

1 **Title Page**

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3 **Full Title:** Building Capacity through ICCPR's Cardiovascular Rehabilitation Foundations
4 Certification (CRFC): Evaluation of Reach, Barriers and Impact

5 **Running Title:** ICCPR CR Foundations Certification Evaluation

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Structured Abstract

Purpose: The International Council of Cardiac Rehabilitation and Prevention (ICCPR) developed an online Cardiac Rehabilitation Foundations Certification (CRFC; <https://globalcardiacrehab.com/Certification>) in October 2017, to build CR delivery capacity in low-resource settings based on their guidelines. Herein we evaluate its' reach globally, barriers to its completion, as well as satisfaction and impact of the course among those completing it.

Methods: The country of origin of all applicants was tallied. An online survey was developed for learners who completed the CRFC (completers), and for those who applied but did not yet complete the program (non-completers), administered using Google Forms.

Results: With regard to reach, 236 applications were received from 23/203 (11.3%) countries; 51 (25%) were from low or middle-income countries. 130 (55.1%) have completed the CRFC; mean scores on the final exam were $88.3 \pm 7.1\%$, with no difference by country income classification ($P=.052$). Sixteen (21.9%) non-completers and 37 (34.3%) completers responded to the survey. Barriers reported by non-completers were time constraints, cost, and technical issues. Overall satisfaction with the CRFC was high ($4.49 \pm 0.51/5$); most completers would highly recommend the CRFC to others (4.30 ± 0.66), and perceived that the information provided will contribute to their work and/or the care of their patients (4.38 ± 0.89); 29 (78.4%) had used the information from the CRFC in their practice.

Conclusions: The reach of the CRFC still needs to be broadened, in particular in low-resource settings. Learners are highly satisfied with the certification, and its impacts on CR practice are encouraging. Input has been implemented to improve the CRFC.

59 **Condensed Abstract**

60 236 learners have applied to ICCPR's Cardiac Rehabilitation Foundations Certification (CRFC)
61 from 23 countries. Evaluation survey responses from CRFC completers and non-completers
62 revealed that the CRFC is exceeding the overall expectations of learners. However, its reach
63 needs to be broadened, and barriers related to cost and technological issues addressed.

64

INTRODUCTION

Cardiovascular diseases are among the leading burdens of disease and causes of disability globally, with particular burden in low and middle-income countries (LMICs).¹ Cardiac rehabilitation (CR) is a comprehensive, cost-effective intervention for secondary prevention. Participation reduces mortality and morbidity, as well as increases quality of life.^{2,3} Based on robust evidence, CR is recommended in clinical practice guidelines globally.⁴

Unfortunately however, CR delivery is lacking across the world, with India and China having the greatest need for CR.^{5,6} Reasons for this dearth have been studied globally, with one of the main issues being lack of programs in low-resource settings⁷ (i.e., LMICs or areas in high-income countries with suboptimal healthcare delivery, financial pressures, underdeveloped infrastructure, etc.)⁸ due, in large part, to lack of trained healthcare providers (e.g., physicians, physiotherapists, nurses, clinical exercise physiologists) to deliver it.^{5,9}

The International Council for Cardiovascular Prevention and Rehabilitation (ICCPR)'s mission includes promoting CR delivery.^{10,11} Accordingly, ICCPR developed an evidence-based consensus statement on how to feasibly and affordably deliver each core component of CR (e.g., patient education, structured exercise training, psychosocial counselling) in low-resource settings.^{12,13} To facilitate application of its recommendations, they developed an educational program—the Cardiovascular Rehabilitation Foundations Certification (CRFC) program. The CRFC is intended for healthcare professionals (including trainees) in any discipline involved in the delivery of CR.

