European Journal of Heart Failure (2015)
doi:10.1002/ejhf.245

Clinical characteristics, management, and outcomes of acute heart failure patients: observations from the Gulf acute heart failure registry (Gulf CARE)

Kadhim Sulaiman[1]*, Prashanth Panduranga[1], Ibrahim Al-Zakwani[2], Alawi A. Alsheikh-Ali[3], Khalid F. AlHabib[4], Jassim Al-Suwaidi[5], Wael Al-Mahmeed[6], Hussam AlFaleh[4], Abdelfatah Elasfar[7], Ahmed Al-Motarreb[8], Mustafa Ridha[9], Bassam Bulbanat[10], Mohammed Al-Jarallah[10], Nooshin Bazargani[11], Nidal Asaad[5], and Haitham Amin[12]

[1]Department of Cardiology, Royal Hospital, Muscat, Oman; [2]Department of Pharmacology & Clinical Pharmacy, College of Medicine & Health Sciences, Sultan Qaboos University & Gulf Health Research, Muscat, Oman; [3]Institute of Cardiac Sciences, Sheikh Khalifa Medical City, Abu Dhabi, United Arab Emirates and Institute for Clinical Research and Health Policy Studies, Tufts Medical Center and Tufts University School of Medicine, Boston, MA, USA; [4]Department of Cardiac Sciences, King Fahad Cardiac Center, King Saud University, Riyadh, Saudi Arabia; [5]Adult Cardiology, Hamad Medical Corporation and Qatar Cardiovascular Research Center, Doha, Qatar; [6]Heart and Vascular Institute, Cleveland Clinic Abu Dhabi, United Arab Emirates; [7]Department of Adult Cardiology, King Salman Heart Center, King Fahad Medical City, Riyadh, Saudi Arabia, Cardiology Department, Tanta University, Egypt; [8]Internal Medicine Department, Faculty of Medicine, Sana'a University, Sana'a, Yemen; [9]Division of Cardiology, Al-Dabous Cardiac Centre, Al Adan Hospital, Kuwait; [10]Department of Cardiology, Sabah Al Ahmed Cardiac Center, Kuwait; [11]Department of Cardiology, Dubai Hospital, Dubai, United Arab Emirates; and [12]Mohammed Bin Khalifa Cardiac Centre, Bahrain

Received 18 October 2014; revised 15 January 2015; accepted 16 January 2015

Aims The purpose of this study was to describe the clinical characteristics, management, and outcomes of acute heart failure (HF) patients from the Gulf acute heart failure registry (Gulf CARE).

Methods and results Data from 5005 HF patients admitted to 47 hospitals in seven Gulf countries during February to November 2012 were analysed. Fifty-five per cent of patients presented with acute decompensated chronic HF, while 45% had new-onset HF. Mean age was 59 ± 15 years, 63% were males, and 83% were Gulf citizens. Co-morbid conditions were hypertension (61%), diabetes mellitus (50%), CAD (47%), and atrial fibrillation or flutter (14%). The median LVEF was 35% (25–45%) with 69% presenting as HF with reduced EF (HFrEF). CAD was the most prevalent aetiology (53%) followed by idiopathic cardiomyopathy (18%), hypertensive heart disease (16%), and valvular heart disease (9%). At discharge, 71% and 78% of patients received beta-blockers and ACE inhibitors/ARBs, respectively. Use of coronary intervention and device therapy was <10%. In-hospital mortality was 6.3%. Re-hospitalization and cumulative mortality at 3 and 12 months were 18%/13% and 40%/20%, respectively.

Conclusions Gulf CARE results show that patients from this region are a decade younger than their Western counterparts, with a high prevalence of diabetes and HFrEF, and a lower prevalence of AF. Use of coronary intervention and device therapy was low, with high re-hospitalization rates. Short- and long-term mortality rates were similar to those of Western registries, but should be interpreted in the light of the younger age of Gulf CARE patients.

