CARDIAC REHABILITATION DOSE: IS ENOUGH PRESCRIBED AROUND THE GLOBE AND HOW MUCH DO PATIENTS ADHERE?

TASLIMA MAMATAZ

A THESIS SUBMITTED TO THE FACULTY OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

GRADUATE PROGRAM IN KINESIOLOGY AND HEALTH SCIENCE
YORK UNIVERSITY
TORONTO, ONTARIO
July 2020

ABSTRACT

Participation in cardiac rehabilitation (CR) is Class I recommendation to mitigate cardiovascular disease burden, a leading cause of disability globally. CR adherence varies greatly and there is little evidence on which to base minimum dose recommendations. Therefore, the aims of this thesis are to describe dose received, including rate of intervening events, impact of risk factors burden on CR attendance by component and then ascertain countries that need to augment their CR dose. I have undertaken two interlinked research studies. The first study on twenty years cohort that demonstrated, in 1/6 of patients, CR attendance and completion were impacted by intervening events, and the remaining cohort attended about half of sessions prescribed. Many patients took advantage of components specific to their risk factors. In the 2nd study, CR is not available in almost half of the countries in the world, and many countries may need to increase their CR dose**.**

Keywords: coronary artery disease; secondary prevention; cardiac rehabilitation; attendance;

Dedication

I would like to dedicate this to my parents. Without their support and encouragement, I would not have come this far.

Acknowledgments

First and foremost, I would like to thank Almighty for all the blessings He's given me during the total process- the abilities and the opportunities and for the strength and guidance to accomplish the degree.

I would like to express my sincerest gratitude to the people who contributed to the completion of my master's thesis, and who have been with me throughout these past two years. Thank you to my supervisor Professor. Sherry Grace, for this great opportunity to work with you, and for your constant support, guidance and encouragement. You have taught me a great deal which I will take with me as I continue in my future endeavors. In addition, I would also like to thank Dr. Paul Oh for approving to be in my thesis supervisory committee. Finally, I would like to thank my thesis committee members, co-investigators from the global CR survey team and my colleagues for their kind and endless support.

Lastly, and most importantly, to my family and to my parents, I would not be where I am today without your encouragement, unconditional love and guidance. You have always encouraged me to challenge myself and have faith on me.

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1. OVERVIEW

Cardiovascular disease (CVD) is estimated to become the leading cause of disability worldwide by 2020 [1]. Cardiac rehabilitation (CR) is an outpatient chronic disease management program designed to reduce the mortality and morbidity burden in patients with CVD [2]. Indeed, previous work has shown that the more CR patients receive, the better the outcomes [3].

Although to date there has been no study examining the amount of CR, or dose, delivered around the world, a review of CR guidelines globally revealed recommendations for variable durations and session frequencies[4]. For example, the recommended duration ranged from a minimum of 3 weeks in Germany (although this is often residential) to a maximum of 12 months in Austria. The frequency recommended by the American Association of Cardiovascular and Pulmonary Rehabilitation, as well as the Canadian and European Associations of Cardiovascular Prevention and Rehabilitation was a minimum of 3 sessions per week, for 12 weeks, whereas guidelines for Austria, Australia, Japan and the United Kingdom recommend 3 or fewer per week. Therefore, the "dose" is not standardized, but likely based on funding policies and past practice. This variation would significantly affect costs to deliver CR, capacity to serve patients, and also outcomes achieved.

The effect of CR dose on morbidity and mortality has been scantly examined in the literature previously [5,6,7,8,9,10] , and has often only been based on prescribed dose and not the actual number of sessions patients attended. Results suggest a linear relationship where more is better,[11] but it does seem at least 12 sessions are needed[3]. How intervening clinical events and disease severity impacts dose received has also not been given much consideration in the field. Moreover, there is also little known about patient adherence to different aspects of CR programs,

such as education, and stress management. Therefore, the objectives of this thesis are to describe CR dose received, considering session type, examine how and whether intervening clinical events as well as disease severity impacts CR session dose received / adherence, and then characterize the dose of CR prescribed around the globe.

2. LITERATURE REVIEW

Cardiovascular disease (CVD) is a leading health burden globally. It accounts 31% of global burden which is equivalent to 17.5 million deaths annually[12]. Due to medical advancement, more people are surviving the initial cardiac event. However, these people with chronic CVD are at higher risk of having subsequent cardiac event [13]. Thus, CVD is among the leading causes of disability around the world, which contributes to 10% of disability adjusted life years (DALYs) lost world-wide [14].

Cardiac Rehabilitation (CR) is a secondary prevention model of care designed to stabilize, slow or even promote regression of CVD. The following core components are offered during CR: initial assessment, risk factor management (i.e., diet, tobacco, hypertension, dyslipidemia), structured exercise, patient education, and psychosocial counselling[15,16]. The recommended core components and standards for CR are quite consistent globally[17,18, 19,20]. Recent Cochrane systematic review and meta-analyses have shown that CR participation is associated with 26% reductions in cardiovascular mortality, and 18% reduction in hospital readmission[21].

2.1. Cardiac Rehabilitation Dose

Despite common guidance around CR standards / core components, and the robust evidence of benefit across many countries, there appears to be great variation in the number of

sessions patients are prescribed or receive/attend to be delivered all the core components and achieve secondary prevention targets, to reduce mortality and morbidity[22]. CR "dose" prescribed refers to the number of sessions prescribed per week times the number of weeks in a program; CR dose received refers to the number of sessions patients actually attend. Sessions would generally be comprised of some patient education or counselling, structured exercise and potentially some risk factor management. This would likely lead to variation in patient outcomes.

In addition to the review of exercise session dose prescribed in CR guidelines globally[4] summarized above, other information on dose prescribed is found in a review of national / regional surveys of CR programs[23]. The review showed that countries in South East Asia and the Western Pacific offer an average of 8.6 CR sessions (1.3 sessions per week for 6.5 weeks). Programs in Europe and Central Asia offer 17 CR sessions (2 sessions per week for 9 weeks). Latin America and Caribbean programs prescribe an average of 33 sessions (2.5 sessions per week for 13 weeks). Programs in the Middle East and North Africa offer 25 sessions (2.3 sessions per week for 11 weeks). Programs in North America offer the highest average dose of 42 sessions (2 sessions per week for 20 weeks). However, there was only data from 40% of the countries of the world that offer CR, and because different surveys were used in each country, comparison is problematic.

2.2. Effect of CR Dose on Patient Outcomes

In the Cochrane reviews on CR, sensitivity analyses on dose were performed, first in 2004[24] and again in 2011[25] and 2016[21] updates. CR dose was operationalized by multiplying the number of weeks of exercise (i.e., program duration) by the number of training sessions per week (i.e., frequency) and by the average duration of exercise sessions in minutes. Dose was then stratified as 1000 or less vs more than 1000 "units." No associations between dose and outcomes

were observed in the first 2 meta-analyses, but in the most recent one, patients who had 1000 or more than 1000 units had 25% lower CV mortality and 26% lower myocardial infarction (MI). Similarly, in the meta-analysis by Lawler et al[26], patients exposed to a higher dose of CR, in this case a program of 3 or more months' duration had significantly lower CV mortality and MI but not all-cause mortality. There have also been some primary studies that examined dose[5, 24, 25, 26, 21, 6, 7, 9, 10]. These studies also report a dose-response association between CR participation and mortality/morbidity.

The first-ever meta-regression focused on the effect of CR dose on mortality and morbidity found that a prescribed dose ≥12 sessions was associated with significantly lower all-cause mortality when compared with lower dose. With regard to morbidity, it was found that a prescribed dose ≥36 sessions was significantly associated with fewer percutaneous coronary interventions. However, a recent analysis of a cohort of patients from the Mayo Clinic in the US on which our lab collaborated where we attempted to determine a minimum dose of CR to improve outcomes, suggested the association between dose and major adverse cardiovascular events is truly linear, with no bottom threshold evident, but also no ceiling[11].

Some of the mixed findings reported above on the association between dose and morbidity could be due to failure to consider disease severity indicators that could impact patient benefit derived from participation and also dose received (not just prescribed). For instance, HF is an indicated condition for CR[27]. Patients with HF likely have much to gain from participation due to serious deconditioning; their cardiorespiratory fitness is very low and hence there is great potential for gains (and fitness is closely associated with mortality and morbidity)[28]. Moreover, HF patients are frequently re-hospitalized[29] and experience acute decompensation which could prevent them from attending CR sessions.

As another example, patients with diabetes and depression as well as smokers are shown to be less adherent to CR (i.e., complete fewer sessions),[30,31,32] but may derive greater benefit from participation due to their comorbidity (e.g, better glycemic control due to exercise and risk factor management; depressive symptom reduction due to social support, stress management and depression screening / identification with treatment). More investigation is needed on dose received in these populations, as well as whether dose needed to achieve benefit differs from cardiac patients without these additional burdens.

2.3. Dose Prescribed Versus Actual

Data available on dose prescribed in clinical practice guidelines and from surveys of CR programs has been reviewed above. It is disheartening that in many instances the dose prescribed does not meet the thresholds outlined above for achieving mortality and morbidity reductions. The doses reported in the review of CR program surveys were shown by World Health Organization (WHO) region. The data did suggest norms vary in different parts of the world, and clearly this variation is not explained with evidence. However, without assessing dose prescribed using a common survey, and in every country offering CR this cannot be ascertained. Moreover, it was suspected CR dose might be impacted by healthcare resources, such that programs in lower-income countries might not be able to offer as many sessions per patient.

2.4. CR Utilization/ Dose Received

It is well-known that CR is under-used[33]. So while patients may be offered a certain number of sessions as outlined above, they do not attend all of them, due to barriers[34], or for legitimate clinical reasons (e.g., re-hospitalization, new onset arrhythmia). CR enrollees adhere to 66% of prescribed sessions on average[35]. Unfortunately, previous research on the impact of

dose on patient outcomes has relied on prescribed dose, rather than dose received. Therefore, research is needed examining the association using actual dose received.

3. OBJECTIVES

3.1. STUDY 1:

The objectives of the first study were to: (1) describe how many patients have clinical events (and what they are) in CR that would impact attendance/dose received (i.e., program interruption); (2) describe CR attendance/dose, considering individual components (in those without intervening clinical events); as well as (3) investigate whether having disease severity indicators/risk factor burden (smoking, diabetes, HF, Canadian Cardiovascular Society [CCS] angina class I, II or III[36], and elevated depressive symptoms) impacts CR session dose received/attendance and component type.

3.2. STUDY 2:

The aims of the second study were to characterize the dose of CR: (1a) in traditional supervised programs, and (b) in alternative models (i.e., home-based, community-based programs) by country, including whether recommended dose meets the minimum thresholds currently known (namely ≥ 12 and ≥ 36 sessions). These were (2) compared by (a) WHO region and (b) WB country income classification. Finally, (3) the drivers of CR dose were examined, such as program funding, geographic considerations, number and nature of healthcare providers on the CR team (including relative expense of front-line personnel, and whether a physician is a medical director of the program), nature and degree of barriers to delivery (e.g., degree to which space and lack of financial resources constrain CR delivery), number and nature of components delivered, program assets (i.e., gym space, individual assessment / counselling room, group

education room, administrative office, electronic medical records, telemetry), nature of patients served, as well as program capacity indicators.

4. METHODS

4.1. STUDY 1

4.1.1. Design and Procedure

This was a retrospective, single-center cohort study. Data were routinely-collected in the electronic medical record pre and post-program; relevant variables were extracted anonymously for the current study.

4.1.2. Participants

The study period was January 1, 1999-December 31, 2017. Adult patients with a cardiac event who were referred to CR were included in the study. Only those who attended at least 1 session were included, such that they attended at least one exercise class following intake assessment. There were several exclusion criteria. Patients who attended home-based CR were excluded, as session dose would be operationalized differently (i.e., calls vs visits, also offered at different frequencies and differential access to education sessions). Patients who had a history of stroke or peripheral vascular disease, or who had New York Heart Association (NYHA)[37] or CCS Angina class IV[36] were excluded, as it was assumed they would have limits to their exercise ability. In addition, some patients came back for CR after another cardiac event post-graduation; only the first CR program was used for all patients. Finally, intervening clinical events which precluded exercise were considered throughout the program; those patients experiencing one were excluded from the analysis for objectives 2 and 3.

4.1.3. Setting

The outpatient CR program of the academic cardiac program in London, Canada is offered at no cost to patients. Eligible inpatients (at hospital discharge) and outpatients are accepted following physician referral. The program is 6-8 months in duration. There is an initial comprehensive medical history taken and assessment, based on which individualized CR programming is determined.

Patients in the supervised program are offered 2 sessions/week of structured exercise at a local community centre (i.e., ≥48 sessions). Given the program duration was individualized based upon patient's need, prescribed supervised exercise was often upwards of 58 to 64 sessions, although in some cases patients could stay in the program longer.

Based on individual patient need and preference as well, patients are also offered education sessions, dietary counselling (individual or group), group stress management sessions (8-10 sessions of education and cognitive-behavioral techniques offered to all patients through 2012), and exercise counselling sessions (individual and group). Individual psychology sessions were offered to patients who scored >7 on either one of the anxiety and depression subscale [i.e., "elevated" symptoms], or >13 overall on the Hospital Anxiety and Depression Scale (HADS[38]), or based on clinician judgment or patient request; this comprised a combination of cognitive-behavioral and psychodynamic approaches delivered by a psychologist. Tobacco users were offered group or individual cessation counselling sessions, with number of sessions based on individual patient need. These were all offered at the hospital, except group exercise education sessions were offered coincident with exercise training at the community centre.