In 2016-2017, the ICCPR created a working group comprised of subject matter experts (listed at link below) from around the world (primarily low-resource settings) on each core component to develop the modules (SDC Table 1). Each module, comprising a slide presentation

narrated through an approximately 1-hour video, was peer-reviewed. There are several case studies for learners to apply their knowledge, as well as supplemental readings provided in addition to the consensus statement. A test bank of multiple-choice questions was developed for each module; learners can access the final exam after viewing each module, and must earn 70% on the timed exam to earn their CRFC designation.

The CRFC's focus on low-resource settings (in terms of content and cost—only USD\$100), and completely online mode of delivery, sets it apart from the 2 only other CR training programs currently in existence⁶. The British and American certification programs are more advanced as is appropriate for high-resource settings, thus the CRFC compliments these existing certifications and is not intended to replace them. Neither has ever been evaluated, although the American certification is accredited. This evaluation characterized the reach of the CRFC, barriers to its completion, as well as satisfaction and impact of the course among those completing it. Given our aim to meet the needs of learners in low-resource settings, these parameters were explored by income classification of the learner's country.

METHODS

The English CRFC was launched in October 2017. Learners must have a minimum of 12 yrs of schooling and 500 hours of experience in healthcare (includes volunteering). Information about modules, requirements, and the final exam can be found online (<https://globalcardiacrehab.com/Certification>). Learners randomly get 10 questions for each of the 8 modules (SDC Table 1), for a total of 80 questions; a practice test is available.

Number of applicants (i.e., learners who may or may not have successfully completed the CRFC at the time of the study) and completers was tallied, including country of origin, to

characterize reach (i.e., the extent and range of effect or influence). Final multiple-choice test scores were examined.

Evaluation surveys were developed using Google Forms. One was developed for learners who completed the CRFC (i.e., completers), and another for those who applied but did not complete the program (i.e., non-completers) to understand their barriers. With consideration of Kirkpatrick's training evaluation model,¹⁴ items were developed by the authors, with forced-choice, Likert-type, and open-ended response options. The survey link was emailed to applicants as applicable in April 2020, and a reminder email was sent to non-responders 2 weeks later. The survey was confidential, and all respondents voluntarily participated.

Descriptive statistics were used to summarize the results of the survey, and open-ended responses were coded. Mean exam scores, overall learners' satisfaction with CRFC and whether learners would recommend CRFC to others were compared by country income classification (high vs upper-middle vs lower-middle-income) according to the World Bank¹⁵ using the Kruskal-Wallis test for non-normally distributed data.

RESULTS

REACH

Overall, 236 applications were received from 23 of the 203^{16,17} (11.3%) countries in the world from inception through November 2020, of which 51 (21.7%) were from MICs (Table 1); note many learners were from Canada where the working group co-chair resides, who had been marketing the course to upper-yr undergraduate kinesiology students upon development for input (their countries of origin are very diverse). All met eligibility criteria, although the 500-hour requirement was reduced for some of the Canadian trainees.

All 236 applicants had some education beyond the minimum high school requirement. They reported a median=3,499.0 (~21 months; interquartile range=100.0–17,860.0) hours working or volunteering in healthcare at the time of application, with 136 (68.7%) having experience working with chronic disease patients specifically.

NON-COMPLETING CRFC APPLICANTS - BARRIERS

Sixteen/73 (21.9%) CRFC non-completers responded to the survey (Table 1). Of these, 11 (68.8%) respondents were female, and 15 (93.8%) worked in healthcare.

When asked about potential barriers impeding their CRFC completion, respondents most strongly cited time constraints, cost and technological glitches (SDC Table 2). The only other barriers stated were “personal reasons”.

When non-completers were asked to what degree they would recommend the CRFC to others (from 1 “definitely not” to 5 “very highly”), the mean score was 4.1 ± 0.8 . When asked how the course could better meet their needs, respondents most commonly replied provision of reading material (n=2), followed by a structured timeline for completion of the program (n=1), and fee waivers (n=1).