Keywords Acute heart failure • Heart failure • Middle East • Registry

*Corresponding author. Department of Cardiology, Royal Hospital, PB 1331, Muscat-111, Oman. Tel: +968 99360025, Fax: +968 24697727, Email: kjsulaiman@hotmail.com

Introduction

Heart failure (HF) is well known in the Western world to cause high morbidity and mortality.[1,2] Many large registries such as the Acute Decompensated Heart Failure National Registry (ADHERE) and the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure (OPTIMIZE-HF) have provided useful data on acute heart failure (AHF) from the Western population.[3−5] These data have contributed to the release of HF guidelines from major associations and societies.[1,2,6,7]

Even though HF data from the Western world are available, a paucity of systematic data from the Middle East exists, except for a prospective registry study from Saudi Arabia [Heart Function Assessment Registry Trial in Saudi Arabia (HEARTS)] and a retrospective study on hospitalized HF patients from Qatar.[8,9] In addition, it has been observed from previous acute coronary syndrome (ACS) registries from the Middle East that the risk profile, practice patterns, and healthcare resources are different from those of Western countries.[10,11] This may also have an influence on the diagnosis and management of AHF in this region. Hence, researchers from the Gulf Heart Association initiated the first multinational, multicentre prospective observational AHF survey involving seven countries from the Middle East, namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Yemen. The aim of this paper is to describe the clinical characteristics, management, and outcomes of AHF patients from the Gulf acute heart failure registry (Gulf CARE).

Methods

Gulf CARE is a prospective, multinational, multicentre registry of patients admitted with the diagnosis of AHF to 47 hospitals in six Middle Eastern countries. Registry design, methodology, and hospital characteristics have been previously described in detail.[12] In brief, males and females above 18 year of age, admitted to the participating hospitals with the admission diagnosis of AHF between 14 February 2012 and 14 November 2012 were recruited. Baseline and admission-based variables captured data on demographics, co-morbidities, risk factors, clinical presentation, investigations including troponin and BNP, medication history and their dosages, in-hospital outcome, aetiology, and precipitating factors for AHF. Whenever performed, echocardiography and coronary angiogram data along with cardiac procedures such as PCI, coronary artery bypass surgery (CABG), device therapy, or any cardiac surgery data were collected during admission and on follow-up.

Follow-up of patients at 3 months and 1 year was performed. Follow-up was done by telephone at 3 months and either by telephone or by a clinic visit at 1 year. Data entry was done online using a custom-designed electronic case record form (CRF) at the Gulf CARE website (www.gulfcare.org). Institutional or national ethical committee or review board approval was obtained in each of the seven participating countries. The study is registered at clinicaltrials.gov (NCT01467973).

Inclusion criteria

Males and females >18 years of age, admitted to the participating hospitals with the admission diagnosis of AHF, were included in the registry. AHF was defined according to the European Society of Cardiology (ESC) as rapid onset of symptoms and signs secondary to abnormal cardiac function and included: (i) symptoms (dyspnoea at rest or on exercise, fatigue, tiredness, and ankle swelling); (ii) signs (tachycardia, tachypnoea, elevated jugular venous pressure, pulmonary rales, pleural effusion, hepatomegaly, and peripheral oedema); and (iii) objective evidence of structural or functional abnormality of the heart at rest (third heart sound, murmurs, cardiomegaly, abnormal echocardiogram, and raised natriuretic peptide concentration).[1] AHF was further classified as either acute decompensated chronic HF (ADCHF) or new-onset AHF (*de novo* AHF) based on ESC guidelines.[1] ADCHF was defined as worsening of HF in patients with a previous diagnosis or hospitalization for HF. *De novo* AHF was defined as AHF in patients with no prior history of HF.

Exclusion criteria

Patients with HF who were discharged from the emergency room without admission were excluded. Patients transferred from a non-registry hospital and those in whom informed consent could not be obtained were also excluded. Patients whose final diagnosis was not HF were excluded from the final analyses.