Patients experiencing intervening clinical events that may impact their safety to exercise were reviewed by the program nurse and physician and recorded in the electronic CR record.

Those deemed unsafe were put on hold until they were safe to resume, at which point they were offered 3 more months of programming, regardless of the amount of the program they had completed to date.

4.1.4. Measures

4.1.4.1 Sociodemographic and Clinical Characteristics

The sociodemographic characteristics of CR participants were extracted from the CR electronic medical record, including age, sex, highest educational attainment, work status, and living situation. The clinical characteristics examined included referral indication (e.g., acute coronary syndrome, and/or revascularization, HF), and cardiovascular risk factors (e.g., dyslipidemia, hypertension, anthropometrics, diabetes, self-reported tobacco use). Major cardiac medication classes patients were taking were recorded (i.e., statins, beta-blockers). Peak metabolic equivalents of task (METs) from the CR entry graded exercise test was extracted. Quality of life was measured with the SF-12[39].

Disease severity indicators/risk factor burden were considered, as it was assumed some of these may impact attendance/dose received, or affect participant's degree of motivation/program adherence[40]. These were: diabetes (type I or II), HF, CCS angina class II or III[36], (i.e., those with class IV were excluded for safety reasons, but class I participants would have no limits to fully participating), tobacco use and elevated depressive symptoms (i.e., , >7 on the depression subscale of the Hospital Anxiety and Depression Scale)[38].

4.1.4.2. Intervening Clinical Events

Events/procedures that happened after CR program initiation and warranted program interruption considered are shown in Table 2. New-onset HF that was not stable or an acute exacerbation precluding exercise were also considered. All events were reported by patients and/or identified

in the electronic records from the hospital electronic health record. The nurse also actively checked for events in all patients in the hospital electronic record at program exit. The nurse entered all clinical event data.

4.1.4.3. CR Component Attendance/Dose Received

Session type (component) was recorded in the database, whether group or individual. Total number (and percent) of sessions attended was computed, as was total number of exercise sessions.

4.1.5. Statistical Analyses

All analyses were performed using SPSS statistical software Version 24.0[41]. The cut-off value for p was set as 0.05 for all analyses, except as specified below.

After selecting patients for inclusion in the cohort, intervening events were examined. Differences in sociodemographic and clinical characteristics of participants excluded, having an intervening event, versus those retained to examine dose and component attendance were tested using chi-square or analysis of variance, as appropriate.

CR session attendance/dose received was described in the retained cohort. Association of total session attendance/dose and exercise session attendance/dose with sociodemographic and clinical characteristics was examined using non-parametric tests as dose was not normally distributed (Mann-Whitney U or Spearman correlation as applicable). A more conservative p-value of <.001 was applied due to the multiple comparisons. Finally, types of CR sessions (components) and total sessions were compared by disease severity indicators/risk factor burden using Mann-Whitney U tests (more conservative p-value threshold not applied due to novel nature of analyses).

4.2. STUDY 2

4.2.1. Design and Procedure

This research was observational and cross-sectional in design. The study was approved by York University's Office of Research Ethics (Toronto) and Mayo Clinic's Institutional Review Board (Rochester, Minnesota).

Methods are described in detail elsewhere.[42,43] In brief, for each country of the world verified to offer CR, identified leaders were sent an e-mail requesting their collaboration to identify all programs, and facilitate administration of a survey to each program in their country.

The most responsible clinician at each program was emailed with the request to complete the survey. Informed consent was secured through an online form. The survey was administered through REDCap, with data collection occurring from June 2016 to July 2017. The data that support the findings of this study may be made available in anonymized form by the corresponding author upon reasonable request from qualified researchers trained in human subject confidentiality protocols, with appropriate research ethics approvals and secure data transfer agreements.

4.2.2. Sample

The sample consisted of all CR programs identified in the world, that offer services to patients following an acute cardiac event or hospitalization (i.e., Phase II). The inclusion criteria were CR programs that offered: (1) initial assessment, (2) structured exercise, and (3) at least one other strategy to control CV risk factors. Countries were categorized by WHO region [44] and WB country income classification (high-income vs upper-middle vs lower-middle or low-income; the

latter 2 were grouped together as there was only 1 responding program from a low-income country).[45]

4.2.3. Measures

The survey is available elsewhere.[43] In short, items were based on previous national/regional CR programs surveys. (e.g.,[46–48]) Most items had forced-choice response options, and skip-logic was used to obtain more detail where applicable. This study focused primarily on 2 items, namely: (1) duration of CR program in weeks, and (2) number of sessions per week, which were multiplied to establish dose (in sessions). For each country, it was also computed whether programs offered a mean ≥12 and ≥36 sessions. There were also items assessing the duration of exercise (dose in sessions [above] was multiplied by exercise session duration to derive dose in hours per program) and education sessions, as well as dose of alternative models where offered.

The potential correlates of dose were also assessed therein. Respondents were asked to report program funding sources, geographic characteristics (e.g., urban, proximity to other programs), number and nature of healthcare providers on the CR teams (as well as perceived expense of front-line personnel rated on a 5-point Likert scale from 1 "free" to 5 "very expensive"; and role of physicians in the program), barriers to delivery (rated on a 5-point Likert scale from 1 "this is definitely not an issue" to 5 "this is a major issue"), number and type of core components delivered, program assets (e.g., cardiopulmonary exercise stress testing, telemetry, group education space), accepted indications (cardiac and non), as well as program capacity indicators (e.g., patients per year, patients per session, wait times).

4.2.4. Statistical Analyses

IBM SPSS version 24 was used for analysis. All initiated surveys were included. The number of responses for each question varied due to missing data (e.g., respondent did not answer a question due to lack of willingness or potential inapplicability, use of skip logic for those not offering alternative models); for descriptive analyses, percentages were computed with the denominator being the number of responses for a specific item.

Descriptive statistics were applied for all closed-ended items in the survey (i.e., frequencies with percentages; means, standard deviations and medians). Dose was characterized and compared by country, WHO region and WB country income classification. Given it was not normally-distributed, dose was log-transformed, and differences by the above categories were tested using analysis of variance (with post-hoc Bonferroni tests where significant).

Correlates of CR dose in supervised and alternative models were examined through two steps. First, uni-variable analysis was performed, using t-tests, analysis of variance or Pearson's correlation as applicable with log of dose as the dependent variable. Where significant, a generalized linear mixed model was performed, with the gamma distribution and log link function given the non-normal distribution of dose, to take into consideration the nesting of programs within countries (i.e., two-level model).

5. RESULTS

5.1. STUDY 1:

Of the 5,508 patients in the cohort that attended ≥1 session, 3,696 (67.10%) did not attend home-based CR (n=1813, 31.10%), had no history of stroke or peripheral vascular disease, and did not

have an NYHA or CCS class of IV at initial assessment. Their characteristics are presented in Table 1.

There were 1,328 (24.11%) intervening events in the cohort, experienced by 912 (16.60%) patients (Table 2; n=250, 27.40% of women; p=0.55). There were no deaths during CR. Among the retained patients without intervening events, 527 (18.92%) had elevated depressive symptoms, 519 (18.64%) were diabetic, 501 (17.99%) were current tobacco users, 84 (3.02%) had CCS class >1, and 74 (2.65%) patients had HF (Table 3).

As shown in Table 1, there were differences in the sociodemographic and clinical characteristics of the groups at intake.

5.1.1. CR Components and Dose

Mean overall CR attendance, and attendance by component are shown in Table 3. The median total number of sessions attended was 27 (Q25-Q75=3-45); the median was 21 for supervised exercise sessions (Q25-Q75=0-37). Overall, 539 (19.36%) participants completed the ~48 prescribed sessions. Overall, 1790 (64.29%) patients attended ≥12 and 1,128 (40.51%) ≥ 36 total sessions.

Table 1 also displays the association between sociodemographic and clinical characteristics pre-CR with total and exercise session attendance or dose. Table 3 also displays session attendance/dose and type in those with disease severity indicators/risk factor burden. CCS Class >1, tobacco use and elevated depressive symptoms were significantly associated with lower total dose; HF and diabetes were not related to overall dose. With regard to specific components, patients with HF attended significantly fewer group dietary sessions. Participants with diabetes attended significantly more exercise counselling and tobacco cessation sessions,

but less group dietary counselling than their non-diabetic counterparts. Patients with higher CCS class attended fewer exercise sessions and group exercise counselling sessions. Those smoking at program start attended on average one tobacco cessation session. They attended significantly fewer supervised exercise sessions, exercise counselling (group and individual), and individual dietary counselling sessions, but attended more individual psychology and group dietary sessions than non-tobacco users. Finally, participants with elevated depressive symptoms attended significantly less of all components than those with subthreshold symptoms, except they attended significantly more psychosocial sessions (group and individual; Table 3).

5.2. STUDY 2

One hundred eleven (54.7%) of 203 countries in the world were determined to offer CR, of which data were collected in 93 (83.8% country response rate). Overall, 1082 surveys were completed (32.0% program response rate). Responses per country are shown in Table 4.

5.2.1. CR Dose

The wide variability in CR dose in supervised programs is shown by country in Table 4. Globally, patients are receiving a median of 22 hours (P25-P75=12.0-36.0) of CR per program, or a median of 3 sessions per week (P25-P75= 2.0-3.0) over 8 weeks (P25-P75=6.0-12.0), at 60 minutes per session (P25-P75=50.0-60.0). Patients were offered a median of 5 hours of patient education per program (P25-P75=2.0-8.1).

Overall, 74 (66.7% of those with CR; n=619 [57.2%] programs) countries meet the threshold of a mean ≥12 sessions for their supervised programs, and 49 (44.1% of those with CR; n=257 [23.8%] programs) countries meet a threshold of a mean ≥36 sessions per program globally (Figure 1 and Table 5). The highest CR dose was offered by Slovenia and lowest in Bosnia and Herzegovina.

Supervised dose by WHO region and WB country income classification is also shown in supplemental Table 1. There was significant variation by region (F=10.54, p≤0.001), with programs in the American region offering a significantly greater dose than those in Europe (Bonferroni post-hoc test p≤0.001), the Western Pacific (Bonferroni post-hoc test p≤0.001) and South-east Asia (Bonferroni post-hoc test p=0.02). Moreover, programs in European countries offered a significantly higher dose than those in the Western Pacific (Bonferroni post-hoc test p=0.02). There was also a trend toward variation by country income classification (F=3.00, p=0.05), with programs in low and lower middle-income countries potentially offering a lower dose than those in upper middle-income countries (Bonferroni post-hoc test p=0.04).

With regard to CR dose in alternative settings, home-based programs were offered by 36 (32.4%) countries; patients were receiving a median of 6 sessions (P25-P75=3.0-17.5) of CR per program, or a median of 3 sessions per month (P25-P75=1.0-4.0) over 12 weeks (P25-P75=8.0-16.0; Table 6). Twenty-six countries (23.4%) offered community-based CR programs; patients were receiving a median of 20 sessions (P25-P75=9.6-36.0) of CR per program, or a median of 8 sessions per month (P25-P75=4.0-12.0) over 10 weeks (P25-P75=8.0-16.0).

Dose delivered in alternative settings by WHO region and WB country income classification are shown in Table 6. With regard to region, there was no significant variation in the number of home-based CR sessions (F= 0.96, p=0.43). Number of community-based sessions did differ significantly by region however (F= 2.87, p< 0.05), and while Bonferroni post-hoc tests could not performed due to small cell sizes, it does appear again that programs in the American region offered a greater dose compared to other regions. Regarding differences by country income classification, there was a significant variation in the number of home-based CR sessions offered by programs (F= 6.66, p= 0.002), with high-income countries offering a

significantly lower dose than upper middle-income countries (Bonferroni post-hoc test p=0.001). There was also a significant variation in the dose of community-based CR sessions by country income classification (F=12.0, p<0.001), and while Bonferroni post-hoc tests could not performed due to small cell sizes, it does appear that upper middle-income countries offer a higher dose than high-income countries. Table 5 displays the proportion of programs meeting the ≥12 and ≥36 session thresholds by WHO region and WB country income classification.

5.2.2. Correlates of CR Dose

Table 7 displays the correlates of the CR dose. In supervised settings, programs offering greater dose were significantly more often proximate to other programs (suggesting density), had more involvement of physicians in their programs, accepted patients with non-cardiac indications, had longer wait times, and less often offered nutrition counselling. Funding source was only a driver at the uni-variable level. Table 3 also displays correlates of dose in alternative settings. Involvement of physicians and funding source were again related to dose, but only at the uni-variable level.

6. DISCUSSION

6.1. STUDY 1

In this large cohort, across 20 years, adherence to CR in those without a documented clinical reason precluding safe exercise was demonstrated to be about half of sessions, but overall patients got an ample "dose" of CR to achieve mortality and morbidity reductions. Approximately one-sixth of the cohort had an event or procedure after program initiation and before program completion, which clearly, and appropriately, impacts overall program attendance rates. Patient groups at greater need of risk reduction, such as depressed patients and smokers, were shown again to be less likely to adhere to exercise sessions than their less

complex counterparts, but they do seem to be appropriately taking greater advantage of other components specific to their needs, with particular use of individual over group counselling and education. While consideration of social determinants of health to promote optimal CR use is important[49], the impact of clinical factors warrant close attention as well.

