

EDITOR'S NOTE



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Dear Colleagues,

Greetings! The Editorial team is extremely pleased to publish this comprehensive and well researched article on Cardiac Rehabilitation by Dr Abraham Babu. Dr Babu is an Associate Professor, Department of Physiotherapy and oversees the CR services at the Kasturba Hospital, Manipal. He focuses his research in CR with a special interest in heart failure and pulmonary hypertension. CR has numerous evidence-based benefits when combined with guideline directed therapies in heart failure like reduction in cardiovascular and all-cause mortality, reduction in heart failure specific readmissions and improvement in the quality of life. Despite these proven benefits, there is only 1 CR centre for every 360 eligible patients with ischemic heart disease in India. There is a need for at least 300,000 more centres in our country. The patients who will benefit from CR are patients who have had CABG/PCI and patients with stable coronary artery disease, chronic stable angina, heart failure, atrial fibrillation, and peripheral vascular disease. I thank Dr Babu for his contribution to the field of CR in India and for being a guest author in this issue of The Revival.

I hope our readers will enjoy reading this article. Here's wishing you "Happy Reading".

- Dr Manoj Durairaj
Editor "The Revival"

SUB EDITOR



Dr Talha Meeran

MBBS, MD, FACC, Consultant Cardiologist, Dept of Advanced Cardiac Sciences and Cardiac Transplant, Sir HN Reliance Foundation Hospital, Mumbai.

Dear Colleagues,

The March issue of REVIVAL features Dr Abraham Babu who writes about the role of cardiac rehab in heart failure and pulmonary hypertension. Despite being a Class 1A recommendation, cardiac rehab is still in its infancy in India and is grossly underutilized. Dr Abraham has eloquently described the core concepts of cardiac rehab and enlisted the latest evidence base justifying its immense benefit in the heart failure and PH population. The article also provides helpful tips to establish a cardiac rehab clinic in your own practice in India.

Sincerely,
Dr Talha Meeran
Sub Editor "The Revival"

PRESIDENTIAL MESSAGE



Prof. (Dr) V. Nandakumar

Director & Chief, Division of Cardio Vascular/Thoracic Surgery & Cardiac Transplantation, Metromed International Cardiac Centre, Calicut, Kerala.

Dear Colleagues,

Greetings from the Society for Heart failure and Transplantation.

March issue of The Revival deals with the role of Cardiac Rehabilitation in cardiac illness. In this article, Dr Abraham Samuel Babu has stressed the need for cardiac rehabilitation programme in more and more centres. Recovery from myocardial infarction,

heart failure or coronary artery disease with or without intervention is highly influenced by the structured cardiac rehabilitation programme which is under utilized at present. Short term and long term benefits thus gained should be given due importance.

Best wishes

- Prof. (Dr) V. Nandakumar
President

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Special thanks to Dr Abraham Samuel Babu for authoring this month's article.

Designed by Maithili Kulkarni

CARDIAC REHABILITATION



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Dr Babu is an Associate Professor in Physiotherapy at Manipal Academy of Higher Education, Manipal and an Honorary Fellow in the Department of Cardiology, Austin Health, University of Melbourne, Australia and currently oversees the cardiac rehabilitation services at Kasturba Hospital, Manipal. He is actively involved with professional organisations in the building of up cardiac rehabilitation and is the Young Ambassador to India for the European Association of Preventive Cardiology. He has been part of the Salim Yusuf's Emerging Leaders program (2019 Heart failure cohort) from the World Heart Federation and has been an Endeavor Fellow to the Department of Cardiology, Austin Health, University of Melbourne. He is also the founding director for Pulmonary Vascular Research Institute-India. Dr. Babu focuses his research in cardiac rehabilitation with a special interest in heart failure and pulmonary hypertension and translational research in pulmonary hypertension and has been funded from various National and International sources.

Introduction

Cardiac rehabilitation (CR) has been defined as the “sum of activities required to influence favourably the underlying cause of the disease, as well as the best possible physical, mental and social conditions, so that they may by their own efforts, preserve or resume when lost, as normal a place as possible in the society. Rehabilitation cannot be regarded as an isolated form of therapy but must be integrated within the entire treatment”.¹ CR first began with Levine and Lown when they started the “Chair Therapy” for patients with MI. This gradually progressed through the years and it was in 1955 that the first structured CR program was started in Israel by Kellermann et al. The first protocol to be following MI was designed by Wenger et al.² From then on, the concept of CR has grown in leaps and bounds since it was introduced in the 1960s.