CRFC COMPLETERS

Overall, 133 (56.4%) applicants attempted the final exam (Table 1; note those not passing successfully were not “completers”). The mean exam score was $88.3 \pm 7.1\%$, with 3 (1.3%) not meeting the required 70% minimum on their first. Exam scores did not differ by country income classification ($P=.052$; highest scores in upper-middle income countries, followed by high-income and then lower-middle). Ratings of the level of difficulty of the material and of the exam itself were positive (Table 2).

Thirty-seven (34.3%) of 108 applicants who had completed the CRFC at the time of survey dissemination responded (Table 1). Twenty-five (67.6%) survey responders were female; 15 (40.5%) were from non-Western countries. Twenty-one (56.8%) worked in healthcare (e.g., physiotherapists, physicians, occupational therapists), and 15 (40.5%) were students (e.g., kinesiology). Among those who worked in healthcare: the average number of yrs since they completed their highest academic qualification was 9.7 ± 8.1 ; 7 (33.3%) worked at a government hospital, 6 (28.6%) at a clinic, 4 (19.0%) at a private hospital, and 4 (19.0%) at other settings; 17 (81.0%) worked in CR or secondary prevention.

When asked to rate their overall satisfaction with the CRFC (from 1 “very dissatisfied” to 5 “very satisfied”), the mean score was 4.45 ± 0.5 (this did not vary by country income classification; $P=.720$). When completers were asked to rate to what degree they would recommend the CRFC to others (from 1 “definitely not” to 5 “very highly”), the mean score was 4.3 ± 0.7 ($P=.048$ by country income classification; highest recommendation in upper-middle income countries, followed by high-income and then lower-middle). Ratings of specific elements of the CRFC are provided in Table 2, and with each module in SDC Figure 1. Overall, 29 (78.4%) learners reported using the CRFC information in their practice; this for example included improving their delivery (e.g., “able to give tips to patients”), patient assessment (e.g., “change assessment methods”), academic enhancement (e.g., “apply the concepts learned ... to my studies”) and research (e.g., “useful for my study”).

Finally, when asked to identify potential barriers to applying what they learned, respondents reported forgetting due to lack of written materials and re-certification requirements, lack of multidisciplinary CR teams in their setting, lack of financial resources to offer high-quality comprehensive programs, and overall limits to CR delivery capacity.

DISCUSSION

The impact of the CRFC on knowledge and clinical practice are encouraging. Learners from all countries, particularly upper-middle income, were highly satisfied with the certification, supporting the value of the CRFC. The World Health Organization will soon be releasing the Package of Rehabilitation Interventions for ischemic heart disease,^{18,19} with care recommendations based on ICCPR's guidelines on which the CRFC is based;^{12,13} thus, the CRFC can serve as a valuable resource to augment high-quality CR delivery capacity globally.

Nine hundred and ninety-four physicians from India completed the CRFC in 2019 (these learners did one module per month through a special training program, and so were not included in this evaluation). Thus, except in India, which does have the greatest CR need,⁵ reach of the CRFC, particularly in LMICs has been modest to date. This could be attributed to language, the cost and technological challenges that exist across LMICs; yet, it was encouraging that MIC learners found the material applicable to their setting and were highly likely to recommend it to others. The CRFC working group continues to work towards broader dissemination. Marketing efforts to date have involved dissemination through ICCPR's 40 member associations and 15 "friends" (e.g., email blasts, websites, social media accounts), sharing the CRFC with CR programs listed in available CR directories globally (<https://globalcardiacrehab.com/Cardiac-Rehab-Centers-Around-the-World>), and direct emails to some physiotherapy, kinesiology, and medical faculties globally. We have also gained continuing education credits for the CRFC through the Canadian Society of Exercise Physiology (CSEP), the American College of Sports Medicine (ACSM), Continuing Professional Development-United Kingdom (CPD-UK), and Canfitpro (Canadian association for fitness professionals). Most recently, we have used Google Ads.