The degree of intervening clinical events highlights the importance of considering program policies regarding CR resumption (and not program termination) where patients experience a new clinical event after enrolment, as well as guideline or consensus statement recommendations on how to handle safety to return and optimally engage patients in the program upon their return. The most common events were myocardial infarctions, followed by percutaneous coronary interventions-- procedures from which most patients could likely return to CR in a few days[50]. This program had the capacity to offer patients a full 3 months further programming to best optimize secondary prevention where patients had recurrent events, and in fact patients who had intervening events did participate in significantly more sessions (data not shown), suggesting they do fully re-engage in their secondary prevention and risk factor management. Many programs however are limited in their capacity and resources, and thus have less flexibility, but we should consider ways to model programs so potentially some patients who are safe to resume can "backfill" the spots of the patients who have to withdraw temporarily from the program until their clinical status stabilizes.

Findings with regard to factors associated with overall session use, such as education, ethnocultural background, social support, waist circumference, tobacco use, and "healthy adherers"[51] to medications, were fairly consistent with the literature. It was surprising women did not participate in fewer sessions than men, but this could be due to consideration of use of non-exercise sessions. In the case of diabetes patients in particular however, where the literature

suggests patients are less likely to adhere, it was encouraging they participated in more exercise counselling and tobacco cessation sessions. Similarly, tobacco users were found to adhere less, and so we must do more to engage this group in CR, but they did more often attend psychological and dietary sessions. Participants with elevated depressive symptoms were indeed more likely to engage in the psychosocial component; this is encouraging given the high burden of mental distress in chronic disease patients, that it often goes unrecognized and untreated[52], and the proven effects of the psychosocial component in particular in reducing mortality[53]. They were unfortunately less likely to engage in supervised exercise, which is ameliorative not only for their physical, but also their mental health[54]. Patients with lower functional capacity at intake also participated in fewer supervised exercise sessions, despite the fact that they likely have more to gain[55]. Again, we must do more to engage these vulnerable sub-populations (i.e., poorer outcomes, but less participation). Overall, it does appear that CR programs can engage patients in the types of sessions/core components they need (i.e., individual tailoring), so patients can meet their rehabilitation goals.

There are several implications of this study. First, program adherence must be optimized for patients to derive maximum benefit. The latest Cochrane review on CR utilization interventions establishes that the interventions in the field do indeed significantly augment program adherence and completion[56]. Meta-regression analyses revealed adherence may be greater when at least some of CR is delivered remotely. In this cohort, home-based CR participants were excluded, but ultimately the impact of home-based CR on utilization warrants further investigation as operationalization of adherence is not comparable in supervised and unsupervised settings[33].

Second, the study buttresses guideline recommendations for menu-based CR, whereby patients are offered components based on their risk and preferences. For example, tobacco-using

patients did take advantage of the tobacco cessation as well as psychosocial components. While these patients were shown to be less likely to attend exercise sessions, as has oft been shown in the literature, by examining attendance by component as we have done here, we can better understand the way patients want to engage with CR. A similar finding was observed with depressed and anxious patients (data not shown); while they were significantly less likely to take advantage of the non-psychosocial components of the program, they were more likely to take advantage of the group and individual psychosocial programming, which likely met their needs quite well.

A strength of this study was the capacity to distinguish between attendance at group and individual sessions, even for the same component. While programs do vary in what they can offer[43], in all cases, patients more often attended the individual versus group counselling or education. While this has resource implications, it would be important for programs to understand their patient preferences, and try to meet them where resources (human, financial, space) allow.

There are some directions for future research which arise based on these findings. This program did not offer return-to-work counselling, as many programs do not[43], so use of that would be important to investigate in future research. Work status is often associated with program attendance. Also, the type and degree of intervening events changed over the 20-year history of this study. In addition to establishing rates of clinical events in CR cohorts that can be expected by programs as outlined below, this should be considered based on the current era of treatment and average patient presentation. This will enable programs to better plan to meet the needs of these patients, so their outcomes can be optimized.

6.1.1. Limitations

Chiefly, generalizability is limited because the study was conducted at a single centre. Further research in other cohorts is needed to determine whether the incidence and type of intervening clinical events are generally consistent, as well as burden of greater disease severity and risk factors, as this may vary in different jurisdictions. At this centre, patients were offered many more sessions than is normative globally[57]. Adherence to fewer prescribed sessions would likely not be proportional. Moreover, exercise sessions were offered at a community centre whereas other components were offered at the hospital, which may have differentially impacted access for patients. The study was also conducted in a universal healthcare system where the patients accessed CR at no cost (other than transportation and parking); In other jurisdictions, cost may hinder participation. Home-based participants were not considered, nor were patients with vascular diseases other than cardiac, again limiting generalizability. Moreover, there were many differences in sociodemographic and clinical characteristics between the selected cohort and excluded patients, although some of these are likely an artifact of the large sample size.

Second, future research should investigate the impact of these clinical factors on percentage of prescribed sessions attended, to establish whether the findings herein are robust. Third, many tests of association were undertaken for this exploratory study, increasing the chance of type I error. For the correlates of session attendance/dose, which have often been studied, a more conservative p-value was applied to mitigate this. But again, replication is needed. Finally, due to the nature of the design, causal conclusions cannot be drawn.

6.2. STUDY 2:

For the first time, the great variation in prescribed CR dose, in supervised, home, and community-based programs has been quantified around the world. First and foremost, CR is not

available in almost half of the countries in the world—in these countries where patients are getting zero CR dose; where CR does exist, most patients do not access it and hence do not get prescribed any sessions/ receive no dose of CR. In the countries that do offer CR, only in < 60% are capable to prescribe at least 12 sessions, which could be considered the minimum to attain benefits (yet it is known that patients adhere to only approximately 2/3rds of sessions,[35] so many of these patients would still receive the minimum needed dose).

Where patients do access CR, they are prescribed a median of 22 supervised sessions, although this is greater in the Americas than other regions. Overall however, supervised CR dose appeared greater in high-income settings, with the opposite holding true for lower-resource settings.

It may be a function of the fact that the duration to deliver each component (except exercise and patient education) was not considered, and that most programs globally are indeed quite comprehensive (potential ceiling effect;[43]). Alternatively, it could be that programs offering more components focus less on exercise sessions. However, more research is needed to understand if there are other factors, unmeasured in the current study, that explain the considerable variation in CR dose observed globally.

Countries (and programs) are encouraged to consider the median dose offered, and where < 12, advocate for more resources to increase. The International Council of Cardiovascular Prevention and Rehabilitation (ICCPR) has an advocacy toolkit, to support programs and CR societies in advocating for reimbursement.[58] Results suggest advocacy efforts could be augmented by engaging physicians to champion their cause.

6.2.1. Limitations

Caution is necessary when interpreting the findings, particularly due to limits on generalizability and potential bias. Firstly, there could be ascertainment bias. It may not have been possible to identify all programs. Second, there could be selection bias. Response rates to online surveys are notoriously low; in the current study while country response rate was very high, program response rates were moderate. While the survey was pilot tested, items were not validated through verification of responses in a random subsample of programme and hence the validity of self-report is unknown. For example, programs may have reported screening for depression, but utilized a non-psychometrically validated tool. Moreover, many respondents did not complete all survey items, even in cases where they were applicable. This missing data may have introduced additional bias. Thirdly and on a related note, programs would be more comprehensively identified in countries with societies and those affiliated with prominent academic centers.

Fourth, respondents may have been inclined to respond in a socially desirable manner, such that results were skewed to reflect greater CR dose/provision. However, participants were informed that their responses were confidential. Fifth, while respondents were informed the study was focusing on phase II programs, some longer duration of programs reported suggests may have been describing their phase III/IV maintenance programs. This may have skewed the dose to appear greater than it is. Results of this study cannot be used to draw conclusions regarding whether the programmes as delivered improve patient outcomes, as that would require investigation of patient-level data. Only the structure and processes of programmes were considered. In this study, multiple comparisons were performed, and there were very few respondents in some regions, and hence the tests of regional differences should be considered exploratory at this stage, with future research needed to further investigate. In addition, one may

challenge the appropriateness of an exercise component as an inclusion criterion for this study in some country context. Physical inactivity may play more of a role in CVD in western countries. Instead, physical activity is often a necessity in resource-constrained settings (e.g. farming communities, walking as primary mode of transport), with other risk factors such as smoking playing a more prominent role. Another limitation relates to the language of the survey. Respondents completed the English-language version of the survey, although this may not have been their first language. Issues of comprehension may have introduced measurement errors. While some translations were undertaken, the authors elected not to translate to too many languages as this could also introduce error, due to differences in phrasing as well as meaning.

Finally, the last limitation is related to several important directions for future research. While results reflect dose prescribed, they do not reflect actual dose received by patients. It is known that patients do not adhere fully to programs,[35] and also it is likely that adherence varies greatly by country due to differences in CR reimbursement among other barriers. Future research is needed to characterize actual dose received by patients, and again whether it is sufficient to achieve the mortality and morbidity reductions associated with CR participation.[59] This is in addition to the ongoing research that is needed to better elucidate the dose of CR that should be prescribed, and consider how this might differ by setting, and by patient characteristics (e.g., comorbidities, indication, severity, number of risk factors, functional capacity). Then we can use known strategies to promote patient adherence[56] to the evidence-based number of sessions needed.[5]

A final consideration relates to measuring dose. For the purposes of this study, we counted contacts with CR staff, but in all programs, patients are prescribed exercise to undergo independently, particularly in home-based programs. In future studies, it would be beneficial to

capture secondary prevention activities undertaken outside of formal contact with the CR program, such as not only unsupervised exercise, but for example time spent reviewing patient education materials, practicing meditation or developing heart-healthy menus and dietary habits. This would then better represent the true dose of CR and enable more accurate dose comparisons between settings.

7. CONCLUSIONS

7.1. STUDY 1

In conclusion, to the best of our knowledge, we believe that we are the first to account for the not insignificant incidence of clinical events when quantifying the associations of a broad spectrum of clinical and psychological factors on adherence and use of usual CR service components. While CR dose received (or session attendance) is likely largely due to patient-related preference as well as access, other factors, such as reverse causality with clinical factors, could not be excluded. Clinical factors and patient preference should always be considered when working to optimize the dose and comprehensiveness of CR service components that patients receive, to optimize the many benefits of CR participation. By considering more closely the types of sessions offered and the corresponding types of risk factors or needs of patients, a clearer picture emerges around use of not just the exercise, but the other core components of CR as well.

7.2. STUDY 2

CR dose varies greatly by country, region and country income class; where available, a median of 22 hours per supervised program is offered globally. The greatest CR dose is offered by programs in the American region, with a median of 36 sessions, while the lowest CR dose is offered by the Western Pacific region. Globally, a median of only 6 sessions are prescribed by home-based programs, which is inadequate; dose was greater in lower resource countries

however. Clearly, we need evidence on which to base dose recommendations, so that patients around the globe can receive the CR care needed to successfully reduce mortality and morbidity.

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TABLES

Table 1: Pre-CR sociodemographic and clinical characteristics by retention status and intervening clinical events.

	Had intervening event n=912 (16.6%)	Retained without intervening event [a, b] n=2784 (50.5%)	Excluded n=1812 (32.9%)	Total N=5,508[c]
Sociodemographic Characteristics				
Sex (% women)	250 (27%)	757 (27%)	469 (26%)	1476 (27%)
Age (years)	62.0 ± 12.1	60.6 ± 11.9 [ab]	61.8 ± 11.5	61.3 ± 11.8[f]
Work status (% full or part-time)	239 (12%)	780 (31%) [b]	645 (36%)	1664 (32%)[f]
Ethnocultural background (% white)	819 (95%)	2278 (93%)[ab]	1681 (94%)	4778 (94%)[f]
Highest education (% some college/university or greater)	327 (38%)	936 (39%) [ab]	626 (36%)	1889 (38%)[f]
Living situation (% alone)	157 (19%)	395 (17%) [ab]	266 (15%)	818 (16%)
Clinical Characteristics				
Risk Factors				
Sedentary lifestyle (% yes)	479 (53%)	1438 (52%)[ab]	1106 (61%)	3023 (55%)[f]
Body mass index (kg/m^2)	29.4 ± 5.3	29.2 ± 5.7	28.7 ± 4.9	29.1 ± 5.4[e]
Waist circumference (cm)	101.5 ± 14.1	100.9 ± 14.5[ab]	99.8 ± 13.7	100.6 ± 14.2[e]
Dyslipidemia (% yes)	678 (75%)	1561 (56%)[ab]	1069 (59%)	33.08 (60%)[f]
Hypertension (% yes)	577 (63%)	1399 (50%)[ab]	970 (54%)	2946 (54%)[f]