The Tables below summarise the various benefits of CR³⁻⁵ (Table 1) and the evidence from Cochrane reviews supporting CR in coronary artery disease⁶, heart failure⁷ and pulmonary hypertension⁸ (Table 2).

Table 1: Benefits of Cardiac Rehabilitation

- Improves control of risk factors
- Reduction in obesity indices (BMI and fat by 1.5% and %5)
- Improves lipid profiles (5% reduction in total cholesterol, 2% reduction in LDL and 6% improvement in HDL)
- Reduction in metabolic syndrome by 37%
- Improves exercise capacity by 15% and 35% for peakVO₂ and MET
- Improves quality of life
- Reduces cardiovascular related mortality (OR: 0.64, 95% CI 0.46 to 0.88)
- Reduces all-cause mortality (OR 0.74, 95% CI: 0.58 to 0.95)
- Reduces 12-month mortality (RR 0.82, 95% CI, 0.67–1.01)
- Reduces risk of re-infarction (OR: 0.53, 95% CI 0.38 to 0.76)
- Reduces 12-month re-admissions (RR 0.75, 95% CI 0.62 to 0.92)
- Reduces heart failure specific admissions (RR 0.61, 95% CI 0.46 to 0.8)

Table 2: Summarising the evidence from various Cochrane reviews, further highlights the benefits of CR in Coronary artery disease, heart failure and pulmonary hypertension

Condition	Reference	Main outcomes
Coronary heart disease	Dibben G, et al. Exercise-based cardiac rehabilitation for coronary heart disease. Cochrane Database Syst Rev. 2021 Nov 6;11(11):CD001800	Reduction in all-cause & CVD related mortality (RR:0.87; 95% CI: 0.73-1.04 and RR: 0.88, 95% CI 0.68–1.15 respectively). Reduction in all-cause & CVD associated hospitalisation (RR: 0.58; 95% CI: 0.43-0.77 and 0.80, 95% CI 0.41–1.59 respectively) Improved QoL by mean difference of 1.23 (95% CI 1.04–3.50) and 2.33 (95% CI 1.02–3.63) for PCS and MCS in SF36
Heart failure	Long, L. et al. Exercise-based cardiac rehabilitation for adults with heart failure. Cochrane Database Syst Rev. 2019 Jan 29;1(1):CD003331.	Reduction in all-cause mortality (RR 0.89; 95% CI 0.66–1.21). Reduction in all-cause and HF related hospitalisations (RR 0.70; 95% CI 0.60–0.83 and RR 0.59; 95% CI 0.42–0.84 respectively)
Pulmonary hypertension	Morris NR, et al. Exercise-based rehabilitation programmes for pulmonary hypertension. Cochrane Database Syst Rev. 2017 Jan 19;1(1):CD011285	Mean six-minute walk distance following exercise training was 60.12 metres higher than control (30.17 to 90.07 metres). Mean change in HRQoL for the SF-36 physical component score was 4.63 points higher (0.80 to 8.47 points) and for the SF-36 mental component score was 4.17 points higher (0.01 to 8.34 points)

All this evidence has resulted in CR being Class 1 recommendation for patients with coronary artery disease and heart failure.⁹ Despite these strong recommendations, CR is a greatly “underutilised level 1A recommendation” in the management of coronary artery disease (<https://www.acc.org/latest-in-cardiology/articles/intouch/2012/02/13/05/47/cardiac-rehabilitation-an-underutilized-level-ia-recommendation>). A recently global survey of CR centres by the International Council for Cardiovascular Prevention and Rehabilitation (ICCP) has shown wide variations in availability of CR centres with inadequacies observed between high and low-middle income countries.¹⁰⁻¹² In India, the state of CR is quite poor with only a handful of centres providing CR. Considering the burden of ischemic heart disease in India (based on 2016 estimates), there is currently only 1 CR centre for every 360 eligible patients with IHD.¹³ This suggests the need for at least 300,000 more centers to cater to the burden of ischemic heart disease – not accounting for the rise in IHD and heart failure.

