Heart and Soul and Cardiac Rehabilitation

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VA

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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

Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019

*GBD 2019 Diseases and Injuries Collaborators**

Lancet 2020; 396: 1204–22

This online publication has been corrected. The corrected version first appeared at thelancet.com on October 23, 2020

*For the list of Collaborators see **Viewpoint** *Lancet* 2020; 396: 1135–59

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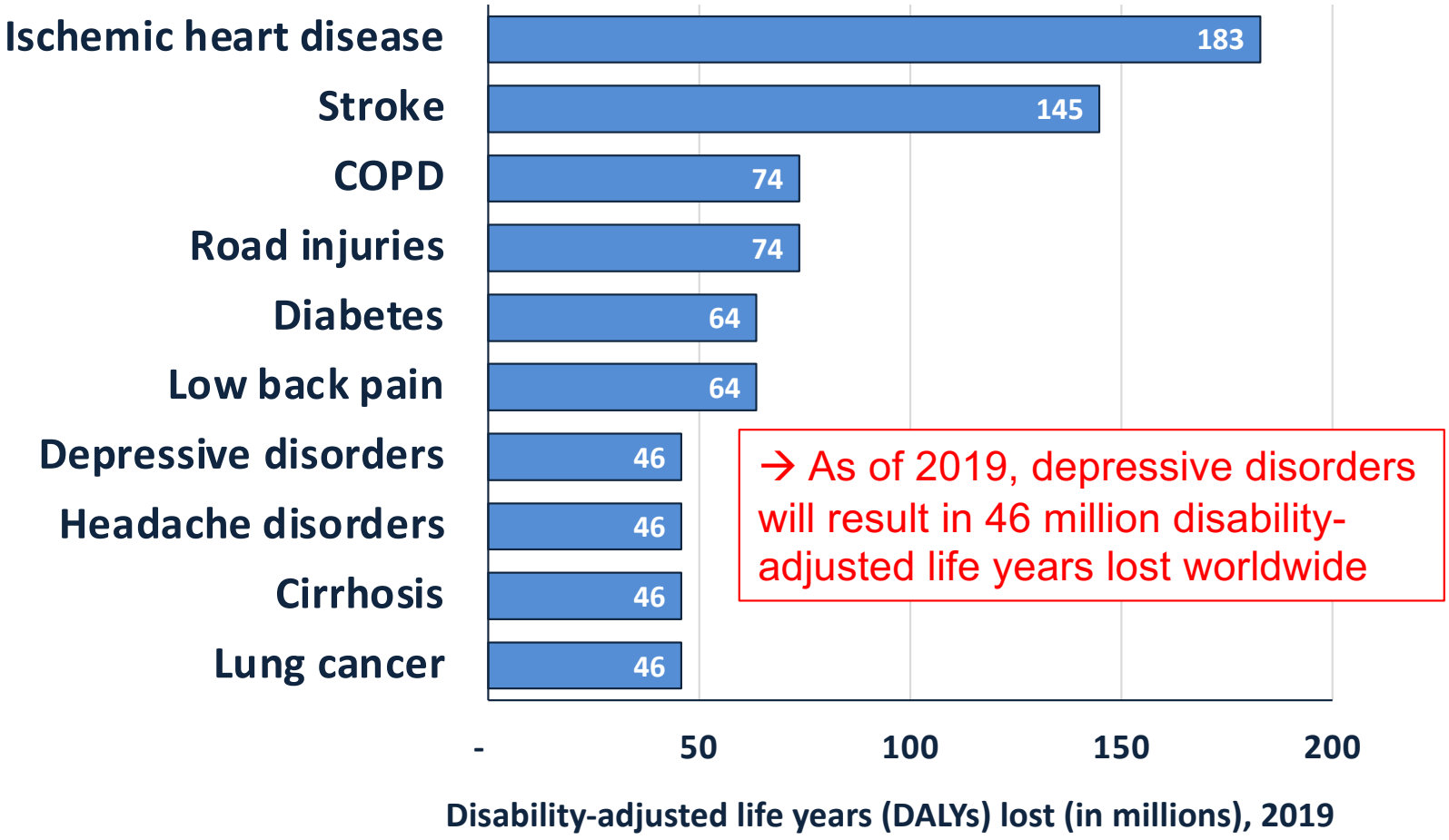
Summary

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 (UIs) 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



Global Burden of Disease Study, Lancet October 2020; 396: 1204–22.

European Heart Journal (2006) 27, 2763–2774
doi:10.1093/eurheartj/ehl338

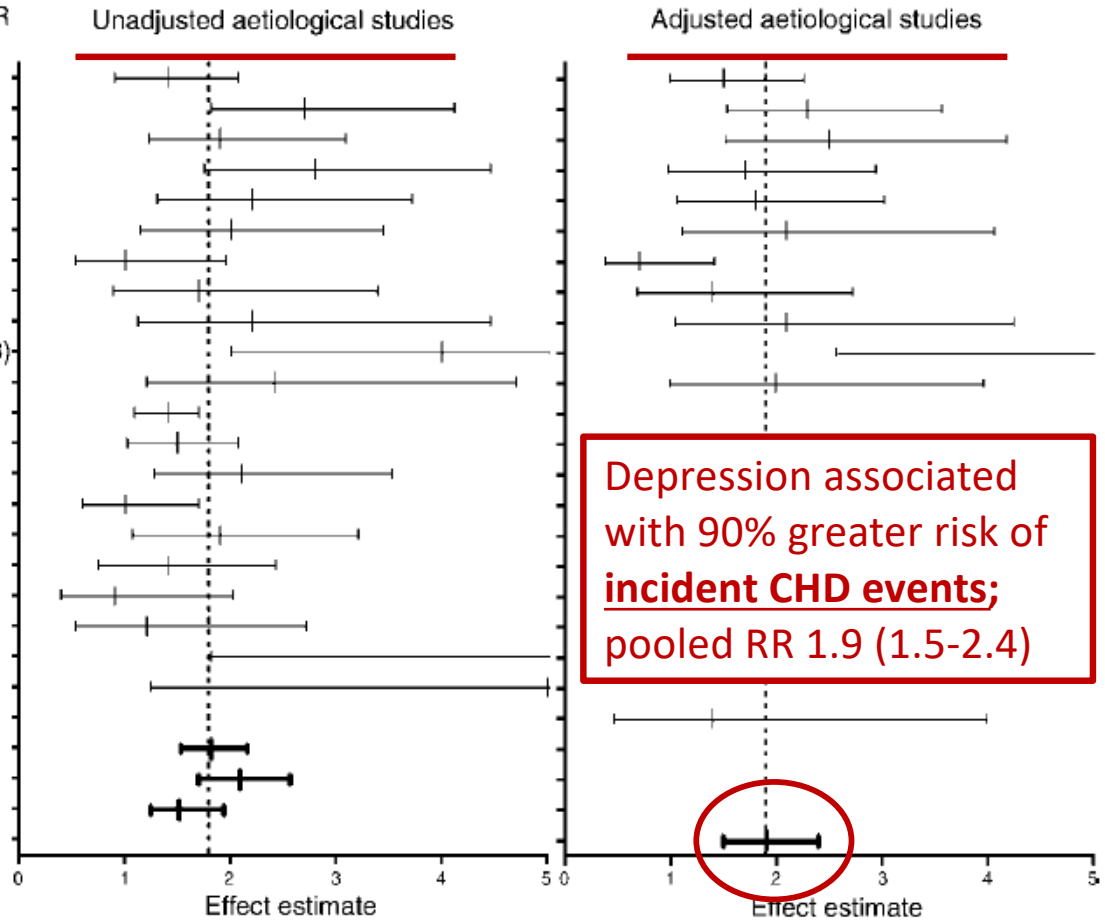
Clinical research
Coronary heart disease

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 Nicholson[1]*, Hannah Kuper[2], and Harry Hemingway[1]

Aetiological studies: Forrest plot of the effect of depression on the incidence of CHD

Reference	Number (events)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
Anda *et al.* (1993)	2832 (189)	1.4 (0.9–2.1)	1.5 (1–2.3)
Ferketich *et al.* (2000)	2888 (137)	2.7 (1.8–4.1)	2.3 (1.5–3.6)
Pratt *et al.* (1996)	1551 (64)	1.9 (1.2–3.1)	2.5 (1.5–4.2)
Whooley and Browner (1998)	7518 (127)	2.8 (1.7–4.5)	1.7 (1.0–3.0)
Cohen *et al.* (2000)	54997 (207)	2.2 (1.3–3.7)	1.8 (1.1–3.1)
Ford *et al.* (1998)	1190 (103)	2.0 (1.1–3.4)	2.1 (1.1–4.1)
Ferketich *et al.* (2003)	5006 (129)	1.0 (0.5–2.0)	0.7 (0.4–1.5)
Luukinen *et al.* (2003)	771 (54)	1.7 (0.9–3.4)	1.4 (0.7–2.7)
Cohen *et al.* (2001)	5474 (112)	2.2 (1.1–4.5)	2.1 (1.0–4.2)
Laplane *et al.* (1995)	5700 (69)	4 (2–8)	5.7 (2.6–12.8)
Penninx *et al.* (2001)	2397 (45)	2.4 (1.2–4.7)	2.0 (1.0–4.0)
Chang *et al.* (2001)	10766 (1401)	1.4 (1.1–1.7)	
Joukamaa *et al.* (2001)	7217 (537)	1.5 (1.0–2.1)	
deLeon (1998)	1446 (233)	2.1 (1.3–3.5)	
Hallstrom *et al.* (1999)	795 (11)	1 (0.6–1.7)	
Mallon *et al.* (2002)	1870 (91)	1.9 (1.1–3.2)	
Seson *et al.* (1998)	1305 (50)	1.4 (0.8–2.4)	
Wassertheil *et al.* (1996)	4508 (139)	0.9 (0.4–2.0)	
Cole *et al.* (1999)	5053 (202)	1.2 (0.5–2.7)	
Pentinnen and Valonen (1999)	332 (83)	5.4 (1.8–16.2)	
Clouse *et al.* (2003)	76 (7)	5 (1.2–20.1)	
Yasuda *et al.* (2002)	817 (26)		1.4 (0.5–4.0)
Summary unadjusted[a]		1.8 (1.5–2.1)	
Summary unadjusted[b]		2.1 (1.7–2.6)	
Summary unadjusted[c]		1.5 (1.2–1.9)	
Summary adjusted			1.9 (1.5–2.4)

