Patient focused internet-based approaches to cardiovascular rehabilitation -- a systematic review

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Summary

Cardiac rehabilitation (CR) has been shown to improve health behaviours and risk factors and the evidence suggests that home CR is as effective as hospital-based CR. Telemedicine offers the potential for more patients to engage in CR. We reviewed the evidence for patient focused Internet-based approaches to cardiovascular rehabilitation. Searches were performed in PubMed, EMBASE, Scopus and the Cochrane Controlled Trials Register (CCTR). In total, 9 studies involving 830patients with heart disease that compared Internet-based cardiac rehabilitation to usual care were identified. The quality of trials was assessed using the Jadad scale. Outcome data were pooled under four subheadings: compliance; physical activity outcomes; clinical outcomes; psychosocial outcomes. Compliance rates were high but dropped over time in all studies. Physical activity measures were generally improved, as were clinical outcomes. Changes in psychosocial measures were positive, with two studies noting no change. No interventions noted a negative effect on outcomes. Despite the relatively small number of trials and the limited outcome measures, the results appeared to be positive with regard to patient outcomes and patient feedback. However, none had progressed to a clinical service.

Introduction

Cardiovascular disease causes about 17 million deaths per year worldwide, or approximately one-third of all deaths.[1] Cardiac rehabilitation (CR) has been shown to improve health behaviours and clinical risk factors in a number of clinical trials.[2-4] The available data are supportive of CR[5]and it is recommended in most national and international heart disease guidelines. However, inequalities in provision, uptake and attendance remain. A recent study found considerable variation in practice across Europe in terms of referral to and uptake of CR.[6] The reasons for this include a lack of engagement, low referral rates, lack of provision and poor uptake due to practical barriers such as transport and employment imposed limitations. Other psychosocial factors may also influence attendance at CR, including anxiety and depression, illness perceptions and misconceptions.

The National Institute of Clinical Excellence (NICE) in the UK has made recommendations for improving engagement with CR services.[7] There are also policy documents which promote the importance of CR.[8-11] However, access and uptake of CR remains poor in many countries.[6]

Previous studies have reported the benefits of home based rehabilitation as an alternative to hospital- or centre-based services. A Cochrane review of CR patients found no difference between home and hospital groups, in terms of mortality, cardiac events, exercise capacity, blood pressure reduction or cholesterol improvements.[12,13] Although there have been few large scale randomized controlled trials (RCTs), the evidence suggests that home CR is as effective as hospital-based CR and may produce longer term gains through maintenance of physical activity.[13]

Telemedicine offers the potential for more patients to engage in CR. We have therefore reviewed the use of the Internet for distance monitoring and education in CR.

Methods

A literature search was performed of PubMed, EMBASE, Scopus and the Cochrane Controlled Trials Register (CCTR) for articles between January 1990 and May 2013. The following search limits were used: involved human subjects, article published in English, involved adult subjects (over 18 years). The reference lists of articles were searched manually to retrieve other relevant publications. The full list of papers was checked for duplicates and for the inclusion and exclusion criteria as listed below. Initially abstracts were reviewed to extract relevant studies, and then full texts were reviewed for suitability by two reviewers. In cases of disagreement, consensus was reached through discussion, see Figure 1.

Studies were included if:

1. The design was a randomized controlled trials, controlled trials or cohort study
2. The intervention was web-based and interactive
3. The sample included cardiac patients
4. The intervention group was compared to a similar patient group (receiving another intervention or usual care)
5. The intervention involved at least one outcome measure assessing patient empowerment and/or cardiac rehabilitation
6. One of the following outcome measures were included: compliance with intervention, physical activity, clinical outcomes (blood pressure; cholesterol; hospital visits), psychosocial outcomes, patient feedback

7. The intervention involved hospital outpatients
8. The intervention did not involve routine home monitoring
9. The intervention was patient focused, providing a service for the patient, not solely the transfer of data between patient and healthcare professional.