Depressive symptoms [g, h]	4.8 ± 3.7	4.3 ± 3.5[b]	4.0 ± 3.4	4.3 ± 3.5[f]
Tobacco Use (% current) [h]	172 (19%)	501 (19%)[ab]	274 (15%)	947 (18%)[f]
Other Disease Severity Indicators				
Diabetes	223 (25%)	519 (19%)	329 (18 %)	1071 (20%)[f]
Heart Failure	32 (4%)	74 (3%)	49 (3%)	155 (3%)
CCS Class (% >1)	51 (7%)	84 (4%)	49 (3%)	184 (4%)[f]
Referral Event / Procedure				
ACS - MI	210 (23%)	1406 (51%)	922 (51%)	2538 (46%)[f]
PCI	174 (19%)	976 (35%) [ab]	758 (42%)	1908 (35%)[f]
CABG	239 (26%)	724 (26%)	462 (26%)	1425 (26%)
ACS - Unstable Angina	84 (9%)	220 (8%)	138 (8%)	442 (8%)
Stable CAD	210 (23%)	145 (5 %)	99 (6%)	454 (8%)[f]
Aortic Valve Procedure	28 (3%)	92 (3%)	76 (4%)	196 (4%)
Cardiac Medications				
Statins	745 (82%)	2271 (82%)[ab]	1648 (91%)	4664 (85%)[f]
Beta-blockers	701 (77%)	2100 (76%)[ab]	1466 (81%)	4267 (78%)[f]
ACE-inhibitors	547 (60%)	1693 (61%)[ab]	1191 (66%)	3431 (62%)[f]
ARBs	98 (11%)	240 (9%)[ab]	275 (15%)	613 (11%)[f]
Other				

Peak Metabolic equivalents of task	6.2 ± 2.9	7.2 ± 3.2[ab]	7.9 ± 3.5	7.3 ± 3.3[f]
QoL - PCS[i]	37.1 ± 9.9	37.4 ± 9.6	37.9 ± 9.9	37.6 ± 9.8
QoL- MCS[i]	48.9 ± 11.3	49.8 ± 10.7[b]	50.4 ± 10.5	49.9 ± 10.7[d]

[a]p<.001 for association with dose (total sessions).
[b]p<.001 association with exercise sessions.
[c]difference by patient status, assessed via chi-square or analysis of variance as applicable; [d] indicates p<0.05, [e] indicates p<0.01 and [f]indicates p<0.001 for total column.
CR, Cardiac Rehabilitation; SF-12 PCS, Physical component scores of quality of life questionnaire; CCS, Canadian Cardiovascular society; CAD, Coronary artery disease; ACS, Acute coronary syndrome; PCI, Percutaneous Coronary Intervention; CABG, Coronary artery bypass grafting; ACS, Acute Coronary Syndrome; MI, myocardial infarction; ARBs, Angiotensin receptor blockers; ACE-inhibitors, Angiotensin converting enzyme inhibitors; QoL, quality of life; PCS, Physical component score; MCS, Mental component score;
Note: n and percentage or mean and standard deviation shown.
[g]Hospital Anxiety and Depression Scale – depression subscale score; scores range from 0-21; scores >7 indicated "elevated" symptoms and higher scores denote greater depressive symptoms.
[h]other disease severity indicators / risk factor burden.
[i]Scores range from 0-100, with higher scores indicating higher QoL.

Table 2 – Intervening Clinical Events that Warrant Cardiac Rehabilitation Program Interruption in total cohort, N=5508

	Number of events (%)	Number of patients (%)
Acute Coronary Syndrome- Myocardial Infarction	466 (35%)	455 (35%)
Percutaneous Coronary Intervention	228 (17%)	222 (17%)
Coronary Artery Bypass Grafting	177 (13%)	172 (13%)
Acute Coronary Syndrome -Other	163 (12%)	163 (13%)
Transient Ischemic Attack / Mild Non-disabling Stroke	89 (7%)	88 (7%)
Other Non-Cardiac Events	88 (7%)	88 (7%)
Decompensated Heart Failure / Acute Exacerbation (unsafe to exercise)	52 (4%)	52 (4%)
Valve Procedures	20 (2%)	16 (1%)
Cardiomyopathy	14 (1%)	14 (1%)
Pulmonary Diseases	10 (1%)	10 (1%)
Cerebrovascular Accident	11 (1%)	11 (1%)
Peripheral Vascular Diseases	9 (1%)	9 (1%)
Other Cardiac (e.g., Arrhythmia, Ablation, Pacemaker, ICD)	1 (0%)	1 (0%)
Total	1328 (24%)	-

ICD: implantable cardioverter defibrillator.

Table 3 – Components attended (mean number of sessions), including by disease severity / risk factor burden

Components	Retained sample without intervening event	Disease Severity Indicators / Risk Factor Burden[a]				
	N=2784	Patients with HF (n=74)	Patients with Diabetes (n=519)	Patients with CCS Class >1 (n=84)	Tobacco Users (n=501)	Patients with Elevated Depressive Symptoms (n=527)
Supervised exercise sessions - group	20.49 ± 17.45 (21.0)	22.96 ± 16.58 (23.5)	20.73 ± 17.13 (20.0)	20.27±17.04 [c] (17.5)	15.76±16.71[d] (9.0)	20.17±16.65[d] (18.0)
Exercise counseling-individual	1.09 ± 0.73 (1.0)	1.12 ± 0.55 (1.0)	1.16 ± 0.65 [b] (1.0)	1.24 ± 0.61 (1.0)	1.08 ± 0.78[c] (1.0)	1.19 ± 0.59 [d] (1.0)
Exercise counseling-group	0.92 ± 1.11 (1.0)	0.92 ± 0.96 (1.0)	0.91 ± 1.09 (0.0)	0.87 ± 1.07 [b] (1.0)	0.81 ± 1.14 [d] (0.0)	0.91 ± 1.08 [d] (1.0)
Dietary-individual	1.67 ± 1.48 (2.0)	1.88 ± 1.69 (2.0)	1.66 ± 1.40 (1.0)	1.77 ± 1.47 (2.0)	1.20 ± 1.24 [d] (1.0)	1.78 ± 1.41 [d] (2.0)
Dietary-group	0.50 ± 0.56 (0.0)	0.36 ± 0.51[b] (0.0)	0.39 ± 0.52 [d] (0.0)	0.39 ± 0.49 (0.0)	0.56 ± 0.55 [b] (1.0)	0.37 ± 0.52 [d] (0.0)
Psychology sessions-individual	1.29 ± 5.94 (0.0)	1.11 ± 3.86 (0.0)	0.94 ± 3.37 (0.0)	2.50 ± 8.43 (0.0)	1.51 ± 7.24 [c] (0.0)	3.12 ± 8.85 [d] (0.0)
Stress management-group	0.23 ± 1.32 (0.0)	0.20 ± 1.09 (0.0)	0.18 ± 1.14 (0.0)	0.26 ± 1.42 (0.0)	0.20 ± 1.16 (0.0)	0.39 ± 1.69 [b] (0.0)
Tobacco cessation[e]	0.28 ± 1.63(0.0)	0.09 ± 0.29 (0.0)	0.29 ± 2.14 [b] (0.0)	0.63 ± 3.24 (0.0)	1.12 ± 3.66 (0.0)	0.36 ± 2.18 [c] (0.0)
Total sessions (dose)	26.49 ± 21.30 (27.0)	28.97 ± 19.54 (32.0)	26.25 ± 19.86 (27.0)	28.11±22.05 [b] (25.0)	22.22±21.76[d] (13.0)	28.31±21.79 [c] (27.0)

[a]significant difference in total dose whether patient has disease severity indicator / risk factor or not
[b] indicates $p<0.05$; [c] indicates $p<0.1$; [d] indicates $p<0.001$;

[e]among tobacco users only
Acronyms: CCS, Canadian Cardiovascular Society; HF, Heart failure;
Note: mean and standard deviation of number of sessions attended per program displayed (median).

Table 4: Mean Supervised Cardiac Rehabilitation Dose (± standard deviation) by Country*, World Health Organization Region and World Bank Country Income Classification

World Health Organization Region *Country	n (%)ǂ	Duration (# weeks)	Frequency (sessions / week)	Total # Sessions / program (# weeks x sessions/wk)	Rank ‡	Pt Education in hours / program (# sessions x mins / session/60)	Intensity (minutes / session)	Total CR Hours (sessions x intensity/60)
African Region								
Algeria‖	1 (100.0%)	-	-	-	-	-	-	-
Benin§	0 (0%)	-	-	-	-	-	-	-
Kenyaɔ	1 (33.3%)	6.0	2.0	12.0	72	0.7	60.0	12.0
Mauritius‖	1 (100.0%)	-	-	-	-	-	45.0	-
Nigeriaɔ	1 (100.0%)	16.0	2.0	32.0	32	9.0	60.0	32.0
South Africa‖	14 (60.7%)	14.5 ± 7.8	2.5 ± 0.7	36.5 ± 24.5	24	4.8 ±3.1	56.8 ± 5.7	35.7 ± 25.2
Tanzania§	0 (0%)	-	-	-	-	-	-	-
Uganda§	0 (0%)	-	-	-	-	-	-	-
Regional Mean ± SD (median)	2.3 ± 4.8 (1.0)	12.9 ± 4.7 (12.0)	2.3 ± 0.7 (2.0)	30.1 ± 12.5 (34.0)	n/a	4.8 ± 3.3 (4.8)	57.5 ± 5.8 (60.0)	29.6 ± 13.3 (34.0)

American Region								
Argentina‖	3 (13.0%)	25.0 ± 22.5	5.0 ± 4.2	99.0 ± 131.5	3	2.6 ± 0.5	70.0 ± 17.3	147.0 ± 199.4
Aruba	0 (0%)	-	-	-	-	-	-	-
Barbados	1 (100.0%)	12.0	3.0	36.0	26	0.5	80.0	48.0
Bermuda	1 (100.0%)	24.0	3.0	72.0	9	14.0	60.0	72.0
Brazil‖	30 (40.0%)	20.8 ± 13.0	2.6 ± 0.4	54.6 ± 38.2	15	5.5 ± 10.7	63.5 ± 11.6	56.6 ± 37.9
Canada	57 (33.5%)	17.4 ± 9.2	2.4 ± 2.7	45.5 ± 74.9	19	10.5 ± 13.0	72.6 ± 15.1	49.5 ± 73.2
Chile	1 (10.0%)	12.0	2.0	24.0	44	4.0	60.0	24.0
Colombia‖	48 (96.0%)	14.1 ± 8.8	3.5 ± 2.3	46.0 ± 30.2	18	4.6 ± 5.0	59.1 ± 6.6	45.1 ± 28.6
Costa Rica‖	6 (100.0%)	15.0 ± 5.6	2.5 ± 0.8	36.3 ± 13.2	25	7.2 ± 6.0	67.5 ± 8.8	40.7 ± 13.6
Cuba‖	8 (100.0%)	20.9 ± 15.3	4.1 ± 0.9	87.4 ± 63.3	4	8.7 ± 11.5	53.6 ± 8.0	82.3 ± 66.8
Curaçao	1 (50.0%)	12.0	2.0	24.0	45	-	52.5	21.0
Dominican Republic‖	1 (50.0%)	8.0	3.0	24.0	46	6.0	50.0	20.0

Ecuador‖	2 (40.0%)	7.5 ± 6.4	4.5 ± 0.7	36.0 ± 33.9	27	6.6 ± 6.6	47.5 ± 3.5	29.5 ± 29.0
El Salvador‖	0 (0%)	-	-	-	-	-	-	-
Grenada‖	0 (0%)	-	-	-	-	-	-	-
Guam	0 (0%)	-	-	-	-	-	-	-
Guatemala¤	2(100.0%)	32.0 ± 28.3	0.63 ± 0.5	12.5 ± 0.7	70	7.7 ± 6.1	25.0 ± 14.1	5.1 ± 2.7
Honduras¤	1 (50.0%)	5.0	2.0	10.0	75	1.0	40.0	6.7
Jamaica‖	1 (33.3%)	-	-	-	-	-	60.0	-
Mexico‖	9 (37.5%)	4.3 ± 1.4	5.8 ± 5.5	28.6 ± 35.0	35	4.8 ± 6.0	54.4 ± 18.8	23.8 ± 24.3
Panama‖	1(100.0%)	8.0	3.5	28.0	37	0.0	45.0	21.0
Paraguay‖	3(100.0%)	20.0 ± 13.9	3.0 ± 0.0	60.0 ± 41.6	12	1.3 ± 0.4	53.3 ± 5.8	52.0 ± 33.0
Peru‖	7 (70.0%)	20.3 ± 15.7	5.8 ± 8.0	83.5 ± 68.9	7	17.4 ± 10.9	94.2 ± 20.7	136.9 ± 120.2
Puerto Rico	0 (0%)	-	-	-	-	-	-	-
Trinidad and Tobago	0 (0%)	-	-	-	-	-	-	-
United States of America	65 (2.5%)	13.7 ± 7.1	5.0 ± 7.5	67.7 ± 97.2	11	8.4 ± 7.1	59.8 ± 10.5	72.2 ± 116.8
Uruguay	5 (41.7%)	28.4 ± 14.9	2.5 ± 0.5	69.2 ± 29.7	10	3.5 ± 2.9	78.0 ± 14.4	86.6 ± 36.4