Definitions of data variables in the CRF were based on the ESC guidelines of 2008 and the American College of Cardiology (ACC) clinical data standards of 2005.[1,13] Khat chewing was defined as chewing khat plant/leaves (*Catha edulis* containing cathionine, an amphetamine-like stimulant which can cause euphoria, hypertension, myocardial infarction, and dilated cardiomyopathy) within 1 month of the index admission. Idiopathic dilated cardiomyopathy was defined as a myocardial disorder in which the heart muscle is structurally and functionally abnormal (in the absence of CAD, hypertension, valvular disease, or congenital heart disease sufficient to cause the observed myocardial abnormality).[1] HF with preserved ejection fraction (HFpEF) was defined as the presence of symptoms and/or signs of HF and an LVEF >40%.[1]

Statistical analysis

Descriptive statistics were used to summarize the data. For categorical variables, frequencies and percentages were reported, and differences between groups were analysed using Pearson's χ^2 test (or Fisher's exact test for cells <5). For continuous variables, the mean and standard deviation (SD) were used to summarize the data, while analysis was done using Student's *t*-test. For those variables that were not normally distributed, the median and interquartile range (25th and 75th percentiles) were used to present the data, while comparative analysis was performed using the non-parametric Mann–Whitney test. An a *priori* two-tailed level of significance was set at a *P*-value of 0.05. Statistical analyses were conducted using STATA version 13.1 (STATA Corporation, College Station, TX, USA).

Results

Baseline characteristics

A total of 47 hospitals in seven Arabian Gulf states (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Yemen) participated in the Gulf CARE project, with a total of 5005 patients enrolled (*Table 1*). The overall mean age of the cohort was 59 ± 15 years, 63% were males, and 83% were Gulf citizens.

Table 1 Baseline characteristics of the Gulf CARE cohort

Characteristic	All ($n = 5005$)	*De novo* AHF ($n = 2276$)	ADCHF ($n = 2729$)	*P*-value
Age, mean ± SD	59 ± 15	57 ± 15	61 ± 15	<0.001
Male gender	3131 (63)	1445 (63)	1686 (62)	0.214
Gulf citizen	4157 (83)	1804 (79)	2353 (86)	<0.001
Main care provider				
Cardiologist	3575 (71)	1658 (73)	1917 (70)	0.042
Internist	1430 (29)	618 (27)	812 (30)	
BMI, kg/m^2, median (IQR)	27 (24–31)	27 (24–31)	27 (24–31)	0.057
Medical history				
Hypertension	3059 (61)	1239 (54)	1820 (67)	<0.001
Diabetes mellitus	2492 (50)	1008 (44)	1484 (54)	<0.001
CAD	2337 (47)	690 (30)	1647 (60)	<0.001
Hyperlipidaemia	1799 (36)	619 (27)	1180 (43)	<0.001
Smoking[a]	1103 (22)	673 (30)	430 (16)	<0.001
Khatt	891 (18)	470 (21)	421 (15)	<0.001
CKD/dialysis	744 (15)	213 (9)	531 (19)	<0.001
Valvular heart disease	674 (13)	173 (8)	502 (18)	<0.001
Atrial fibrillation	607 (12)	145 (6)	462 (17)	<0.001
Stroke/TIA	404 (8.1)	126 (5.5)	278 (10.2)	<0.001
PVD	223 (4.5)	89 (3.9)	134 (4.9)	0.088
Alcohol[b]	176 (3.5)	111 (4.9)	65 (2.4)	<0.001
Clinical presentation				
Dyspnoea	4898 (98)	2203 (97)	2695 (99)	<0.001
Orthopnoea	3942 (79)	1686 (74)	2256 (83)	<0.001
PND	3216 (64)	1279 (56)	1937 (71)	<0.001
Easy fatiguability	2834 (57)	1089 (48)	1745 (64)	<0.001
Abdominal/lower limb swelling	2242 (45)	729 (32)	1513 (55)	<0.001
Chest pain	2200 (44)	1213 (53)	987 (36)	<0.001
Palpitation	1520 (30)	698 (31)	822 (30)	0.675
Weight gain	1307 (26)	443 (19)	864 (32)	<0.001
Basal lung crepitations	4597 (92)	2104 (92)	2493 (91)	0.160
Peripheral oedema	2727 (54)	946 (42)	1781 (65)	<0.001
Raised JVP	2526 (50)	986 (46)	1540 (56)	<0.001
Gallop	1876 (37)	887 (39)	989 (36)	0.047
Enlarged tender liver	1338 (27)	497 (22)	841 (31)	<0.001
Signs of pleural effusion	924 (18)	363 (16)	561 (21)	<0.001
Ascites	723 (14)	157 (7)	566 (21)	<0.001
HR, b.p.m., mean ± SD	97 ± 23	98 ± 24	95 ± 22	<0.001
SBP, mmHg, mean ± SD	137 ± 34	142 ± 35	134 ± 33	<0.001
DBP, mmHg, mean ± SD	81 ± 20	85 ± 20	78 ± 19	<0.001
NYHA at admission				<0.001
Not known	107 (2.1)	73 (3.2)	34 (1.3)	
I	129 (2.6)	62 (2.7)	67 (2.5)	
II	1005 (20)	455 (20)	550 (20)	
III	2161 (43)	904 (40)	1257 (46)	
IV	1603 (32)	782 (34)	821 (30)	