The search terms used were:

heart OR coronary OR cardiac OR ischaemic disease

other derivatives used were: ischaem*

rehabilitation OR prevention and control OR secondary prevention

other derivatives used were: rehab*; prevent*

Internet OR web OR online OR technology

The following information was extracted from each study: study characteristics (source and year of publication, country of origin, aim and sample size); patient characteristics (type of disease, age, gender, comorbidities, computer experience and Internet use); intervention characteristics (content, duration, frequency, compliance and dropout rate).

Quality of intervention

The types of intervention varied but included Internet-based monitoring, Internet-based patient web sites, interactive voice recognition systems and mobile phone applications. The quality of trials was assessed using the Jadad scale[14] to cover selection bias, study design limitations, confounding factors, method of blinding, reporting of withdrawals and drop outs, intervention integrity and analyses.

As patients cannot usually be blinded to participation in cardiac rehabilitation this criterion of the Jadad Scale was not applicable to the present review. Papers were scored in a range from 1 (strong) to 3 (weak), i.e. an Effective Public Health Practice Project (EPHPP) score. The scoring was completed independently by two reviewers who then met to reach consensus.

Current status

The research team of each primary study were contacted and asked to provide information about the current status of their intervention. Where this was not possible an Internet search was undertaken to try and identify whether there was a current service for patients.

Results

In total, 9 studies involving 830 patients with heart disease that compared Internet-based cardiac rehabilitation to usual care were identified (Figure 1). Studies rarely gave sufficient information about what constituted usual care so it was difficult to compare studies in this respect (Table 1). The studies had been conducted in a range of locations worldwide and differed greatly in terms of the intervention, from comprehensive Internet-based CR, similar to hospital input, to a compliance device with Internet-based monitoring. This variation limited the possibilities of direct comparisons between trials. It was not possible to pool results due to the heterogeneity of methods, interventions and outcome measures in the studies identified. Therefore, a formal meta-analysis was not possible.

The patient types included those with heart failure, myocardial infarction, coronary artery bypass grafting, percutaneous coronary intervention and cardiac transplant (Table 1). As would be expected there was also variation in the gender and age of the patients.

The median rating for the quality of the studies was an EPHPP score of 2, representing a moderately strong methodology, see Table 1.

Outcomes

Compliance was measured as an outcome measure in eight of the nine studies.[15-22] The approach to measuring compliance varied between studies, including adherence to medication, number of log-ins to the CR programme, usage of the CR programme, completion of tutorials or completion of weekly tasks. Compliance with the intervention ranged from 36 to 97%. Studies which measured compliance over time noted a significant drop in rates during the trial.

Physical activity was measured as an outcome measure in six of the nine studies.[15,18-20,22] Of these, four noted a positive outcome[18-20,22] and two noted no change in activity levels following intervention.[15,23] A variety of subjective and objective measures were used, including the 6-Minute Walk Test (6-MWT), pedometer, self-report, minutes of exercise and activity MET (Metabolic Equivalent of Task). Direct comparison between studies was therefore not possible. Clinical outcomes which included hospital visits, length of stay, cardiovascular events, bodyweight loss, blood pressure, dyspnoea and fatigue (via the Congestive Heart Failure Questionnaire) and cholesterol were measured in five of the nine studies.[17,19,20,22,23] All 5 studies noted a positive improvement in the clinical outcome measured.

Psychosocial outcomes were explored in eight of the nine studies.[15-20,22,23]

Five of the articles observed positive outcomes, and two noted no change in their chosen outcome measures, namely quality of life (QoL) and depression scores.[19,23] Improvements were seen in QoL, anxiety and depression, self-efficacy and functional emotion. Different instruments were used to calculate the outcomes which made direct comparison between studies difficult. However, most of the trials showed a benefit.

Patient comments

Access to all patient comments was not available, and therefore formal thematic analysis was not performed. However the reported comments could be broadly divided into positive and negative.