On a final note, in 2021 ICCPR entered into an agreement with the Chinese Society of Cardiovascular Prevention and Rehabilitation to translate and disseminate the CRFC within their country (<http://www.xklmchina.com/>). Some applicants were struggling with the language and others had issues accessing the CRFC website within China. This is important, given the second greatest unmet need exists there after India,⁵ and they currently have the greatest CR growth rates globally to our knowledge.²⁰ Initial interest has been strong. There is a post-certification evaluation survey embedded, so we will review learner responses and modify the CRFC accordingly in future. Russia, Pakistan, Brazil and Ukraine also have the greatest unmet need globally⁷; we have reached learners in Brazil only, so will target those other countries next.

There are several limitations to the CRFC. Due to the online delivery mode, technical and clinical skills cannot be taught or tested, only knowledge. Moreover, without a pre-test, it is difficult to draw firm conclusions on the degree of knowledge gained through CRFC completion. The final exam success rate was very high; whether this is due to the excellence of the modules or level of difficulty cannot be known at this time. The working group is hesitant to make the test items more difficult without first seeing pre-test results, given for many learners English is likely not their first language. Finally, whether the CRFC will impact learner delivery of CR well beyond certification completion is also unclear. There is currently no annual re-certification requirement or capacity, which should be considered by the working group.

In terms of future directions, several technological (e.g., sound, site navigation) and other improvements have been made to the CRFC based on the findings, including provision of written materials to all learners, with module summaries available upon request. We recently reviewed the content in each module and updated them based on the latest evidence. Moreover, ICCPR is currently developing a registry for low-resource settings (<https://globalcardiacrehab.com/ICRR->

Governance), which may in future be used as the basis for program certification, to complement this provider certification scheme.

There are several limitations to this evaluation. First is the question of generalizability. As discussed above, there was modest participation from LMICs. Moreover, sample size and response rate, particularly for non-completers, was low. This also raises questions about whether some information has been missed. Second, there is likely recall bias. As the CRFC has been in existence for almost 3 yrs, some of the survey respondents may have had difficulty remembering reasons why they did not complete the CRFC or their perceptions of the CRFC and its utility.

CONCLUSIONS

Despite the limitations acknowledged, the CRFC is exceeding expectations of learners globally, with many being able to translate learnings into their practice. With this preliminary evidence of the utility of the CRFC, efforts to promote it in low-resource settings, where CR is needed most, are underway. Given the great need for cardiovascular secondary prevention, we hope the CRFC will continue to serve as a tool to support further availability of CR in low-resource settings where it is needed most.

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304 **Table 1. Reach of CRFC, Completion Rate, and Evaluation Survey Response Rate, by**
305 **Region and Country**

Country (WHO Region)	World Bank Income Classification 13	Estimated Number of CR Programs in Country ⁵	Number CRFC Applicants (% Completed CRFC)	Number Responding to Completer Survey (%)	Number Responding to Non-Completer Survey (%)
<i>Africa</i>					
South Africa	UMIC	23	2 (50)	1 (100)	0 (0)
Regional total			2		
<i>Americas</i>					
Brazil	UMIC	75	3 (100)	NA	1 (50)
Canada	HIC	170	115 (70)	19 (26)	0 (0)
United States	HIC	2632	2 (100)	2 (100)	NA
Regional total			120		
<i>Eastern Mediterranean</i>					
Iran	UMIC	34	2 (0)	NA	1 (50)
Kuwait	HIC	1	1 (0)	NA	0 (0)
Qatar	HIC	1	10 (100)	4 (44)	1 (20)
United Arab Emirates	HIC	1	1 (100)	1 (100)	NA
Regional total			14		
<i>Europe</i>					
Azerbaijan	UMIC	0	1 (100)	NA	0 (0)
Czech Republic	HIC	15	2 (100)	2 (100)	NA
Greece	HIC	4	1 (100)	0 (0)	NA
Ireland	HIC	37	1 (100)	0 (0)	NA
United Kingdom	HIC	365	2 (50)	0 (0)	NA
Regional total			7		
<i>South-East Asia</i>					