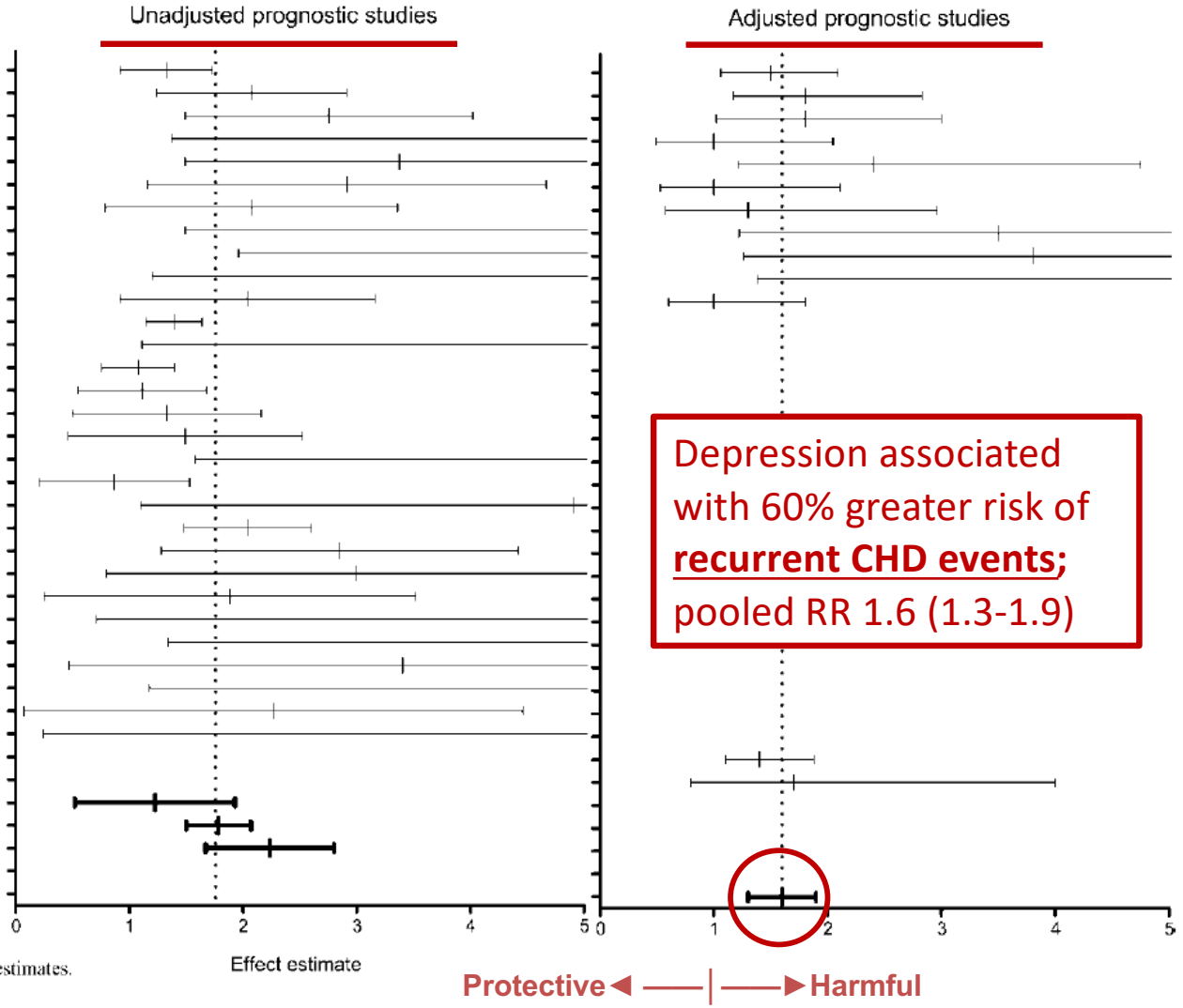


[a]Studies reporting an unadjusted effect estimate.
[b]Studies reporting an unadjusted effect estimate that also reported an adjusted effect estimate.
[c]Studies reporting an unadjusted effect estimate that do not reported an adjusted effect estimate.

Prognostic studies: Forrest plot of the effect of depression on prognosis after CHD

Reference	Number (events)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
Blumenthal *et al.* (2003)	817 (122)	1.3 (0.9–1.7)	1.5 (1.1–2.1)
Penninx *et al.* (2001)	450 (93)	1.9 (1.2–2.9)	1.8 (1.2–2.8)
Welin *et al.* (2000)	267 (67)	2.5 (1.5–4.0)	1.8 (1.0–3.0)
Denollet *et al.* (1996)	303 (38)	2.4 (1.3–4.4)	1.0 (0.5–2.1)
Carney *et al.* (2003)	766 (47)	2.8 (1.5–5.3)	2.4 (1.2–4.8)
Kaufmann *et al.* (1999)	318 (33)	2.3 (1.2 4.7)	1.0 (0.5 2.1)
Lauzon *et al.* (2003)	550 (28)	1.6 (0.8–3.4)	1.3 (0.6–3.0)
Bush *et al.* (2001)	267 (17)	3.8 (1.5 9.6)	3.5 (1.2–10.0)
Ladwig *et al.* (1991)	553 (12)	5.9 (2.0–17.9)	3.8 (1.2–11.6)
Burg *et al.* (2003)	89 (5)	10.2 (1.2 87.3)	23.2 (1.4–390)
Carinci *et al.* (1997)[a]	2449 (63)	1.7 (0.9–3.2)	1.0 (0.6–1.8)
Barefoot *et al.* (1996)	929 (488)	1.4 (1.2–1.6)	
Lesperance *et al.* (2002)	896 (155)	2.0 (1.5–2.6)	
Moir *et al.* (1973)	201 (91)	1.0 (0.8 1.4)	
Jenkinson *et al.* (1993)	1177 (189)	1.0 (0.6–1.7)	
Lane *et al.* (2002)	288 (38)	1.0 (0.5–2.2)	
Berkman *et al.* (1992)	187 (73)	1.1 (0.5–2.5)	
Romanelli *et al.* (2002)	153 (17)	3.8 (1.6–9.1)	
Schleifer *et al.* (1989)	283 (16)	0.6 (0.2 1.5)	
Thomas *et al.* (1997)	347 (24)	3.1 (1.1–8.7)	
Lesperance *et al.* (2000)	430 (16)	3.3 (1.1–9.5)	
Denollet *et al.* (1995)	105 (15)	4.6 (1.4–15.3)	
Borowicz *et al.* (2002)	117 (15)	2.0 (0.8–5.2)	
Sullivan *et al.* (2003)	198 (10)	0.9 (0.3–3.5)	
Peterson *et al.* (2002)	123 (8)	2.8 (0.7–10.7)	
Denollet and Britsaert (1998)	79 (13)	5.6 (1.3 23.8)	
Shiotani *et al.* (2002)	1042 (9)	1.7 (0.5–6.3)	
Baker *et al.* (2001)	158 (6)	6.2 (1.2 33.0)	
Connerney *et al.* (2001)	309 (8)	0.6 (0.1–4.5)	
Carney *et al.* (1988)	52 (3)	2.4 (0.2–23.7)	
Bosworth *et al.* (1999)	2885 (NA)		1.4 (1.1–1.9)
Irvine *et al.* (1999)	318 (NA)		1.7 (0.8–4.0)
Null		1.0 (0.5–1.9)	
Summary unadjusted[a]		1.8 (1.5 2.1)	
Summary unadjusted[b]		2.2 (1.7–2.8)	
Summary unadjusted[c]		1.5 (1.2–2.0)	
Summary adjusted			1.6 (1.3–1.9)

[a]Studies reporting unadjusted effect estimates.
[b]Studies reporting unadjusted effect estimates that also report an adjusted effect estimates.



Depression associated with 60% greater risk of **recurrent CHD events;** pooled RR 1.6 (1.3-1.9)