All values are given as *n* (%) unless specified.
Numbers might not add up to 100% due to rounding up.
ADCHF, acute decompensated chronic heart failure; AHF, acute heart failure; BMI, body mass index; CKD, chronic kidney disease; DBP, diastolic blood pressure; HR, heart rate; IQR, interquartile range; JVP, jugular venous pressure; PND, paroxysmal nocturnal dyspnoea; PVD, peripheral vascular disease; SBP, systolic blood pressure; SD, standard deviation; TIA, transient ischaemic attack.
[a]Smoking includes chewing tobacco and/or smoking a water-pipe.
[b]Daily alcohol consumption.

Table 2 Laboratory, electrocardiogram, and echocardiography investigations

Characteristic	All ($n = 5005$)	*De novo* AHF ($n = 2276$)	ADCHF ($n = 2729$)	*P*-value
Laboratory investigations, mean ± SD, unless specified otherwise				
Haemoglobin, g/dL	12.6 (11–14)	13.0 (12–15)	12.2 (11–14)	<0.001
Serum urea, mmol/L	11 ± 8	10 ± 8	12 ± 9	<0.001
Serum creatinine, mmol/L	130 ± 117	123 ± 117	136 ± 116	<0.001
eGFR, mL/min, ($n = 4934$)	64 (44–86)	69 (50–91)	60 (40–82)	<0.001
Serum sodium, mmol/L	138 ± 5	138 ± 6	138 ± 5	0.303
Serum potassium, mmol/L	4.2 (3.9–4.6)	4.2 (3.9–4.5)	4.2 (3.9–4.6)	0.002
BNP, pg/mL, median ($n = 358$)	1300 (850–4233)	1605 (933–5870)	1154 (800–2948)	0.007
NT-proBNP, pg/mL, median ($n = 850$)	3209 (1342–7160)	3236 (1404–6849)	3127 (1298–7769)	0.738
HbA_{1c}, % ($n = 1900$)	6.7 (5.5–8.5)	7.0 (5.6–8.9)	6.6 (5.5–8.4)	0.020
Total cholesterol, mmol/L ($n = 3606$)	4.5 (3.6–5.5)	4.6 (3.8–5.7)	4.4 (3.3–5.4)	<0.001
ECG, *n* (%), unless specified otherwise				
Rhythm status				<0.001
Sinus rhythm	4091 (82)	1949 (86)	2142 (78)	
AF/flutter	685 (14)	231 (10)	454 (16)	
CHB	60 (1.2)	48 (2.1)	12 (0.4)	
Paced	80 (1.6)	11 (0.5)	69 (2.5)	
SVT	26 (0.5)	9 (0.4)	17 (0.6)	
Others	63 (1.3)	28 (1.2)	35 (1.3)	
LV hypertrophy	1521 (30)	653 (29)	868 (32)	0.017
ST-depression/T-inversion	2215 (44)	1006 (44)	1209 (44)	0.943
STEMI	526 (11)	433 (19)	93 (3)	<0.001
Pathological Q waves	1178 (24)	438 (19)	740 (27)	<0.001
QRS duration <0.12 ms	3967 (79)	1922 (84)	2045 (75)	
QRS duration >0.12 ms				
LBBB	657 (13)	213 (9)	444 (16)	<0.001
RBBB	222 (4.4)	97 (4.3)	125 (4.6)	
IVCD	159 (3.2)	44 (1.9)	115 (4.2)	
Echocardiography, *n* (%), unless specified otherwise				
LVEF, %, median (IQR) ($n = 4577$)	35 (25–45)	38 (30–48)	34 (25–45)	<0.001
LVEF, >40% ($n = 4577$)	1549 (31)	810 (36)	739 (27)	<0.001