Venezuela‖	8 (88.9%)	12.1 ± 4.0	3.6 ± 0.8	42.7 ± 13.3	20	8.0 ± 3.2	67.5 ± 19.4	48.3 ± 25.6
Regional Mean ± SD (Median)	9.3 ± 17.8 (1.5)	15.5 ± 10.1 (12.0)	3.6 ± 4.3 (3.0)	51.1 ± 61.8 (36.0)	n/a	7.6 ± 9.4 (5.0)	63.2 ± 15.1 (60.0)	54.6 ± 70.1 (36.0)
Eastern Mediterranean Region								
Afghanistan§	1 (100.0%)	-	-	-	-	-	-	-
Bahrain	1 (100.0%)	8.0	3.0	24.0	47	5.5	60.0	24
Egypt¤	2 (100.0%)	-	-	-	-	0.25	-	-
Iran‖	14 (41.2%)	9.2 ± 4.1	2.8 ± 0.5	25.3 ± 12.6	42	5.4 ± 8.4	76.3 ± 29.4	32.8 ± 21.9
Kuwait	0 (0%)	-	-	-	-	-	-	-
Lebanon‖	1 (100.0%)	20.0	3.0	60.0	13	30.0	5.0	5.0
Morocco¤	1 (100.0%)	-	-	-	-	15.0	-	-
Pakistan¤	2 (50.0%)	6.0 ± 0.0	4.5 ± 2.1	27.0 ± 12.7	39	5.7 ± 6.1	22.5 ± 10.6	9.0 ± 0.0
Qatar	1 (100.0%)	8.0	3.0	24.0	48	1.5	60.0	24.0

Saudi Arabia	0 (0%)	-	-	-	-	-	-	-
Tunisia[c]	1 (100.0%)	5.0	4.0	20.0	59	1.7	120.0	40.0
United Arab Emirates	0 (0%)	-	-	-	-	-	-	-
Regional Mean ± SD (Median)	2.0 ± 3.8 (1.0)	9.1 ± 4.5 (8.0)	3.1 ± 0.9 (3.0)	27.0 ± 13.5 (24.0)	n/a	6.4 ± 9.1 (2.0)	66.9 ± 35.4 (60.0)	28.0 ± 20.3 (23.3)
European Region								
Austria	5 (19.2%)	9.3 ± 12.7	10.6 ± 9.9	72.7 ± 52.3	8	32.5 ± 50.7	36.0 ± 12.9	49.9 ± 50.5
Belarus[‖]	1 (20.0%)	6.0	3.0	18.0	62	-	36.0	10.8
Belgium	9 (18.8%)	16.0 ± 4.0	2.9 ± 0.2	46.7 ± 11.7	17	17.5 ± 22.6	77.1 ± 16.0	60.4 ± 22.6
Bosnia and Herzegovina[‖]	1 (100.0%)	2.0	1.0	2.0	80	0.75	45.0	1.5
Bulgaria[‖]	1 (100.0%)	-	-	-	-	.33	37.5	-
Croatia	3(100.0%)	7.5 ± 6.4	4.5 ± 2.1	27.0 ± 12.7	40	8.8 ± 3.2	47.5 ± 3.5	21.8 ± 11.7
Cyprus	0 (0%)	-	-	-	-	-	-	-
Czech Republic	6 (40.0%)	10.0 ± 4.0	2.9 ± 0.3	28.5 ± 11.4	36	2.9 ± 5.1	56.2 ± 7.5	26.6 ± 11.6
Denmark	8 (22.9%)	9.6 ± 3.6	3.5 ± 3.0	24.0 ± 6.5	49	15.2 ± 18.7	75.0 ± 17.3	29.0 ± 6.0

England	57 (21.4%)	9.9 ± 7.7	2.5 ± 3.6	20.4 ± 26.2	57	6.9 ± 6.9	64.1 ± 16.8	21.0 ± 26.9
Estonia	2 (100.0%)	12.0 ± 0.0	3.0 ± 0.0	36.0 ± 0.0	28	1.0 ± 0.0	60.0 ± 0.0	36.0 ± 0.0
Finland	11 (44.0%)	2.5 ± 0.7	15.0 ± 0.0	37.5 ± 10.6	23	23.4 ± 22.7	60.0 ± 0.0	37.5 ± 10.6
France	16 (12.3%)	5.5 ± 3.4	6.8 ± 6.6	48.7 ± 85.6	16	9.6 ± 7.3	48.4 ± 11.3	38.6 ± 65.1
Georgia‖	13 (76.5%)	9.3 ± 3.3	17.6 ± 34.5	86.3 ± 134.1	2	2.9 ± 3.7	42.1 ± 14.2	58.4 ± 89.2
Germany	34 (28.3%)	5.3 ± 8.4	18.4 ± 12.1	59.1 ± 31.5	14	17.7 ± 23.9	45.2 ± 30.4	34.6 ± 16.5
Greece	4 (100.0%)	15.0 ± 6.0	2.5 ± 0.5	42.0 ± 20.8	21	1.4 ± 1.0	58.8 ± 10.3	41.3 ± 22.0
Hungary	20 (60.6%)	3.5 ± 1.4	3.9 ± 1.9	12.7 ± 5.6	69	5.3 ± 4.4	42.1 ± 10.2	9.6 ± 5.8
Iceland	4 (100.0%)	9.7 ± 9.0	2.5 ± 0.7	27.5 ± 17.7	38	5.7 ± 2.3	48.3 ± 16.1	26.9 ± 18.6
Ireland	7 (18.9%)	8.5 ± 1.0	2.5 ± 0.6	20.3 ± 4.5	58	12.2 ± 2.5	58.0 ± 4.5	19.5 ± 5.2
Israel	6 (27.8%)	42.0 ± 24.0	2.0 ± 0.0	84.0 ± 48.0	5	1.5 ± 0.9	58.0 ± 4.4	80.4 ± 46.4
Italy	70 (31.7%)	4.8 ± 2.8	4.9 ± 3.5	20.7 ± 10.5	56	6.1 ± 7.9	55.6 ± 20.5	19.3 ± 11.0

Kazakhstan‖	1 (100.0%)	-	-	-	-	-	-	-
Kyrgyz Republic‖	0 (0%)	-	-	-	-	-	-	-
Latvia	1 (50.0%)	-	-	-	-	1.5	-	-
Lithuania	9 (36.0%)	10.0 ± 12.1	-	-	-	7.7 ± 13.5	35.0 ± 7.1	-
Luxembourg	0 (0%)	-	-	-	-	-	-	-
Malta	1(100.0%)	6.0	2.0	12.0	73	5.0	90.0	18.0
Moldovaᵊ	1(100.0%)	-	-	-	-	5.0	-	-
Montenegro‖	0 (0%)	-	-	-	-	-	-	-
Netherlands	29 (32.3%)	13.2 ±11.5	2.3 ± 0.6	29.2 ± 22.4	33	6.0 ± 3.7	57.2 ± 11.3	26.6 ± 16.5
Northern Ireland	10 (76.9)	8.4 ± 1.0	1.2 ± 0.4	9.9 ± 2.8	77	6.0 ± 3.1	55.5 ± 6.9	9.2 ± 2.8
Norway	0 (0%)	-	-	-	-	-	-	-
Poland	21 (37.5%)	3.8 ± 1.6	7.9 ± 7.4	28.9 ± 24.8	34	2.8 ± 2.0	33.9 ± 10.8	15.8 ± 9.5
Portugal	21 (91.3%)	22.5 ± 18.1	3.4 ± 3.8	73.6 ± 67.3	7	14.6 ± 13.9	65.3 ± 11.3	83.9 ± 90.0
Romania‖	2 (66.7%)	2.0 ±0.0	5.0 ± 0.0	10.0 ± 0.0	76	4.6 ± 0.6	45.0 ± 21.2	10.0 ± 0.0
Russia‖	1 (100.0%)	1.5	7.5	11.3	74	0.0	20.0	3.8

Scotland	24 (34.8%)	9.5 ± 1.4	1.8 ± 2.2	17.6 ± 22.5	64	4.0 ± 2.3	60.1 ± 9.2	17.8 ± 22.6
Serbia‖	2 (100.0%)	3.0 ± 0.0	7.0 ± 0.0	21.0 ± 0.0	55	8.0 ± 3.5	50.0 ± 0.0	17.5 ± 0.0
Slovak Republic	1 (14.3%)	10.0	2.0	20.0	60	1.5	60.0	20.0
Slovenia	2 (100.0%)	32.0 ± 28.3	5.5 ± 3.5	226.0 ± 268.7	1	51.5 ± 68.6	60.0 ± 21.2	178.5 ± 188.8
Spain	47 (54.0%)	9.1 ± 6.6	4.2 ± 4.9	38.4 ± 48.8	22	8.3 ± 6.6	74.7 ± 19.7	43.5 ± 44.8
Sweden	1 (1.4%)	12.0	2.0	24.0	50	-	60.0	24.0
Switzerland	4 (7.8%)	7.5 ± 6.4	3.0 ± 0.0	36.0 ± 0.0	29	9.0 ± 0.0	60.0 ± 0.0	36.0 ± 0.0
Turkey‖	9 (90.0%)	7.6 ± 3.2	3.7 ± 1.0	26.3 ± 8.7	41	12.3 ± 13.4	48.6 ± 17.0	21.6 ± 10.0
Wales	16 (94.1%)	8.8 ± 5.0	1.6 ± 0.5	13.2 ± 5.1	67	6.8 ± 4.7	57.1 ± 12.5	12.8 ± 5.4
Regional Mean ± SD (Median)	10.5 ± 15.3 (4.0)	9.6 ± 9.4 (8.0)	4.8 ±7.8 (3.0)	33.7 ± 47.6 (20.0)	n/a	8.9 ± 14.0 (6.0)	58.8 ± 18.7 (60.0)	31.6 ± 42.7 (20.0)
South-East Asia Region								
Bangladesh¤	1 (100.0%)	1.0	3.0	3.0	79	1.6	60.0	3.0
South Korea	12 (70.6%)	8.7 ± 2.8	2.5 ± 1.0	22.6 ± 14.5	53	1.1 ± 1.1	59.1 ± 7.9	23.3 ± 19.4
India¤	18 (78.3%)	7.5 ± 5.7	3.9 ± 2.9	24.8 ± 14.2	43	1.6 ± 1.3	52.7 ± 7.3	21.9 ± 13.5
Indonesia¤	10 (76.9%)	5.7 ± 2.1	2.5 ± 0.8	12.4 ± 2.2	71	0.9 ± 1.0	48.9 ± 10.6	10.4 ± 3.9
Nepal§	1 (100.0%)	6.0	6.0	36.0	30	6.0	-	-

Sri Lanka[c]	2 (50.0%)	20.0 ± 17.0	0.63 ± 0.5	8.0 ± 0.0	78	6.0 ± 2.8	50.0 ± 14.1	6.7 ± 1.9
Thailand[‖]	0 (0%)	-	-	-	-	-	-	-
Regional Mean ± SD (Median)	6.28 ± 7.0 (2)	7.9 ± 7.5 (6.0)	3.3 ± 2.5 (3.0)	19.6 ± 13.7 (12.0)	n/a	2.0 ± 1.9 (1.9)	53.1 ± 7.5 (56.0)	17.4 ± 12.7 (12.0)
Western Pacific Region								
Australia	85 (27.1%)	6.8 ± 1.4	2.4 ± 3.2	18.0 ± 36.1	63	7.3 ± 3.2	59.8 ± 12.2	18.1 ± 36.2
Brunei	2 (100.0%)	12.0 ± 0.0	2.0 ± 0.0	24.0 ± 0.0	51	15.5 ± 0.7	60.0 ± 0.0	24.0 ± 0.0
China	83 (38.4%)	9.2 ± 9.1	2.3 ± 1.4	22.5 ± 25.6	54	3.1 ± 7.5	49.1 ± 27.5	19.1 ± 22.5
Japan	9 (2.8%)	15.0 ± 8.0	0.9 ± 0.2	13.0 ± 6.7	68	4.6 ± 7.6	55.0 ± 12.2	12.8 ± 8.0
Malaysia	4 (66.7%)	6.0 ± 2.0	3.3 ± 3.2	23.3 ± 28.3	52	3.2 ± 1.9	60.0 ± 0.0	23.3 ± 28.3
Mongolia[c]	1 (100.0%)	-	-	-	-	-	-	-
New Zealand	27 (62.8%)	7.9 ± 2.8	2.4 ± 2.0	18.1 ± 14.4	61	6.9 ± 4.0	58.9 ± 13.3	19.4 ± 20.6
Philippines[c]	10 (100.0%)	5.0 ± 2.1	2.9 ± 0.3	13.7 ± 6.8	65	2.3 ± 1.4	64.8 ± 28.1	16.4 ± 8.6
Singapore	7 (100.0%)	7.0 ± 1.4	1.9 ± 0.6	13.7 ± 4.5	66	3.2 ± 2.6	82.9 ± 12.5	18.8 ± 8.5
Taiwan	23 (65.7%)	13.2 ± 4.1	2.6 ± 0.6	33.9 ± 13.4	31	4.7 ± 9.8	47.1 ± 12.3	27.3 ± 13.6
Regional Mean ± SD (Median)	25.1 ± 32.2 (9.5)	8.5 ± 6.1 (7.0)	2.4 ± 2.2 (2.0)	20.6 ± 26.8 (12.0)	n/a	5.3 ± 6.5 (4.0)	56.0 ± 20.7 (60.0)	19.3 ± 26.2 (12.0)
Global Mean± SD (median)	9.7 ± 17.3 (2.0)	10.9 ± 9.0 (8.0)	3.7 ± 5.5 (3.0)	34.2 ± 47.4 (24.0)	n/a	7.3 ± 10.7 (5.0)	59.2 ± 18.8 (60.0)	34.0 ± 49.3 (22.5)

By Country Income Classification								
High-income country mean (median)	13.3 ± 19.9 (5.0)	10.5 ± 8.5 (8.0)	3.8 ± 5.2 (2.0)	33.4± 51.2 (20.0)	n/a	8.4 ± 11.8 (6.0)	60.6 ± 16.9 (60.0)	33.5 ± 53.3 (20.2)
Upper middle-income country mean (median)	9.3 ± 16.8 (2.0)	12.3 ± 10.2 (12.0)	3.6 ± 6.6 (3.0)	38.9 ± 41.2 (32.0)	n/a	5.3 ± 8.1 (2.5)	56.9 ± 22.0 (60.0)	38.2 ± 42.8 (30.0)
Lower middle- and low-income country mean (median)	3.3 ± 4.6 (1.0)	8.4 ± 9.6 (6.0)	3.1 ± 2.1 (3.0)	18.2 ± 11.7 (12.0)	n/a	2.7 ± 2.9 (2.1)	55.9 ± 22.2 (60.0)	16.6 ± 11.8 (12.0)

ǁupper middle-income country; ⋐lower middle-income country; §low-income country (all others high)
*only countries which offer supervised CR shown.
ǂ number of completed surveys from country (response rate of total number of programs).
‡ Country rank by CR dose (1 is greatest)
- unknown, as no responders.
n/a, not applicable.
Acronyms: CR, cardiac rehabilitation; SD, standard deviation;
Abbreviations : Pt, patient; wk, week; mins, minutes.
Note: Due to missing data, percentages are computed where the denominator is the number of valid responses from responding programs.