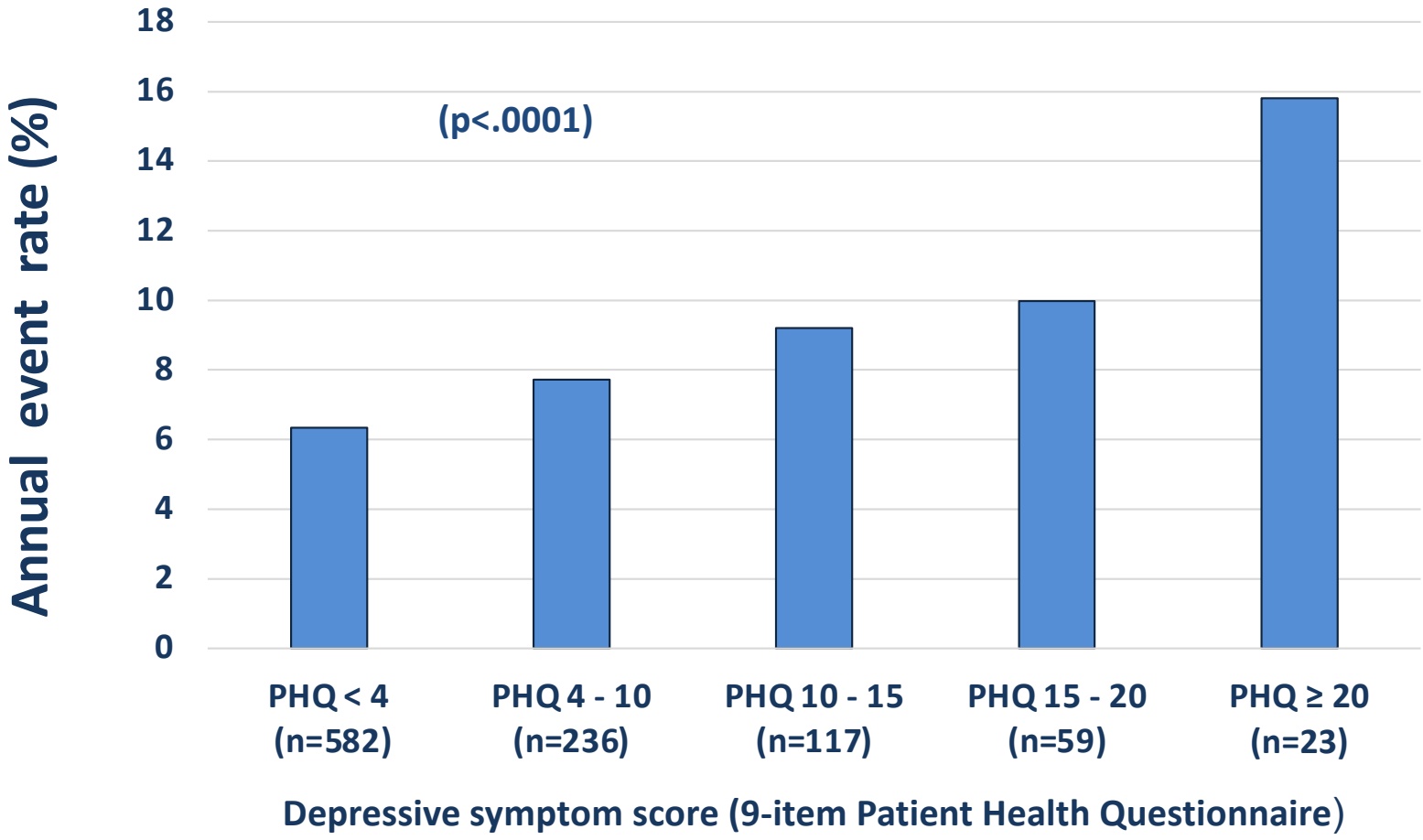
The Heart and Soul Study

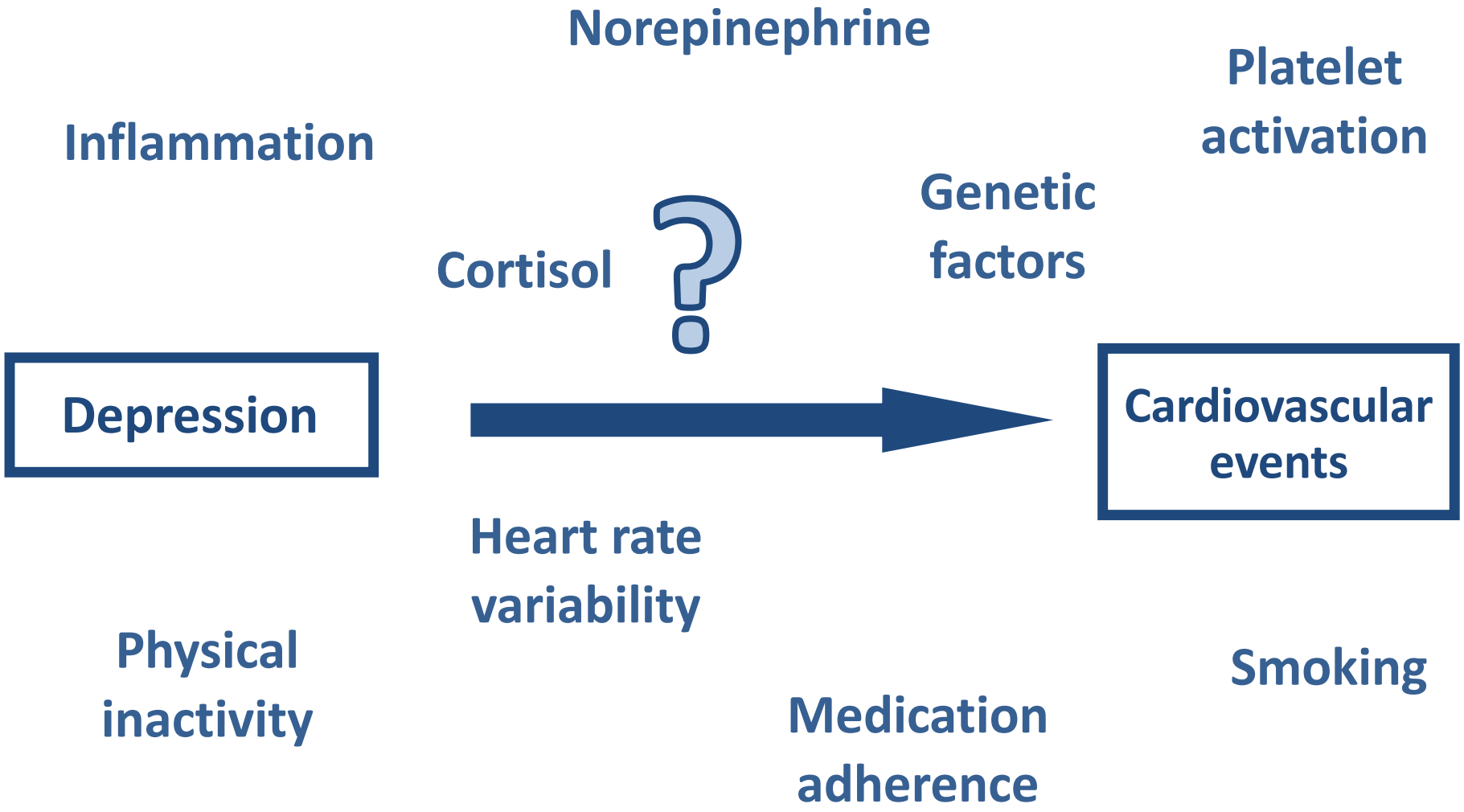
- Prospective cohort study of 1017 outpatients with stable coronary disease, enrolled 9/00 – 12/02
- Goal was to determine why depression is associated with adverse cardiovascular outcomes
- Baseline exam included psychiatric interview, blood draw, exercise treadmill, stress echocardiography, 24-hour 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)

JAMA. 2008;300:2379-2388. https://doi.org/*10.1001/jama.2008.711*

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




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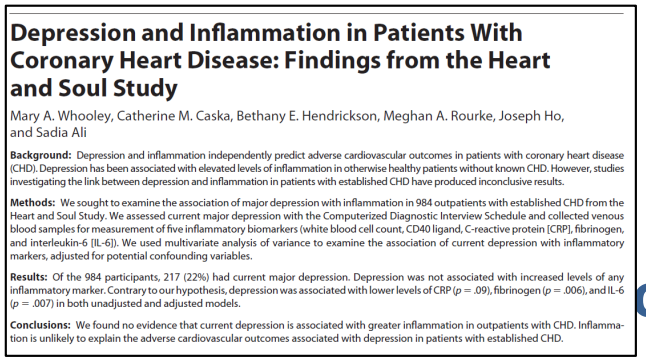
Depression
Cardiovascular events
Heart rate variability
Physical inactivity
Smoking
Medication adherence



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

Mary A. Whooley, Catherine M. Caska, Bethany E. Hendrickson, Meghan A. Rourke, Joseph Ho, and Sadia Ali

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 inconclusive results.

Methods: We sought to examine the association of major depression with inflammation in 984 outpatients with established CHD from the Heart and Soul Study. We assessed current major depression with the Computerized Diagnostic Interview Schedule and collected venous blood samples for measurement of five inflammatory biomarkers (white blood cell count, CD40 ligand, C-reactive protein [CRP], fibrinogen, and interleukin-6 [IL-6]). We used multivariate analysis of variance to examine the association of current depression with inflammatory markers, adjusted for potential confounding variables.

Results: Of the 984 participants, 217 (22%) had current major depression. Depression was not associated with increased levels of any inflammatory marker. Contrary to our hypothesis, depression was associated with lower levels of CRP ($p = .09$), fibrinogen ($p = .006$), and IL-6 ($p = .007$) 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 unlikely to explain the adverse cardiovascular outcomes associated with depression in patients with established CHD.

Norepinephrine

Platelet activation

Genetic factors

ortisol

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Depression

Cardiovascular events

Heart rate variability

Physical inactivity

Smoking

Medication adherence


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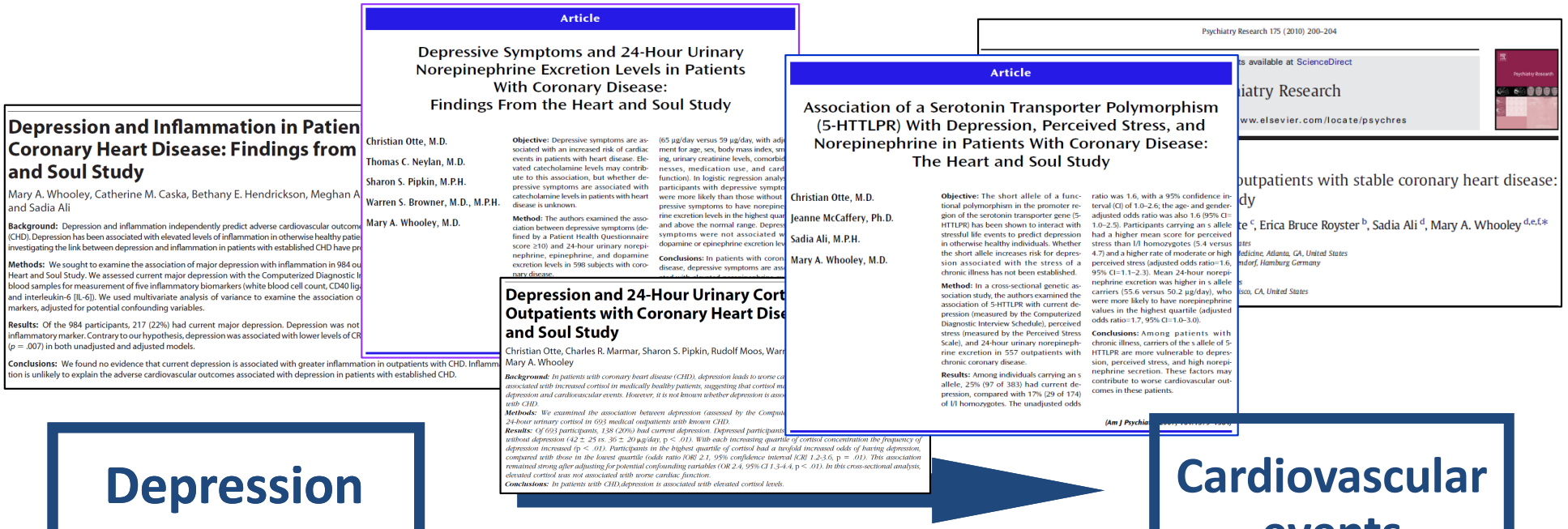
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Sunaina Dowray, MPH
Beeya Na, MPH
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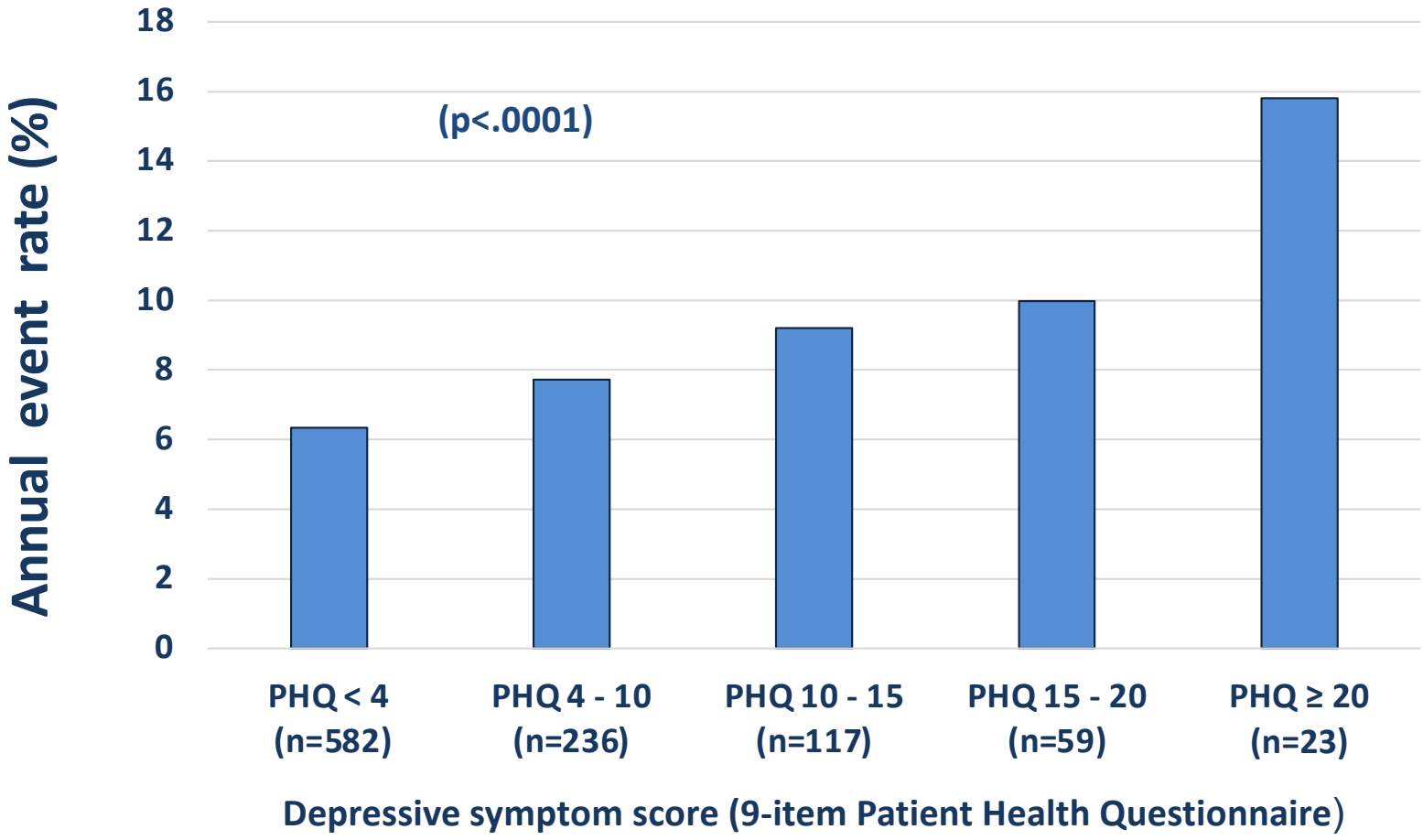
Annual rate of recurrent cardiovascular events (MI, CHF, stroke, or death) during 5-year follow up in 1017 patients



