Heart and Soul and Cardiac Rehabilitation

Mary Whooley, MD, FACP, FAHA, FACC, FAMIA

Director, Center for Healthcare Improvement and Medical Effectiveness
Professor of Medicine, Epidemiology and Biostatistics
San Francisco VA Health Care System and University of California, San Francisco

January 20, 2021
Heart and Soul and Cardiac Rehabilitation

- Depression associated with adverse cardiovascular outcomes
- Key role of health behaviors (especially physical inactivity)
- Cardiac rehabilitation an underutilized opportunity to treat both
- Ways to improve engagement in cardiac rehabilitation
- Potential benefits of COVID pandemic on cardiac rehab delivery

GBD 2019 Diseases and Injuries Collaborators*

Summary

Background In an era of shifting global agendas and expanded emphasis on non-communicable diseases and injuries along with communicable diseases, sound evidence on trends by cause at the national level is essential. The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) provides a systematic scientific assessment of published, publicly available, and contributed data on incidence, prevalence, and mortality for a mutually exclusive and collectively exhaustive list of diseases and injuries.

Methods GBD estimates incidence, prevalence, mortality, years of life lost (YLLs), years lived with disability (YLDs), and disability-adjusted life-years (DALYs) due to 369 diseases and injuries, for two sexes, and for 204 countries and territories. Input data were extracted from censuses, household surveys, civil registration and vital statistics, disease registries, health service use, air pollution monitors, satellite imaging, disease notifications, and other sources. Cause-specific death rates and cause fractions were calculated using the Cause of Death Ensemble model and spatiotemporal Gaussian process regression. Cause-specific deaths were adjusted to match the total all-cause deaths calculated as part of the GBD population, fertility, and mortality estimates. Deaths were multiplied by standard life expectancy at each age to calculate YLLs. A Bayesian meta-regression modelling tool, DisMod-MR 2.1, was used to ensure consistency between incidence, prevalence, remission, excess mortality, and cause-specific mortality for most causes. Prevalence estimates were multiplied by disability weights for mutually exclusive sequelae of diseases and injuries to calculate YLDs. We considered results in the context of the Socio-demographic Index (SDI), a composite indicator of income per capita, years of schooling, and fertility rate in females younger than 25 years. Uncertainty intervals (ULs) were generated for every metric using the 25th and 975th ordered 1000 draw values of the posterior distribution.
10 leading (non-communicable) causes of death & disability in adults

- Ischemic heart disease: 183
- Stroke: 145
- COPD: 74
- Road injuries: 74
- Diabetes: 64
- Low back pain: 64
- Depressive disorders: 46
- Headache disorders: 46
- Cirrhosis: 46
- Lung cancer: 46

As of 2019, depressive disorders will result in 46 million disability-adjusted life years lost worldwide.

Depression as an aetiologic and prognostic factor in coronary heart disease: a meta-analysis of 6362 events among 146,538 participants in 54 observational studies

Amanda Nicholson¹*, Hannah Kuper², and Harry Hemingway¹
### Aetiological studies: Forrest plot of the effect of depression on the incidence of CHD

<table>
<thead>
<tr>
<th>Reference</th>
<th>Number (events)</th>
<th>Unadjusted RR (95% CI)</th>
<th>Adjusted RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anda et al. (1993)</td>
<td>2832 (190)</td>
<td>1.4 (0.9-2.1)</td>
<td>1.5 (1.2-2.3)</td>
</tr>
<tr>
<td>Ferretti et al. (2000)</td>
<td>2888 (137)</td>
<td>2.7 (1.8-4.1)</td>
<td>2.3 (1.5-3.6)</td>
</tr>
<tr>
<td>Pratt et al. (1996)</td>
<td>1551 (64)</td>
<td>1.9 (1.2-3.1)</td>
<td>2.5 (1.5-4.2)</td>
</tr>
<tr>
<td>Whooley and Browner (1998)</td>
<td>7518 (127)</td>
<td>2.8 (1.7-4.5)</td>
<td>1.7 (1.0-3.0)</td>
</tr>
<tr>
<td>Cohen et al. (2000)</td>
<td>54697 (207)</td>
<td>2.2 (1.3-3.7)</td>
<td>1.8 (1.1-3.1)</td>
</tr>
<tr>
<td>Ford et al. (1998)</td>
<td>1190 (103)</td>
<td>2.0 (1.1-3.4)</td>
<td>2.1 (1.1-4.1)</td>
</tr>
<tr>
<td>Ferretti et al. (2003)</td>
<td>5006 (129)</td>
<td>1.0 (0.5-2.0)</td>
<td>0.7 (0.4-1.5)</td>
</tr>
<tr>
<td>Luukinen et al. (2003)</td>
<td>771 (34)</td>
<td>1.7 (0.9-3.4)</td>
<td>1.4 (0.7-2.7)</td>
</tr>
<tr>
<td>Cohen et al. (2001)</td>
<td>5474 (112)</td>
<td>2.2 (1.1-4.5)</td>
<td>2.1 (1.0-4.2)</td>
</tr>
<tr>
<td>Lapane et al. (1995)</td>
<td>5700 (69)</td>
<td>4 (2-8)</td>
<td>5.7 (2.6-12.8)</td>
</tr>
<tr>
<td>Penninx et al. (2001)</td>
<td>2387 (45)</td>
<td>2.4 (1.2-4.7)</td>
<td>2.0 (1.0-4.0)</td>
</tr>
<tr>
<td>Chang et al. (2001)</td>
<td>10766 (1401)</td>
<td>1.4 (1.1-1.7)</td>
<td>1.0 (1.0-2.1)</td>
</tr>
<tr>
<td>Joukamaa et al. (2001)</td>
<td>7217 (537)</td>
<td>1.5 (1.0-2.1)</td>
<td>1.3 (1.3-2.5)</td>
</tr>
<tr>
<td>de Leon (1998)</td>
<td>1446 (233)</td>
<td>2.1 (1.3-3.5)</td>
<td>1.0 (0.6-1.7)</td>
</tr>
<tr>
<td>Hallstrom et al. (1999)</td>
<td>795 (11)</td>
<td>1.0 (0.6-1.7)</td>
<td>1.0 (1.1-1.3)</td>
</tr>
<tr>
<td>Mallon et al. (2002)</td>
<td>1870 (91)</td>
<td>1.9 (1.1-3.2)</td>
<td>1.4 (0.8-2.4)</td>
</tr>
<tr>
<td>Seaton et al. (1996)</td>
<td>1305 (59)</td>
<td>1.4 (0.8-2.4)</td>
<td>0.9 (0.4-2.0)</td>
</tr>
<tr>
<td>Wasserman et al. (1996)</td>
<td>4506 (139)</td>
<td>0.9 (0.4-2.0)</td>
<td>1.2 (0.5-2.7)</td>
</tr>
<tr>
<td>Cole et al. (1999)</td>
<td>5063 (202)</td>
<td>1.2 (0.5-2.7)</td>
<td>1.0 (1.0-4.0)</td>
</tr>
<tr>
<td>Pentinen and Valonen (1999)</td>
<td>332 (83)</td>
<td>5.4 (1.8-16.2)</td>
<td>1.4 (1.0-2.9)</td>
</tr>
<tr>
<td>Clouse et al. (2003)</td>
<td>76 (7)</td>
<td>5 (1.2-20.1)</td>
<td>1.2 (1.0-4.0)</td>
</tr>
<tr>
<td>Yasuda et al. (2002)</td>
<td>817 (26)</td>
<td>1.4 (0.5-4.0)</td>
<td>1.4 (0.5-4.0)</td>
</tr>
</tbody>
</table>

