Dear Reviewer,

Thank you for providing these detailed review comments. We have specifically and thoroughly addressed each of the suggestions and have indicated where the content was addressed with a copied and pasted portion from the revised manuscript when appropriate, as you will see below.

Cardiac rehabilitation and its essential role in the secondary prevention of cardiovascular diseases.

The article represent an overview of the current situation of cardiac rehabilitation services in the world. The authors did well in gathering the information about the current services. However, there are some necessary changes need to be made, and some points needs to be clarified. Additionally, language editing is very necessary.

Author response: My co-authors and I would like to thank you for a comprehensive review of our work. We really appreciate your thorough comments and will address them immediately below.

There are many statements that need to be backed up with immediate reference, to make it easier for the reader to track the source of the information stated. For example "Determinants also exist at the social, economic, and cultural levels – globalization, urbanization, and population aging" .

"CVDs are also related to psychological disorders such as anxiety, depression, and sleep disorders"

" Already in 1772, Heberden observed the beneficial effects in the patient he advised saw wood for 30 mins daily over six months"

And many more!

Author response: Thank you for the comment. We tried to identify all these statements and back them up immediately with valid references.

In the manuscript it is stated "rom today's perspective, it is unfortunate that these first positive observationsthese first positive observations" How many obeservation we notices since 1772?

Author response: Thank you for this comment. We noticed a lot of observations since 1772. We decided to delete this sentence because it is misleading and not really important for our article.

Ovrall the cardiac rehabilitation paragraph requires a lot of backing up statement with references.

There are some abbreviations that were used before introducing them. CR was introduced in Cardiac rehabilitation paragraph and was not given what it stands for. Similarly, for AHA.

Author response: Thank you. We checked all abbreviations appearing in the article. Now it should be correct. For example, abbreviations "CR" and "AHA" are introduced immediately in section INTRODUCTION.

The statement "A comprehensive CR program is primarily based on the favorable effects of physical exercise, but contemporary programs also include educational sessions focusing on risk factors, lifestyle and its modification, nutritional advice, psychological support, and optimized pharmacotherapy" This is exactly the definition of comprehensive CR so there is no need for contemporary.

Author response: Thank you for the above suggestion. We deleted "contemporary", now it is clearer.

"CR consists of the following phases: hospitalization phase (Phase I), outpatient phase (Phase II), and maintenance phase (Phase III)" There are many guidelines for CR prgrams, where some of them introduce CR in 4 phases not just 3 (for example the british association for cardiac rehabilitation and Scotish intercolligiate guidelines network). Therefore, backing up this statement is rquired with immediate reference is needed.

Additionally, Phase 1 is mainly initiated immediately from the first day post operation and not just wait until prior discharge.

Author response: Thank you for these comments. We added also Phase IV and backed it up with immediate reference. We also reformulated our statement about Phase I to make it clearer.

"(classical and/or cardiopulmonary exercise testing" what do you mean by classical here?

Author response: Thank you for this comment. It was misunderstanding, "too wordy statement". We have simplified it.

Change: with the input from exercise stress testing (cardiopulmonary exercise testing; e.g., spiroergometry or walk tests)[27,28].

The paragraph describing the phases of CR require a lot of clarification and need to be re-written as some statements it is unknown which phase of CR is wirtten about. Also there is no information about phase 1 which is during the inpatient phase. For example, introduction to life style changes should be initated from the phase 1 via education and providing leaflets and education materials to the patients.

Author response: Thank you for these comments. We tried to re-write this paragraph due to your suggestions.

Change: CR consists mainly of the following phases: hospitalization phase (Phase I), outpatient phase (Phase II), and maintenance phase (Phase III/IV)[27,28,29]. Phase I is initiated early in hospital (in most cases till 48 hours post operation)[29] and is aimed at patients cardiovascular system adaptation to physical activity, as well as having a crucial role in terms of discharge planning[27,28]. At least as important is the education of patients about risk factors and initiation of their lifestyle changes. A long-term secondary prevention plan is set up during that phase[27,28].

"The aim is to maintain the established principles under minimal professional supervision with the target of permanent stabilization of the patient's health" There is so much ambigouity in this statement. What are exactly the main principles that need to be maintained.

Author response: Thank you for this suggestion. An adjustment is inserted below.

Change: The aim of Phase III/IV is to maintain the established lifestyle changes under minimal professional supervision with the target of stabilization patient's health[27,28,29].

"According to the retrospective study by Pavy et al.[32], 1 event is associated with 49,565 hours of physical exercise and 8,484 stress tests" What is 1 event ? do you mean cardic arrest? Or sever ischemic changes?