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

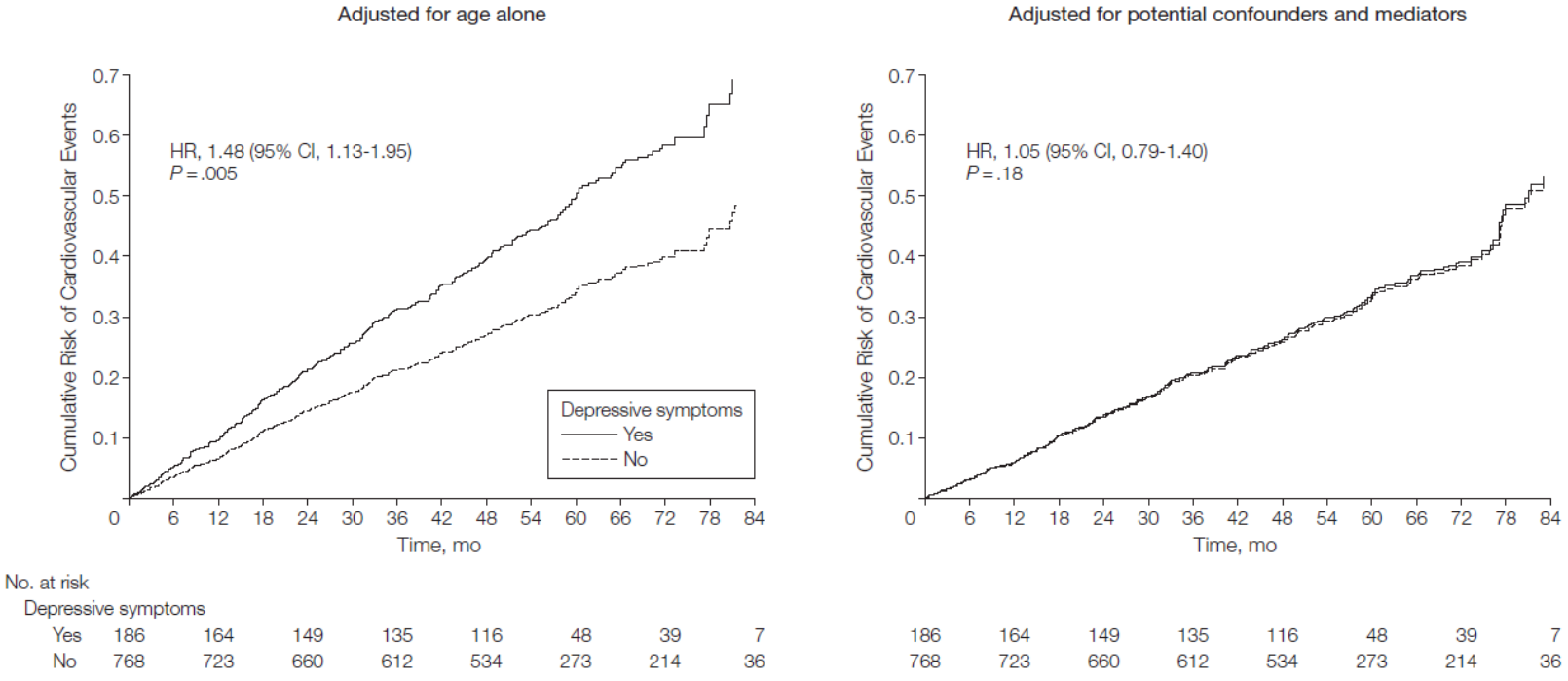
Covariates adjusted for	*Excess risk associated with depressive symptoms*
Age	50%

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

Covariates adjusted for	*Excess risk associated with depressive symptoms*
Age	50%
Add education, prior MI, DM, CHF, LV ejection fraction	31%
Add log CRP	24%
Add smoking	20%
Add medication non-adherence	18%
Add physical inactivity	5%

Poor health behaviors (especially physical inactivity) responsible for excess risk of cardiovascular events

Figure 1. Cumulative Risk of Cardiovascular Events



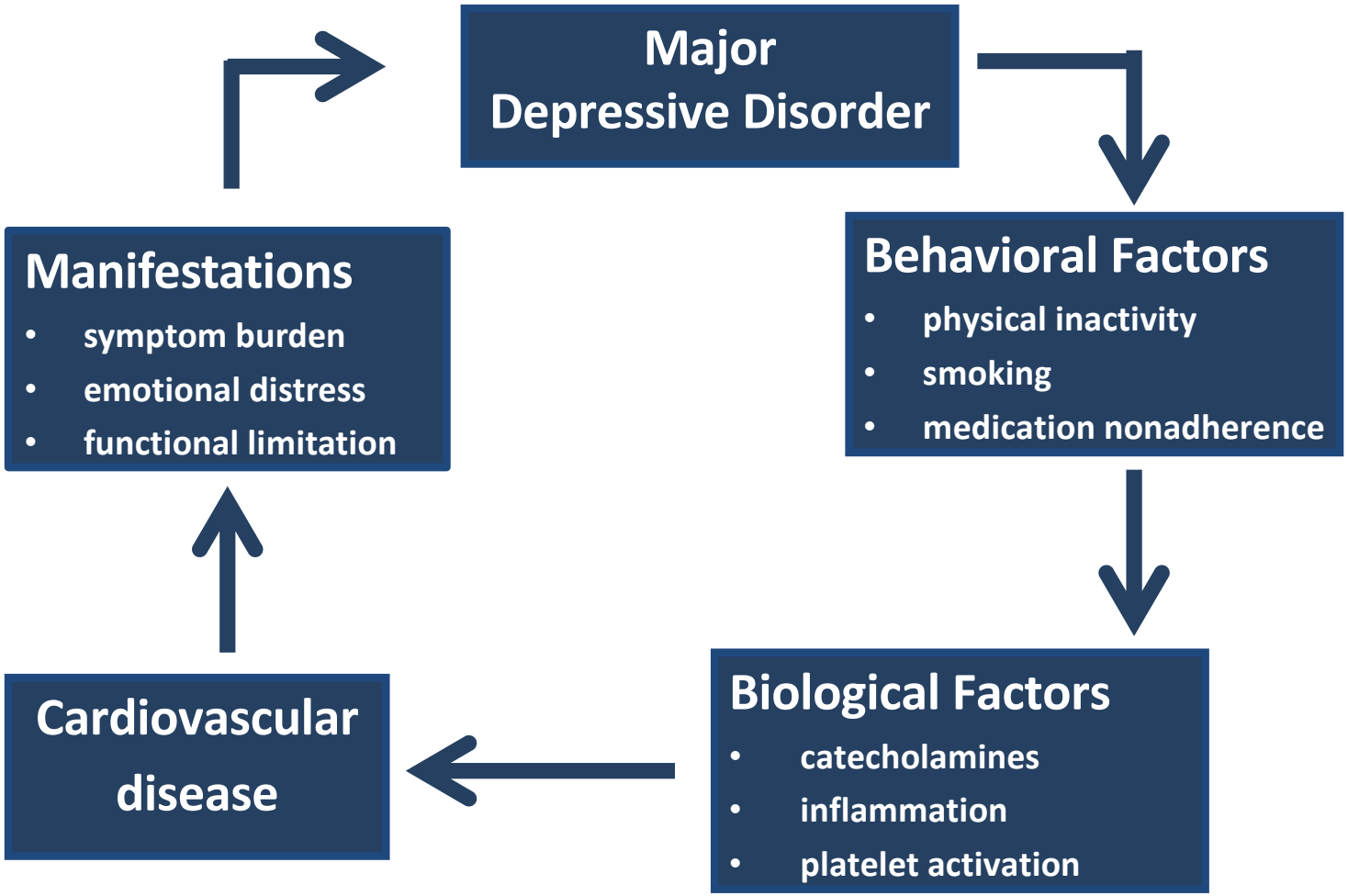
Data are stratified by depressive symptoms before and after adjustment for health behaviors in 954 participants with complete data. The adjusted hazard ratio (HR) differs slightly from Table 4 because 63 patients with incomplete data were excluded from the analysis. CI indicates confidence interval.