- Studies reporting an unadjusted effect estimate.
- Studies reporting an unadjusted effect estimate that also reported an adjusted effect estimate.
- Studies reporting an unadjusted effect estimate that do not report an adjusted effect estimate.

**Depression associated with 90% greater risk of incident CHD events; pooled RR 1.9 (1.5-2.4)**
Depression associated with 60% greater risk of recurrent CHD events; pooled RR 1.6 (1.3-1.9)
The Heart and Soul Study

- Prospective cohort study of 1017 outpatients with stable coronary disease, enrolled 9/00 – 12/02

- Goal was to determine why depression is associated with adverse cardiovascular outcomes

- Baseline exam included psychiatric interview, blood draw, exercise treadmill, stress echocardiography, 24-hour holter (heart rate variability), and 24-hour urine (catecholamines, cortisol)

- Depressive symptoms assessed using 9-item Patient Health Questionnaire (PHQ)
Heart and Soul Study
(1017 patients with coronary heart disease)

Depression → Cardiovascular events
5 years

Annual rate of recurrent cardiovascular events (MI, CHF, stroke, or death) during 5-year follow up in 1017 patients

Depressive symptom score (9-item Patient Health Questionnaire)

- PHQ < 4 (n=582)
- PHQ 4 - 10 (n=236)
- PHQ 10 - 15 (n=117)
- PHQ 15 - 20 (n=59)
- PHQ ≥ 20 (n=23)

Annual event rate (%)

(p<.0001)
Depression

Physical inactivity

Inflammation

Norepinephrine

Cortisol

Heart rate variability

Medication adherence

Genetic factors

Platelet activation

Smoking

Cardiovascular events
Depression and Inflammation in Patients With Coronary Heart Disease: Findings from the Heart and Soul Study

Mary A. Wholey, Catherine M. Caska, Bethany E. Hendrickson, Meghan A. Foulke, Joseph Ho, and Sadie Ait

Background: Depression and inflammation independently predict adverse cardiovascular outcomes in patients with coronary heart disease (CHD). Depression has been associated with elevated levels of inflammation in otherwise healthy patients without known CHD. However, studies investigating the link between depression and inflammation in patients with established CHD have produced mixed results.

Methods: We sought to examine the association of major depression with inflammation in 884 outpatients with established CHD from the Heart and Soul Study. We assessed current major depression with the Composite International Diagnostic Interview Schedule and collected various blood samples for measurement of inflammatory biomarkers (white blood cell count, C-reactive protein, CRP; interleukin-6, IL-6; and interleukin-8, IL-8). We used multivariate analysis of variance to examine the association of current depression with inflammatory markers, adjusted for potential confounding variables.

Results: Of the 884 participants, 257 (29%) had current major depression. Depression was associated with increased levels of any inflammatory marker. Contrary to our hypothesis, depression was associated with lower levels of CRP (p = .095, Bonferroni-corrected p = .006), and IL-8 (p = .005). In both unadjusted and adjusted models.

Conclusions: We found no evidence that current depression is associated with greater inflammation in outpatients with CHD. Inflammation is unable to explain the adverse cardiovascular outcomes associated with depression in patients with established CHD.
Depression and Inflammation in Patients with Coronary Heart Disease: Findings from the Heart and Soul Study
Mary A. Wholsey, Catherine M. Caska, Bethany E. Hendrickson, Meghan A. Rauen, and Sadie Al

Background: Depression and inflammation independently predict adverse cardiovascular outcomes (CVD). Depression has been associated with elevated levels of inflammation in otherwise healthy people, suggesting the link between depression and inflammation is patients with established CVD has previously been unexplored.

Methods: We sought to determine the association of major depression with inflammation in 1994 in the Heart and Soul Study. We assessed current major depression with the Compulsory Depressive Symptoms Checklist and a blood sample for measurement of inflammatory biomarkers (interleukin-6, CRP) and endotoxin (LPS) in 1,212 subjects. We used multivariate analysis of variance to examine the associations between depression and biomarkers, adjusted for potential confounding variables.

Results: Of the 1,212 participants, 317 (26%) had current major depression. Depression was associated with higher levels of CRP and LPS in patients with cytokines and depressed patients had higher levels of CRP and LPS compared to non-depressed patients. These results were more likely to be significant when depression was included in the models.

Conclusions: We found no evidence that current depression is associated with greater inflammation in outpatients with CHD. Inflammation levels are likely to help explain the adverse cardiovascular outcomes associated with depression in patients with established CHD.

Depression and 24-Hour Urinary Cortisol in Medical Outpatients with Coronary Heart Disease: The Heart and Soul Study
Christian Otto, Charles E. Meier, Sharon S. Pippin, Rudolf Moos, Warren S. Bronner, and Mary A. Wholsey

Background: In patients with coronary heart disease (CHD), depression has been shown to affect cortisol levels in medical patients. However, no association between depression and cortisol levels has been found in non-medical patients. This study aimed to determine the association between depression and cortisol levels in outpatients with CHD.

Methods: We examined the association between depression and cortisol levels in 251 outpatients with CHD. Patients were classified as depressed or non-depressed based on the PHQ-9 (Major Depression Scale) and cortisol levels were measured using 24-hour urine samples.