India	LMIC	23	26 (54)	5 (63)	8 (73)
Indonesia	UMIC	13	1 (100)	1 (100)	NA
Sri Lanka	LMIC	4	3 (67)	1 (50)	NA
Regional total			30		
<i>Western Pacific</i>					
Australia	HIC	314	12 (50)	1 (100)	3 (50)
China / Hong Kong	UMIC / HIC	218	8 (38)	0 (0.0)	0 (0)
Malaysia	UMIC	6	4 (25)	NA	1 (50)
New Zealand	HIC	43	2 (50)	1 (100)	0 (0)
Philippines	LMIC	10	1 (100)	NA	NA
Singapore	HIC	7	3 (33)	0 (0)	0 (0)
South Korea	HIC	17	1 (0.0)	NA	0 (0)
Regional total			11		
Total			236 (55)	37 (34)	16 (22)

Abbreviations: CR, cardiac rehabilitation; CRFC, Cardiovascular Rehabilitation Foundations

Certification; HIC, high-income country; LMIC, lower-middle-income country; NA, not applicable; UMIC, upper-middle-income country; WHO, World Health Organization.

Note: “Applicants” refers to learners who applied to the CRFC, but who may or may not have completed and passed the final exam. “Completers” refers to learners who applied and successfully passed the final CRFC exam. “Non-completers” refers to learners who applied but did not successfully pass the final CRFC exam by the time of survey administration.

Data are presented as n (%).

317 **Table 2. CRFC Evaluation by Completers (N=37)**

Survey Items	Response ^a
a. The modules achieved their stated learning objectives. ^b	4.5 ± 0.5
b. I felt that the contents were evidenced-based and balanced. ^b	4.6 ± 0.8
c. The information provided will contribute to my work and/or the care of my patients. ^b	4.4 ± 0.9
d. The multiple-choice test was fair. ^b	4.4 ± 1.0
e. The CRFC met my learning needs and goals. ^b	4.3 ± 0.9
f. The course fee was acceptable. ^b	4.3 ± 0.9
g. The terminology and language used was clear and appropriate. ^b	4.3 ± 0.9
h. The website was easy to access and use. ^b	4.3 ± 0.8
i. The information presented was relevant to my geographic context. ^b	4.2 ± 0.8
j. The slides for each module were helpful. ^b	4.2 ± 1.0
k. The case studies were useful to help apply what I learned and better grasp and retain the information. ^b	4.1 ± 1.0
l. The information was presented in a logical sequence. ^b	4.1 ± 0.8
m. The CRFC website and modules were easy to navigate. ^b	4.1 ± 1.0
n. The multiple-choice questions were directly relevant and appropriate to the content. ^b	4.1 ± 1.0
o. Numbers appearing in the modules were clear and easy to understand. ^b	4.1 ± 1.0
p. I got all the information I was looking for. ^b	4.0 ± 0.9
q. The text in the slides was clear to read. ^b	4.0 ± 1.1
r. The module contents were presented clearly. ^b	4.0 ± 1.0
s. The visual aids were used in a way that supported my learning. ^b	4.0 ± 1.0
t. Each module had a helpful summary. ^b	4.0 ± 1.1
u. I was engaged by the quality of the presentations. ^b	3.9 ± 0.9
v. The organization of the content into the modules made intuitive sense. ^b	3.9 ± 1.0
w. Helpful resources were provided to implement the content. ^b	3.9 ± 1.0
x. The videos for each module were easy to hear and follow. ^b	3.7 ± 1.0
y. The level of the material was too difficult. ^c	3.8 ± 1.3

z. There was too much content. ^c	3.7 ± 1.2
Overall	4.2 ± 0.5

318 Abbreviations: CRFC, Cardiovascular Rehabilitation Foundations Certification.

319 Note: mean ± standard deviation are shown.

320 ^ahigher score indicates more positive evaluation.