JAMA. 2008;300:2379-2388. https://doi.org/*10.1001/jama.2008.711*

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



Annual Review of Clinical Psychology. 2013; 9:327-54. https://doi.org/10.1146/annurev-clinpsy-050212-185526

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**

Guideline > Clin Pract Guidel Quick Ref Guide Clin 1995 Oct;(17):1-23.

Cardiac rehabilitation as secondary prevention. Agency for Health Care Policy and Research and National Heart, Lung, and Blood Institute

N K Wenger, E S Froelicher, L K Smith, P A Ades, K Berra, J A Blumenthal, C M Certo, A M Dattilo, D Davis, R F DeBusk, et al.

PMID: 8595435

 0025–7125/00 $8.00 + .00

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.[17, 63] Outpatient exercise programs were initially limited to low-risk coronary patients but evolved to incorporate additional risk reduction interventions for a broader patient population.[63]

Medical Clinics of North America, 2000

Review Article

Medical Progress

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.[1] It is also a major cause of physical disability, particularly in the rapidly growing population of elderly persons.[2,3] In 1997, acute myocardial infarction was diagnosed in 1.1 million Americans, and 800,000 patients underwent coronary revascularization.[1] 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,[4-6] once the benefits of ambulation during prolonged hospitalization for coronary events had been recognized.[7] 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 ary prevention are broad and compelling. Controlled trials of exercise after myocardial infarction, reported in the 1980s, have demonstrated reductions in overall mortality and in mortality from cardiovascular causes.[9,10] Trials of exercise combined with nutritional counseling have demonstrated a slowing of the atherosclerotic process[12,13,15,16] and decreased rates of subsequent coronary events and hospitalization.[11,13] 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[17,18] 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.[14,19] 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.[20,21] 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.[13,22,23]

N Engl J Med, Vol. 345, No. 12 · September 20, 2001

Exercise-Based Cardiac Rehabilitation for Coronary Heart Disease

Cochrane Systematic Review and Meta-Analysis

Lindsey Anderson, PhD,* Neil Oldridge, PhD,† David R. Thompson, PhD,‡ Ann-Dorthe Zwisler, MD,§ Karen Rees, PhD,‖ Nicole Martin, MA,¶ Rod S. Taylor, PhD*

ABSTRACT

BACKGROUND Although recommended in guidelines for the management of coronary heart disease (CHD), concerns have been raised about the applicability of evidence from existing meta-analyses of exercise-based cardiac rehabilitation (CR).

OBJECTIVES The goal of this study is to update the Cochrane systematic review and meta-analysis of exercise-based CR for CHD.

METHODS The Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, CINAHL, and Science Citation Index Expanded were searched to July 2014. Retrieved papers, systematic reviews, and trial registries were hand-searched. We included randomized controlled trials with at least 6 months of follow-up, comparing CR to no-exercise controls following myocardial infarction or revascularization, or with a diagnosis of angina pectoris or CHD defined by angiography. Two authors screened titles for inclusion, extracted data, and assessed risk of bias. Studies were pooled using random effects meta-analysis, and stratified analyses were undertaken to examine potential treatment effect modifiers.

RESULTS A total of 63 studies with 14,486 participants with median follow-up of 12 months were included. Overall, CR led to a reduction in cardiovascular mortality (relative risk: 0.74; 95% confidence interval: 0.64 to 0.86) and the risk of hospital admissions (relative risk: 0.82; 95% confidence interval: 0.70 to 0.96). There was no significant effect on total mortality, myocardial infarction, or revascularization. The majority of studies (14 of 20) showed higher levels of health-related quality of life in 1 or more domains following exercise-based CR compared with control subjects.

CONCLUSIONS This study confirms that exercise-based CR reduces cardiovascular mortality and provides important data showing reductions in hospital admissions and improvements in quality of life. These benefits appear to be consistent across patients and intervention types and were independent of study quality, setting, and publication date.
(J Am Coll Cardiol 2016;67:1–12)

- **Cardiac rehab leads to 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 [a,b], Yang Zheng [a,b], Jing Ma [c], Maomao Zhang [a,b], Yongxiang Zhang [a,b], Xianglan Liu [a,b], Liangqi Chen [a,b], Qingyuan Yang [a,b], Yong Sun [a,b], Jian Wu [a,b*], Bo Yu [a,b]

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

ARTICLE INFO

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Available online 23 October 2018

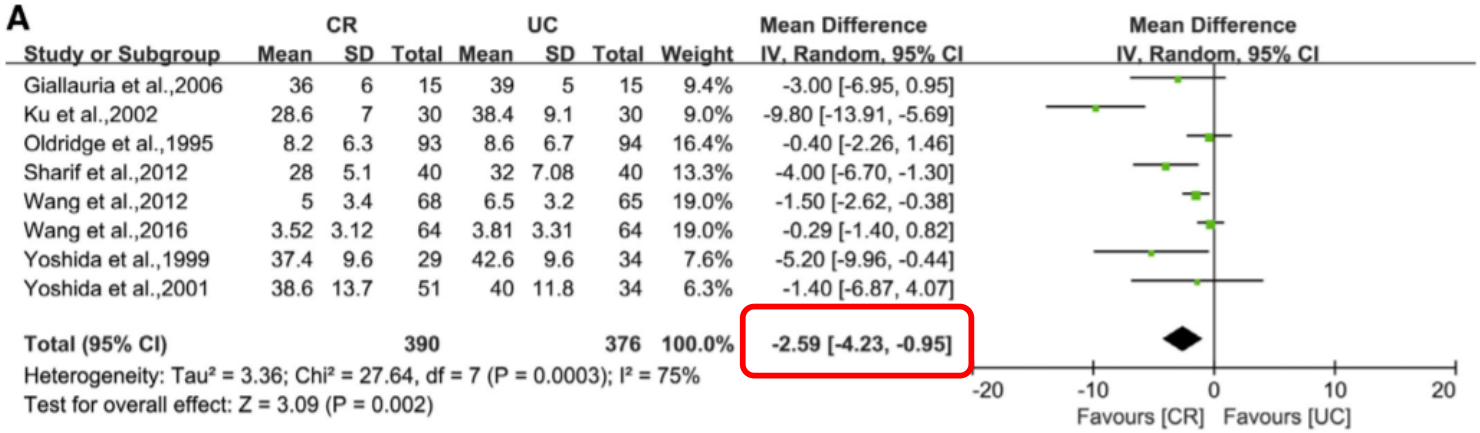
Keywords:
Cardiac rehabilitation
Anxiety
Depression
Myocardial infarction

ABSTRACT

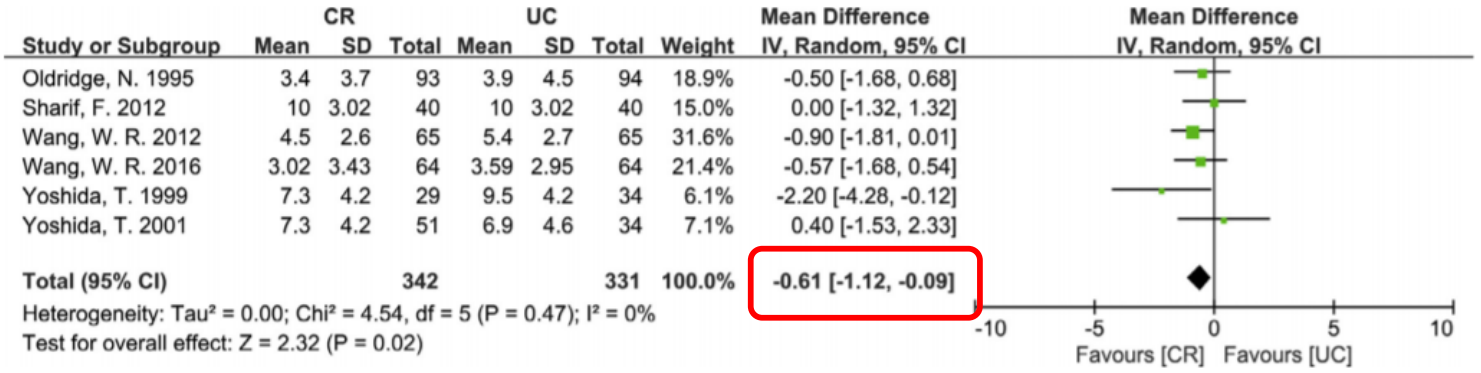
Background: Cardiac rehabilitation (CR) has been shown to provide the best social, psychological and physical conditions for patient recovery after myocardial infarction (MI).
Objectives: The aim of present study was to quantify the efficacy of exercise-based CR treatments in terms of relief from symptoms of anxiety and depression symptoms among patients with MI.
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.
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.
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.

https://doi.org/10.1016/j.hrtlng.2018.09.011

Effects of exercise-based CR on anxiety



Effects of exercise-based CR on depression



PTSD and depression associated with *higher* CR participation rates in 86,537 Veterans with ischemic heart disease