Note: where no standard deviation is shown, there was only 1 response.

Table 5 – Proportion of Programs Meeting Dose Thresholds of ≥12 and ≥36 Sessions by Setting, World Health Organization Region and Country Income Classification, in Countries that Offer Cardiac Rehabilitation Globally

Setting	Supervised		Home-Based		Community-Based	
Dose (# sessions / patient for full program)	≥12	≥36	≥12	≥36	≥12	≥36
Country Income Classification						
High-income	404 (53.4%)	140 (18.5%)	29 (27.4%)	6 (5.7%)	41 (54.7%)	13 (17.3%)
Upper middle-income	186 (24.6%)	111 (14.7%)	11 (10.4%)	6 (5.7%)	10 (13.3%)	9 (12.0%)
Lower middle-income	28 (3.8%)	5 (0.8%)	1 (0.9%)	.0 (0%)	1 (1.3%)	0 (0.0%)
Low-income	1 (0.1%)	1 (0.1%)	-	-	-	-
WHO region						
Africa	15 (2.0%)	8 (1.1%)	1 (0.9%)	0 (0%)	-	-
America	214 (28.3%)	127 (16.8%)	19 (17.9%)	4 (3.8%)	16 (21.3%)	9 (12.0%)
Eastern Mediterranean	18 (2.4%)	4 (0.5%)	2 (1.9%)	1 (0.9%)	-	-
Europe	230 (30.4%)	74 (9.8%)	14 (13.2%)	5 (4.7%)	24 (32.0%)	8 (10.7%)
South East Asia	18 (2.4%)	5 (0.7%)	-	-	1 (1.3%)	0 (0.0%)
Western Pacific	124 (16.4%)	39 (9.8%)	5 (4.7%)	2 (1. 9%)	11 (14.7%)	5 (6.7%)
Global	619 (57.3%)	257 (23.8%)	41 (38.7%)	12 (11.3%)	52 (69.3%)	22 (29.3%)

-not offered

Note: Due to missing data, percentages are computed where the denominator is the number of valid responses from responding programs.

WHO, World Health Organization

Table 6 Mean Alternative Cardiac Rehabilitation Setting Program Dose (± standard deviation) by Country‡, World Health Organization Region and World Bank Country Income Classification

Setting	Home-Based				Community-Based			
Region Country	Program Duration (# weeks)	Frequency (sessions / month)	Total CR Sessions / Program (# weeks/4 x sessions/month)	Rank *	Program Duration (# weeks)	Frequency (sessions / month)	Total CR Sessions / Program (# weeks / 4 x sessions/ month)	Rank *
African								
South Africa†	16.0	8.0	32.0	7	n/o	n/o	n/o	-
Regional Mean ± SD (median)	-	-	-	-	-	-	-	-
Americas								
Bermuda	24.0	3.0	18.0	12	n/o	n/o	n/o	-
Brazil†	38.0 ± 13.1	5.0 ± 6.1	57.3 ± 71.8	4	~	1.0	~	-
Canada	21.8 ± 16.5	2.5 ± 1.6	13.0 ± 10.9	14	17.8 ± 13.0	7.8 ± 3.8	29.0 ± 18.4	8
Costa Rica†	12.0	~	~	-	18.0 ± 8.5	12.0 ± 0.0	54.0 ± 25.5	5
Cuba†	36.0 ± 0.0	10.0 ± 2.8	90.0 ± 25.5	1	36.0 ± 21.4	13.8 ± 2.1	124.3 ± 81.6	1
Guatemala|	12.0	2.0	6.0	25	n/o	n/o	n/o	-
Mexico†	8.0	4.0	8.0	22	n/o	n/o	n/o	-
Paraguay†	36.0	2.0	27.0	8	n/o	n/o	n/o	-

Venezuela†	12.0	4.0	12.0	17	n/o	n/o	n/o	-
Regional Mean ± SD (Median)	22.7 ± 15.3 (16.0)	3.4 ± 2.8 (3.0)	20.3 ± 26.3 (12.0)	-	22.1 ± 16.1 (16.0)	9.4 ± 4.2 (9.0)	54.4 ± 56.2 (36.0)	-
Eastern Mediterranean								
Iran†	9.8 ± 3.2	6.2 ± 4.6	14.1 ± 12.6	13	12.0	~	~	-
Regional Mean ± SD (Median)	9.8 ± 3.2 (12.0)	6.2 ± 4.6 (5.0)	14.1 ± 12.6 (10.0)	-	-	~	~	-
Europe								
Austria	n/o	n/o	n/o	-	6.0	50.0	75.0	2
Belgium	12.0	4.0	12.0	15	~	8.0	~	-
Czech Republic	11.0 ± 1.4	2.3 ± 0.6	5.5 ± 0.7	26	n/o	n/o	n/o	-
Denmark	12.0	24.0	72.0	2	n/o	n/o	n/o	-
England	12.4 ± 14.7	2.9 ± 2.0	7.4 ± 6.1	23	15.0 ± 21.8	6.8 ± 2.9	21.9 ± 22.4	11
Estonia	12.0	12.0	36.0	6	n/o	n/o	n/o	-
France	n/o	n/o	n/o	-	10.0	4.0	10.0	16
Georgia†	10.0	20.0	50.0	5	12.0	12.0	36.0	7
Germany	n/o	n/o	n/o	-	3.0	~	~	-
Hungary	6.0	40.0	60.0	3	6.0	40.0	60.0	4
Ireland	n/o	n/o	n/o	-	8.0	2.0	4.0	18

Italy	6.0	10.0 ± 8.7	9.0	20	14.8 ± 8.1	12.4 ± 4.6	47.3 ± 34.5	6
Moldova|	12.0	4.0	12.0	16	n/o	n/o	n/o	-
Netherlands	26.0	3.3 ± 1.1	26.0	9	~	8.0	~	-
Scotland	9.2 ± 2.3	1.6 ± 0.9	3.2 ± 1.3	27	9.0 ± 0.9	5.9 ± 2.3	13.9 ± 5.6	14
Spain	8.0 ± 0.0	3.2 ± 1.3	6.3 ± 2.7	24	8.0 ± 0.0	14.0 ± 2.8	28.0 ± 5.7	9
Wales	12.0 ± 5.7	3.8 ± 3.0	11.08 ± 9.8	18	9.9 ± 6.8	4.4 ± 2.7	11.3 ± 12.6	15
Regional Mean ± SD (Median)	10.8 ± 7.9 (8.0)	5.2 ± 7.4 (3.0)	12.7 ± 16.2 (6.0)	-	11.9 ± 14.0 (8.0)	9.1 ± 9.7 (8.0)	23.7 ± 23.2 (16.0)	-
South-East Asia								
South Korea	10.0 ± 4.0	2.6 ± 3.1	8.3 ± 10.8	21	n/o	n/o	n/o	-
India|	~	6.5 ± 7.8	~	-	n/o	n/o	n/o	-
Indonesia|	n/o	n/o	n/o	-	30.0	2.0	15.0	13
Regional Mean ± SD (Median)	10.0 ± 4.0 (8.0)	2.6 ± 3.1 (3.0)	8.3 ± 10.8 (9.0)	-	-	-	-	-
Western Pacific								
Australia	8.4 ± 9.2	2.9 ± 2.3	3.2 ± 2.7	28	6.2 ± 3.8	5.1 ± 3.0	9.4 ± 8.4	17
China	7.9 ± 7.2	6.4 ± 6.7	24.6 ± 46.9	10	25.6 ± 22.1	10.8 ± 6.8	65.2 ± 75.3	3
Japan	4.0	1.0	1.0	30	31.0 ± 26.9	2.7 ± 1.5	26.5 ± 33.2	10
Malaysia	8.0 ± 5.7	1.0 ± 0.0	2.0 ± 1.4	29	24.0	~	~	-
New Zealand	10.0 ± 12.1	3.0 ± 0.8	9.5 ± 12.6	19	8.2 ± 3.4	8.6 ± 5.7	21.5 ± 17.1	12

Philippines|	~	8.0	~	-	n/o	n/o	n/o	-
Taiwan	16.0 ± 5.7	6.5 ± 7.8	20.5 ± 21.9	11	n/o	n/o	n/o	-
Regional Mean ± SD (Median)	9.2 ± 7.4 (6.0)	4.0 ± 4.8 (3.0)	11.8 ± 25.3 (3.0)	-	14.3 ± 14.7 (10.0)	6.9 ± 5.6 (5.3)	26.0 ± 39.0 (13.5)	-
Global Mean ± SD (median)	14.3 ± 12.1 (12.0)	4.4 ± 5.5 (3.0)	15.3 ± 22.0 (6.1)	-	15.1 ± 15.0 (10.0)	8.5 ± 7.7 (8.0)	31.2 ± 38.7 (20.0)	-
Mean across countries ± SD (median)								
High-income country mean (median)	14.2 ± 12.4 (12.0)	3.8 ± 5.3 (3.0)	11.5 ± 13.3 (6.0)	-	12.7 ± 13.4 (9.0)	8.1 ± 8.0 (8.0)	22.9 ± 21.2 (16.0)	-
Upper middle-income country mean (median)	15.0 ± 11.7 (12.0)	6.7 ± 5.9 (4.0)	29.4 ± 38.0 (11.0)	-	26.5 ± 18.1 (24.0)	11.2 ± 5.3 (12.0)	75.1 ± 71.1 (48.5)	-
Lower middle-income country mean (median)	-	3.0 ± 1.4 (3.0)	-	-	n/o	n/o	n/o	-

†upper middle-income country; \|lower middle-income country (all others high)
‡only countries which offer alternative CR models shown.
- not applicable
~unknown, as no responders.
* by country (1 is greatest dose).
n/o, not offered;
SD, Standard Deviation; CR, Cardiac Rehabilitation;
Note: where no standard deviation is shown, there was only 1 response.

