

## Availability and delivery of cardiac rehabilitation in the Eastern Mediterranean Region: How does it compare globally?☆

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### ABSTRACT

**Background:** This study aimed to (1) confirm cardiac rehabilitation (CR) availability, (2) establish CR density and unmet need, as well as (3) the nature of programs in the Eastern Mediterranean Region (EMR), and (4) compare these (a) by EMR country and (b) to other countries.

**Methods:** In this cross-sectional study, a survey was administered to CR programs globally. Cardiac associations and local champions facilitated program identification. CR need was based on Global Burden of Disease study ischemic heart disease (IHD) estimates.

**Results:** Of the 22 EMR countries, CR programs were identified in 12 (54.5%). Nine (75.0% country response rate) countries participated, and 24/49 (49.0% program response rate) surveys were initiated.

There was 1 CR spot for every 104 incident IHD patients/year (versus 12 globally). One-third of responding programs were privately funded ( $n = 8$ ; versus globally  $p < .001$ ), and in 18 (75.0%) programs patients paid some or all of the cost out-of-pocket (versus  $n = 378$ , 36.3% globally;  $p < .001$ ). Over 80% of programs accepted guideline-indicated patients. Nurses ( $n = 20$ , 95.2%), cardiologists ( $n = 18$ , 85.7%) and dietitians ( $n = 18$ , 85.7%) were the most common healthcare providers on CR teams (mean =  $6.4 \pm 2.2$ /program;  $5.9 \pm 2.8$  globally,  $p = .18$ ). On average, programs offered  $8.9 \pm 1.7/11$  core components (versus  $8.7 \pm 1.9$  globally,  $p = .90$ ). These were most commonly initial assessment, management of risk factors, and patient education ( $n = 21$ , 100.0% for each), and least commonly return-to-work counselling ( $n = 15$  71.4%). Mean dose was  $27.0 \pm 13.5$  sessions (versus  $28.7 \pm 27.6$  globally,  $p = .38$ ). Seven (33.3%) programs offered some alternative models.

**Conclusion:** CR is insufficiently implemented, with 2,079,283 more spots needed/year across the EMR. But where offered, CR is consistent with guidelines.

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### 1. Introduction

Cardiovascular diseases (CVD) are among the leading burdens of disease and disability worldwide [1]. Of all 6 World Health Organization

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(WHO) regions, after Africa, CVD mortality is estimated to increase most dramatically in the next decade in the Eastern Mediterranean Region (EMR) [2]. Ischemic heart disease (IHD) alone accounts for 9.2% of disability-adjusted life years in the EMR [3].

Clearly, there is great need for CVD secondary prevention in the EMR. Unfortunately however, a recent review revealed there is wide variability in receipt of secondary prevention medications in cardiac patients across the region, and low use of cardiac rehabilitation (CR) [4]. CR is comprised of several core components, namely risk factor

assessment and management, patient education, structured exercise training and stress management, delivered by a multidisciplinary team (e.g., dietitians, nurses) [5] to ensure all secondary prevention recommendations are provided.

It is well-established that CR results in significant reductions in CV mortality and morbidity, among other benefits also demonstrated in the EMR [6,7]. Despite this and its cost-effectiveness [6,8,9], CR is not readily available in the region. A 2015 review revealed only 6 (27.3%) of the 22 Arab countries (19 of which are in the EMR) even offer any CR [10], and where it was offered the density ranged from 1 program per 1.4 million inhabitants in Bahrain, to 1 program per 50.5 million inhabitants in Pakistan (results from the Global CR Program Survey, under review by the eClinical Medicine).

There has been no original study to characterize the nature of CR in the EMR. There has been one study of CR programs in the region (again in Arab countries however [10]); 4/6 (66.6%) countries believed to have CR at the time were represented in the sample, and only 5 (62.5%) of the 8 available programs at the time completed a survey (and all respondents were from high-income countries [HICs] except Egypt) [10]. Results revealed programs were primarily situated in hospitals, and patients attended an average of  $2.3 \pm 1.5$  sessions per week over a duration of <3 months. No programs offered unsupervised sessions (e.g., home-based CR), but 60% offered women-only classes. In terms of the core components, only 60% offered supervised exercise training, with the same for stress management. Most programs were led by cardiologists, and also had a nurse on staff.

Clearly, more needs to be known about CR in the EMR, and how it compares to guideline recommendations [11]. Accordingly, the objectives of this investigation were to: (1) characterize the availability, volumes, capacity and density of CR by (a) EMR country, and (b) in comparison to other WHO regions; and (2) characterize the following aspects of CR: (a) setting, (b) funding sources and costs, (c) type of patients served, (d) number and types of healthcare professionals on CR team, (e) number of program sessions (i.e., dose), (f) core components delivered, and (g) delivery of alternative models (including women-only classes), again by EMR country, and in comparison to other WHO regions.