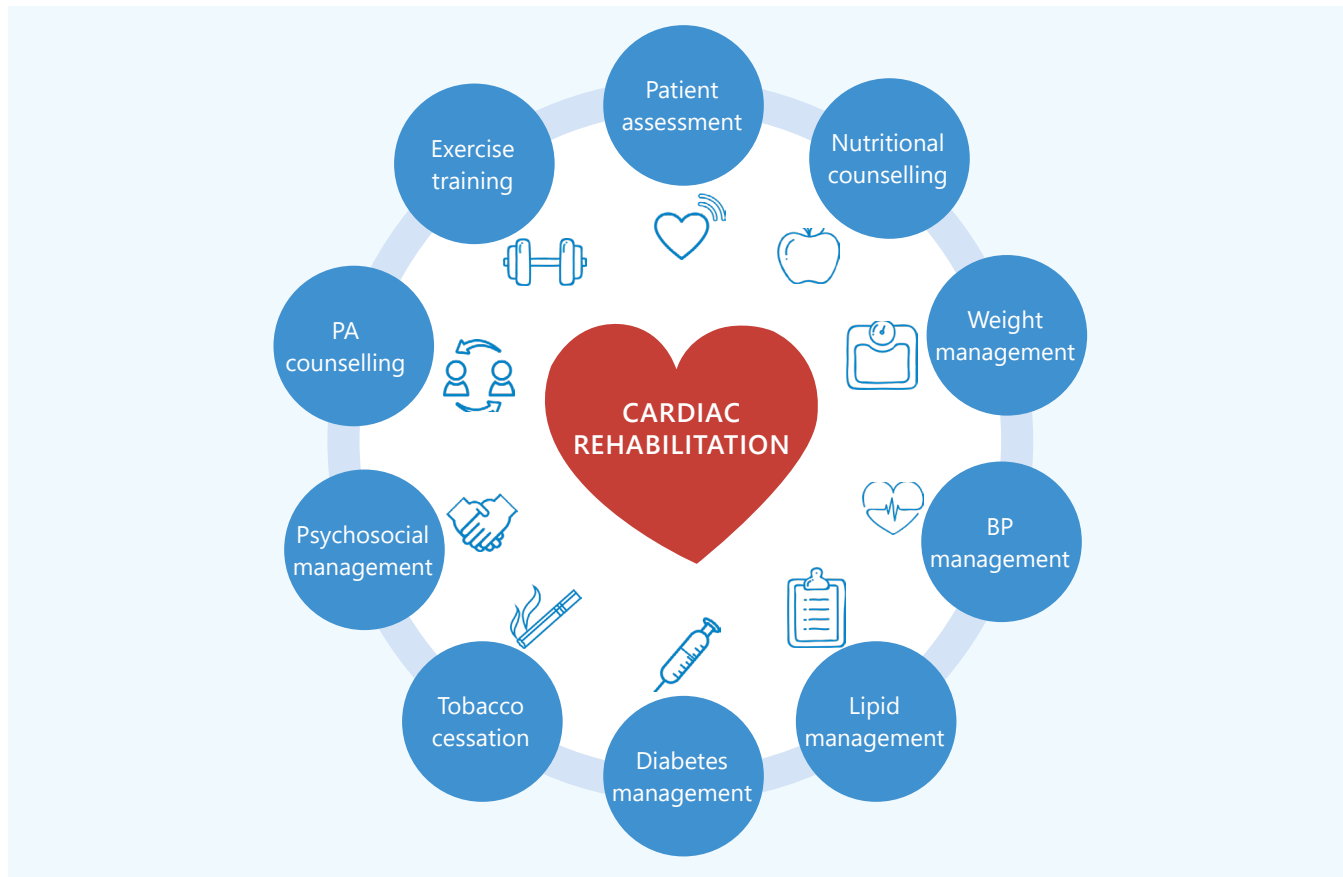
Phases & Core components of Cardiac Rehabilitation:

CR currently encompasses three phases viz., Phase-1 (acute phase), Phase-2 (immediate post-discharge) and Phase-3 (long-term out-patient).¹⁴ Earlier, there was a phase-4 focusing on long term maintenance, however, this is no longer used as per the recommendations from the European Association of Preventive Cardiology. Phase-1 should be initiated at the earliest within the hospital once patients are medically stable with the goals of preventing the deleterious effects of immobilisation. Phase-2 delivers CR following the index event and can be delivered through various settings (i.e., home, community or institution) including the use of telerehabilitation methods. Phase-3 looks at a sustained delivery of CR through the community.

CR initially was focused on exercise training. However, with the growth of literature in the area, it came to light that CR should

focus on components beyond exercise training. This resulted in the American Association of Cardiovascular Prevention & Rehabilitation (AACVPR) along with the American Heart Association (AHA) putting forward the core components of CR.¹⁵ This included various domains that should be a part of the CR program (Figure 1).