(1) Positive. Heart failure patients using a compliance device and Internet-based monitoring found they enjoyed the reminders and they were better able to adhere to their medication regime. The messages also encouraged them to be more active and to make healthier choices with their food. Some would have liked to have kept the devices at the end of the study.[15] Patients using a care assessment platform found the intervention easy to use and motivational in achieving their cardiac rehabilitation goals.[21] An Internet-based recording system to monitor health behaviours in heart failure patients had 100% of patients who were satisfied or very satisfied with the system. The reasons for the satisfaction included perceived better health and support from healthcare providers.[20] All patients involved in this study felt they were more confident in dealing with their heart failure following the intervention.

A multi-faceted Internet-based intervention also produced responses that the website was easy to use, that patients actively participated in the site and made good use of discussion groups and educational modules on the site.[16]

(2) Negative. The majority of negative comments involved technical problems, including not having access to the Internet or a computer,[21] not being able to read the screen properly, not hearing the beep when a reminder came,[15] out of date software for Internet browser or hesitation in using the computer and Internet.[16] Other factors were that patients felt guilty when they had no exercise to input on a particular day and that the monitors were a nuisance and intrusive.[20]

Current status

Only four researchers could be contacted using the email address on the primary publication. None of these programmes had been developed into clinical systems, although one research group was undertaking a larger trial,[22] with results expected to be published in a peer reviewed journal. Internet searches were carried out to follow up authors whom we were unable to contact. However, we found very little information and were not able to access any relevant contact details.

Discussion

Despite the potential utility of an Internet-based approach to cardiac rehabilitation, we identified only nine studies meeting our search criteria. Overall patient compliance and feedback was positive for Internet-based CR.

The approach is potentially flexible, more accessible to patients and may allow a return to work more quickly without the interruptions caused by attendance at hospital-based classes. Outcomes, as reported, appeared to be positive, including compliance, clinical outcomes and physical activity. The primary outcomes were all improved by the relevant interventions, with the exception of one RCT which provided risk factor management, and education and monitoring services.[23] Perhaps the latter reflects a failure of this particular approach since other studies reported positive outcomes, although recent research has questioned the efficacy of certain CR programmes.[24]

Study quality and patient numbers varied widely in the trials and even patient type was not consistent so the results of the present review should be interpreted with caution. From a methodological perspective the two strongest studies found conflicting results in terms of physical activity and psychosocial outcomes. Four studies were classified as weak, principally due to selection bias and poor study design. Most of the studies involved patients from the US, where the structure of healthcare is different from many other parts of the world. All these factors limited our ability to draw generalisable conclusions.

Mentors supervising patients in the studies reviewed expressed concern that patients might experience difficulties, but found that the systems trialled were practical and easy to use, and that patients benefited from not having to travel to hospital-based CR and were therefore able to return to work while completing the programme.[21] There were some concerns about patients exercising without supervision and that patients would miss out on the peer support provided from a conventional CR programme in a centre or hospital.

Despite its inclusion in all the major international guidelines, CR is not delivered in a comprehensive or equitable manner around the world.[6] This, no doubt reflects the considerable differences in the organisation of health care and financial constraints. Despite CR being relatively cheap compared with other cardiac interventions there has been a widespread failure to fully integrate CR into clinical services. Telemedicine-based cardiac rehabilitation has the potential to reach more patients and may increase attendance in a cost effective manner. The results from the present review indicate an improvement in compliance with interventions but it is not clear from the studies how much of the target population was assessed, making it hard to generalise the results. We do not know whether telemedicine-based approaches are reaching the people who are unable or unlikely to use conventional rehabilitation services. We also must establish whether the high compliance rates reported can be replicated in routine clinical practice.

The present review attempted to describe the integration of programmes into clinical practice. Of the nine studies identified, none appear to have been integrated into local services despite broadly positive outcomes.

Limitations

The present review had certain limitations, For example, six of the nine studies involved fewer than 100 patients, so the results may not generalisable. There may have been a reporting bias since eight studies reported positive outcomes. Objective end points such as death and readmission to hospital were not widely reported and may need larger trials to establish whether this style of intervention is safe and effective for the cardiac population. The quality of the studies analysed varied greatly.