## 2. Methods

### 2.1. Design & procedure

This research was cross-sectional in design. Detailed methods are reported elsewhere [12,13].

Upon compiling a list of all countries, those where CR services were available were identified first through previous reviews [10,14–18]. In countries where CR services were not suspected to be available, first the internet was searched and second major CR and cardiology societies were contacted to identify any programs or verify lack thereof. Countries were categorized by WHO region [19], including the EMR.

For each country identified to offer CR, first available CR or cardiac societies leadership was contacted, and if there was no society available or response, “champions” were identified from the peer-reviewed, or secondly, grey literature/web. Identified leaders were sent an e-mail requesting their collaboration to: (a) identify the number of programs in their country, and (b) provide a contact email for each.

Each program was emailed with the request to complete the survey. Informed consent was secured through an online form. The confidential survey was administered through REDCap, with data collection occurring from June 2016 to July 2017.

### 2.2. Setting and sample

For the global study, 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.

For the purposes of this study, CR programs in the EMR were selected: Afghanistan, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen [20]. The population in these countries ranges from 0.8 to 153.1 million individuals in Djibouti and Pakistan, respectively, with a total estimated population of 583 million inhabitants. Six of these EMR countries are considered HICs, 14 are middle-income (MICs), and 2 are low (LICs) [21]. Predominantly, the religious context is Islamic and the most common language spoken is Arabic. There is active conflict in 12 countries.

### 2.3. Measures

With regard to the first objective, CR program volume was defined as the median number of patients served annually (reported in survey, described below). National CR capacity was computed by multiplying the median number of patients a program could serve annually (reported in survey) among the responding programs in a given country, by the total number of programs in that jurisdiction. This was ascertained from literature reviews [17] and/or champions. Regional capacity was the sum of national capacity for countries within that region. For countries where no surveys were completed, national capacity was computed by multiplying the number of programs by regional median program capacity. Lastly, to compute density, information on IHD incidence was pulled from the Global Burden of Disease study [22]. The ratio of capacity per annual incident IHD case was computed (i.e., density); this was then ranked from best (i.e., most spots per incident patient) to worst.

Development of the survey is described in detail elsewhere [10]. In short, items were based on previous national/regional CR programs surveys [15,18,23]. Most items had forced-choice response options. This was pilot-tested in the Arab world and Canada [10].

The following variables were assessed: (i) where the programs are situated (i.e., in an urban center, academic hospital) as well as proximity to other programs (< or >20 km radius), (ii) who funds the program (i.e., private sources such as healthcare insurance, public sources such as government, or a combination of these sources), (iii) the type (e.g., myocardial infarction, as well as non-cardiac indications) and number of patients served per session (as well as staff-to-patient ratio), (iv) the number and types of healthcare professionals on the CR team (part-time staff were counted as 0.5), (v) dose of CR (in hours; i.e., sessions per week  $\times$  duration in weeks  $\times$  duration of exercise sessions in minutes divided by 60); (vi) the type and number of core components delivered (of 11; i.e., initial assessment, risk assessment, exercise [counselling, prescription and/or training], patient education, management of CVD risk factors, nutrition counselling, stress management, tobacco cessation interventions, vocation counselling, communication with a primary healthcare provider, and end of program re-assessment), and (vii) whether the program offers alternative CR models (i.e., home or community-based programs, or hybrid models where patients transition from supervised to unsupervised settings, as well as women-only classes).

### 2.4. Statistical analyses

SPSS version 25 was used for analysis, and  $p < .05$  considered significant [24]. 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 descriptive analyses, percentages were computed with the denominator being the valid number of responses for a specific item. Descriptive statistics were used to characterize volume, capacity, density, as well as other closed-ended items in the survey (e.g., funding sources, core components delivered, and healthcare professionals on the CR team). All open-ended responses were coded/categorized. Where sufficient data were available, comparisons were made using Fisher's exact tests for categorical variables, and Mann-Whitney test or Kruskal-Wallis test for continuous dependent variables. Due to the sample sizes in the EMR, multivariate analyses could not be undertaken.