Figure 1: Core components of Cardiac Rehabilitation



Each of these domains have specific descriptions and targets that are driven by current guidelines and strategies (Table 3).

Table 3: Domains of Cardiac Rehabilitation

Domain	Description	Targets
Patient assessment	Perform a detailed physical and medical examination to include any testing and referral to specialists. Ensure adherence to medications.	Formulate short term goals for intervention strategies and follow up plans. Summarize long term goals and strategies for success.
Nutritional counselling	Evaluate dietary history and eating habits. Provide dietary interventions that are culturally relevant to the patient.	Ensure delivery of education and behavioural strategies to and address and adhere healthy nutritional choices.
Weight management	Evaluate height, weight and waist circumference and determine body mass index.	Establish short-term and long-term goals through lifestyle changes to achieve weight loss.

BP management	Perform BP measurements > 2 visits of both arms and in different positions. Ensure appropriate therapies when relevant.	Establish short-term and long-term targets for BP control and management.
Lipid management	Assess lipid profiles and initiate management and monitoring as per guidelines	Establish short- and long-term goals for control and management through lifestyle and pharmacological interventions
Diabetes management	Review records for history of diabetes, provide education and ensure control of blood sugars. Identify those at risk of exercise induced complications. Include appropriate referrals to specialist diabetes educators, physicians and dieticians.	Short-term, ensure education of the patient to identify signs/symptoms and monitoring of blood sugar. Long-term, obtain optimal blood sugar control.
Tobacco cessation	Identify the risk and assess readiness to change and encourage and support change in behaviour through education, counselling and pharmacological interventions.	Short-term, promote the change in behaviour and in the long-term, support for abstinence from smoking.
Psychosocial management	Look for signs of psychological distress and any relevant history. Offer stress management, counselling and pharmacotherapy (where indicated), along with referrals to specialists.	Emotional well-being and provide support for psychosocial issues identified
PA counselling	Assess current levels of PA and determine readiness to change. Provide advice, support and counselling to promote PA to ensure targets are achieved.	Adoption of a healthy and active lifestyle, with improvement in body composition, risk factor profile and fitness
Exercise training	Perform baseline evaluation of exercise capacity and perform risk stratification prior to prescribing appropriate exercises.	Ensure patient is able to monitor symptoms during exercise and understands the warning signs. Aim to improve cardiorespiratory fitness and thereby reduce cardiovascular risk.

Who will benefit from Cardiac Rehabilitation?

Cardiac rehabilitation has grown to encompass numerous conditions. Initially focused only on those coronary artery disease, CR has now shown to be beneficial to various groups with strong levels of evidence to support its use. The table below summarises the various conditions who would benefit from CR.

Table 4: Indications for Cardiac Rehabilitation

- Coronary artery disease undergoing revascularisation with PCI or CABG
- Stable coronary artery disease
- Chronic stable angina
- Heart failure
- Atrial fibrillation
- Peripheral vascular disease