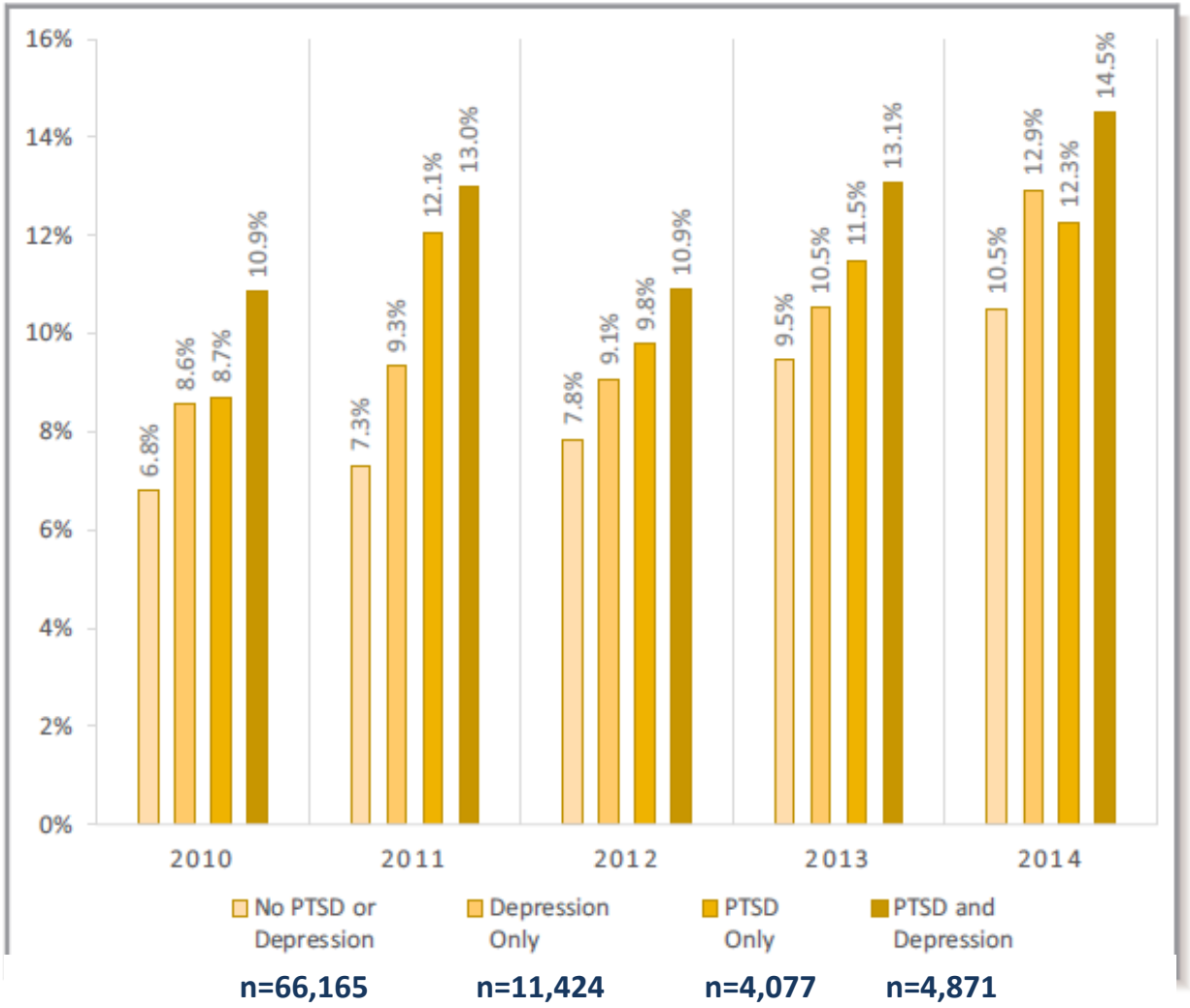
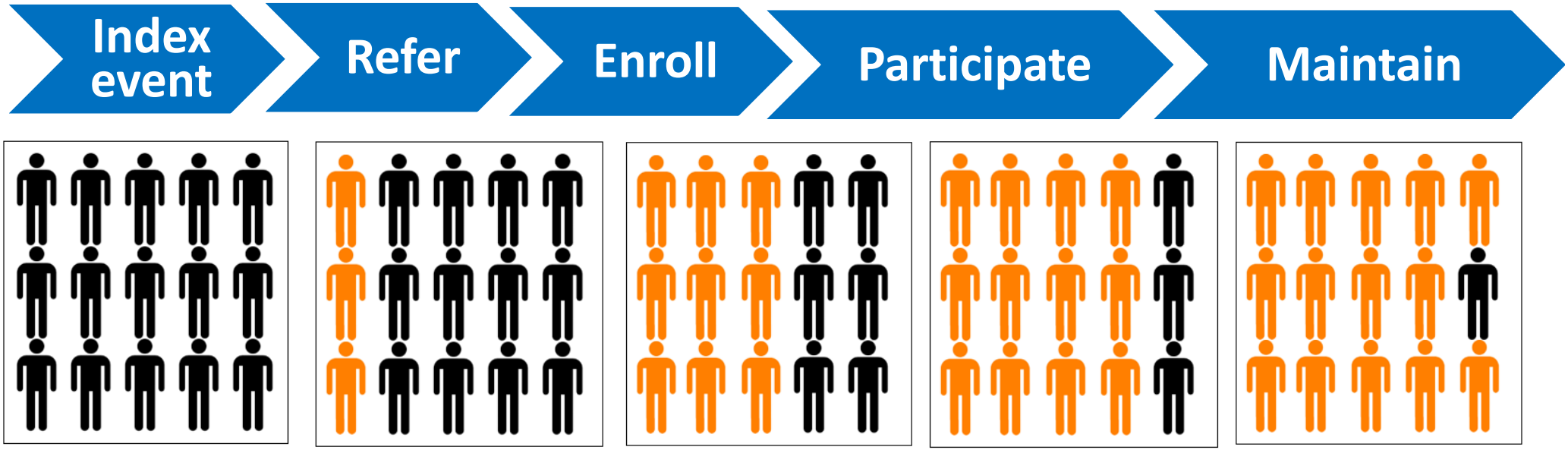


Figure. Adjusted cardiac rehabilitation participation rates by posttraumatic stress disorder (PTSD)/ depression status and year.

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.



80% 40% 20% <10%

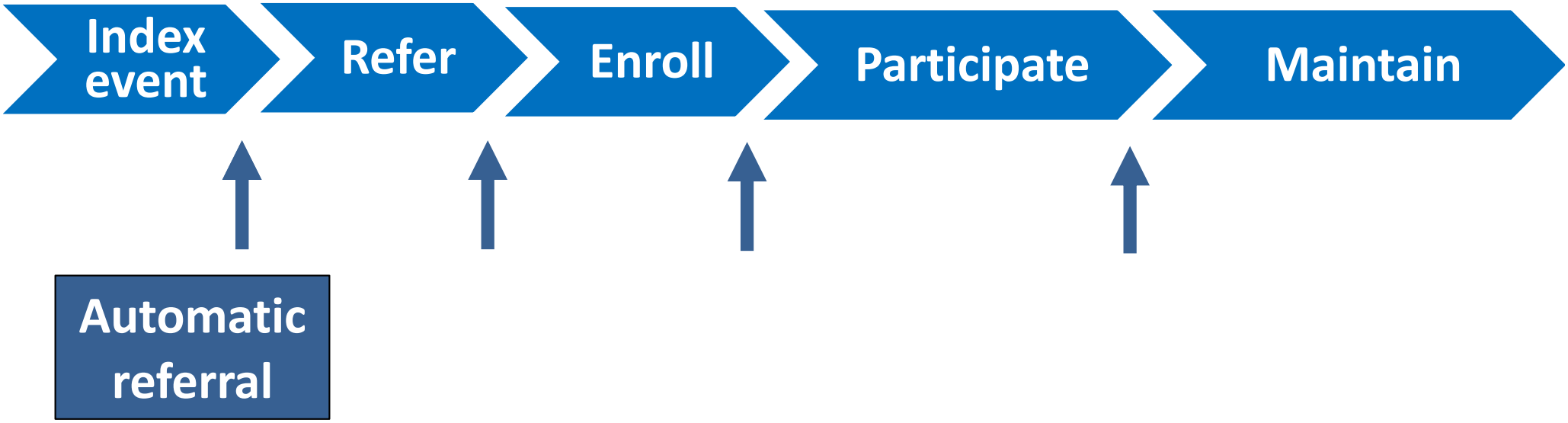
MAYO CLINIC

Mayo Clinic Proceedings, 2017;92:234-242

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



Journal of Cardiopulmonary Rehabilitation and Prevention, 2009

Effect of a Computerized Referral at Hospital Discharge on Cardiac Rehabilitation Participation Rates

Enkhtuyaa Mueller, MD, Patrick D. Savage, MS, David J. Schneider, MD, Laura L. Howland, RN, and Philip A. Ades, MD

→ Automated referral (embedded in discharge summary) improved participation in >800 patients with MI or CABG

CACRC

Canadian Cardiovascular Society

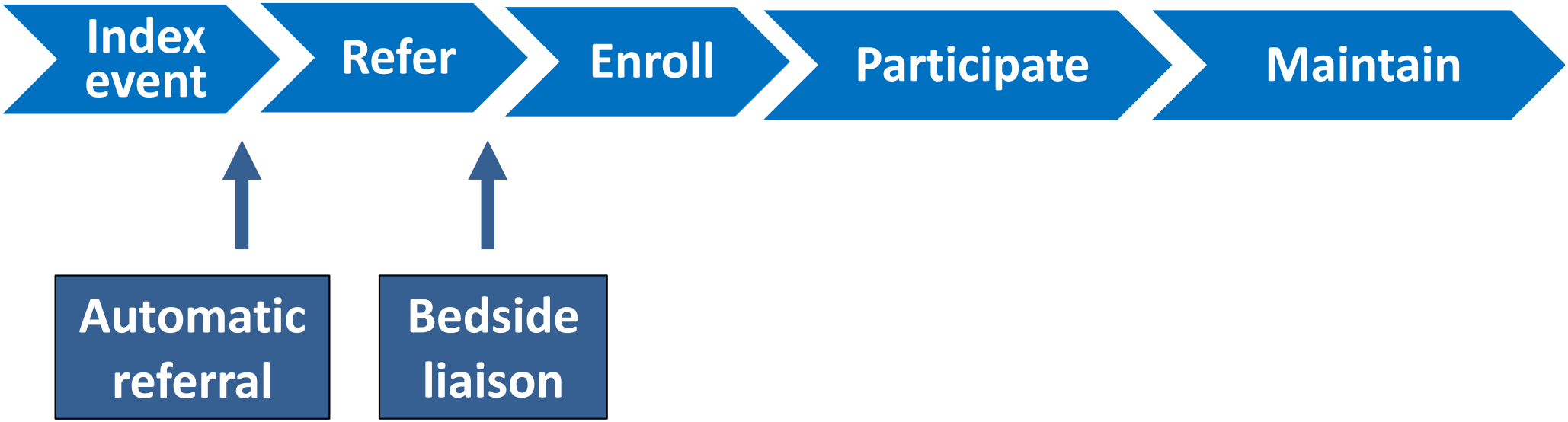
CANADIAN ASSOCIATION OF CARDIAC REHABILITATION (CACR) –
CANADIAN CARDIOVASCULAR SOCIETY POSITION STATEMENT (CCS)

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
Printed in *CJC* 2011;27:192-199 and online *JCRP*, March/April 2011 Vol. 31, Issue 2.