321 ^bscores ranged from 1 “strongly disagree” to 5 “strongly agree”.

322 ^cscores ranged from 1 “strongly agree” to 5 “strongly disagree”; scores were reversed to allow

323 for a straightforward comparison and calculation of an overall mean and standard deviation.

324

325 **SUPPLEMENTAL DIGITAL CONTENT**

326 Building Capacity in Cardiac Rehabilitation Through the International Council of Cardiovascular
327 Prevention and Rehabilitation's Cardiovascular Rehabilitation Foundations Certification (CRFC)
328 Program: Evaluation of Reach, Barriers and Impact

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334 SDC Table 1. List of CRFC Modules

335 SDC Table 2. Reasons for Non-Completion of the CRFC Program

336 SDC Figure 1. CRFC Module Evaluation by Completers

337 **SDC Table 1: List of CRFC modules**

338

Module	Title
1.	Patient Assessment (and Re-assessment)
2.	Diet
3.	Exercise Training
4.	Tobacco Cessation
5.	Mental Health / Psychosocial / Return to work
6.	Medical Risk Factor Management (lipids, hypertension, obesity, medications, diabetes)
7.	Patient Education & Counselling
8.	Alternative Delivery Settings
Optional	Cardiac Rehabilitation Overview for Physicians
Optional	Cardiac Rehabilitation Delivery During COVID-19

339 CRFC: Cardiac Rehabilitation Foundations Certification.

340 **SDC Table 2. Reasons for Non-Completion of the CRFC Program (N=16)**

Survey Items	Response ^a	Not Applicable
a. I didn't have time. ^b	3.1 ± 1.2	0 (0)
b. The course fee was too high. ^b	3.0 ± 1.1	1 (6)
c. I started the modules, but they were too easy for me based on the experience and knowledge I already have. ^b	3.0 ± 1.0	4 (25)
d. I had technical challenges with the website. ^b	2.6 ± 1.1	1 (6)
e. I didn't have the requirements to be eligible to take the course. ^b	2.4 ± 1.4	4 (25)
f. I had trouble paying the course fee via Paypal. ^b	2.4 ± 1.5	3 (19)
g. I didn't have the information needed to submit with my application. ^b	2.4 ± 1.1	2 (13)
h. I started the modules, but they were too hard for me. ^b	2.1 ± 1.0	3 (19)
i. I started the modules, but they were not relevant or of interest to me. ^b	1.9 ± 0.8	3 (19)
j. It was very clear how to apply and get started with the CRFC. ^c	2.6 ± 1.4	0 (0)
k. If I had any problems, the CRFC admin person was quickly able to help me. ^c	2.5 ± 1.2	2 (13)
Overall	2.5 ± 0.5	-