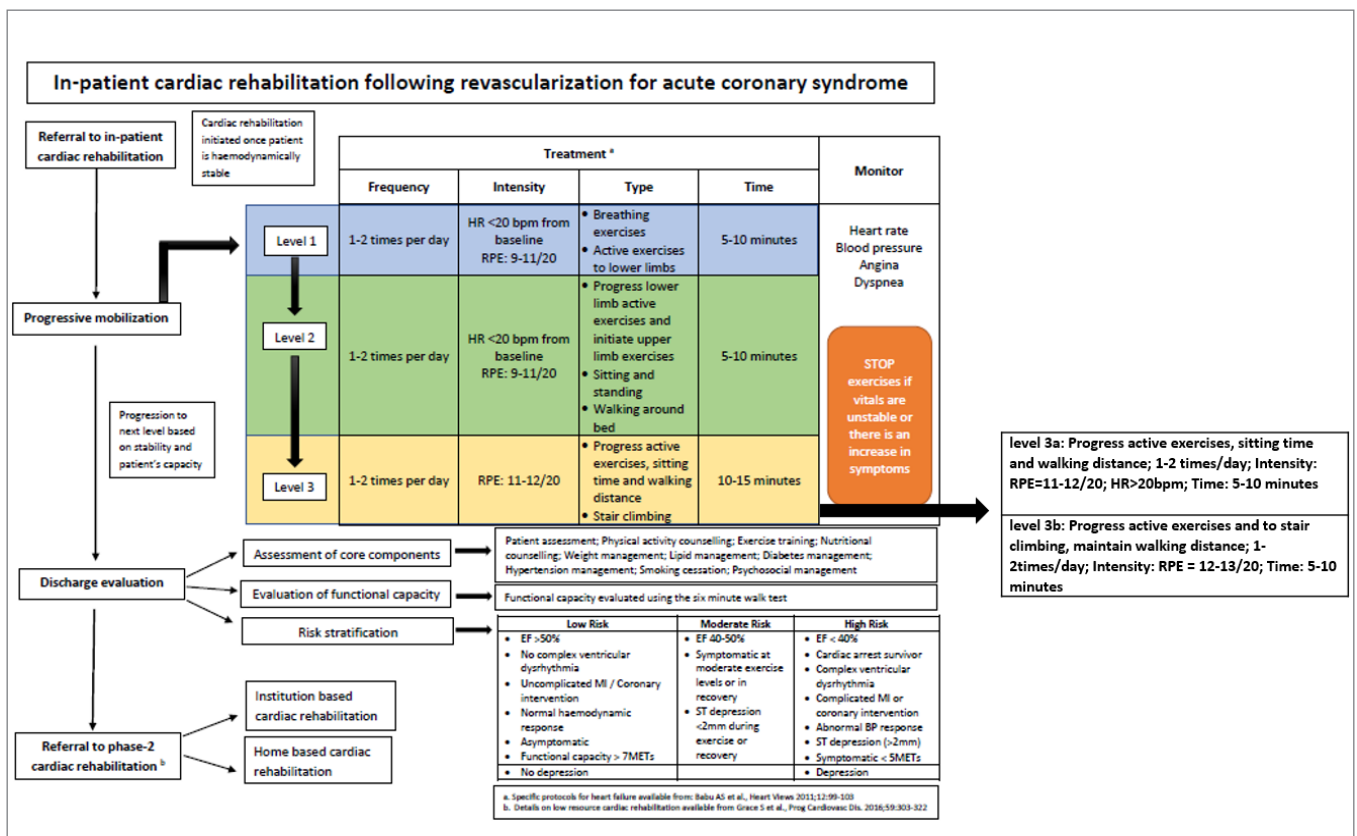
In addition to those listed above, certain conditions like acute decompensated heart failure,^{16,17} abdominal aortic aneurysm^{18,19} and pulmonary hypertension²⁰ are gaining attention for the benefits of CR and more specifically, exercise training.

How do we implement CR in our settings?

In the simplest form, CR can begin during the hospitalisation phase with early mobilisation and some simple active exercises. A referral to a physiotherapist will facilitate this process. Promotion of a healthy lifestyle through exercise and physical activity, along with diet and risk factor modification should be emphasised by all those involved in the care of the patient during the hospitalisation. The use of multiple healthcare professionals is desired, but in situations where not available, it is vital to implement task sharing, which has recently shown to be helpful in the management of chronic disease. Thus, healthcare professionals involved in cardiac care have a vital role to play in promoting CR as shown in a recent consensus document in which individual face-to-face encounters while in-hospital were more valuable to CR referrals.²¹

In-hospital CR: When providing CR to patients admitted in hospital, most of the CR that is provided is exercise based and traditionally is classified as Phase-1 CR. This includes gradual mobilization and low intensity exercise training. The Cardiology Society of India developed various treatment algorithms for the management of ST elevation myocardial infarction, one of which was for phase-1 CR.²² This algorithm was found to be feasible when used for phase-1 CR and did incorporate a slight modification to the protocol.²³ The modified protocol is given below.

Figure 2: Phase-1 CR in patients with STEMI undergoing revascularisation



Similar protocols are also available for heart failure – both for stable patients and those being admitted for decompensation.^{16,24}

Home-based CR: This involves patients exercising at home through a structured program which is as effective as supervised CR program.²⁵ This has now become an easy way to provide CR to patients who are limited by various geographical or economical constraints. Participation in home-based CR gives participants the flexibility to participation in CR, minimal to no travel times and integration with the regular home routine.²⁶ Some of the exercise prescriptions that have been used for home-based CR in the Indian context are based on the use of active exercises, walking at moderate intensity using the

Borg's rating of perceived exertion and the use of resistance exercises to upper limbs using water bottles and the use of body weight supported exercises. These exercises have been used for coronary artery disease^{22,27}, heart failure^{16,24} and pulmonary hypertension²⁸.