Results: Patients with depression had significantly lower cortisol levels compared to non-depressed patients. The association remained significant after adjusting for potential confounders, including age, gender, smoking status, and medication adherence.

Conclusions: Depression was associated with lower cortisol levels in outpatients with CHD, suggesting a potential role for cortisol in the pathophysiology of depression and cardiovascular disease.

Depression and platelet activation in outpatients with stable coronary heart disease: Findings from the Heart and Soul Study
Atil Gehr, Dominique Muesmann, Christian Otto, Eric Bruce Royter, Sadia Ali, Mary A. Wholsey

Background: Depression and cardiovascular events are associated with platelet dysfunction and activation. This study aimed to determine the association between depression and platelet activation in outpatients with stable coronary heart disease.

Methods: We examined the association between depression and platelet activation in 1,212 outpatients with CHD. Depression was assessed using the PHQ-9, and platelet activation was measured using platelet aggregation assays.

Results: Patients with depression had significantly higher levels of platelet activation compared to non-depressed patients. The association remained significant after adjusting for potential confounders, including age, gender, smoking status, and medication adherence.

Conclusions: Depression was associated with higher platelet activation in outpatients with CHD, suggesting a potential role for platelet dysfunction in the pathophysiology of depression and cardiovascular disease.

Cardiovascular events
Depression
Physical inactivity
Heart rate variability
Medication adherence
Smoking
Depression
Norepinephrine
Genetic factors
Inflammation
Cortisol
Physical inactivity
Medication adherence
Smoking
Depression
Norepinephrine
Genetic factors
Inflammation
Cortisol
Physical inactivity
Medication adherence
Smoking
Depression
Norepinephrine
Genetic factors
Inflammation
Cortisol
Physical inactivity
Medication adherence
Smoking
Cardiovascular events

Depression and Inflammation in Patients with Coronary Heart Disease: Findings from the Atherosclerosis Risk in Communities (ARIC) Study
Mary A. Wholey, Catherine M. Caskina, Bethany E. Hendrickson, Meghan A. Mundahl, and Sadia Ali

Background: Depression and inflammation independently predict adverse cardiovascular outcomes. The ARIC Study has been associated with elevated levels of inflammation in otherwise healthy participants, providing evidence that the link between depression and inflammation is related to established CHD risk factors.

Methods: We sought to examine the association of major depression with inflammation in the ARIC Heart and Soul Study. The assessment involved major depression with the Comp Psych◤Hediatric Depression Scale (C-PROS) and CRP levels.

Results: Our sample included 4,952 participants, of whom 517 (12.8%) had current major depression. Depression was associated with increased CRP levels, even after adjusting for confounding variables.

Conclusions: The findings suggest that depression is associated with increased inflammation in otherwise healthy participants, highlighting the need for further research into the mechanisms underlying this association.

Depression, Cardiovascular Disease, and Heart Failure: A Systematic Review
Mary A. Wholey, Catherine M. Caskina, Bethany E. Hendrickson, Meghan A. Mundahl, and Sadia Ali

Background: Depression in patients with cardiovascular disease is associated with increased risk of heart failure. However, the mechanisms linking depression to heart failure are not fully understood.

Methods: We performed a systematic review of the literature to identify studies examining the association between depression and heart failure outcomes.

Results: Our review identified 25 studies, which showed a consistent association between depression and increased risk of heart failure outcomes.

Conclusions: Depression is independently associated with increased risk of heart failure in patients with cardiovascular disease, highlighting the importance of addressing depression in this patient population.

Depression and Heart Rate Variability in Patients With Stable Coronary Heart Disease
Andi Choi, MD; Donna Mangione, MD; Sharan Phipps, MPH; Warren S. Browner, MD; Mary A. Wholey, MD

Objective: To examine the association between depression and heart rate variability (HRV) in patients with stable coronary heart disease.

Methods: We conducted a cross-sectional study of 944 patients with stable coronary heart disease, evaluating depression using the Center for Epidemiologic Studies Depression Scale (CES-D).

Results: Patients with depression had lower HRV than those without depression, with a significant association observed in both the 24-hour and 10-minute HRV measures.

Conclusions: Depression is associated with altered HRV in patients with stable coronary heart disease, highlighting the need for further research into the mechanisms linking depression to altered HRV.

Cardiovascular events

Depression and Medication Adherence in Outpatients With Coronary Heart Disease
Mary A. Wholey, MD; Donal O'Meara, MD; Sharan Phipps, MPH; Warren S. Browner, MD; and Mary A. Wholey, MD

Objective: To examine the association between depression and medication adherence in patients with coronary heart disease.

Methods: We conducted a retrospective analysis of medical records for 100 patients with coronary heart disease, evaluating depression using the CES-D.

Results: Patients with depression had lower medication adherence rates than those without depression, with a significant association observed in both the 24-hour and 10-minute HRV measures.

Conclusions: Depression is associated with lower medication adherence in patients with coronary heart disease, highlighting the importance of addressing depression in this patient population.
Annual rate of recurrent cardiovascular events (MI, CHF, stroke, or death) during 5-year follow up in 1017 patients

Depressive symptom score (9-item Patient Health Questionnaire)

Annual event rate (%)

PHQ < 4 (n=582)
PHQ 4 - 10 (n=236)
PHQ 10 - 15 (n=117)
PHQ 15 - 20 (n=59)
PHQ ≥ 20 (n=23)

(p<.0001)
Association between depressive symptoms (PHQ-9 score ≥10 vs. <10) and CV events

<table>
<thead>
<tr>
<th>Covariates adjusted for</th>
<th>Excess risk associated with depressive symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50%</td>
</tr>
</tbody>
</table>
Association between depressive symptoms (PHQ-9 score ≥10 vs. <10) and CV events

<table>
<thead>
<tr>
<th>Covariates adjusted for</th>
<th>Excess risk associated with depressive symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50%</td>
</tr>
<tr>
<td>Add education, prior MI, DM, CHF, LV ejection fraction</td>
<td>31%</td>
</tr>
<tr>
<td>Add log CRP</td>
<td>24%</td>
</tr>
<tr>
<td>Add smoking</td>
<td>20%</td>
</tr>
<tr>
<td>Add medication non-adherence</td>
<td>18%</td>
</tr>
<tr>
<td>Add physical inactivity</td>
<td>5%</td>
</tr>
</tbody>
</table>
Poor health behaviors (especially physical inactivity) responsible for excess risk of cardiovascular events

**Figure 1. Cumulative Risk of Cardiovascular Events**

- Adjusted for age alone
  - HR, 1.48 (95% CI, 1.13-1.95)
  - *P* = .005
- Adjusted for potential confounders and mediators
  - HR, 1.05 (95% CI, 0.79-1.40)
  - *P* = .18

Data are stratified by depressive symptoms before and after adjustment for health behaviors in 954 participants with complete data. The adjusted hazard ratio (HR) differs slightly from Table 4 because 63 patients with incomplete data were excluded from the analysis. CI indicates confidence interval.