Percentages may not add up to 100% due to rounding up.
ADCHF, acute decompensated chronic heart failure; AHF, acute heart failure; CHB, complete heart block; eGFR, estimated glomerular filtration rate; HbA_{1c}, glycated haemoglobin; IQR, interquartile range; IVCD, intraventricular conduction delay; RBBB, right bundle branch block; SD, standard deviation; STEMI, ST-segment elevation myocardial infarction; SVT, supraventricular tachycardia.

More than half of the patients (55%) presented with ADCHF while the rest (45%) had *de novo* AHF. Cardiologists were the main healthcare provider for 71% of the patients. Co-morbid conditions were common, particularly hypertension (61%), diabetes mellitus (50%), CAD (47%), and hyperlipidaemia (36%). The three most common presenting signs and symptoms were dyspnoea (98%), basal lung crepitations (92%), and orthopnoea (79%). The rest of the characteristics are shown in *Table 1*. On admission, the mean heart rate was 97 ± 23 b.p.m. and the predominant NYHA class was III/IV (75%).

Acute decompensated chronic heart failure vs. new-onset acute heart failure

Patients with ADCHF had generally more co-morbidities compared with those with *de novo* AHF. They were older (61 vs. 57 years; $P < 0.001$), and were significantly more likely to have a history of CAD (60% vs. 30%; $P < 0.001$), valvular heart disease (18% vs. 8%; $P < 0.001$), AF (17% vs. 6%; $P < 0.001$), hypertension (67% vs. 54%; $P < 0.001$), diabetes mellitus (54% vs. 44%; $P < 0.001$), hyperlipidaemia (43% vs. 27%; $P < 0.001$), chronic kidney disease/dialysis (19% vs. 9%; $P < 0.001$), and prior stroke/transient ischaemic attack (10.2% vs. 5.5%; $P < 0.001$). In addition, they were more likely to present with dyspnoea (99% vs. 97%), orthopnoea (83% vs. 74%), paroxysmal nocturnal dyspnoea (71% vs. 56%), abdominal/lower limb swelling (55% vs. 32%), weight gain (32% vs. 19%), easy fatiguability (64% vs. 48%), peripheral oedema (65% vs. 42%), ascites (21% vs. 17%), enlarged tender liver (31% vs. 22%), and signs of pleural effusion (21% vs. 16%). *De novo* AHF patients, on the other hand, were more likely to be smokers (30% vs. 16%), alcohol consumers (4.9% vs. 2.4%), and khat chewers (21% vs. 15%), and more likely to present with chest pain (53% vs. 36%), gallop (39% vs. 36%), NYHA class IV (34% vs. 30%), and higher heart rate (98 vs. 95 b.p.m.) than ADCHF patients.

Table 3 Precipitating causes, aetiology, in-hospital course, and cardiac procedures in the Gulf CARE cohort