Setting up a CR clinic:

This can seem daunting. However, breaking it down to make things simple makes it easy ensure, CR is available at almost each center. The International Council for Cardiovascular Prevention and Rehabilitation (ICCPR) has provided a consensus statement for the implementation of CR in low resource settings.²⁹

Table 6: Domains of CR

Domain	Low cost	High cost
Assessment	Evaluation by a general physician	Multidisciplinary evaluation by a team of specialists
Risk factor modification	Advice and treatment by treating physician or advice by any other healthcare professional available on the need for healthy living and the basic assessment of these aspects from medical history	Evaluations by medical specialists and nutritionists or dieticians, followed by reinforcement by the primary care physician
Tobacco cessation		Evaluation by respiratory medicine specialists and clinical psychologists to devise strategies to help overcome tobacco – along with the use of specialised clinics
Psychosocial management		
Exercise training	Simple tests like the 6MWT can be used to determine exercise capacity and the use of simple home-based walking programs can be given	Evaluation by Referral to exercise specialists where specific exercise-based evaluations to evaluate exercise capacity can be done. Specific training methods can be used like treadmills, cycles, weights, among others in specialised centers with or without telemetry.
PA promotion	Engaging in simple household activities and activities outside the house	Detailed evaluations of energy expenditure can be performed along with objective measurements of physical activity using accelerometry by experienced physiotherapists along with strategies to promote PA through efforts of physiotherapists and clinical psychologists

Despite the constrains of setting up an advanced CR clinic, it is advisable to at least ensure the basic healthy living advice and recommendations are provided so that the cardiovascular care that patients receive remain completely evidence based.

Steps forward:

Scaling up CR availability is the need of the hour in India. With almost all hospitals having healthcare professionals (i.e., physicians, nurses, physiotherapists, among others) available to deliver various aspects of cardiac care, task sharing among these healthcare professionals needs to be considered. Building capacity among these professionals is vital to ensure promoting CR in the clinical setting. The ICCPR has developed a CR foundations course (CRFC) which helps train healthcare professionals in CR through an online mode (<http://iccpr.estv.in/>). The course contains seven modules with an exam at the end, to help the individual earn the title of "CRFC". This has shown to have a good reach and very positive feedback with

substantial impact on clinical practice; though with limited participants from low-resource settings.³⁰ Having these professionals take up this course, will help in creating the workforce deliver CR to low-risk individuals. Those patients of high risk, will still require specialised CR interventions from qualified physiotherapists/exercise specialists with training in CR. Further certification programs are available from the American Association of Cardiovascular Prevention & Rehabilitation (AACVPR).

CONCLUSION:

CR in India has a long way to go. There is a need to build capacity among healthcare professionals on the competencies to deliver CR. However, the need of the hour is to increase the number of centers offering CR, even if for the acute period of illness, across all cardiac centers of the country. Expansion of existing services to include home-based CR or technologically driven CR is vital for the expansion and reach of CR to patients across the country.

References:

1. Committee WE. Rehabilitation after cardiovascular diseases, with special emphasis on developing countries. In: WHO Technical Report Series. Geneva; 1993.
2. Wenger N, Gilbert C, Skorapa M. Cardiac conditioning after myocardial infarction. An early intervention program J Cardiac Rehabil. 1971;2:17-22.
3. Sagar VA, Davies EJ, Briscoe S, Coats AJ, Dalal HM, Lough F, Rees K, Singh S, Taylor RS. Exercise-based rehabilitation for heart failure: systematic review and meta-analysis. *Open heart*. 2015;2:e000163. doi: 10.1136/openhrt-2014-000163
4. Lavie CJ, Arena R, Swift DL, Johannsen NM, Sui X, Lee DC, Earnest CP, Church TS, O'Keefe JH, Milani RV, et al. Exercise and the cardiovascular system: clinical science and cardiovascular outcomes. *Circulation research*. 2015;117:207-219. doi: 10.1161/circresaha.117.305205
5. Lawler PR, Filion KB, Eisenberg MJ. Efficacy of exercise-based cardiac rehabilitation post-myocardial infarction: a systematic review and meta-analysis of randomized controlled trials. *Am Heart J*. 2011;162:571-584.e572. doi: 10.1016/j.ahj.2011.07.017
6. Dibben G, Faulkner J, Oldridge N, Rees K, Thompson DR, Zwisler AD, Taylor RS. Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database Syst Rev*. 2021;11:CD001800. doi: 10.1002/14651858.CD001800.pub4
7. Long L, Mordi IR, Bridges C, Sagar VA, Davies EJ, Coats AJ, Dalal H, Rees K, Singh SJ, Taylor RS. Exercise-based cardiac rehabilitation for adults with heart failure. *Cochrane Database Syst Rev*. 2019;1:CD003331. doi: 10.1002/14651858.CD003331.pub5
8. Morris NR, Kermeen FD, Holland AE. Exercise-based rehabilitation programmes for pulmonary hypertension. *The Cochrane database of systematic reviews*. 2017;1:CD011285. doi: 10.1002/14651858.CD011285.pub2
9. Simon M, Korn K, Cho L, Blackburn GG, Raymond C. Cardiac rehabilitation: A class 1 recommendation. *Cleve Clin J Med*. 2018;85:551-558. doi: 10.3949/ccjm.85a.17037
10. Supervia M, Turk-Adawi K, Lopez-Jimenez F, Pesah E, Ding R, Britto RR, Bjarnason-Wehrens B, Derman W, Abreu A, Babu AS, et al. Nature of Cardiac Rehabilitation Around the Globe. *EClinicalMedicine*. 2019;13:46-56. doi: 10.1016/j.eclinm.2019.06.006