## 3. Results

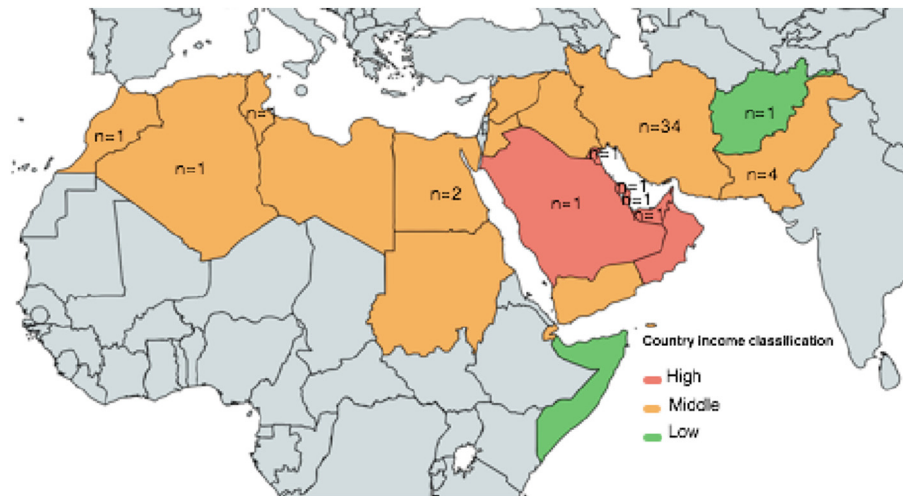
As reported elsewhere [12,13], there were 111/203 (54.7%) countries in the world with existent CR programs, of which data were collected in 93 (83.8%). There were 1082 surveys completed (32.1% response rate). Response rate by WHO region is also shown there.

As shown in Fig. 1, of the 22 EMR countries, 12 (54.5%) offered CR, with a total of 49 programs. Data were collected in 9 (75.0%) countries. Twenty-four programs participated in the study (response rate = 49.0%; Table 1 displays response rate by country).

### 3.1. Availability, volumes, capacity and density

Fig. 1 and Table 1 display the EMR countries offering CR. The number of programs per country ranged from 1 (in 9 of the 12 countries) to 34 (Iran; median = 1 vs 1 globally). The first program in the EMR opened in Iran in 1994 (vs 1944 globally), where approximately 2/3rds of programs in the EMR are situated. Fifteen (65.2%) programs opened  $\geq 2010$ . Of the 6 HICs in the EMR, 5 (83.3%) offered CR, whereas only 6 (42.9%) of the MICs, and 1 (50.0%) of the LICs offered it.

As shown in Table 1, volumes ranged from 20 patients per program per year in Egypt to 900 patients in Pakistan (median 120 in EMR vs 157 globally,  $p = .47$ ). Where offered, the ratio of patient capacity to volume served was 1.8:1 spots/program/year (range 1.2:1 to 5.0:1 in Qatar and



**Fig. 1.** Availability of cardiac rehabilitation in the Eastern Mediterranean Region, by country income classification. Note: Colored countries are in the Eastern Mediterranean Region. Numbers represent number of cardiac rehabilitation programs in a country. Countries without numbers have zero programs. Country income classification based on World Bank.

Egypt, respectively; vs 1.25:1 globally). Under-utilized capacity is depicted in Supplementary Fig. 1.

There was 1 CR spot for every 213 incident IHD patients in countries with CR in the EMR (range from 8 patients per spot in Bahrain to 1847 patients in Egypt; *Table 1*) versus per 21 patients globally. In the EMR countries without CR, there are an additional 439,275 incident IHD patients/year (Supplementary Table 1, such that across all countries in the EMR there is only 1 spot for every 104 patients in need vs 12 patients globally. The greatest need for CR is in Pakistan, Egypt, Iran, Morocco, Iraq, and Sudan (all >100,000 spots needed/year). When considering the density of CR in the WHO regions of the world, the EMR ranks among the poorest.

### 3.2. CR delivery

#### 3.2.1. CR setting

All ( $n = 24$ ; 100.0%) programs were located in an urban area (vs  $n = 775$ , 72.8% globally,  $p = .001$ ). Nine (39.1%) programs reported that there was another CR program within a 20 km radius.

The majority of programs ( $n = 21$ ; 91.3%) were located in hospitals; of which 18 (78.3%) were tertiary hospitals or academic centers (vs  $n = 466$ , 45.4% globally,  $p < .01$ ). Of those located in hospitals, 19 (90.5%) had an inpatient cardiology unit. Eight (38.1%) programs reported systematic inpatient referral to the CR. Programs were most often under a cardiology ( $n = 9$ ; 39.1%) or physical medicine and rehabilitation department ( $n = 9$ ; 39.1%), while 3 (13.0%) programs were stand-alone, and 1 (4.3%) was in a community facility.