Table 7: Correlates of Cardiac Rehabilitation Dose

Correlates	**Dose** (Mean ± SD)	**Uni-variable Test Statistic**	**Uni-variable p**	**GLMM F**	**p**
SUPERVISED					
Program Funding					
Most common source		F= 7.991	<0.001	1.481	0.228
Public	31.1 ± 44.7*ǂ				
Private	43.3 ± 60.0*				
Hybrid	38.7 ± 48.6ǂ				
Any government funding		t= -2.248	0.025	2.138	0.144
Yes	33.8 ± 46.4				
No	42.7 ± 59.2				
Any private healthcare insurance Coverage		t = -6.330	<0.001	0.011	0.918
Yes	45.9 ± 60.7				

No	32.3 ± 44.6				
Any patient funding		t = -3.231	0.001	0.009	0.924
Yes	39.5 ± 48.9				
No	33.2 ± 50.0				
Geographic factors					
Program location		F=1.055	0.349	-	-
Urban	36.5±49.6				
Suburban	38.8 ± 64.3				
Rural or countryside	26.8 ± 22.6				
Other CR program located within 20 km (12.43 miles) radius		t = -3.338	0.001	9.464	0.002
Yes	40.4 ± 54.5				
No	31.1 ± 43.7				

CR located within an academic hospital Yes No	 32.7 ± 44.0 39.1 ± 54.7	t=2.295	0.022	0.138	0.711
Healthcare professionals on CR team					
Total number of staff (part-time counted as .5)	-	r=0.012	0.747	-	-
Cardiologist Yes No	 38.0±53.1 27.3±33.1	t=-3.037	0.002	1.322	0.251
Any physician Yes No	 38.6±47.2 33.8±51.2	t=2.243	0.025	0.685	0.408
Dietitian / Nutritionist Yes	 34.8±49.2	t=1.694	0.091	-	-

No	40.4±52.7				
Administrative assistant Yes No	 36.6±50.0 31.3±42.1	t=-2.903	0.004	2.776	0.096
Any mental health care specialist (other than nurse) Yes No	 40.3±49.7 33.9±47.3	t=2.100	0.036	2.187	0.140
Perceived expense of front-line personnel	-	r=0.044	0.252	-	-
Physician as medical director Yes No	 39.2±51.8 28.4±43.5	t=-4.390	<0.001	4.982	0.026

Patient receives individual consult with physician Yes No	 40.0±53.5 24.7±35.6	t=-4.729	<0.001	22.751	<0.001
Barriers to delivery					
Insufficient human resources	-	r=-0.071	0.054	-	-
Insufficient financial resources	-	r=-0.025	0.490	-	-
Insufficient space	-	r=-0.039	0.292	-	-
Insufficient patient referral	-	r=0.084	0.021	0.238	0.626
Insufficient equipment	-	r=-0.054	0.141	-	-
Core components					

Total number delivered	-	r=0.032	0.387	-	-
Management of cardiovascular risk factors Yes No	 35.5±49.6 49.4±51.5	t=1.533	0.126	-	-
Nutrition counselling Yes No	 34.5±48.9 52.7±55.5	t=3.034	0.002	8.701	0.003
Stress management Yes No	 35.4±51.7 37.4±38.9	t=2.164	0.031	1.244	0.265

Smoking cessation interventions Yes No	 33.9±48.1 40.9±53.0	t=2.523	0.012	3.430	0.064
Resistance training Yes No	 35.9±48.9 33.2±57.0	t=-1.948	0.052	-	-
Patient education Yes No	 35.7±49.9 22.4±22.3	t=-1.510	0.146	-	-
Number of risk factors assessed	-	r=0.035	0.339	-	-
Program assets					
Cardiopulmonary exercise stress testing facilities		t=-0.962	0.337	-	-

Yes	37.9±53.6				
No	33.3±44.6				
Gym space		t=-0.950	0.343	-	-
Yes	35.5±49.0				
No	39.1±60.9				
Group education space		t=1.094	0.274	-	-
Yes	35.8±51.3				
No	33.5±30.8				
Telemetry		t=-3.014	0.003	1.242	0.265
Yes	38.3±56.5				
No	30.3±33.6				
Electronic patient charts		t=-2.859	0.004	0.198	0.656
Yes	38.5±55.7				
No	30.8±36.6				

Administrative office Yes No	 36.1±52.2 33.1±34.8	t=-0.093	0.926	-	-
Accepted Patient types					
Heart failure Yes No	 35.7±48.7 35.6±55.5	t=-0.075	0.941	-	-
Non-cardiac indications Yes No	 41.3±52.5 32.3±47.2	t=-4.700	<0.001	4.376	0.037
Accept high-risk patients Yes No	 37.2±50.6 33.4±51.3	t=-3.022	0.003	0.211	0.646
Program capacity					

# Patients that could be served / year	-	r=-0.089	0.026	0.024	0.877
Wait time to start	-	r=0.138	<0.001	6.451	0.011
Number of patients per exercise session	-	r=0.080	0.031	2.299	0.130
Staff-to-patient ratio	-	r=0.031	0.413	-	-
ALTERNATIVE DELIVERY SETTINGS					
Home-based					
Model reimbursed by government or health insurance Yes No	 18.2±22.3 13.2±22.1	t=-1.313	0.192	-	-
Year home-based program started	-	r=0.048	0.648	-	-

Proportion patients served in home-based program	-	r=-0.054	0.607	-	-
Perception sufficient home-based capacity Yes No	 16.6±26.3 11.8±10.1	t=1.015	0.313	-	-
Perceive insufficient funding Yes No	 11.6±9.5 16.4±23.3	t=-1.594	0.115	-	-
Perceive insufficient staff Yes No	 11.5±9.7 17.2±24.7	t=-0.565	0.573	-	-

Accept high-risk patients in home-based Yes No	 14.3±21.3 14.4±21.6	t=-0.725	0.470	-	-
Uses any form of information or communication technology Yes No	 14.9±22.1 15.7±5.3	t=0.671	0.504	-	-

Physician directly interacts with patient in home-based Yes No	 21.1±29.8 12.1±16.6	t=-0.499	0.619	-	-
Uses some form or remote monitoring Yes No	 31.7±41.2 13.7±19.6	t=-0.086	0.931	-	-
Community-based					
Program reimbursed by government/health insurance Yes No	 18.2±22.3 13.2±22.1	t=-2.202	0.031	0.761	0.386

Facility Type Public Private or Semi-private	 32.5±46.4 31.8±25.5	t=-1.273	0.207	-	-
Proportion patients served in community-based program	-	r=-0.098	0.446	-	-
Mean patients per community-based session	-	r=0.142	0.256	-	-
Physician most responsible to supervise sessions Yes No	 58.9±46.0 27.2±36.1	t=-2.248	0.028	1.928	0.169

Telemetry available Yes No	 15.2±18.5 32.5±39.7	t=0.552	0.583	-	-

Bonferroni post-hoc: *p<0.05, ǂp<0.01

-not applicable

Acronyms: CR, cardiac rehabilitation, SD, Standard Deviation; CI, Confidence Interval; GLMM, Generalized Linear Mixed Model.

Abbreviations: pts, patients;

FIGURES

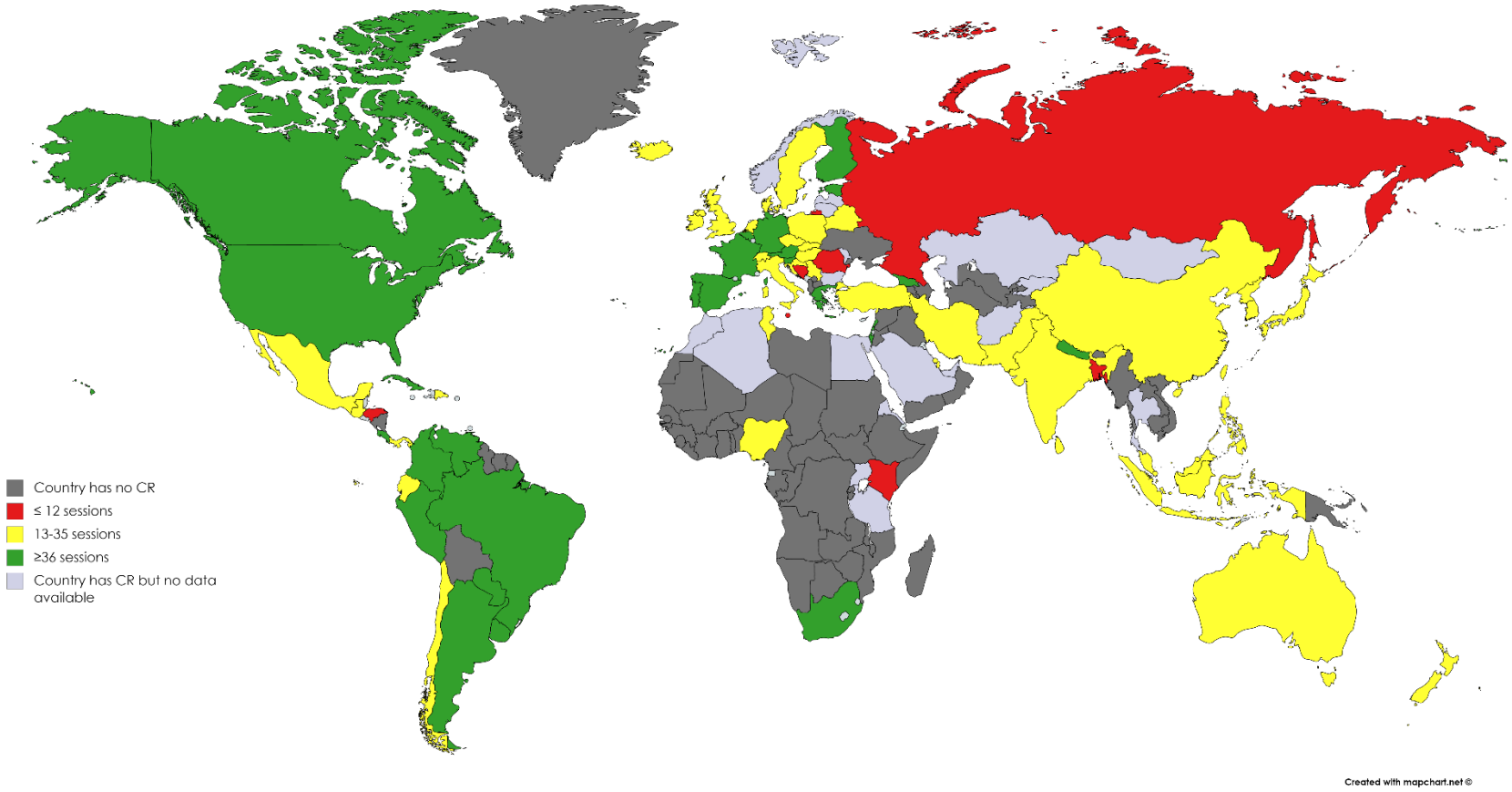

Figure 1

Figure Legend: Supervised cardiac rehabilitation dose by country program mean

CR, Cardiac rehabilitation

9. APPENDICES

Appendix A: Global CR Program Survey Informed Consent Form

GLOBAL CARDIAC REHABILITATION PROGRAM SURVEY

Consent form

You are being asked to participate in a research study to understand the availability and characteristics of cardiac rehabilitation programs globally. You are being asked to participate because you are the most responsible clinician or administrator of a cardiac rehabilitation program.

What You Will Be Asked to Do in the Research:
If you agree to participate, you will be asked to respond to an online survey that takes about 20 minutes to complete.
Data will be collected primarily via online survey. Phone or paper administration may be possible in some instances if you do not have internet access and are willing to provide your information in this manner.

Confidentiality:
All information you supply during the research will be held in confidence, and your name will not appear in any report or publication of the research.

Your data will be safely stored. Each completed survey will only be identifiable by a unique research identification number. Electronic survey responses will be stored on a secure database. It will not be stored on any portable media. Only the research team will have access to the collected information. The Principal Investigators will destroy the data 15 years after the completion of the project: the electronic database will be deleted from the system. Confidentiality will be provided to the fullest extent possible by law.

Benefits of the Research and Benefits to You:
This research is designed to understand the availability of cardiac rehab, particularly in low- and middle-income countries where there is a growing burden of cardiovascular disease. We hope to use the findings to inform policy in international and national fora, on the status of and gaps in cardiac rehabilitation.

If you are interested, we will provide you with comparative information about the characteristics of other cardiac rehabilitation programs in your country or region. This information may be of use to you in advocating for CR services in your region.

You will not receive payment for your participation.

Risks and Discomforts:

We do not foresee any risks or discomfort from your participation in the research. You may refuse to answer any question(s) that you do not wish to answer.

Voluntary Participation:
Your participation in the study is voluntary and you may choose to stop participating at any time. Your decision not to volunteer will not influence the nature of the ongoing relationship you may have with the researchers, or study staff, or the nature of your relationship with York University of the Mayo Clinic either now, or in the future. You have the right to withdraw your consent or discontinue participation at any time without penalty.

Questions About the Research?
If you have questions about the research in general or about your role in the study, please feel free to contact [redacted] either by telephone at [redacted], extension [redacted] or by e-mail ([redacted]) or [redacted] by e-mail ([redacted])

This research has been reviewed and approved by the Human Participants Review Sub-Committee, York University's Ethics Review Board, and conforms to the standards of the Canadian Tri-Council Research Ethics guidelines. If you have any questions about this process or about your rights as a participant in the study, please contact the Sr. Manager & Policy Advisor for the Office of Research Ethics, 5th Floor, York Research Tower, York University (telephone [redacted] or e-mail [redacted]). In addition, if you have any concerns, complaints, or general questions about research or your rights as a participant, please contact the Mayo Institutional Review Board (IRB) to speak to someone independent of the research team at [redacted] or toll free at [redacted].

Legal Rights and Consent:

I consent to participate in "*Global Cardiac Rehabilitation Survey: Availability and Characteristics of Programs*" conducted by Drs. [redacted] & [redacted]. I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by completing this form. My checkmark below indicates my consent.

- ❑ I consent

Today's date: _____ (dd/mmm/yyyy)

Appendix B: Global CR Program Survey Questionnaire

CARDIAC REHABILITATION PROGRAM QUESTIONNAIRE

1. What is your Title/Position at the cardiac rehabilitation program? (check ✓one):
   - ☐ Director
   - ☐ Coordinator / Manager / Supervisor
   - ☐ Clinician, specify: _____
   - ☐ Other, specify: _____

SECTION A: GENERAL INFORMATION

2. In what country is your cardiac rehabilitation program? _____

3. City / Region: _____(optional)

4. Your cardiac rehabilitation program is located in an:

   - ☐ Urban area (e.g.larger cities, towns)
   - ☐ Suburban (a residential district located on the outskirts of a city)
   - ☐ Rural area or countryside (a geographic area that is located outside towns and cities).

5. In what year was your cardiac rehabilitation program initiated? _____ (year)

6. Who pays for cardiac rehabilitation ? (Check all that apply)
   - ☐ Social security / government
   - ☐ Hospital or clinical center where the cardiac rehab service is based
   - ☐ Patient (answer 6b & c)
   - ☐ Private health insurance
   - ☐ Other (specify): _____

6b. What is average percent of the total program cost that patients pay, if they complete the program?