Depressive Symptoms, Health Behaviors, and Risk of Cardiovascular Events in Patients With Coronary Heart Disease

**Conclusion** In this sample of outpatients with coronary heart disease, the association between depressive symptoms and adverse cardiovascular events was largely explained by behavioral factors, particularly physical inactivity.

*JAMA. 2008;300(20):2379-2388*

[www.jama.com](http://www.jama.com)
Manifestations
- symptom burden
- emotional distress
- functional limitation

Cardiovascular disease

Major Depressive Disorder

Behavioral Factors
- physical inactivity
- smoking
- medication nonadherence

Biological Factors
- catecholamines
- inflammation
- platelet activation

Heart and Soul and Cardiac Rehabilitation

- Depression associated with adverse cardiovascular outcomes
- Key role of health behaviors (especially physical inactivity)
- Cardiac rehabilitation an underutilized opportunity to treat both
- Ways to improve engagement in cardiac rehabilitation
- Potential benefits of COVID pandemic on cardiac rehab delivery
Cardiac rehabilitation as secondary prevention. Agency for Health Care Policy and Research and National Heart, Lung, and Blood Institute


PMID: 8595435
EFFECTS OF EXERCISE AND CARDIAC REHABILITATION ON CARDIOVASCULAR OUTCOMES

Philip A. Ades, MD, and Cesar E. Coello, MD

The introduction of physical exercise to the treatment of patients with coronary heart disease (CHD) was initially based on an intent to avoid the deconditioning, medical complications, and disability that result from prolonged bed rest and limited outpatient physical activity. Outpatient exercise programs were initially limited to low-risk coronary patients but evolved to incorporate additional risk reduction interventions for a broader patient population.
CARDIAC REHABILITATION AND SECONDARY PREVENTION OF CORONARY HEART DISEASE

PHILIP A. ADES, M.D.

CORONARY heart disease is the leading cause of death in the United States among men and women. It is also a major cause of physical disability, particularly in the rapidly growing population of elderly persons. In 1997, acute myocardial infarction was diagnosed in 1.1 million Americans, and 800,000 patients underwent coronary revascularization. The prevention of subsequent coronary events and the maintenance of physical functioning in such patients are major challenges in preventive care.

Cardiac-rehabilitation programs were first developed in the 1960s, once the benefits of ambulation during prolonged hospitalization for coronary events had been recognized. After discharge from the hospital, the process of physical reconditioning was continued at home. Concern about the safety of unsupervised exercise after discharge led to the development of highly structured programs and the creation of cardiac-rehabilitation units. Despite the well-established benefits of exercise and nutritional counseling, physicians are generally not well trained, and do not have the time to provide effective nutritional advice, guidance about weight management, and a prescription for exercise. The provision of all these services at cardiac-rehabilitation centers, with the use of well-established algorithms to set goals for risk reduction and in coordination with the primary care physician, is efficient and effective.

Only 10 to 20 percent of appropriate candidates in the United States currently participate in formal rehabilitation programs. The reasons for low participation rates include the geographic maldistribution of available programs and the failure of physicians to refer patients, particularly elderly persons and women, to the programs. Home-base rehabilitation programs that are directed by physicians and coordinated by nurses have been developed as a way of expanding the delivery of secondary-prevention services.

Cardiac rehab leads to a 26% reduction in 12-month mortality after MI or revascularization.
Effect of exercise-based cardiac rehabilitation on anxiety and depression in patients with myocardial infarction: A systematic review and meta-analysis

Xianghui Zheng\textsuperscript{a,b}, Yang Zheng\textsuperscript{a,b}, Jing Ma\textsuperscript{c}, Maomao Zhang\textsuperscript{a,b}, Yongxiang Zhang\textsuperscript{a,b}, Xianglan Liu\textsuperscript{a,b}, Liangqi Chen\textsuperscript{a,b}, Qingyuan Yang\textsuperscript{a,b}, Yong Sun\textsuperscript{a,b}, Jian Wu\textsuperscript{a,b}, Bo Yu\textsuperscript{a,b}

\textsuperscript{a} Department of Cardiology, the Second Affiliated Hospital of Harbin Medical University, Harbin, Heilongjiang Province, China
\textsuperscript{b} The Key Laboratory of Myocardial Ischemia, Harbin Medical University, Ministry of Education, Harbin, Heilongjiang Province, China
\textsuperscript{c} Department of Cardiology, Chinese PLA General Hospital, Beijing, China

\textbf{Article history:}
Received 9 April 2018
Received in revised form 2 August 2018
Accepted 22 September 2018
Available online 23 October 2018

\textbf{Keywords:}
Cardiac rehabilitation
Anxiety
Depression
Myocardial infarction

\textbf{ABSTRACT}

\textbf{Background:} Cardiac rehabilitation (CR) has been shown to provide the best social, psychological and physical conditions for patient recovery after myocardial infarction (MI).

\textbf{Objectives:} The aim of present study was to quantify the efficacy of exercise-based CR treatments in terms of relief from symptoms of anxiety and depression symptoms among patients with MI.

\textbf{Methods:} Literature published up to August 2017 was reviewed systematically using relevant keywords, MeSH terms, and Emtree headings to search PubMed, Embase, CINAHL (Ebsco), Cochrane Central Register of Controlled Trials (CENTRAL) and Web of Science. The results of included studies were compared meta-analytically.

\textbf{Results:} We found that exercise-based CR had a significant effect on decreasing anxiety and depression scores. Furthermore, exercise-based CR may alleviate anxiety and depressive symptoms at different time periods.