Physicians were the main source of patient referral to CR ( $n = 21$ ; 91.3%). Patient self-referral was allowed in 5 countries and was the 2nd most common referral source ( $n = 12$  programs, 52.2%). Patients were less frequently referred by allied healthcare providers and/or nurses ( $n = 6$ ; 26.1%), which was the practice in Iran, Pakistan and Lebanon (vs  $n = 465$ , 47.0% globally,  $p = .06$ ). Referral by community healthcare workers was the least common ( $n = 5$  programs; 21.7%), but was practiced in Iran, Pakistan, and Egypt. The median waiting time from patient discharge to enrollment in CR was less than the recommended 4 weeks [25] in 3 of 8 (37.5%) EMR countries with CR (median = 3.3 weeks, Q25–Q75 = 2–14.5; vs 2.5 weeks, Q25–Q75 = 1.5–4.0 globally;  $p < .001$ ).

### 3.3. Source of funding and cost

Most CR programs in the EMR were funded by multiple sources (Supplementary Table 2). This differed significantly from other

countries, where public sources were most frequent ( $n = 587$ , 56.5%;  $p < .01$ ). In 18 (75.0%) programs, patients paid some or all of program costs, and in 3 (12.5%) programs patients were the sole source of funding (vs  $n = 378$ , 36.3%,  $p < .001$  and  $n = 90$ , 8.7% globally,  $p = .46$ , respectively). Using purchasing power parity conversions (2016 USD [26]), where patients paid, they paid on average  $39.6 \pm 27.6\%$  of the cost or  $\$493.2 \pm 821.0$  per program (vs  $46.4 \pm 39.3\%$ ,  $p = .38$ ;  $\$591.5 \pm 1049.1$ ,  $p = .75$  globally, respectively). Finally, the estimated average cost to treat 1 patient for a full program was consistent with that globally ( $p = .9$ ; Supplementary Table 2).

### 3.4. Cardiac rehabilitation indications

As shown in Supplementary Table 3, over 80% of programs accepted each of the guideline-recommended indications for CR, with no differences from other countries globally. Among non-cardiac indications, high-risk/primary prevention and diabetes patients were equally the most accepted by programs ( $n = 12$ ; 66.7%; Supplementary Table 3).

### 3.5. Healthcare professionals on the cardiac rehabilitation team

As shown in *Table 2*, the most common type of healthcare professionals on CR teams were nurses, followed equally by cardiologists and dietitians. Exercise professionals were less represented on CR teams. Sport medicine physicians were significantly more common on CR teams in the EMR when compared to other countries ( $p < .001$ ). Mental healthcare professionals were differentially represented on CR teams in EMR (i.e., more psychiatrists and fewer psychologists).

It was a physician who had the overall responsibility for CR programs most commonly ( $n = 19$ ; 90.5%; vs  $n = 661$ ; 68.6% globally;  $p = .03$ ), followed equally by a nurse or physiotherapist ( $n = 1$ ; 4.8% for each). In 17 (94.4%) programs, patients received an individual consult with a physician, with an average of  $5.5 \pm 6.9$  consultations over the course of a program. Further, in 18 (85.7%) programs, patients received an individual consult with a nurse. The average number of staff on CR teams was 6 (*Table 2*), with a significantly lower staff-to-patient ratio than seen globally ( $p < .01$ ).

### 3.6. Core components

The mean number of core components offered by programs was  $8.9 \pm 1.7/11$  (consistent globally; *Table 3*). Return-to-work counseling was the least likely to be offered by programs (similar globally),

**Table 1**  
Cardiac rehabilitation availability and density by Eastern Mediterranean Region country, and comparison to other regions.