341 Acronym: CRFC, Cardiovascular Rehabilitation Foundations Certification.

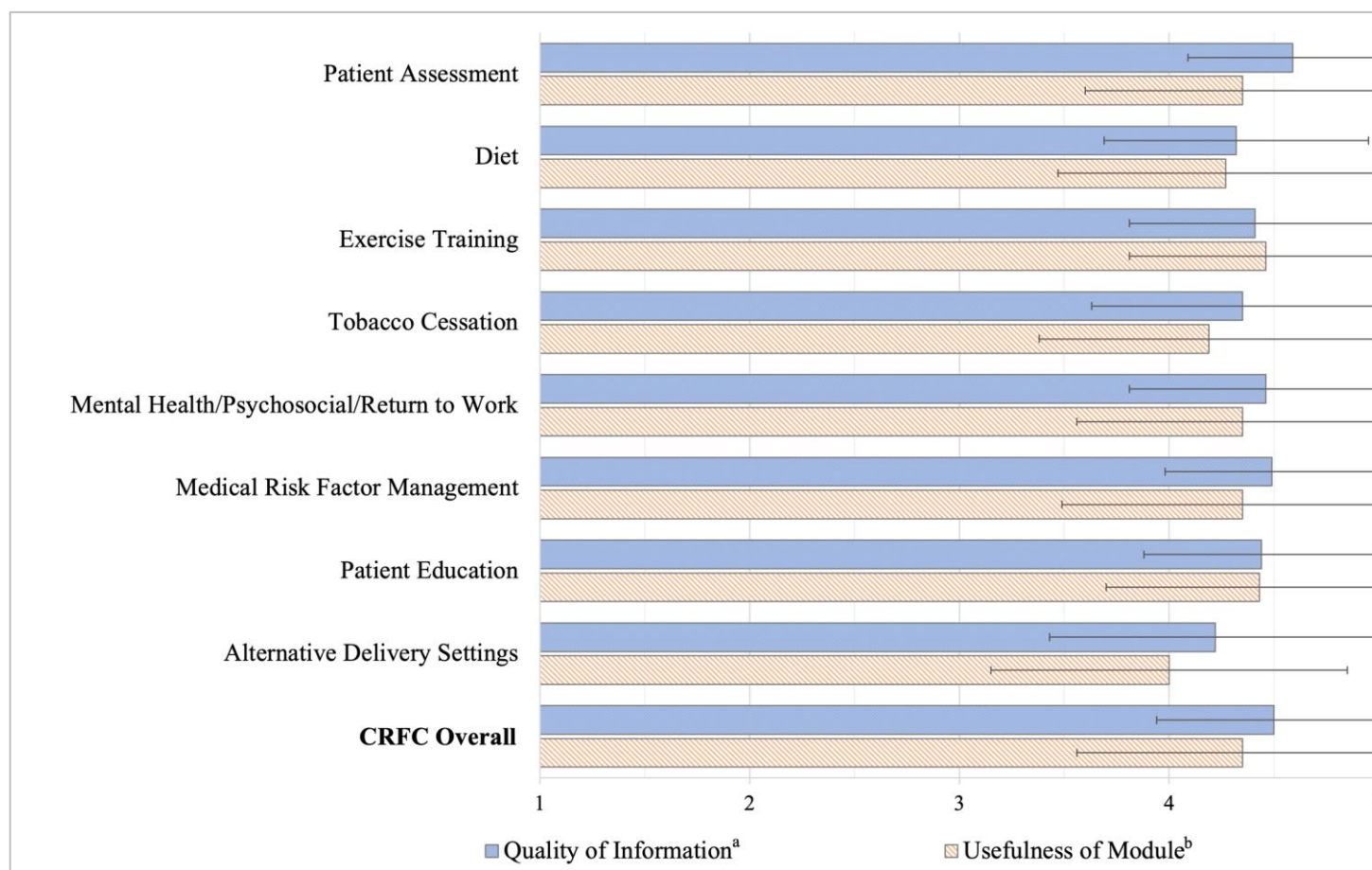
342 Note: mean ± standard deviation or n (%) are shown.

343 ^ahigher score indicates greater barrier to completion.

344 ^bscores ranged from 1 “strongly disagree” to 5 “strongly agree”.

345 'scores ranged from 1 "strongly agree" to 5 "strongly disagree"; scores were reversed to allow
346 for a straightforward comparison and calculation of an overall mean and standard deviation.

SDC Figure 1. CRFC Module Evaluation by Completers (N=37)



Acronym: CRFC, Cardiovascular Rehabilitation Foundations Certification.

Note: Data are presented as mean and standard deviation; higher scores indicate more positive evaluation.

^ascores ranged from 1 “poor” to 5 “excellent”.

^bscores ranged from 1 “not at all useful” to 5 “very useful”.