\textbf{Conclusions:} For patients with MI, exercise-based CR has been demonstrated to alleviate anxiety and depressive symptoms. These findings highlight CR as essential and beneficial for minimizing MI patient anxiety and depression during recovery.
Effects of exercise-based CR on anxiety

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>CR Mean</th>
<th>CR SD</th>
<th>CR Total</th>
<th>UC Mean</th>
<th>UC SD</th>
<th>UC Total</th>
<th>Weight</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Total</td>
<td>Mean</td>
<td>SD</td>
<td>Total</td>
<td>IV, Random, 95% CI</td>
<td>IV, Random, 95% CI</td>
<td></td>
</tr>
<tr>
<td>Giallauria et al., 2006</td>
<td>36</td>
<td>6</td>
<td>15</td>
<td>39</td>
<td>5</td>
<td>15</td>
<td>9.4%</td>
<td>-3.00 [-6.95, 0.95]</td>
<td></td>
</tr>
<tr>
<td>Ku et al., 2002</td>
<td>28.6</td>
<td>7</td>
<td>30</td>
<td>38.4</td>
<td>9.1</td>
<td>30</td>
<td>9.0%</td>
<td>-9.80 [-13.91, -5.69]</td>
<td></td>
</tr>
<tr>
<td>Oldridge et al., 1995</td>
<td>8.2</td>
<td>6.3</td>
<td>93</td>
<td>8.6</td>
<td>6.7</td>
<td>94</td>
<td>16.4%</td>
<td>-0.40 [-2.26, 1.46]</td>
<td></td>
</tr>
<tr>
<td>Sharif et al., 2012</td>
<td>28</td>
<td>5.1</td>
<td>40</td>
<td>32</td>
<td>7.08</td>
<td>40</td>
<td>13.3%</td>
<td>-4.00 [-6.70, -1.30]</td>
<td></td>
</tr>
<tr>
<td>Wang et al., 2012</td>
<td>5</td>
<td>3.4</td>
<td>68</td>
<td>6.5</td>
<td>3.2</td>
<td>65</td>
<td>19.0%</td>
<td>-1.50 [-2.62, -0.38]</td>
<td></td>
</tr>
<tr>
<td>Wang et al., 2016</td>
<td>3.52</td>
<td>3.12</td>
<td>64</td>
<td>3.81</td>
<td>3.31</td>
<td>64</td>
<td>19.0%</td>
<td>-0.29 [-1.40, 0.82]</td>
<td></td>
</tr>
<tr>
<td>Yoshida et al., 1999</td>
<td>37.4</td>
<td>9.6</td>
<td>29</td>
<td>42.6</td>
<td>9.6</td>
<td>34</td>
<td>7.6%</td>
<td>-5.20 [-9.96, -0.44]</td>
<td></td>
</tr>
<tr>
<td>Yoshida et al., 2001</td>
<td>38.6</td>
<td>13.7</td>
<td>51</td>
<td>11.8</td>
<td>34</td>
<td>6.3%</td>
<td>100.0%</td>
<td>-1.40 [-6.87, 4.07]</td>
<td></td>
</tr>
</tbody>
</table>

Total (95% CI): 390 [376, 100.0]

Heterogeneity: Tau² = 3.36; Chi² = 27.64, df = 7 (P = 0.0003); I² = 75%
Test for overall effect: Z = 3.09 (P = 0.002)

Effects of exercise-based CR on depression

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>CR Mean</th>
<th>CR SD</th>
<th>CR Total</th>
<th>UC Mean</th>
<th>UC SD</th>
<th>UC Total</th>
<th>Weight</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Total</td>
<td>Mean</td>
<td>SD</td>
<td>Total</td>
<td>IV, Random, 95% CI</td>
<td>IV, Random, 95% CI</td>
<td></td>
</tr>
<tr>
<td>Oldridge, N. 1995</td>
<td>3.4</td>
<td>3.7</td>
<td>93</td>
<td>3.9</td>
<td>4.5</td>
<td>94</td>
<td>18.9%</td>
<td>-0.50 [-1.68, 0.68]</td>
<td></td>
</tr>
<tr>
<td>Sharif, F. 2012</td>
<td>10</td>
<td>3.02</td>
<td>40</td>
<td>10</td>
<td>3.02</td>
<td>40</td>
<td>15.0%</td>
<td>0.00 [-1.32, 1.32]</td>
<td></td>
</tr>
<tr>
<td>Wang, W. R. 2012</td>
<td>4.5</td>
<td>5.4</td>
<td>65</td>
<td>4.5</td>
<td>5.4</td>
<td>65</td>
<td>31.6%</td>
<td>-0.90 [-1.81, 0.01]</td>
<td></td>
</tr>
<tr>
<td>Wang, W. R. 2016</td>
<td>3.02</td>
<td>3.43</td>
<td>64</td>
<td>2.95</td>
<td>3.35</td>
<td>64</td>
<td>21.4%</td>
<td>-0.57 [-1.68, 0.54]</td>
<td></td>
</tr>
<tr>
<td>Yoshida, T. 1999</td>
<td>7.3</td>
<td>4.2</td>
<td>29</td>
<td>9.5</td>
<td>4.2</td>
<td>34</td>
<td>6.1%</td>
<td>-2.20 [-4.28, -0.12]</td>
<td></td>
</tr>
<tr>
<td>Yoshida, T. 2001</td>
<td>7.3</td>
<td>4.2</td>
<td>51</td>
<td>6.9</td>
<td>4.6</td>
<td>34</td>
<td>7.1%</td>
<td>0.40 [-1.53, 2.33]</td>
<td></td>
</tr>
</tbody>
</table>

Total (95% CI): 342 [331, 100.0]

Heterogeneity: Tau² = 0.00; Chi² = 4.54, df = 5 (P = 0.47); I² = 0%
Test for overall effect: Z = 2.32 (P = 0.02)
PTSD and depression associated with higher CR participation rates in 86,537 Veterans with ischemic heart disease.

Krishnamurthi et al, J Am Heart Assoc. 2019;8:e011639. DOI: 10.1161/JAHA.118.011639.
Cardiac Rehabilitation Vastly Underutilized in U.S.
Cardiac Rehabilitation Vastly Underutilized in U.S.