11. Turk-Adawi K, Supervia M, Lopez-Jimenez F, Pesah E, Ding R, Britto RR, Bjarnason-Wehrens B, Derman W, Abreu A, Babu AS, et al. Cardiac Rehabilitation Availability and Density around the Globe. *EClinicalMedicine*. 2019;13:31-45. doi: 10.1016/j.eclinm.2019.06.007
12. Pesah E, Turk-Adawi K, Supervia M, Lopez-Jimenez F, Britto R, Ding R, Babu A, Sadeghi M, Sarrafzadegan N, Cuenza L, et al. Cardiac rehabilitation delivery in low/middle-income countries. *Heart*. 2019;105:1806-1812. doi: 10.1136/heartjnl-2018-314486
13. Babu AS, Turk-Adawi K, Supervia M, Lopez Jimenez F, Contractor A, Grace SL. Cardiac Rehabilitation in India: Results from the International Council of Cardiovascular Prevention and Rehabilitation's Global Audit of Cardiac Rehabilitation. *Global Heart*. 2020;15:28. doi: doi.org/10.5334/gh.783
14. Piepoli MF, Corra U, Adamopoulos S, Benzer W, Bjarnason-Wehrens B, Cupples M, Dendale P, Doherty P, Gaita D, Hofer S, et al. Secondary prevention in the clinical management of patients with cardiovascular diseases. Core components, standards and outcome measures for referral and delivery: a policy statement from the cardiac rehabilitation section of the European Association for Cardiovascular Prevention & Rehabilitation. Endorsed by the Committee for Practice Guidelines of the European Society of Cardiology. *Eur J Prev Cardiol*. 2014;21:664-681. doi: 10.1177/2047487312449597
15. Balady GJ, Williams MA, Ades PA, Bittner V, Comoss P, Foody JA, Franklin B, Sanderson B, Southard D. Core components of cardiac rehabilitation/secondary prevention programs: 2007 update: a scientific statement from the American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee, the Council on Clinical Cardiology; the Councils on Cardiovascular Nursing, Epidemiology and Prevention, and Nutrition, Physical Activity, and Metabolism; and the American Association of Cardiovascular and Pulmonary Rehabilitation. *J Cardiopulm Rehabil Prev*. 2007;27:121-129. doi: 10.1097/01.HCR.0000270696.01635.aa
16. Babu AS, Maiya AG, George MM, Padmakumar R, Guddattu V. Effects of Combined Early In-Patient Cardiac Rehabilitation and Structured Home-based Program on Function among Patients with Congestive Heart Failure: A Randomized Controlled Trial. *Heart views : the official journal of the Gulf Heart Association*. 2011;12:99-103. doi: 10.4103/1995-705x.95064
17. Kitzman DW, Whellan DJ, Duncan P, Pastva AM, Mentz RJ, Reeves GR, Nelson MB, Chen H, Upadhyya B, Reed SD, et al. Physical Rehabilitation for Older Patients Hospitalized for Heart Failure. *N Engl J Med*. 2021;385:203-216. doi: 10.1056/NEJMoa2026141
18. Kato M, Kubo A, Green FN, Takagi H. Meta-analysis of randomized controlled trials on safety and efficacy of exercise training in patients with abdominal aortic aneurysm. *J Vasc Surg*. 2019;69:933-943. doi: 10.1016/j.jvs.2018.07.069
19. Nakayama A, Morita H, Komuro I. Comprehensive Cardiac Rehabilitation as a Therapeutic Strategy for Abdominal Aortic Aneurysm. *Circ Rep*. 2019;1:474-480. doi: 10.1253/circrep.CR-19-0095
20. Grünig E, Eichstaedt C, Barberà JA, Benjamin N, Blanco I, Bossone E, Cittadini A, Coghlan G, Corris P, D'Alto M, et al. ERS statement on exercise training and rehabilitation in patients with severe chronic pulmonary hypertension. *Eur Respir J*. 2019;53. doi: 10.1183/13993003.00332-2018
21. Santiago de Araujo Pio C, Beckie TM, Varnfield M, Sarrafzadegan N, Babu AS, Baidya S, Buckley J, Chen SY, Gagliardi A, Heine M, et al. Promoting patient utilization of outpatient cardiac rehabilitation: A joint International Council and Canadian Association of Cardiovascular Prevention and Rehabilitation position statement. *Int J Cardiol*. 2020;298:1-7. doi: 10.1016/j.ijcard.2019.06.064
22. Mishra S, Ramakrishnan S, Babu AS, Roy A, Bahl VK, Singru KV, Chugh S, Sengupta S, Kaul U, Boopathy SN, et al. Management algorithms for acute ST elevation myocardial infarction in less industrialized world. *Indian Heart J*. 2017;69 Suppl 1:S98-s103. doi: 10.1016/j.ihj.2017.03.005
23. Satyamurthy A, Prabhu N, Padmakumar R, Babu AS. Feasibility of an exercise-based cardiac rehabilitation algorithm in patients following percutaneous coronary intervention for acute coronary syndrome. *Indian Heart J*. 2020;72:289-292. doi: 10.1016/j.ihj.2020.07.011
24. Babu AS, Padmakumar R, Devasia T. Exercise based evaluations and rehabilitation in heart failure: An addendum to the Cardiology Society of India's management protocols for chronic heart failure. *Indian Heart J*. 2018;70:459-461. doi: 10.1016/j.ihj.2018.04.007