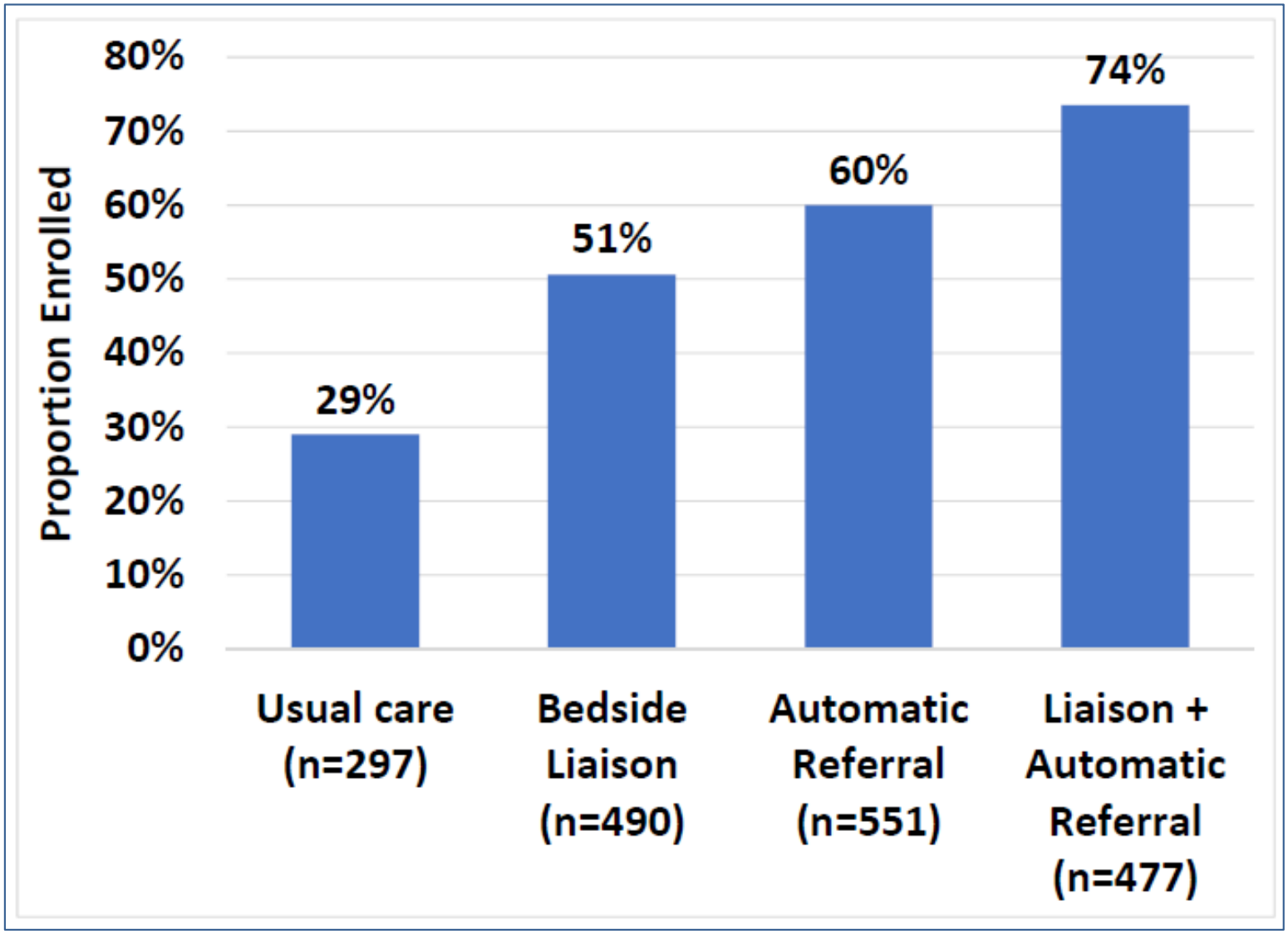
Sherry L. Grace, PhD (chair) & Caroline Chessex, MD, FRCPC (co-Chair)
Primary Panel Writing Group: Heather Arthur, Sammy Chan, Cleo Cyr, William Dafoe, Martin Juneau, Paul Oh, Neville Suskin.
Secondary Panel Writing Group: Paul Poirier, Rob Stevenson, Jim Stone.

Quality Gaps = Opportunities for Improvement



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

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.

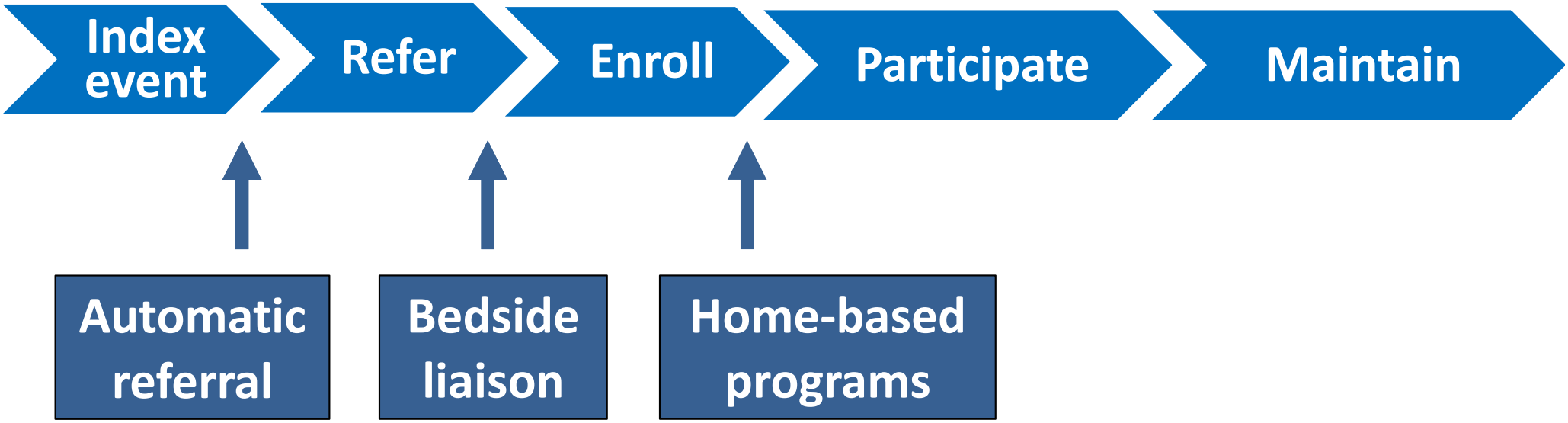
Methods: In this prospective controlled study, 2635 inpatients with coronary artery disease from 11 Ontario, Canada, hospitals using 1 of the 4 referral strategies completed a sociodemographic survey, and clinical data were extracted from medical charts. One year later, 1809 participants completed a 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; 85.8% referral, 73.5% enrollment), followed by automatic only (OR, 3.27; 70.2% referral, 60.0% enrollment), and liaison only (OR, 3.35; 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



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, Vt***

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/fatigue 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

Cochrane Library

Cochrane Database of Systematic Reviews

Cochrane Database of Systematic Reviews
2017, Issue 6
www.cochranelibrary.com

Home-based versus centre-based cardiac rehabilitation (Review)

Anderson L, Sharp GA, Norton RJ, Dalal H, Dean SG, Jolly K, Cowie A, Zawada A, Taylor RS.

23 randomized trials → home- and center-based cardiac rehabilitation equally effective for improving clinical and health-related quality of

Home-Based vs. Center-Based CR

Outcome (3 to 12 months)	# Studies	Total # Subjects	Risk Ratio	95% CI
Smoking	5	986	1.02	0.83 – 1.27
Mortality	11	1505	1.19	0.65 – 2.16
Completion	22	2615	1.04	1.00 – 1.08

Veterans Health Administration

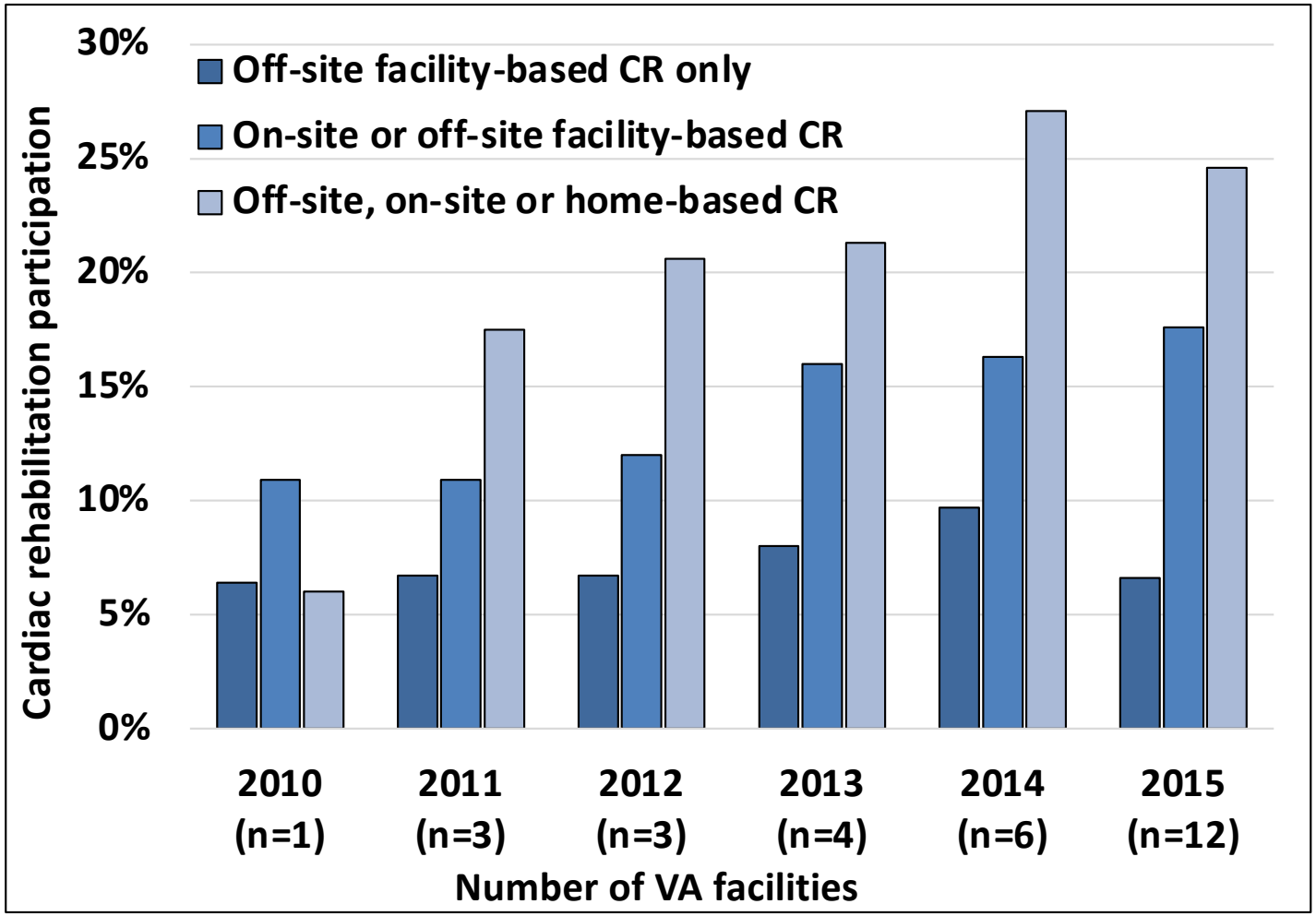
The Design and Implementation of a Home-Based Cardiac Rehabilitation Program