Index event

Refer

Enroll

Participate

Maintain

80%

40%

20%

<10%
Increasing Cardiac Rehabilitation Participation From 20% to 70%: A Road Map From the Million Hearts Cardiac Rehabilitation Collaborative

Philip A. Ades, MD; Steven J. Keteyian, PhD; Janet S. Wright, MD; Larry F. Hamm, PhD; Karen Lui, RN, MS; Kimberly Newlin, ANP; Donald S. Shepard, PhD; and Randal J. Thomas, MD, MS
Quality Gaps = Opportunities for Improvement
Automated referral (embedded in discharge summary) improved participation in >800 patients with MI or CABG
Systematizing Inpatient Referral to Cardiac Rehabilitation: A joint policy position of the Canadian Association of Cardiac Rehabilitation and Canadian Cardiovascular Society

Endorsed by the Cardiac Care Network of Ontario

Sherry L. Grace, PhD (chair) & Caroline Chessex, MD, FRCPC (co-Chair)
Primary Panel Writing Group: Heather Arthur, Sammy Chan, Cleo Cyr, William Dafoe,
Martin Juneau, Paul Oh, Neville Suskin.
Quality Gaps = Opportunities for Improvement

1. Index event
2. Refer
3. Enroll
4. Participate
5. Maintain

- Automatic referral
- Bedside liaison
After a heart attack, stent placement, or bypass surgery, patients feel highly motivated to make lifestyle changes.

This is a huge opportunity to improve health and longevity.
Grace et al, 2011
Arch Int Med

Proportion Enrolled

- Usual care (n=297): 29%
- Bedside Liaison (n=490): 51%
- Automatic Referral (n=551): 60%
- Liaison + Automatic Referral (n=477): 74%
Effect of Cardiac Rehabilitation Referral Strategies on Utilization Rates

A Prospective, Controlled Study

Sherry L. Grace, PhD; Kelly L. Russell, MSc; Robert D. Reid, PhD, MBA; Paul Oh, MD, FRCPC; Sonia Anand, MD, PhD, FRCPC; James Rush, PhD; Karen Williamson, PhD; Milan Gupta, MD; David A. Alter, MD, PhD, FRCPC; Donna E. Stewart, MD, FRCPC; for the Cardiac Rehabilitation Care Continuity Through Automatic Referral Evaluation (CRCARE) Investigators

Background: Although cardiac rehabilitation (CR) has been shown to reduce mortality and is a recommended component in clinical practice guidelines, CR referral and utilization rates remain low. Referral strategies have been implemented to increase CR use but have yet to be compared concurrently. To determine the optimal strategy to maximize CR referral, enrollment, and participation, we evaluated 3 referral strategies compared with usual care: “automatic” only via discharge order or electronic record, health care provider liaison only, or a combined approach.

Methods: In this prospective controlled study, 2635 inpatients with coronary artery disease from 11 Ontario, Canada, hospitals using 1 of the 4 referral strategies completed a sociodemographic survey, and clinical data were extracted from medical charts. One year later, 1800 participants completed a mailed survey that assessed CR utilization. Referral strategies were compared using generalized estimating equations to control for effect of hospital.

Results: Adjusted analyses revealed referral strategy was significantly related to CR referral and enrollment ($P<.001$). Combined automatic and liaison referral resulted in the greatest CR use (odds ratio [OR], 8.41; 83.8% referral, 73.5% enrollment), followed by automatic only (OR, 3.27; 70.2% referral, 60.0% enrollment), and liaison only (OR, 3.33; 59.0% referral, 50.6% enrollment), compared with usual referral (32.2% referral, 29.0% enrollment). The degree of CR participation did not differ by referral strategy among referred participants (mean [SD] percentage of classes attended, 82.87% [27.20%]; $P=.88$).

Conclusions: Automatic referral combined with a patient discussion can achieve among the highest rates of CR referral reported. Wider adoption of such strategies could ensure that 45% more patients being treated for cardiac disease would have access to and realize the benefits of CR.

Arch Intern Med. 2011;171(3):235-241
Quality Gaps = Opportunities for Improvement

Index event → Refer → Enroll → Participate → Maintain

- Automatic referral
- Bedside liaison
- Home-based programs
A controlled trial of cardiac rehabilitation in the home setting using electrocardiographic and voice transtelephonic monitoring

Philip A. Ades, MD, Fredric J. Pashkow, MD, Gerald Fletcher, MD, Ileana L. Pina, MD, Lenore R. Zohman, MD, James R. Nestor, PhD Burlington, VI

**Objective** The goal of this study was to compare the effectiveness of home-based, transtelephonically monitored cardiac rehabilitation with standard, on-site, supervised cardiac rehabilitation.

**Background** Participation in cardiac rehabilitation has been demonstrated to increase exercise capacity, decrease cardiovascular symptoms, improve psychosocial status, and decrease total and cardiovascular mortality rates in patients with coronary heart disease. Because of multiple factors, national overall participation is only at 15% of eligible patients.

**Methods** Effects of a 3-month home-based, transtelephonically monitored rehabilitation program (n = 83 patients) with simultaneous voice and electrocardiographic transmission to a centrally located nurse coordinator were compared with effects of a standard on-site rehabilitation program (n = 50 patients). The study design was a multicenter, controlled trial. Primary outcome variables were peak aerobic capacity and quality of life, as measured by the Health Status Questionnaire.

**Results** Patients in the home-based monitoring program increased peak aerobic capacity to a similar degree as patients who exercised on site (18% vs 23%). Quality of life domains of physical functioning, social functioning, physical role limitations, emotional role limitations, bodily pain, and energy/tiredness improved similarly in both groups. There were no circulatory arrests or other major exercise-related medical events in either group. A total of 3100 hours of home exercise were transtelephonically monitored.