	Income classification	IHD incidence <sup>a</sup>	Year 1st CR program	# CR programs	# responding (%)	Median annual volume/program	Median annual capacity/program	National CR capacity <sup>b</sup>	CR density <sup>c</sup>	CR density ranking <sup>d</sup>	CR need <sup>e</sup>
<b>EMR country with CR</b>											
Afghanistan	LIC	89,056	2014	1	1 (100.0%)	100	150	150	594	8	88,906
Bahrain	HIC	3842	1998	1	1 (100.0%)	140	500	500	8	1	3342
Egypt	LMI	369,488	2010	2	2 (100.0%)	20	100	200	1847	10	369,288
Iran	UMI	235,157	1994	34	14 (41.2%)	250	475	16,150	15	2	219,007
Kuwait <sup>f</sup>	HIC	7648	NA	1	0 (0.0%)	NA	246	246	31	3	7222
Lebanon	UMI	27,633	2014	1	1 (100.0%)	100	300	300	92	6	27,333
Morocco <sup>f</sup>	LMI	156,088	2016	1	1 (100.0%)	NA	246	246	635	9	155,842
Pakistan	LMI	622,146	2004	4	2 (50.0%)	900	1500	6000	104	6	616,146
Qatar	HIC	7003	2013	1	1 (100.0%)	157	192	192	37	4	6811
Saudi Arabia <sup>f</sup>	HIC	82,510	NA	1	0 (0.0%)	NA	246	246	335	7	82,264
Tunisia	LMI	50,217	2010	1	1 (100.0%)	90	150	150	335	7	50,067
United Arab Emirates <sup>f</sup>	HIC	21,885	NA	1	0 (0.0%)	NA	246	246	89	5	21,639
EMR countries with CR <sup>g</sup>		66,363 (11,208–215,389)	2010 (2001–2014)	1 (1–2)	24 (49.0%)	120 (93–227)	246 (161–431)	2546 (194–450)	213 (32–529)	–	69,487 (11,942–331,718)
<b>WHO regions<sup>h</sup></b>											
EMR		50,217 (13,941–114,097)	2010 (2001–2014)	1 (0–1)	24 (49.0%)	0 (0–110)	125 (0–246)	150 (0–246)	104	–	2,079,283
Africa		16,436 (3569–31,106)	2011 (1994–2013)	0 (0–0)	18 (56.3%)	0 (0–0)	0 (0–0)	0 (0–0)	529	–	1,345,695
Americas		10,656 (11,512–47,682)	1994 (1973–2008)	2 (0–9)	261 (38.6)	36 (0–120)	172 (0–200)	200(0–1460)	4	–	2,204,166
Europe		26,066 (11,135–69,698)	1984 (1974–1994)	4 (1–34)	484 (30.4%)	200 (43–490)	300(110–468)	2300 (375–10,770)	8	–	4,520,156
South East Asia		66,676 (1695–199,828)	2003 (1998–2011)	1 (0–5)	32 (68.1%)	49 (0–170)	100 (0–200)	200 (0–1300)	283	–	4,267,368
Western Pacific		10,390 (399–86,224)	1984 (1975–2007)	0 (0–12)	263 (26.9%)	0 (0–175)	0 (0–250)	0 (0–4588)	17	–	4,186,174
Global		19,332 (5191–66,739)	1992 (1975–2009)	1 (0–6)	1082 (32.1%)	0 (0–150)	60 (0–250)	120 (0–2000)	12	–	18,624,568

– Not applicable.

Acronyms: IHD, ischemic heart disease; LIC, Low-income country; LMI, lower middle-income; UMI, Upper middle-income; HIC, high-income country; CR cardiac rehabilitation; NA, not available; EMR, Eastern Mediterranean Region; WHO, World Health Organization.

Abbreviations: No., number; Pts, patients. Note: Due to missing data, percentages are computed where the denominator is the number of valid responses from responding programs.

<sup>a</sup> Estimated incidence of IHD was obtained from Global Burden of Disease study [22].

<sup>b</sup> National CR capacity calculated using median number of patients program could serve per year (from survey) multiplied by the number of programs in the country (ascertained from national/regional champions). Value represents the number of patients who could receive CR in a year (i.e., CR spots).

<sup>c</sup> Based on ratio of need (i.e., IHD incidence) to supply (i.e., CR capacity). Represents number of CR spots per IHD patient in need.

<sup>d</sup> 1 represents the most spots per incident IHD patient, and higher numbers represent the least spots per patient.

<sup>e</sup> Number of additional spots needed to treat all IHD patients.

<sup>f</sup> Country without a response; national capacity estimated based on regional median program capacity multiplied by number of programs in that country.

<sup>g</sup> Values shown are medians (Q25–Q75) per country (except for total responses and mean national response rate shown).

<sup>h</sup> Values shown are medians (Q25–Q75) per country across all countries in region (including those without CR), except for total responses, mean national response rate, and density shown.

**Table 2**

Most common healthcare professional types on cardiac rehabilitation teams by EMR country and versus other countries.