_____ % OR □ I don't know

6c. What is the direct cost to patients to participate, if they complete the program?

_____ _____ OR □ I don't know
Amount currency

7. Is your cardiac rehabilitation program located within a hospital (check ✓one)?
   - ☐ Yes – it is in a referral centre/ quarternary / tertiary facility and / or academic centre
   - ☐ Yes – it is in a community hospital
   - ☐ Yes - it is in a rehabilitation hospital/ residential facility
     If checked: Is your CR program a spa/residential program? □ Yes □ No
   - ☐ Yes – other (please specify: _____)
   - ☐ No (skip to question 10)

8. If Q7 was marked yes, does the hospital have an inpatient cardiology service? Check one box:
   - ☐ Yes, and these patients are referred to our cardiac rehabilitation program regularly
   - ☐ Yes, and these patients are sometimes referred to our cardiac rehabilitation program
   - ☐ Yes, and these patients are rarely referred to our cardiac rehabilitation program
   - ☐ No

9. If Q7 and Q8 were marked yes, do they offer? (check all that apply)
   - ☐ Revascularization via percutaneous coronary intervention (PCI)
   - ☐ Coronary artery bypass graft surgery (CABG)
   - ☐ Percutaneous valve implantation
   - ☐ Implantable heart devices (pacemakers or defibrillators)
   - ☐ Cardiac transplant
   - ☐ None

10. In what department is the cardiac rehabilitation program situated administratively?
    - ☐ Cardiology department
    - ☐ Physical Medicine and Rehabilitation department
    - ☐ Internal Medicine department
    - ☐ Primary / general practice
    - ☐ It is in a community facility
    - ☐ None – it is stand-alone
    - ☐ Other (specify) :_____

11. For patients referred following a cardiac hospitalization, on average how many weeks after discharge does a patient start your program? (i.e., initial assessment appointment)

    _____ weeks

12. How many unique cardiac rehabilitation patients do you <u>provide service</u> to each year in your program?

    _____ patients per year

13. How many patients do you have <u>capacity</u> to serve each year, in terms of staff and space?
_____ patients per year

14. What is the cost to your program to serve one (1) patient, if they complete the program?

_____ _____ OR □ I don't know

Amount currency

15. Who can refer a patient to your program? Check all that apply
- ☐ Patients can self-refer
- ☐ Physicians
- ☐ Allied healthcare providers and / or nurses
- ☐ Community health care workers
- ☐ Other, please specify: _____

16. Are there any other Cardiac Rehabilitation programs in your area? Check one box
- ☐ Yes, within approximately a 20 km radius
- ☐ Yes, but more than 20 km away
- ☐ None
- ☐ I don't know

17. Please rate the degree to which each of the following are barriers to greater patient participation in your cardiac rehab program, from "this is definitely not an issue" to "this is a major issue": Check one per row.

	This is definitely not an issue 1	This is not an issue 2	Neutral 3	This is a minor issue 4	This is a major issue 5
Lack of patient referral	○	○	○	○	○
Lack of equipment (specify:_____)	○	○	○	○	○

Lack of space	○	○	○	○	○
Lack of human resources	○	○	○	○	○
Lack of financial resources/ budget	○	○	○	○	○
Other (specify:_____)	○	○	○	○	○

SECTION B: DETAILS ABOUT YOUR CARDIAC REHABILITATION PROGRAM

18. Who has overall responsibility for cardiac rehabilitation at your program? Please check one box:
    - ☐ Cardiologist
    - ☐ Physician specialist in internal medicine
    - ☐ Physical medicine and rehabilitation (physiatrist)
    - ☐ Physician, other specialty (please specify: _____)
    - ☐ Nurse
    - ☐ Exercise physiologist
    - ☐ Physiotherapist
    - ☐ Other (specify)_____

19. How expensive are the following aspects of delivering your cardiac rehab program? (check one box per row)

	Free	Only a minor cost	Costs a bit	costs quite a bit	Very expensive	Not applicable as we do not have this
a. Front-line personnel						
b. Space						
c. Exercise equipment						
d. Equipment / supplies for cardiovascular risk assessment (not including exercise stress tests)						
e. Exercise stress testing on a treadmill or cycle ergometer						
f. Patient education materials						
g. Blood pressure assessment device						
h. Blood collection and lipid testing						
i. Free weights etc. for resistance training						

20. Which of the following components of cardiac rehabilitation are provided in your program? If they are provided, are they provided in all the models you deliver? (i.e., supervised and home-based programs)?

Please check one box per row. If you only offer one model of rehabilitation and you offer the listed component, please check "yes, in all models".

	Yes In all models	Yes For some models	No
Initial assessment			
Individual consultation with a physician			
Individual consultation with a nurse			
Exercise stress test			
Other functional capacity test (please specify: _____)			
Assessment of strength (e.g., handgrip)			
Assessment for comorbities / issues that could impact exercise (e.g., cognition, vision, musculoskeletal / mobility issues, frailty, and / or balance / falls risk)			
Exercise prescription			
Physical activity counseling			
Supervised exercise training			
Heart rate measurement training for patients			
Resistance training			
Management of cardiovascular risk factors			
Prescription and/or titration of secondary prevention medications			
Nutrition counseling			
Depression screening			
Psychological counseling			
Smoking cessation sessions/classes			
Vocational counseling / support for return-to-work			
Stress management / Relaxation techniques			
Alternative forms of exercise, such as yoga, dance, or tai chi (please specify: _____)			
Women-only classes			
End of program re-assessment			
Electronic patient charting			
Communication of patient assessment results with their primary care provider			
Follow-up after oupatient program			
Other (please specify): _____			

21. How many education sessions are provided to each patient in your program? _____ (enter zero if none)

22. How many minutes on average is each education session? _____ minutes (enter zero if none)

23. In your program, do you assess the following risk factors? Please check one box per row.

	Yes	No
Time spent being sedentary		
Tobacco use		
Harmful use of alcohol		
Blood pressure		
Body mass Index		
Waist circumference		
Hip circumference		
Body composition		
Total Cholesterol		
Cholesterol fractions (HDL-c, LDL-c)		
Triglycerides		
HbA1c for diabetic patients		
Blood glucose for non-diabetic patients		
Sleep apnea		
Depression / Anxiety		
Physical inactivity		
Poor diet		
Other (please specify:_____)		

24. Which types of personnel are part of your cardiovascular rehabilitation (CR) team? If they are part of your team, do they work in Cardiac Rehabilitation only, or do they have other department obligations? (Check one box in each row):

a. Cardiologist Yes- only CR ( ) Yes- partial ( ) No ( )

b. Physiatrist (Physical medicine and rehabilitation) Yes- only CR ( )Yes- partial ( ) No ( )
c. Sports Medicine Physician Yes- only CR ( ) Yes- partial ( ) No ( )
d. Other Physician (specify:_____)Yes- only CR ( ) Yes- partial ( ) No ( )
e. Physiotherapist Yes- only CR ( ) Yes- partial ( ) No ( )
f. Nurse Yes- only CR ( ) Yes- partial ( ) No ( )
g. Nurse practitioner Yes- only CR ( ) Yes- partial ( ) No ( )
h. Psychiatrist Yes- only CR ( ) Yes- partial ( ) No ( )
i. Psychologist Yes- only CR ( ) Yes- partial ( ) No ( )
j. Social worker Yes- only CR ( ) Yes- partial ( ) No ( )
k. Dietitian Yes- only CR ( ) Yes- partial ( ) No ( )
l. Kinesiologist Yes- only CR ( ) Yes- partial ( ) No ( )
m. Pharmacist Yes- only CR ( ) Yes- partial ( ) No ( )
n. Exercise specialist Yes- only CR ( ) Yes- partial ( ) No ( )
o. Community Health worker Yes- only CR ( ) Yes- partial ( ) No ( )
p. Administrative assistant/ Secretary Yes- only CR ( ) Yes- partial ( ) No ( )
q. Other (specify): _____ Yes- only CR ( ) Yes- partial ( ) No ( )

25. Do all your clinical staff supervising patients during exercise sessions have cardiopulmonary resuscitation (CPR) training / certification?

☐ Yes
☐ No (skip to question 26)

25b. If yes, are they required to renew their CPR training regularly?

☐ Yes
☐ No

25c. If yes, is the CPR certification advanced or basic? (circle one per row)

Physicians:	Advanced	Basic
Nurses:	Advanced	Basic
Other:	Advanced	Basic

26. Does your program have each of the following ítems, and if yes, is its' use dedicated to your program or shared with another group (circle one option in each row)?

Bicycle ergometer	Dedicated	Shared	Not available
Treadmill ergometer	Dedicated	Shared	Not available
Arm cycloergomenter	Dedicated	Shared	Not available
Doppler Echocardiography	Dedicated	Shared	Not available
Stress test (no O_2)	Dedicated	Shared	Not available
Stress test with O2	Dedicated	Shared	Not available
Telemetry	Dedicated	Shared	Not available
Group education room	Dedicated	Shared	Not available
Gym space	Dedicated	Shared	Not available
Individual assessment/ Counselling room	Dedicated	Shared	Not available
Patient change room	Dedicated	Shared	Not available
Administrative office	Dedicated	Shared	Not available
Electronic patient charts	Dedicated	Shared	Not available
Resistance training equipment	Dedicated	Shared	Not available
Body composition analyzer	Dedicated	Shared	Not available
Staff meeting room	Dedicated	Shared	Not available
Staff office space	Dedicated	Shared	Not available
Other (specify):	Dedicated	Shared	Not available

27. Does your site offer a supervised Cardiac Rehabilitation program?

☐ Yes
☐ No (skip to section D)

SECTION C: CARDIAC REHABILITATION – Supervised Program

28. Which of the following cardiac diagnoses or indications do you accept for your supervised program? (Check all that apply)
    - ☐ Post Myocardial Infarction / acute coronary syndrome
    - ☐ Stable coronary artery disease, without a recent event or procedure
    - ☐ Post percutaneous coronary intervention (PCI)
    - ☐ Post coronary artery bypass graft surgery (CABG)
    - ☐ Heart failure
    - ☐ Patients who have had valve surgery/repair or transcatheter aortic valve implantation (TAVI)
    - ☐ Heart transplant
    - ☐ Patients with ventricular assist devices
    - ☐ Arrhythmias (hemodynamically-stable)
    - ☐ Patients with implanted devices for rhythm control (i.e., ICD / CRT, pacemaker)
    - ☐ Congenital heart disease
    - ☐ Cardiomyopathy
    - ☐ Rheumatic heart disease
    - ☐ Patients at high-risk of cardiovascular disease (primary prevention)
    - ☐ Non-cardiac chronic diseases
    - ☐ Other (specify): _____

29. Which of the following non-cardiac diagnoses or indications do you accept for your on-site program? (Check all that apply)
    - ☐ Stroke
    - ☐ Intermittent claudication / peripheral vascular disease
    - ☐ Cancer
    - ☐ Diabetes
    - ☐ Chronic lung disease
    - ☐ None
    - ☐ Other (specify): _____

30. Which of the following patient levels of cardiac risk do you accept for your supervised program? (Check all that apply)
    - ☐ Low
    - ☐ Moderate
    - ☐ High
    - ☐ Not applicable because we do not risk stratify at our program

31. Do patients have an individual consult with a physician during the program?
    - ☐ Yes, please specify # times in a full program: _____
    - ☐ No

32. What is the standard duration of the on-site cardiac rehabilitation program that you provide to patients?

_____ weeks

33. On average, for how many sessions do patients come on-site each week?

_____ sessions per week OR _____ sessions / day (residential programs)

34. On average, how many patients are in each exercise session?

_____ patients / session

35. On average, how long is each exercise session (including warm up, aerobic exercise, strength training and/ or cold down)?

_____ minutes / session

36. What is the maximum number of patients that your program allows in the same exercise session?

_____ patients / session

37. What is the staff to patient ratio during supervised exercise at your program? _____:_____ patients

38. Which healthcare professionals are usually present during exercise sessions? (Check one box in each row)

a. Cardiologist Yes ( ) No ( )
b. Physiatrist (Physical Medicine and Rehabilitation) Yes ( ) No ( )
c. Sports Medicine Physician Yes ( ) No ( )
d. Other Physician (specify:_____) Yes ( ) No ( )
e. Physiotherapist Yes ( ) No ( )

f. Nurse Yes ( ) No ( )
g. Nurse practitioner Yes ( ) No ( )
h. Psychiatrist Yes ( ) No ( )
i. Psychologist Yes ( ) No ( )
j. Social worker Yes ( ) No ( )
k. Dietitian Yes ( ) No ( )
l. Kinesiologist Yes ( ) No ( )
m. Pharmacist Yes ( ) No ( )
n. Exercise specialist Yes ( ) No ( )
o. Community health worker Yes ( ) No ( )
p. Other (specify): _____

39. Does the supervised program offer telemetry or another method of monitoring patients' clinical status while exercising? (check all that apply)
    - ☐ Yes, telemetry
    - ☐ Yes, other method of monitoring; please specify:
        - ☐ Borg scale (perceived exertion)
        - ☐ Heart rate
        - ☐ Other: _____
    - ☐ None