Author response: Thank you for this suggestion. An adjustment is inserted below.

Change: According to the retrospective study by Pavy et al.[37], 1 severe cardiac event was associated with 49,565 hours of physical exercise and 8,484 stress tests. The cardiac arrest rate was calculated to be 1.3 per million hours of training.

"permanent stabilization of the patient's health" the use of the word permenant is very optimistic and less realistic, I suggest deleting it.

"ejection fraction, functional capacity, the presence of ischemia (on exercise testing), and any presence of cardiac arrhythmias, as well as by other diagnostic tests which could be considered as relevant" the presence of ischemia is detected by ST segement changes, please add that to your statement with explanation. Presence of cardiac arrythmias is very broad, you need to specify it for example uncontrolled arrythmias, as most of the patients will experience cardiac arrythmias.

Author response: Thank you for these comments. We added explanation to this statement and made some other changes due to your suggestions.

Change: "ejection fraction, functional capacity, the presence of ischemia (electrocardiography ST segment changes; e.g., during exercise stress testing), and any presence of uncontrolled cardiac arrhythmias, as well as by other diagnostic tests which could be considered as relevant"

"Chronic HF is an increasing health problem" since you introduced HF, I would suggst discussing the types of HF including HFrEF and HFpEF. And make sure backing your statement with immediate references. And when HF is mentioned try to specifiy which type is mentioned in the studies you cited when available.

Author response: Thank you for the above comments. We discussed the types of HF as you mention and also we tried to specify these types in the rest of the article when possible.

Also in the same paragraph you firstly introduced exercise based CR. I suggest when you described CR to define that there is comprehensive CR and only exercise based CR.

And make sure when you mention CR to identify which is which. For example, "CR makes little or no difference in all-cause mortality over the short term (but may improve it in the long-term)" Which CR is this?

Author response: Thank you. Exercise-based CR was defined due to your comment and specified in the rest of the article.

Change: A CR program is primarily based on the favorable effects of physical exercise (exercise-based CR), but comprehensive programs also include educational sessions focusing on risk factors, lifestyle and its modification, nutritional advice, psychological support, and optimized pharmacotherapy (Figure 1).

"exercise-based CR makes little or no difference in all-cause mortality over the short term (but may improve it in the long-term)"

"In the protocol-specified primary analysis, exercise training resulted in nonsignificant reductions in mortality or hospitalization" which protocol?

Author response: Thank you for this. It was the protocol of the study, but we decided to make it easier. We think it was not really important for this statement.

Change: In the primary analysis, exercise training resulted in nonsignificant reductions in mortality or hospitalization. Nevertheless, after adjusting for highly prognostic predictors, exercise-based CR was associated with modest significant decreases in both all-cause mortality/hospitalization and cardiovascular mortality/HF-specific hospitalization.

"It seems that CR efficiency in HF also depends on the ejection fraction of the left ventricle" for this reason you need to specify which HF patient types you are mentioning.

"Aerobic endurance exercise is the gold standard of the outpatient training program. While most European and North American guidelines recommend a moderate-high intensity, lower-intensity exercise is preferred in the UK, Australia, and New Zealand" what is the reference used for this statement?

Author response: Thank you for the comment. The valid reference was added.

"The latter countries also put less accent on technical stress examination (such as electrocardiography, spiroergometry) while routinely using walk tests (e.g. the 6-min walk test, shuttle walk test) to assess the functional capacity" there should be a justification why 6MWT and ISWT is more preferred in some areas for some reasons. For example, there graded

exercise testing require sophysicated equipment. Please discuss thid further, also keep in mind that there are justifications for the use of 6mwt and ISWT. Also ISWT should not be underestimated as some studies found that it provoke similar challenges to the heart as the GXT.

Author response: Thank you. We discussed all your suggestions in the article.

Addition: Timed walk tests are easy to implement, requires fewer resources, does not require expensive equipment, and can be a feasible alternative to evaluate functional capacity[50,51]. In the study by Harris et al.[52], results from 6-min walk test highly correlated with peak oxygen uptake (peakVO_2) measurement among CR patients. Due to Lelis et al.[51], Incremental Shuttle Walk Test (ISWT) can contribute to identifying patients at low risk for a cardiac event during exercise at moderate intensity. Hanson et al. [50] provide support for the ISWT as a convenient field test, but not as a surrogate to predict symptom-limited exercise test duration for individuals. Recently, however, there has been an increasing emphasis on comprehensive stress assessment prior to and after completing the training program[53] including technical exercise stress testing, especially for high-risk patients[30].

"Training sessions should be organized 3-5 times a week, and each session should last 20-60 mins" 20 min is very short to include warming up and cooling down with exercise session!