Health professional specialty	Afghanistan (n = 1)	Bahrain (n = 1)	Egypt (n = 2)	Iran (n = 14)	Lebanon (n = 1)	Morocco (n = 1)	Pakistan (n = 2)	Qatar (n = 1)	Tunisia (n = 1)	EMR Total (n = 24)	Global (N = 1058)
Nurse	1 (100.0%)	1 (100.0%)	1 (100.0%)	12 (100.0%)	1 (100.0%)	1 (100.0%)	1 (50.0%)	1 (100.0%)	1 (100.0%)	20 (95.2%)	796 (88.0%)
Cardiologist	1 (100.0%)	1 (100.0%)	1 (100.0%)	9 (75.0%)	1 (100.0%)	1 (100.0%)	2 (100.0%)	1 (100.0%)	1 (100.0%)	18 (85.7%)	721 (77.9%)
Dietitian	0 (0.0%)	1 (100.0%)	1 (100.0%)	10 (83.3%)	1 (100.0%)	1 (100.0%)	2 (100.0%)	1 (100.0%)	1 (100.0%)	18 (85.7%)	739 (80.2%)
Administrative assistant/secretary	1 (100.0%)	0 (0.0%)	0 (0.0%)	8 (72.7%)	1 (100.0%)	0 (0.0%)	2 (100.0%)	1 (100.0%)	1 (100.0%)	14 (70.0%)	596 (65.6%)
Physio-therapist	0 (0.0%)	1 (100.0%)	1 (100.0%)	7 (58.3%)	1 (100.0%)	1 (100.0%)	1 (50.0%)	1 (100.0%)	1 (100.0%)	14 (66.7%)	719 (79.6%)
Physical medicine and rehab. physician/physiatrist	1 (100.0%)	1 (100.0%)	1 (100.0%)	6 (54.5%)	1 (100.0%)	1 (100.0%)	1 (50.0%)	0 (0.0%)	1 (100.0%)	13 (65.0%)	389 (43.4%)
Sports medicine physician	1 (100.0%)	0 (0.0%)	0 (0.0%)	8 (66.7%)	1 (100.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	12 (57.1%)	171 (19.7%)*
Psychiatrist	0 (0.0%)	0 (0.0%)	1 (100.0%)	7 (63.6%)	0 (0.0%)	1 (100.0%)	2 (100.0%)	0 (0.0%)	0 (0.0%)	11 (55.0%)	197 (22.8%)*
Kinesiotherapist/exercise specialist	1 (100.0%)	0 (0.0%)	0 (0.0%)	6 (50.0%)	1 (100.0%)	0 (0.0%)	1 (50.0%)	1 (100.0%)	1 (100.0%)	11 (52.4%)	478 (53.6%)
Social worker	1 (100.0%)	1 (100.0%)	0 (0.0%)	4 (36.4%)	1 (100.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (40.0%)	380 (42.2%)
Psychologist	1 (100.0%)	0 (0.0%)	1 (100.0%)	4 (33.3%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	7 (33.3%)	520 (58.4%)*
Pharmacist	0 (0.0%)	1 (100.0%)	0 (0.0%)	2 (16.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	4 (20.0%)	366 (41.0%)
Community health worker	1 (100.0%)	0 (0.0%)	0 (0.0%)	1 (8.3%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (14.3%)	166 (18.7%)
Total staff <sup>a</sup>	6.5	4.5	5.5	6.3 ± 2.3	10.0	4.0	5.8 ± 1.1	7.0	10.0	6.4 ± 2.2	5.9 ± 2.8
1 staff to patient ratio	–	1:5.0	–	1:1.7 ± 1.3	1:1	–	1:1.6 ± 1.9	1:2.0	1:3.0	1:1.7 ± 1.5	1:2.2 ± 2.5

EMR: Eastern Mediterranean Region.

– No response.

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

\* Significant difference ( $p < .05$ ) between EMR and global.<sup>a</sup> Full-time personnel count as 1 and part-time personnel count as 0.5. Mean (and standard deviation where  $>1$  response) shown.

with also communication with primary care and tobacco cessation services not as commonly offered. Patients received an average of  $7.1 \pm 6.4$  (median = 4.5) education sessions per program, with each session lasting  $46.4 \pm 32.3$  (median = 30) minutes. There was a trend towards more risk assessment in EMR program than those globally ( $p = .05$ ); no other differences were observed.

CV risk factors were appropriately and consistently assessed during initial assessment (Supplementary Table 5). There was no significant difference between EMR countries and other countries in assessment of any of these factors.

The mean program dose of 28 h to deliver these components is shown in Supplementary Table 6. This was consistent with other countries globally, but session frequency was significantly lower.

Program equipment available to deliver these components included most commonly bicycle ergometers ( $n = 20$ ; 95.2%) followed by treadmills ( $n = 19$ ; 95.0%), while the most commonly available space was an individual assessment/counselling room ( $n = 20$ ; 95.2%), a gym ( $n = 20$ ; 95.2%), and administrative office space ( $n = 20$ , 95.2%). Equipment availability did not differ in the EMR and other countries (all  $p > .05$ ). In 12 (57.1%) programs, patient records were electronic rather than paper.