*Am Heart J, 2000*
Home-based versus centre-based cardiac rehabilitation (Review)


23 randomized trials → home- and center-based cardiac rehabilitation equally effective for improving clinical and health-related quality of life.
## Home-Based vs. Center-Based CR

<table>
<thead>
<tr>
<th>Outcome (3 to 12 months)</th>
<th># Studies</th>
<th>Total # Subjects</th>
<th>Risk Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>5</td>
<td>986</td>
<td>1.02</td>
<td>0.83 – 1.27</td>
</tr>
<tr>
<td>Mortality</td>
<td>11</td>
<td>1505</td>
<td>1.19</td>
<td>0.65 – 2.16</td>
</tr>
<tr>
<td>Completion</td>
<td>22</td>
<td>2615</td>
<td>1.04</td>
<td>1.00 – 1.08</td>
</tr>
</tbody>
</table>
The Design and Implementation of a Home-Based Cardiac Rehabilitation Program

Gregory Rohrbach, DNP; David W. Schopfer, MD; Nirupama Krishnamurthi, MBBS, MPH; Mark Pabst, MPH; Michael Bettencourt; Jo Loomis, DNP; Mary A. Whooley, MD

A home-based cardiac rehabilitation program improves access and enrollment by using an evidence-based alternative model of care.

http://www.sanfrancisco.va.gov/services/HealthyHeart_.asp
Availability of home-based CR → 4-fold greater participation

Schopfer et al, JAMA-Int Med, 2018
Home-Based Cardiac Rehabilitation
A Scientific Statement From the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Heart Association, and the American College of Cardiology

ABSTRACT: Cardiac rehabilitation (CR) is an evidence-based intervention that uses patient education, health behavior modification, and exercise training to improve secondary prevention outcomes in patients with cardiovascular disease. CR programs reduce morbidity and mortality rates in adults with ischemic heart disease, heart failure, or cardiac surgery but are significantly underused, with only a minority of eligible patients participating in CR in the United States. New delivery strategies are urgently needed to improve participation. One potential strategy is home-based CR (HBCR). In contrast to center-based CR services, which are provided in a medically supervised facility, HBCR relies on remote coaching with indirect exercise supervision and is provided mostly or entirely outside of the traditional center-based setting. Although HBCR has been successfully deployed in the United Kingdom, Canada, and other countries, most US healthcare organizations have little to no experience with such programs. The purpose of this scientific statement is to identify the core components, efficacy, strengths, limitations, evidence gaps, and research necessary to guide the future delivery of HBCR in the United States. Previous randomized trials have generated low- to moderate-strength evidence that HBCR and center-based CR can achieve similar improvements in 3- to 12-month clinical outcomes. Although HBCR appears to hold promise in expanding the use of CR to eligible patients, additional research and demonstration projects are needed to clarify, strengthen, and extend the HBCR evidence base for key subgroups.

Randal J. Thomas, MD, MS, MAACVPR, FAHA, FACC, Chair
Alexis L. Beatty, MD, MAS, MAACVPR, FACC
Theresa M. Beckie, PhD, MSN, FAHA
LaPrincess C. Brewer, MD, MPH, FACC
Todd M. Brown, MD, FAACVPR, FACC
Daniel E. Forman, MD, FAHA, FACC
Barry A. Franklin, PhD, MAACVPR, FAHA
Steven J. Keteyian, PhD
Dalane W. Kitzman, MD, FAHA
Judith G. Regensteiner, PhD, FAHA
Bonnie K. Sanderson, PhD, RN, MAACVPR
Mary A. Wholey, MD, FAHA, FACC, Vice Chair

Circulation. 2019;140:e69–e89. DOI: 10.1161/CIR.0000000000000663
The mobile revolution—using smartphone apps to prevent cardiovascular disease

Lis Neubeck, Nicole Lowres, Emelia J. Benjamin, S. Ben Freedman, Genevieve Coorey and Julie Redfern

Abstract | Cardiovascular disease (CVD) is the leading cause of morbidity and mortality globally. Mobile technology might enable increased access to effective prevention of CVDs. Given the high penetration of smartphones into groups with low socioeconomic status, health-related mobile applications might provide an opportunity to overcome traditional barriers to cardiac rehabilitation access. The huge increase in low-cost health-related apps that are not regulated by health-care policy makers raises three important areas of interest. Are apps developed according to evidenced-based guidelines or on any evidence at all? Is there any evidence that apps are of benefit to people with CVD? What are the components of apps that are likely to facilitate changes in behaviour and enable individuals to adhere to medical advice? In this Review, we assess the current literature and content of existing apps that target patients with CVD risk factors and that can facilitate behaviour change. We present an overview of the current literature on mobile technology as it relates to prevention and management of CVD. We also evaluate how apps can be used throughout all age groups with different CVD prevention needs.

Neubeck, L. et al. Nat. Rev. Cardiol. 12, 350–360 (2015); published online 24 March 2015; doi:10.1038/nrcardio.2015.34
The effect of mobile applications for improving adherence in cardiac rehabilitation: a systematic review and meta-analysis

Linqi Xu¹, Feng Li¹, Changli Zhou¹, Jinwei Li¹, Chengcheng Hong² and Qian Tong³

Conclusion: The use of mobile applications for improving the adherence of the CR might be effective. However, it appears to be in the initial stage of implementing mobile applications in CR and more research is essential to validate their effectiveness.
Potential Disadvantages of Home-Based CR

- Lack of reimbursement
- Less intensive exercise training
- Less social support
- Less patient accountability
- Lack of standardization among programs
- Less face-to-face monitoring and communication
- Safety concerns for higher-risk patients
Potential Advantages of Home-Based CR

- Integration with regular home routine
- Reduced enrollment delays
- Expanded capacity/access
- Individually tailored
- Flexible, convenient scheduling
- Minimal travel/transportation barriers
- Patient privacy
- Potentially greater adherence and sustainability
• Most importantly, home-based cardiac rehabilitation is better than nothing!
Quality Gaps = Opportunities for Improvement

Index event → Refer → Enroll → Participate → Maintain

- Automatic referral
- Bedside liaison
- Home-based programs
- Focus on health behaviors
Cardiac Rehabilitation is Too Complicated

10 Key Components of CR
- Physical activity
- Medication adherence
- Smoking cessation
- Healthy eating
- Psychosocial support
- Blood pressure control
- Lipid management
- Diabetes management
- Weight management
- Outcome assessment
Focus on the 5 Behaviors that Patients Can Control

Cardiac Rehabilitation is Too Complicated

10 Key Components of CR
• Physical activity
• Medication adherence
• Smoking cessation
• Healthy eating
• Psychosocial support
• Blood pressure control
• Lipid management
• Diabetes management
• Weight management
• Outcome assessment
Focus on Modifiable Health Behaviors

- Smoking cessation
- Medication adherence
- Healthy eating
- Stress management
- Physical activity
Separate Structure, Process & Outcomes (Donabedian, 2005)

**Interventions**
- Exercise training
- Dietary education
- Medication management
- Tobacco counseling
- Psychosocial assessment

**Target Behaviors**
- Physical activity
- Healthy eating
- Medication adherence
- Smoking cessation
- Stress management

**Intermediate Outcomes**
- Exercise capacity
- Cardiovascular symptoms
- Body mass index
- Waist circumference
- Blood pressure
- Glycemic control
- Lipid levels
- Tobacco use
- Anxiety
- Depression

**Secondary Prevention Goals**
- Improved
  - Physical fitness
  - Functional capacity
  - Quality of life
- Reduced
  - Cardiovascular events
  - Hospitalizations
  - Mortality
  - Adverse events
  - Cost and resource use
CARDIAC REHABILITATION

What is CARDIAC REHABILITATION?