25. Taylor RS, Dalal H, Jolly K, Zawada A, Dean SG, Cowie A, Norton RJ. Home-based versus centre-based cardiac rehabilitation. The Cochrane database of systematic reviews. 2015:Cd007130. doi: 10.1002/14651858.CD007130.pub3
26. Thomas RJ, Beatty AL, Beckie TM, Brewer LC, Brown TM, Forman DE, Franklin BA, Keteyian SJ, Kitzman DW, Regensteiner JG, et al. Home-Based Cardiac Rehabilitation. *Journal of the American College of Cardiology*. 2019;74:133-153. doi: 10.1016/j.jacc.2019.03.008
27. Babu AS, Noone MS, Haneef M, Naryanan SM. Protocol-Guided Phase-1 Cardiac Rehabilitation in Patients with ST-Elevation Myocardial Infarction in A Rural Hospital. *Heart views : the official journal of the Gulf Heart Association*. 2010;11:52-56. doi: 10.4103/1995-705x.73209
28. Babu AS, Padmakumar R, Nayak K, Shetty R, Mohapatra AK, Maiya AG. Effects of home-based exercise training on functional outcomes and quality of life in patients with pulmonary hypertension: A randomized clinical trial. *Indian Heart J*. 2019;71:161-165. doi: 10.1016/j.ihj.2019.03.002
29. Grace SL, Turk-Adawi KI, Contractor A, Atrey A, Campbell NR, Derman W, Ghisi GL, Sarkar BK, Yeo TJ, Lopez-Jimenez F, et al. Cardiac Rehabilitation Delivery Model for Low-Resource Settings: An International Council of Cardiovascular Prevention and Rehabilitation Consensus Statement. *Prog Cardiovasc Dis*. 2016. doi: 10.1016/j.pcad.2016.08.004
30. Babu AS, Heald FA, Contractor A, Ghisi GLM, Buckley J, Mola A, Atrey A, Lopez-Jimenez F, Grace SL. Building Capacity Through ICCPR Cardiovascular Rehabilitation Foundations Certification (CRFC): EVALUATION OF REACH, BARRIERS, AND IMPACT. *J Cardiopulm Rehabil Prev*. 2021. doi: 10.1097/hcr.0000000000000655

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