Characteristic	All ($n = 5005$)	*De novo* AHF ($n = 2276$)	ADCHF ($n = 2729$)	*P*-value
Aetiology of heart failure[a]				
Ischaemic HD	2663 (53)	1249 (55)	1414 (52)	<0.001
Idiopathic cardiomyopathy	915 (18)	360 (16)	555 (20)	
Hypertensive HD	802 (16)	418 (18)	384 (14)	
Valvular HD	461 (9)	169 (7)	292 (11)	
Pulmonary hypertension	128 (2.6)	56 (2.5)	72 (2.6)	
Congenital HD	18 (0.4)	8 (0.4)	10 (0.4)	
Myocarditis	17 (0.3)	15 (0.7)	2 (0.1%)	
Precipitating causes of heart failure				
Acute coronary syndrome	1365 (27)	893 (39)	472 (17)	<0.001
Non-compliance with medications	964 (19)	205 (9)	759 (28)	
Infection	731 (15)	253 (11)	478 (18)	
Uncontrolled hypertension	410 (8.2)	220 (9.7)	190 (7.0)	
Uncontrolled arrhythmias	301 (6.0)	123 (5.4)	178 (6.5)	
Worsening renal failure	221 (4.4)	71 (3.1)	150 (5.5)	
Anaemia	154 (3.1)	70 (3.1)	84 (3.1)	
Non-compliance with diet	136 (2.7)	35 (1.5)	101 (3.7)	
Salt-retaining drugs	26 (0.5)	18 (0.8)	8 (0.3)	
Pulmonary embolism	8 (0.2)	5 (0.2)	3 (0.1)	
Unknown	689 (14)	382 (17)	306 (11)	
Cardiac procedures, during admission				
PCI	299 (6.0)	226 (9.9)	73 (2.7)	<0.001
CABG	69 (1.4)	46 (2.0)	23 (0.8)	<0.001
Device therapy	84(1.7)	14(0.6)	70(2.6)	<0.001
CRT	31	3	28	
ICD	53	11	42	
Valve repair/replacement	94 (1.9)	37 (1.6)	57 (2.1)	0.230
In-hospital course				
Infection requiring therapy	1208 (24)	506 (22)	702 (26)	0.004
Inotropes	783 (16)	357 (16)	426 (16)	0.942
NIV	473 (9.5)	240 (10.5)	233 (8.5)	0.016
Intubation/ventilation	424 (8.5)	207 (9.1)	217 (8.0)	0.148
Cardiogenic shock	402 (8.0)	198 (8.7)	204 (7.5)	0.113
AF requiring therapy	311 (6.2)	113 (5.0)	198 (7.3)	0.001
Blood transfusion	254 (5.1)	113 (5.0)	141 (5.2)	0.746
VT/VF requiring therapy	222 (4.4)	124 (5.5)	98 (3.6)	0.001
Acute dialysis/ultrafiltration	135 (2.7)	51 (2.2)	84 (3.1)	0.069
IABP	82 (1.6)	55 (2.4)	27 (1.0)	<0.001
Stroke	68 (1.4)	32 (1.4)	36 (1.3)	0.792

All values are given as *n* (%) unless specified.
ADCHF, acute decompensated chronic heart failure; AHF, acute heart failure; CABG, coronary artery bypass graft; HD, heart disease; IABP, intra-aortic balloon pump; ICD, implantable cardioverter-defibrillator; NIV, non-invasive ventilation; VT/VF, ventricular tachycardia/ventricular fibrillation.
[a]One patient had a missing aetiology of heart failure.

Table 2 shows the laboratory, ECG, and echocardiography findings. The median haemoglobin of the cohort was 12.6 g/dL (11–14 g/dL). Renal impairment was more prevalent in ADCHF when compared with *de novo* AHF [serum creatinine, 136 vs. 123 mmol/L; estimated glomerular filtration rate (eGFR) 60 vs. 69 mL/min]. The median BNP was significantly higher in *de novo* AHF patients than in those with ADCHF (1605 vs. 1154 pg/mL; $P = 0.007$). However, median NT-proBNP levels were similar between the two cohorts (3236 vs. 3127 pg/mL; $P = 0.738$).

Eighty-two per cent of the patients were in sinus rhythm, with 14% demonstrating atrial fibrillation or flutter, more in the ADCHF group than in the *de novo* AHF cohort (16% vs. 10%). Overall, 79% of patients had QRS duration <120 ms, with only 13% of the cohort had LBBB morphology on ECG. ADCHF patients were more likely to have LBBB than those with *de novo* AHF (16% vs. 9%). The overall median LVEF of the cohort was 35% (25–45%). HF with reduced ejection fraction (HFrEF) was seen in 69% of the patients.

Table 3 presents the aetiology, precipitating factors, cardiac procedures, and in-hospital course. The three most prevalent aetiologies of HF were CAD (53%), idiopathic cardiomyopathy (18%), and hypertensive heart disease (HHD) (16%). Valvular heart disease, as an aetiology, accounted for 9% of the patients. While CAD was the most prevalent aetiology in both types of HF, idiopathic

Table 4 Pre-admission and discharge medications of the Gulf CARE cohort.