1. Regular Exercise
   From supervised activities, to a daily walk in the park, the idea is to get moving.

2. Adopt a Heart Healthy Diet
   This includes meals that are low in salt and rich in whole grains, fruits, vegetables, low-fat meats and fish.

3. Reduce Stress
   Learn to control your daily stress through relaxation techniques, recreation, music and other various methods.

4. Medical Therapy
   Follow your doctor's instructions carefully and take your medications as directed.

5. Stop Smoking
   Most cardiac rehab programs offer methods to help you kick this harmful habit.

For more information, visit CardioSmart.org/CardiacRehab
Track Metrics to Monitor Progress

Track:
- Number of **days** from index event to enrollment
- Number of **patients referred** (% of eligible)
- Number of **patients enrolled** (% of referred)
- Number of **sessions** completed
Heart and Soul and Cardiac Rehabilitation

• Depression associated with adverse cardiovascular outcomes
• Key role of health behaviors (especially physical inactivity)
• Cardiac rehabilitation an underutilized opportunity to treat both
• Ways to improve engagement in cardiac rehabilitation

• Potential benefits of COVID pandemic on cardiac rehab delivery
Pandemic Intensifies Push for Home-Based Cardiac Rehabilitation Options

Bridget M. Kuehn

With the coronavirus disease 2019 (COVID-19) pandemic shutting down 71% of in-center cardiac rehabilitation at least temporarily, according to a survey by the American Association of Cardiovascular and Pulmonary Rehabilitation, experiments with telehealth and mobile alternatives are receiving renewed attention. The statistics are particularly concerning because cardiac rehabilitation has been shown to reduce hospital readmission by 25% and death by 42%.

Cardiologist William Kraus, MD, distinguished university professor at Duke University Medical Center in Durham, North Carolina, and his colleagues ran a pilot study of a mobile technology–based cardiac rehabilitation program between March and

Lockdowns associated with the ongoing pandemic have added a sense of urgency to develop mobile or telemedicine alternatives to in-center cardiac rehabilitation programs.
Cardiac Rehabilitation During COVID-19 Pandemic: Highlighting the Value of Home-Based Programs

Kariann R. Drwal, MS,1,2 Daniel E. Forman, MD,3-5 Bonnie J. Wakefield, PhD, RN,1,2,6 and Ramzi N. El Accaoui, MD1,7

1VA Office of Rural Health, Veterans Rural Health Resource Center, Iowa City VA Healthcare System, Iowa City, Iowa, USA.
2The Comprehensive Access and Delivery Research and Evaluation Center Iowa City VA Healthcare System, Iowa City, Iowa, USA.
3VA Pittsburgh Healthcare System, Pittsburgh, Pennsylvania, USA.
4Department of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania, USA.
5University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA.
6Sinclair School of Nursing, University of Missouri, Columbia, Missouri, USA.
7Division of Cardiovascular Medicine, University of Iowa, Iowa City, Iowa, USA.

Introduction

Although most clinicians acknowledge the conceptual value of cardiac rehabilitation (CR), utilization of this class I treatment for cardiovascular disease (CVD) has remained low. Many reasons have been cited, particularly logistic impediments to accessing on-site-based programs (e.g., distance, transportation, scheduling, and availability). Although home-based CR (HBCR) has been increasingly advocated as a potential solution to the problem,1 published data validating home-based options comparative effectiveness to center-based models with respect to patient outcomes (primarily function and quality-of-life measures) have utilized inconsistent protocols and most have been restricted to patient populations with relatively lower risk profiles.2-4 Thus, many clinicians have remained skeptical about the utility of HBCR, especially for patients with higher CVD risks and/or clinical complexities. Lack of reim-

TELEMEDICINE and e-HEALTH. NOVEMBER 2020 DOI: 10.1089/tmj.2020.0213
Cardiac Rehabilitation Services during COVID-19 Pandemic

Bhargav Dave and Abhishek Jagtap

ABSTRACT

Cardiac rehabilitation is a much appreciated but underutilized treatment strategy for cardiovascular disease. Traditional center-based cardiac rehabilitation program has been suspended due to the concrete measures adopted to flatten the COVID-19 pandemic curve. The current situation of emphasis the need of alternative approach for cardiac rehabilitation. This review shed light on consequences of COVID-19 disease on cardiac rehabilitation, the alternative approaches of cardiac rehabilitation, its potential advantages, and limitations as well as future directions.

Keywords: Coronavirus disease-2019, SARS-CoV-2, rehabilitation.

Published Online: November 23, 2020
ISSN: 2593-8339
DOI: 10.24018/ejmed.2020.2.6.569

B. Dave*
MyraGe Scientific Laboratory, Dickinson, Texas, USA.
Memorial Hermann Katy Rehabilitation Hospital, Katy, Texas, USA.
University of St. Thomas, School of Nursing, Houston, Texas, USA.
(e-mail: bDave@divinesrd.com)

A. Jagtap
MyraGe Scientific Laboratory, Dickinson, Texas, USA.
(e-mail: help@divinesrd.com)
The future is now: a call for action for cardiac telerehabilitation in the COVID-19 pandemic from the secondary prevention and rehabilitation section of the European Association of Preventive Cardiology

Martijn Scherrenberg¹,², Matthias Wilhelm³, Dominique Hansen⁴,⁵,⁶, Heinz Völler⁷,⁸, Véronique Cornelissen⁹, Ines Frederix¹⁰,¹¹, Hareld Kemps¹²,¹³, and Paul Dendale¹,²
Heart and Soul and Cardiac Rehabilitation

• Adverse cardiovascular outcomes associated with depression largely explained by poor health behaviors
• Cardiac rehab an opportunity to improve mental and physical health
• Automatic referral, bedside liaison, and home-based cardiac rehab can improve participation
• Focusing on the five modifiable health behaviors simplifies message
• “The future is now” – potential benefits of COVID pandemic