### 3.7. Alternative models

Seven programs (33.3%) offered alternative models: 6 (50.0%) in Iran and 1 (50.0%) in Pakistan. Globally, this was 278 (31.1%) programs

**Table 3**

Cardiac rehabilitation components by EMR country with program(s).

Components	Afghanistan (n = 1)	Bahrain (n = 1)	Egypt (n = 2)	Iran (n = 14)	Lebanon (n = 1)	Morocco (n = 1)	Pakistan (n = 2)	Qatar (n = 1)	Tunisia (n = 1)	EMR Total (n = 24)	Global (N = 1058)*
Initial assessment	1 (100.0%)	1 (100.0%)	1 (100.0%)	12 (100.0%)	1 (100.0%)	1 (100.0%)	2 (100.0%)	1 (100.0%)	1 (100.0%)	21 (100.0%)	918 (98.8%)
Patient education	1 (100.0%)	1 (100.0%)	1 (100.0%)	12 (100.0%)	1 (100.0%)	1 (100.0%)	2 (100.0%)	1 (100.0%)	1 (100.0%)	21 (100.0%)	874 (96.8%)
Management of CV risk factors	1 (100.0%)	1 (100.0%)	1 (100.0%)	12 (100.0%)	1 (100.0%)	1 (100.0%)	2 (100.0%)	1 (100.0%)	1 (100.0%)	21 (100.0%)	907 (98.2%)
Nutrition counselling	1 (100.0%)	1 (100.0%)	1 (100.0%)	12 (100.0%)	1 (100.0%)	0 (0.0%)	2 (100.0%)	1 (100.0%)	1 (100.0%)	20 (95.2%)	860 (92.7%)
End of program re-assessment	1 (100.0%)	1 (100.0%)	0 (0.0%)	12 (100.0%)	1 (100.0%)	1 (100.0%)	1 (50.0%)	1 (100.0%)	1 (100.0%)	19 (90.5%)	839 (91.4%)
Exercise counselling/prescription	0 (0.0%)	1 (100.0%)	0 (0.0%)	12 (100.0%)	1 (100.0%)	1 (100.0%)	2 (100.0%)	1 (100.0%)	1 (100.0%)	19 (90.5%)	815 (88.1%)
Risk assessment	1 (100.0%)	1 (100.0%)	1 (100.0%)	10 (90.9%)	1 (100.0%)	1 (100.0%)	1 (50.0%)	1 (100.0%)	1 (100.0%)	18 (90.0%)	638 (69.6%)†
Stress management	1 (100.0%)	1 (100.0%)	1 (100.0%)	10 (83.3%)	1 (100.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)	1 (100.0%)	17 (81.0%)	754 (81.7%)
Tobacco cessation sessions/classes	1 (100.0%)	1 (100.0%)	1 (100.0%)	7 (63.6%)	1 (100.0%)	1 (100.0%)	2 (100.0%)	1 (100.0%)	0 (0.0%)	15 (75.0%)	677 (73.3%)
Communication with primary care provider	1 (100.0%)	1 (100.0%)	0 (0.0%)	10 (83.3%)	1 (100.0%)	1 (100.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	15 (71.4%)	773 (84.3%)
Return-to-work counselling	1 (100.0%)	1 (100.0%)	1 (100.0%)	9 (75.0%)	1 (100.0%)	0 (0.0%)	1 (50.0%)	1 (100.0%)	0 (0.0%)	15 (71.4%)	599 (65.6%)
Mean total # components (/11) (±SD)	10 ± 0.0	11 ± 0.0	8 ± 0.0	9.5 ± 1.3	11 ± 0.0	10 ± 0.0	9 ± 2.5	11 ± 0.0	8 ± 0.0	8.9 ± 1.7	8.7 ± 1.9

EMR: Eastern Mediterranean Region; CV, cardiovascular; SD, standard deviation.

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

\* No significant difference ( $p > .05$ ) between EMR and other countries in the provision of any of these components.† There was a trend for risk assessment ( $p = .05$ ).

( $p = .83$ ). Among these 7 programs, one (14.3%) offered a community-based program, 5 (71.4%) offered home-based, and 3 (42.9%) offered a hybrid model. Three (42.8% of those offering alternative models) programs reported using smartphones, an “app”, or text messaging with patients (i.e., some form of eCR). This was comparable to other countries ( $n = 80$ , 68.4%;  $p = .90$ ). In the EMR, 6 (30.0%) programs offered alternative forms of exercise (e.g., yoga, tai chi; vs 349 [38.2%] programs globally,  $p = .50$ ). Women-only classes were offered by over half of programs ( $n = 11$ , 52.4%), and this was significantly greater than other countries ( $n = 99$ , 10.9%;  $p < .001$ ).