Author response: Thank you for this comment. An adjustment is inserted below, we hope it is clearer now.

Change: Training sessions should be organized 3-5 times a week, and each session (main exercise) should last 20-60 mins[54].

"The optimum exercise intensity lies within the range of 40-70% of the heart rate (HR) reserve or 50-80% of the exercise capacity" this statement need clarification. 50-80% of the max HR achieved during exercise testing?

Author response: Thank you for this comment. An adjustment is inserted below, we hope it is clearer now.

Change: The optimum exercise intensity lies within the range of 40-70% of the heart rate (HR) reserve or 50-80% of the exercise capacity (peak HR, peakVO2) achieved during exercise stress testing[54,55].

"Some of the main goals of an optimally set exercise-based CR program are the achievement of improved physical fitness, exercise tolerance" The word physical finess and exercise tolerance what is the difference between them?

Author response: Thank you for this comment. It was a mistake; it is almost the same. We think the term "cardiorespiratory fitness" instead of "physical fitness" is more valid.

"Current HIIT research limitations are that most studies use mostly one training modality, which is not a reflection of the real environment where different types of physical activity are common[60]. Besides, future research should also focus on women, as this population is a minority in the studies and this gender bias represents a limitation in generalizing the results" This statement need clarfication, for example, what real environment is referred to here!

Author response: Thank you. We used "real world" instead of "environment". We hope, this statement in now understandable.

Resistance training paragraph need to be written in past tens.

Author response: Thank you, we have processed this comment.

"As other alternatives, this may be a suitable choice for patients for whom the conventional form of CR is unavailable" This statement about yoga can not be made as the referenced article did not compare between conventional CR and yoga.

Author response: Thank you for this comment, it was a mistake on our side. We re-wrote the paragraph.

Change: Yoga as a combination of physical and respiratory exercise and meditation can also be a useful CR supplement. Yoga was demonstrated to reduce stress and improve the autonomous nervous system's function, thereby affecting cardiovascular risk factors[82]. An alternative approach through Yoga has been shown to improve the

subjective assessment of health status, reaching pre-infarct levels[83]. If Yoga is found to be effective in CR, it has the potential to transform the care of acute myocardial infarction patients in India and other low-middle income country settings[84].

"García et al.[78] compared the effect of conventional and modified tennis training in"
what is modified tennis training and what it has to do with dancing?

Author response: Thank you. An adjustment is inserted below, we hope it is clearer now. Also, we separated paragraphs about tennis and dance.

Change: "García et al.[78] compared the effect of conventional and modified tennis training (to control the exercise intensity according to the patient's functional capacity; e.g., walking slowly, walking fast, jogging and running)"

"Virtual reality seems to be a feasible, effective, and safe complementary strategy within CR. Besides, playing video games is fun, which improves the motivation to exercise"
This statement need to be toned down as there is no certainity that virtual training is applicable to all types of CVD patients. Is there a reference that indicate that virtula reality is safe effective?

Author response: Thank you very much for this comment. You are absolutely right; an adjustment is inserted below.

Change: Technological progress also offers the opportunity to make use of virtual reality. New generations of active video games allow the user to interact with the platform through targeted movement exercises. Several significant cardiovascular benefits in this context are demonstrated by the reviews of García-Bravo et al. and Ruivo[88,89]. Besides, playing video games is fun, which improves the motivation to exercise[89]. The use of virtual reality could be considered as complementary tools of exercise training in CR. However, it is necessary to carry out studies with adequate methodological quality to determine the ideal technological systems, target populations and clear protocols to study their effects in the short, medium and long-term assessments[90].

"Adamopoulos et al.[86] demonstrate that the addition of inspiratory muscle training to CR results in supplementary improvement in respiratory muscle function, dyspnea, quality of life, and inflammatory/cardiac biomarkers, but not in cardiopulmonary exercise parameters in moderate HF" what do you mean by cardiopulmonary exercise parameters? And what type of HF patients here?

Author response: Thank you very much. An adjustment is inserted below. And the type of HF was also added if possible.

Change: Adamopoulos et al.[95] demonstrate that the addition of inspiratory muscle training to CR resulted in a supplementary improvement in respiratory muscle function, dyspnea, QoL, and inflammatory/cardiac biomarkers, but not in cardiopulmonary exercise parameters (e.g., peakVO_2, ventilatory threshold, exercise duration) in moderate chronic HF.

"There is a consensus that the inclusion of respiratory training can support the effect of conventional exercise and hence, should become a standard option of CR[85,86]" conventional exercise here need to be clarified, is it the one which include aerobic and resistance training?