Conclusions

Despite the relatively small number of trials and the limited outcome measures, the results appeared to be positive with regard to patient outcomes and patient feedback. However, none had progressed to a clinical service.

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Table 1. Studies reviewed

Study	Patient group	n	Intervention	Study design (Quality Score EPHPP)	Duration (active intervention)	Compliance (% or log in rate)	Physical activity outcomes	Clinical outcomes	Psychosocial outcomes	In current use?	If not – why not?	Country of research
Artinan 2003[15]	CHF	18	Compliance device linked to web based monitoring system.	RCT Score - 2	3 months	96% compliance with medication.	unchanged 6MWT	Unchanged NYHA	Improved QoL unchanged pill counts unchanged self-care behaviours	Not known	-	USA
Dew 2004[16]	CT	20	Multi-faceted web-based intervention. Used by patients and care givers over 4 months.	Cohort Score - 1	4 months	50% logged in at least weekly, unchanged medical compliance	Not measured	Improved compliance for attending clinic appointments, completing blood work and following diet.	Improved anxiety and depression Improved QoL in social functioning Improved care givers anxiety and hostility	No	No fiscal support	USA
Lorig 2012[17]	Chronic disease[1]	254	Internet-based DMP	Cohort Score - 3	6 weekly sessions	97% -1st session 65% -6th session	Not measured	Fewer ER visits Improved health status (Health statuses includes pain, shortness of breath, fatigue, intrusiveness, health distress, disability and self-reported global health)	Improved health behaviours and self-efficacy	Not known	-	Australia
Reid 2011[18]	CHD	223	CardioFit Internet-based expert system. 5 online tutorials over 6 months with access to an exercise specialist	RCT Score - 1	12 weeks	Completion rates for tutorials 70%– Week 2 43%– Week 20	Improved PA.	Improved PA over 7 days at 6months and 12 months.	Group effect in emotional and physical subscales of MacNew, higher QoL scores in intervention group.	Not known	-	Canada

Ruggerio 2000[19]	CHF	69	(1) Web-based intervention (2) Interactive voice response via telephone. Web site used as an adjunct to a DMP.	RCT Score - 3	Not known	Web entry- 83.74%, IVR usage - 76.41% Average compliance to interventions was 80%.	Over 75% patients Improved PA	Less hospitalisation Shorter length of stay in the web based group.	Unchanged QoL	Not known	-	USA
Southard 2003[23]	Cardiovascular disease	104	Internet-based programme providing risk factor management and education and monitoring services.	RCT Score - 1	6 months	Not measured	Unchanged PA	Less cardiovascular events. Improved weight loss	Unchanged depression, blood pressure, lipid levels and dietary habits	Not known	-	USA
Tomita 2009[20]	CHF	40	Web based recording system of vital signs and health behaviours with patient feedback	RCT Score - 1	1 year	85% adherence	Improved PA Improved exercises	Improved systolic BP Improved dyspnea and fatigue Fewer ER room visits. Shorter length of hospital stay	Improved functional emotion, knowledge level and quality of life	No	Pilot study only	USA
Varnfield 2011[21]	MI	87	Care Assessment Platform via web or mobile phone with wellness diary and mobile phone applications	Controlled Trial Score - 3	6 weeks	36% Internet 92% mobile phone 97% step counter	Not measured	Not measured	Not measured	No	Discussions in progress.	Australia
Zutz 2007[22]	CHD	15	Virtual cardiac rehabilitation programme	RCT Score -3	12 weeks	66% completion for weekly tasks. Average of 4.2 log ins per week.	Improved exercise capacity (METs) Improved PA	Improved HDL-C/ total cholesterol	Improved exercise specific self-efficacy	No	Ongoing larger trial	Canada

CT, cardiac transplant; CHF, chronic heart failure; CHD, coronary heart disease; CVD, cardiovascular disease; MI, myocardial infarction; DMP, disease management programme; ER, emergency room; PA, physical activity; EPHPP, Effective Public Health Practice Project scores 1=Strong, 2=Moderate, 3=Weak

1. Search strategy

Munro - fig 1