concluded that supervised CR could be cost-effective compared to no CR. Three studies compared supervised versus home-based CR, and four studies home-based versus no CR. Results showed that home-based CR was equivalently cost-effective when compared to supervised CR, and was *cost-saving* when compared to no CR.

The above research was undertaken mainly in high-income countries. In a recent review on the economics of CR in LMICs by Oldridge et al. [16], studies were identified in Brazil and Colombia, and both

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showed CR as cost-effective in patients with heart failure. Obviously there would be many differences between high-income countries and LMICs which would influence the cost-effectiveness of CR. Overall, the literature suggests that across settings, type of program, population, and perspective, CR is an economically-attractive option compared to no CR.

Despite the clinical and economic benefits of CR, it is not widely implemented [17,18], particularly in LMICs where it could be especially beneficial. In this resource-constrained era, lower-cost models may be more feasibly implemented on a broad scale; this could enable reach to a greater number of patients in need, and hence have a greater impact at the population-level. Therefore, the objectives of this review were to: (1) describe the costs associated with delivering CR, (a) as well as its individual components, (b) by delivery setting (e.g., home-based), and (c) by country income classification (i.e., high and LMIC), (2a) describe approaches to lowering delivery costs, and (b) lower-cost models of CR, as well as (3) consider implications for society, health systems and research.

2. Cost of delivering supervised cardiac rehabilitation

Traditional CR consists primarily of supervised exercise sessions delivered in an outpatient setting, such as a hospital or clinic. Overall, delivering the traditional model of CR carries with it costs associated with personnel, equipment and other supplies, space and other operating costs [19–21] Only a handful of studies have reported all costs to run a program per patient (see also [20,22,23] for costs to run alternative models). For example, the study by Oldridge et al. in Canada reported direct costs for a 16-session supervised program were: space $290CAD (1987; Purchasing Power Parity PPP$506 in 2016 dollars), overall personnel $148 (PPP$258), equipment $64 (PPP$112), and resource literature $5 (PPP$9), for a total of $PPP884 [19]. The study by Whittaker et al. reported the costs of 6-week supervised program were overall $1845AUD (2013; PPP$1312), comprised of facility $595 (PPP$423), administration $450 (PPP$320), coaching and mentoring $225 (PPP$160), assessment $195 (PPP$139), gymnasium $180 (PPP$128), communications $125 (PPP$89), technology $40 (PPP$28) and education $35 (PPP$25) costs [20].

The available literature on CR personnel costs specifically is displayed in Table 1. Given the multi-component nature of CR, and hence the multiple disciplines required to deliver it comprehensively, personnel costs are quite high. There is wide variation in the staffing complement of CR programs, as well as program policies around staff-to-patient ratios during exercise for safety [24–26]; correspondingly overall costs to programs would vary. As shown, there was no available literature on the costs of occupational therapy within the CR setting; this is a significant omission considering the importance of return-to-work to patients and society. The value of the personnel with respect to achieving beneficial patient outcomes is not reflected, but strategies to mitigate these costs are considered below.

Table 1
Summary of findings regarding healthcare personnel costs for supervised cardiac rehabilitation delivery.

Healthcare provider type	Cost (currency year)	Per patient per	PPP (2016)
Physicians			
Specialist (e.g., Cardiologist) [19]	$118 (1987CAD)	Program	$205
Generalist/Primary Care [12]	236 (1988 SEK)	Hour	$60
Nurse [58]	£50 (2002)	Hour	$97
Allied healthcare workers [58]			
Dietitian	£39 (2002)	Hour	$75
Exercise physiologist	£39 (2002)	Hour	$75
Physiotherapist	£39 (2002)	Hour	$75

£, British Pound; CAD, Canadian Dollar; PPP, Purchasing Power Parity; SEK, Swedish Krona.

The available literature on the cost of delivering each of the core CR components is displayed in Table 2. As shown, there was no available data regarding costs for the non-patient-care related component of program audit and evaluation. For some medications and smoking cessation, data was available for cost of secondary prevention but outside of CR settings.

The overall cost of delivering supervised CR was expressed on a per patient (for a complete program), or per session basis in the literature (no studies were identified reporting the cost to run a program per year for example). Table 3 summarizes the available data on the cost to deliver CR by country, sorted by country income classification. These costs are considerably less expensive than the cost of acute cardiac procedures [18]. In high-income countries (HICs), the cost to deliver a supervised CR session ranged from PPP$12 in Finland to PPP$310 in Italy.

Available data on supervised CR delivery costs in LMICs is also shown in Table 3. As shown, there is only information on delivery in MICs in South America. Costs were also reported in Mexico, but only the range of $600-3400USD [27]. In most countries, delivery costs are higher in private versus public healthcare. Unfortunately, whether these costs can be attributed to differences in CR care quality in these settings is not known, but the lower cost is likely due to higher volume of patients (personal communication, Claudia Anchique Santos, December 18, 2016). The review by Oldridge et al. juxtaposed these overall CR costs in relation to healthcare expenditure per capita [16]. It was concluded that CR as delivered traditionally was not affordable in the LIC setting, but was in MICs. However, clearly CR is delivered at much lower cost than in HICs, and what evidence is available suggests equivalent benefits are achieved [17].

Finally, one must consider costs to patients to attend CR. It is hoped that patients do not have to pay for CR care, however in a snowball survey of CR associations globally, it was found that patients pay out-

Table 2
Summary of findings regarding cost to deliver cardiac rehabilitation components in a supervised setting.

Core component	Cost (currency year)	Per patient per	PPP (2016)
Patient assessment			
[58]	£50 (2002)	Hour	$97
[20]	$195 (2013)[b]	Program	$139
Lifestyle risk factor management			
Smoking cessation[a] [59]			
Nicotine Replacement Therapy	$263(2008USD)	Program	$293
Bupropion	$246(2008USD)	Program	$274
Varenicline	$361(2008USD)	Program	$402
Exercise training [21]	$110(2004USD)	Program	$140
Lifestyle counselling [21]	$167(2004USD)	Program	$212
Coaching and mentoring [20]	$225 (2013AUD)[b]	Program	$160
Medical risk factor management and cardioprotective therapies			
Risk factor counselling [21]	$75 (2004USD)	Program	$95
ACE-inhibitors[a] [60]	£18 (2007)	Month	$30
Ramipril			
Antiplatelets[a] [60]	£1.4 (2007)	Month	$2.3
Aspirin			
Beta-blockers[a] [60]	£2.6 (2007)	Month	$4
metoprolol			
Diuretics [12]	272 (1988SEK)	Year	$68
Statins[a] [61]	£387 (2000)	Year	$615
Pravastatin [60]	£7.5 (2007)	Month	$12
Nitrates [12]	469 (1988SEK)	Year	$117
Psychosocial health			
Psychosocial counselling [21]	$93 (2004USD)	Program	$118
Patient education [20]	$35 (2013AUD)	Program	$25

ACE, Angiotensin Converting Enzyme; AUD, Australian Dollar; £, British Pound; CR, Cardiac Rehabilitation; PPP, Purchasing Power Parity; USD, United States Dollar.

[a] Not in cardiac rehabilitation setting.

[b] Year of currency not stated in study, therefore, date of the costs/benefits model development by the author was reported and used for PPP calculation.