Author response: Thank you for your comment. An adjustment is inserted below. We hope it is clear now.

Change: There is a consensus that the inclusion of respiratory training can support the effect of conventional aerobic exercise and hence, should become a standard option of CR[94,95].

The paragraph about patients with comorbidities, I do not get what is the delivered message from this paragraph. The model of personolized multimorbidity rehabilitation need clarification. Do you mean primary prevention?

Author response: Thank you for your comment. This section was completely re-written to give a clear message to the reader.

"A lower level of utilization is observed among several subgroups, such as older people[98], patients with comorbidities, unemployed, single, and less-educated individuals[99]" what is the input about this, any reasons?

Author response: Thank you for your comment here. The input of this study is data analysis about CR barriers in these subgroups of the population. But the real reasons are unknown, may be different in individuals. It could be really potent discussion, but we think beyond the scope of our article.

Again past tense of the writing need to be observed.

Author response: Thank you, we have processed this comment.

"Efficient strategies include personal meetings and telephone calls[128], shortening of the time to the start of the CR (≤10 days)" This is the variation between different CR programs, please mention other guidelines that emphasize the importance of initiating phase 1 from the first day especially in post cardiac revascularization.

Author response: Thank you very much for your comment. We tried to discuss it more.

Addition: The importance of initiating appropriate prevention early before hospital discharge cannot be overemphasized, as prevention treatment tends to decrease post-hospitalization[28]. It is necessary to emphasize the preventive measures (e.g., education, referral to CR) directly to the patient, even during the first days after admission/cardiac event, because failure to do so may suggest that these measures are valueless[28,29].

"This type of intervention appeared to be efficient, particularly in HF patients, low-income and low-educated patients" Reference for this statement?

One of the important strategies to improve adherence and completion is the behavioural strategies promote adherence. Please discuss it.

Author response: Thank you. We tried to discuss it more in this section.

Change/Addition: Due to review by Room et al. [150], focused on behavioural strategies for adherence promotion in older patients, the feedback and monitoring (e.g., individualized

graphic feedback on exercise goals and problem-solving support) showed positive outcomes, although there was a lack of evidence to recommend their use currently. According to Lynggaard et al.[151], individual patient education based on the Learning and Coping Strategies improved adherence compared to the standard program. This type of intervention appeared to be efficient, particularly in HF patients, low-income and low-educated patients[151]. It is suggested that patients may need ongoing attention and guidance during the outpatient phase of CR, but also in the long-term maintenance of their lifestyle changes[150,152].

"Although unsupervised delivery is not optimal for all CR patients (e.g. high-risk patients, especially from the beginning of Phase II) and utilization measurement in different settings may be difficult to compare, as it appears, strategies based on unsupervised delivery are most efficient for improving CR adherence." This is a very long sentence which need to be broken down. And why are you referring to the patients as CR patients. I would suggest the use of CVD patients.

Author response: Thank you. An adjustment is inserted below.

Change: As it appears, strategies based on unsupervised delivery are most efficient for improving CR adherence. Due to Pio et al.[124], such options result in completion improvement by 13%, although utilization measurement in different settings may be difficult to compare and unsupervised delivery is not optimal for all CVD patients (e.g., high-risk patients, especially from the beginning of Phase II)[124].

Home based program need language checking.

Author response: Thank you. The manuscript was reviewed in terms of English grammar and spelling through a translation agency.

"Like the center-based program, this option has a favorable effect on the risk factors, quality of life, and the risk of death or a cardiac event" This statement need to be backed up with a reference.

Author response: Thank you for the comment. The valid reference was added.

"while Batalik et al.[153] used an optical sensor" the optical sensors here, has it been checked for validity?

Author response: Thank you. Yes, optical wrist sensor was checked for validity, but only in health population. E.g., Henriksen A, Grimsgaard S, Horsch A, Hartvigsen G, Hopstock L. Validity of the Polar M430 Activity Monitor in Free-Living Conditions: Validation Study. JMIR Form Res 2019;3(3):e14438. doi: 10.2196/14438

"completion rate of TR interventions" why using completion rate, what is the standard completion rate? how completion rate is anough to assume that TR is an alternative to centre based CR?

Author response: Thank you very much. We made a little adjustment. Center-based cardiovascular rehabilitation has been shown to be effective (the mean completion rate is about 70%). There was fear about that TR would not reach such a completion rate as center-based (no professional supervision, potentially lower motivation to exercise, …) and TR will not be so effective. But this has not been proven (TR has even better adherence to exercise), so in this context, TR is an alternative to center-based CR also.