#### 4. Discussion

This is the first study to comprehensively characterize CR in the EMR, it is established that only half of countries even offer it. There are a mere 50 programs across the entire region, with most of these being in Iran, where successful advocacy lead to CR reimbursement by private healthcare insurance [27]. The greatest need is in Pakistan and Egypt, but overall there is only one CR spot for every 104 IHD patient, and this does not take into consideration heart failure patients or the other non-CVD patients who are being treated in 2/3rds of programs [28].

Where available, patients take longer to access programs than in other regions of the world, which could be due to the low practice of systematic inpatient referral. Programs were more often situated in tertiary care centers than other countries. There is less public funding for care than in other regions, and patients more often pay out-of-pocket for care, doing so in 3/4 of programs.

Guideline-indicated patients are accepted in over 80% of programs. Teams are comprised of 6 members on average (similar to other regions), chiefly nurses, followed by cardiologists, dietitians, administrative assistants, physiotherapists and psychiatrists. This complement is well-positioned to comprehensively deliver all secondary prevention recommendations [29]. Physicians more often have overall program responsibility (almost universal) than in other regions. These staff deliver on average 9 core components, or over 80% of those recommended, but there is need for more communication with primary care, as well as provision of support to patients to return-to-work and in tobacco cessation. This is disconcerting given the fact that CVD affects a younger, working age population in LMICs (which 16 EMR countries are) than HICs [30], and that there is widespread and growing use of smokeless tobacco [31]. These components are delivered over on average 28 h, which is consistent with dose globally.

CR programs in the EMR were significantly more likely to offer women-only classes. This could be due to cultural and religious factors [10]. Whether there is tailoring of women's classes to their unique needs remains a question for investigation, as is what adherence rates are achieved [32]. Programs would be prudent to focus in particular on interventions to address obesity and mental illness as these are very common CV risk factors for women in the region [33].

The primary implications of this study are that the great need for broader CR delivery has been quantified, and results point to some fruitful areas where capacity could be more readily increased. First, as in Iran, advocacy for CR reimbursement by private healthcare insurance seems to greatly support proliferation of programs [27]. Second, surprisingly, volumes were incredibly low and the spaces that were available were under-used. This could be remedied by increasing reimbursement as outlined above, increasing staff-to-patient ratios which were also lower than other regions, and also by implementing systematic referral at the tertiary centers where most of these programs are located [34]. On a related note, the programs situated in urban, tertiary care centers are likely expensive, but also centers of excellence that could spawn satellite programs in alternate settings such as home and community (indeed only 1/3 of the programs offered any CR unsupervised programming, and these were chiefly in Iran).

Finally, there appears to be over-reliance on physicians when compared to other countries. This is consistent with findings in LMICs

countries [35], likely reflecting lower wages. Task-shifting could result in more human resource capacity to deliver services.

#### 5. Limitations

First, while the country response rate was high, the program response rate was only 50%, which while quite good for online surveys suggests there could be selection bias, especially for resourced programs which could overestimate the quality of the CR in EMR. Second, it may not have been possible to identify all programs leading to ascertainment bias, especially in low or middle-income EMR countries where there are limited resources and they may not have CR websites or have published any research on CR, and in countries where no society or champion was identified.

Thirdly, over half of participating programs were from Iran and therefore results may not be as generalizable outside of Iran. On a related note, sample sizes from many of the countries were low, and hence these findings should be interpreted with caution.

Fourth, the survey was self-report; respondents may have been inclined to respond in a socially-desirable manner, such that results were skewed to reflect better provision of CR in that program or country. Moreover, while pilot-tested [10], a random subsample of survey responses were not validated against actual CR delivery to establish validity and reliability.

The fifth 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, due the nature of the study design, causal conclusions and directional inferences cannot be drawn.

#### 6. Conclusion

CR exists in only half of EMR countries, with a total of only 49 programs in the entire region; there is a need for 2,079,283 more spots per year to treat IHD patients alone, not considering other guideline-recommended indications such as heart failure. Where offered, responding programs reported delivery that is quite consistent with CR guidelines however; guideline-indicated patients receive on average 9/11 core components, delivered by a multidisciplinary team of 6 providers, over 28 h. Strategies to scale-up capacity to be pursued include securing reimbursement by public source or healthcare insurance, developing satellite sites from the tertiary centers, increasing program volumes through task-shifting from physicians and improving staff-to-patient ratios, greater implementation of alternative models such as home-based and eCR services, and implementing systematic CR referral.

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#### Conflict of interest

All authors declare no conflict of interests.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijcard.2019.02.065>.

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