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

Scientific Statement jointly published by 3 societies in 2019

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. Whooley, 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

Incorporating Digital Technologies

Xu *et al. BMC Cardiovascular Disorders* (2019) 19:166
https://doi.org/10.1186/s12872-019-1149-5

BMC Cardiovascular Disorders

RESEARCH ARTICLE Open Access

The effect of mobile applications for improving adherence in cardiac rehabilitation: a systematic review and meta-analysis

Linqi Xu[1], Feng Li[1], Changli Zhou[1], Jinwei Li[1], Chengcheng Hong[2] and Qian Tong[3*]

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

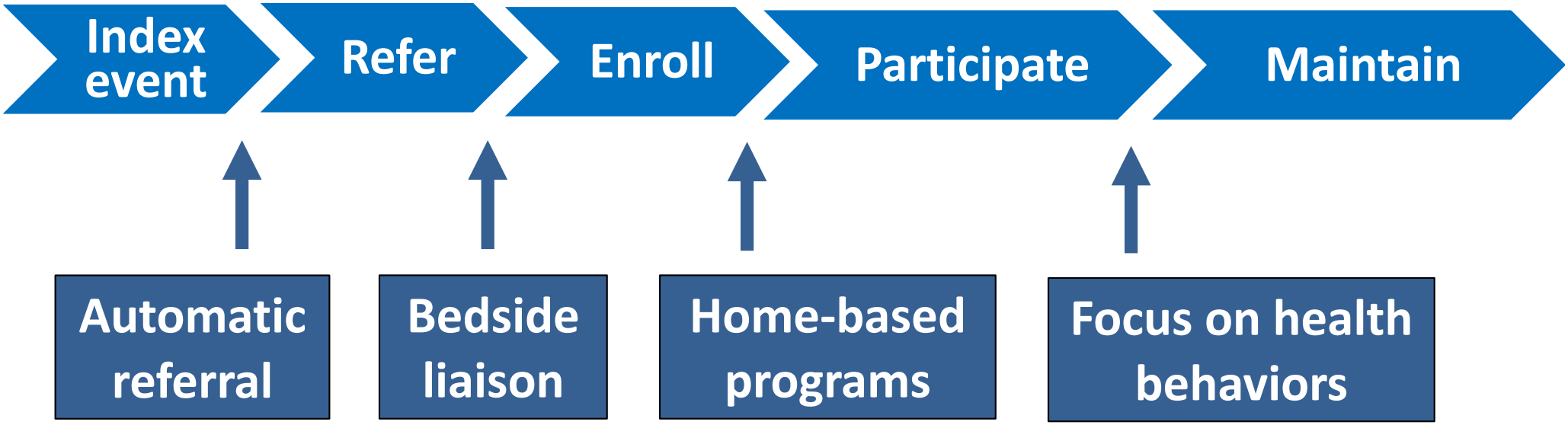
- Lack of reimbursement
- Less intensive exercise training
- Less social support
- Less patient accountability
- Lack of standardization among programs
- Less face-to-face monitoring and communication
- Safety concerns for higher-risk patients

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



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

Cardiac Rehabilitation is Too Complicated

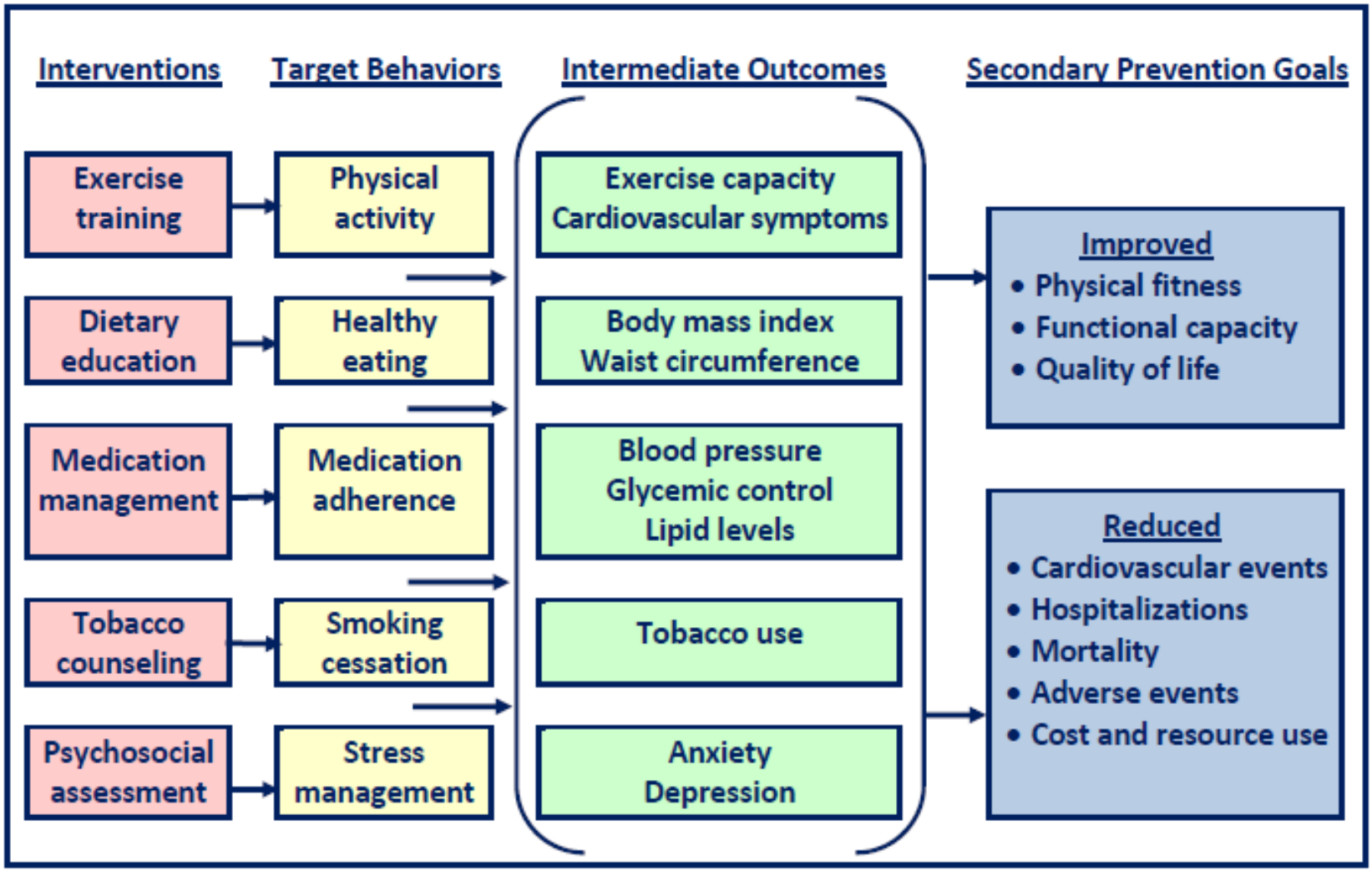
10 Key Components of CR

- 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

Focus on Modifiable Health Behaviors

Separate Structure, Process & Outcomes (Donabedian, 2005)



CARDIAC REHABILITATION

CardioSmart
American College of Cardiology

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

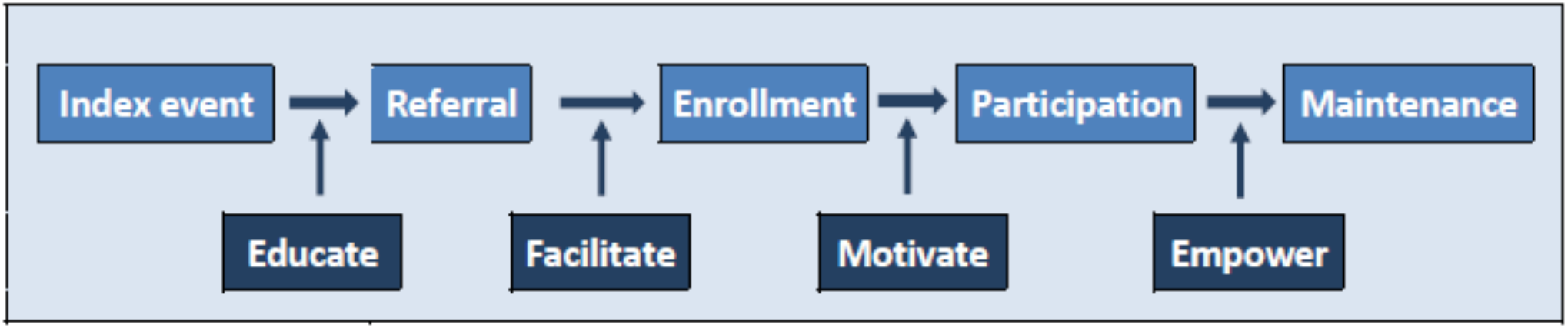
Follow your doctor's instructions carefully and take your medications as directed.

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

Circulation. 2020;142:1781–1782.
DOI: 10.1161/CIRCULATIONAHA.120.051769

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, MD[1,7]

[1]VA Office of Rural Health, Veterans Rural Health Resource Center Iowa City VA Healthcare System, Iowa City, Iowa, USA.
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[4]Department of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania, USA.
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[7]Division 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

European Journal of Medical and Health Sciences
www.ejmed.org

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

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Review

European Journal of Preventive Cardiology

ESC European Society of Cardiology

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 Scherrenberg[1,2], Matthias Wilhelm[3], Dominique Hansen[4,5,6], Heinz Völler[7,8], Véronique Cornelissen[9], Ines Frederix[10,11], Hareld Kemps[12,13] and Paul Dendale[1,2]

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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