Change: A comparable completion of TR interventions with center-based programs supports the assumption for a sufficient alternative method[155].

With regards to TR, What are the basic necessary tools for TR?

Author response: Thank you for your comment here. We made an adjustment and inserted below.

Change: TR is defined as using information and telecommunication technologies to provide health service (rehabilitation) at a large distance. TR includes several approaches, such as remote monitoring, e-learning, and telecoaching[159] (Figure 3). They are approaches that may be used with advantage in home-based or community-based CR

programs. Among the most frequently used technologies are smartphones, computers, wearable sensors (for monitoring exercise parameters; e.g., HR, duration of physical activity) and the Internet[160,161].

". However, this risk population was already better represented in remote-controlled studies to assess lifestyle changes and psychological interventions. For these reasons, it follows that remotely monitored exercise training as part of TR is considered a safe alternative to outpatient CR only for CAD patients with a low-moderate risk of cardiovascular complications[67,157]" the message in this part need clarification.

Author response: Thank you very much for your comment. This section was re-written to give a clearer message to the reader.

Change: TR studies have been performed in almost all cardiac patients (including low-high risk patients). A comparable completion of TR interventions with center-based programs supports the assumption for a sufficient alternative method[155]. TR can affect barriers and is particularly suitable for those who face specific barriers and can not participate in center-based programs.

The assessment of the safety aspect of TR is based on the experience of center-based rehabilitation. Adverse events are rare in center-based programs[37]. A review of TR interventions reported no cardiovascular complication or death associated with physical training, mostly in studies that evaluated patients with low-moderate risk of cardiovascular complications[161]. Although patients at higher risk (e.g., HF patients) was already better represented in remote-controlled studies to assess lifestyle changes and psychological interventions, this high-risk population is under-represented in TR exercise interventions studies[170]. For these reasons, it follows that remotely monitored exercise training as part of TR is considered a safe alternative to outpatient CR only for CAD patients with a low-moderate risk of complications[74,161,170].

"Optimum treatment of a CVD requires a healthy lifestyle sustained in the long run, including regularly practiced physical activity. Such habits are introduced during CR Phase II" this should be introduced earlier not just on the phase 2.

Author response: Thank you very much, you are right. I hope we made it clear now.

Change: Optimum treatment of a CVD requires a healthy lifestyle sustained in the long run, including regularly practiced physical activity. Such habits are accepted and strengthened during Phase II of CR[27,28,29].

The rest of the comments are concerned with backing up the statement with references. As many statement in the rest of the manuscript need to be supported with evidence. Please check them. Also observe consistency in the terminology used. As some time the use of stress testing was observed wherase, in other parts the use of cardiopulmionary exercise testing was utelized.

Author response: Thank you very much once again for your review comments. We tried to identify all these statements and back them up immediately with valid references. We also checked the consistency of the terminology used. In this case, e.g., exercise stress testing.

Round-2:

The authors did their best to answer the comments and made necessary amendments. However, there are still some points need to be improved before considering this manuscript for publication. There are some grammatical issues which make some statements difficult to comprehend. For example: "In the 1960s, progressively earlier mobilization after the acute coronary event was practiced. It was realized that the belief that there would be measurable physical invalidism after an acute event was mostly unfounded[13]. this statment need clarification. There are some typos need to be fixed. Therefore, I suggest a good thorough proofreading of the manuscript as it still need some improvement.

Author response: Dear Editor and Reviewer, Thank you very much for providing review comments. We tried to do our best for improving our manuscript due to your suggestions. We made thorough proofreading to make some statements more comprehend.

Author response: The section "CARDIAC REHABILITATION" has been modified as you commented. Paragraph: …"In the 1960s, progressively earlier mobilization after the acute coronary event was practiced. It was realized that the belief that there would be measurable physical invalidism after an acute event was mostly unfounded [13]…"

Change: The "chair" therapy was introduced in the 1940s[14], and a short daily walk of 3-5 mins was allowed 4 wk after the coronary events first in the early 1950s[12]. Concerns about measurable physical invalidism after myocardial infarction were mostly unfounded. Many healed patients had exercise capacity equal to presumably healthy, sedentary middle-aged men[13]. In 1952 the first inpatient exercise training program for patients with CAD was described by Newman et al[15]. Controlled physical activity began during the second week in the hospital and increased until discharge at 6 wk.

We hope the text is more clarified now and better to comprehend for the reader. Our manuscript also received BPG Filipodia Service Confirmation – "Grade A: priority publishing; no language polishing required after editing." An English language certificate is attached below. Thank you once again. We tried to identify all grammatical and other typos due to your comments and make appropriate changes. We hope these improvements will be sufficient.