	All ($n = 5005$)	*De novo* AHF ($n = 2276$)	ADCHF ($n = 2729$)	*P*-value
Medications pre-admission				
Diuretics	2882 (58)	565 (25)	2317 (85)	<0.001
Beta-blocker	2208 (44)	659 (29)	1549 (57)	<0.001
ACE inhibitor	2132 (43)	680 (30)	1452 (53)	<0.001
ARB	647 (13)	200 (9)	447 (16)	<0.001
Aldosterone antagonist	840 (17)	101 (4)	739 (27)	<0.001
Digoxin	850 (17)	104 (5)	746 (27)	<0.001
CCB	662 (13)	255 (11)	407 (15)	<0.001
Hydralazine	221 (4.4)	50 (2.2)	171 (6.3)	<0.001
Antiarrhythmic	126 (2.5)	22 (1.0)	104 (3.8)	<0.001
Ivabradine	115 (2.3)	19 (0.8)	96 (3.5)	<0.001
Aspirin	3089 (62)	1031 (45)	2058 (75)	<0.001
Statin	2555 (51)	813 (36)	1742 (64)	<0.001
Nitrates	1305 (26)	329 (14)	976 (36)	<0.001
Clopidogrel	966 (19)	300 (13)	666 (24)	<0.001
Anticoagulant	618 (12)	123 (5)	495 (18)	<0.001
I.v. medications during admission[a]	All ($n = 4542$)	*De novo* AHF ($n = 2056$)	ADCHF ($n = 2486$)	
Frusemide, bolus	4150 (91)	1855 (90)	2295 (92)	0.012
Frusemide, infusion	782 (17)	241 (12)	541 (22)	<0.001
Nitrates, infusion	932 (21)	501 (24)	431 (17)	<0.001
Medications at discharge[a]	All ($n = 4542$)	*De novo* AHF ($n = 2056$)	ADCHF ($n = 2486$)	
Diuretics	4266 (94)	1872 (91)	2394 (96)	<0.001
Beta-blocker	3239 (71)	1481 (72)	1758 (71)	0.329
ACE inhibitor	2753 (61)	1297 (63)	1456 (59)	0.002
ARB	781 (17)	318 (15)	463 (19)	0.005
Aldosterone antagonist	1974 (43)	769 (37)	1205 (48)	<0.001
Digoxin	1155 (25)	408 (20)	747 (30)	<0.001
CCB	708 (16)	318 (15)	390 (16)	0.838
Hydralazine	335 (7.4)	106 (5.2)	229 (9.2)	<0.001
Ivabradine	234 (5.2)	107 (5.2)	127 (5.1)	0.885
Antiarrhythmic	215 (4.7)	70 (3.4)	145 (5.8)	<0.001
Aspirin	3684 (81)	1700 (83)	1984 (80)	0.014
Statin	3286 (72)	1493 (73)	1793 (72)	0.712
Nitrates	1748 (38)	695 (34)	1053 (42)	<0.001
Clopidogrel	1713 (38)	922 (45)	791 (32)	<0.001
Anticoagulant	862 (19)	264 (13)	598 (24)	<0.001

All values are given as *n* (%) unless specified.
ADCHF, acute decompensated chronic heart failure; AHF, acute heart failure; CCB, calcium channel blocker.
[a]Medications at discharge excluded those that died ($n = 313$; 6.25%) as well as those that left against medical advice ($n = 150$; 3%) ($n = 463 = 5005 - 4542$).

cardiomyopathy and valvular heart disease were more prevalent in patients with ADCHF (20% vs. 16% and 11% vs. 7%, respectively) and HHD was more prevalent in patients with *de novo* AHF (18% vs. 14%). The three most common precipitating causes of HF were ACS 27%, non-compliance with medications 19%, and infection 15%. Non-compliance with medications was the most prevalent precipitating cause in patients with ADCHF, while ACS was the most prevalent cause in patients with *de novo* AHF, with 19% having ST elevation on ECG on admission.

A total of 6.0% and 1.4% of the patients had PCI and CABG, respectively, with *de novo* AHF patients more likely to have these procedures than those patients with ADCHF (9.9% vs. 2.7%, PCI; 2.0% vs. 0.8%, CABG). The three most prevalent in-hospital events/courses included infection requiring therapy 24%, requirement for inotropes 16%, and non-invasive ventilation (NIV) 9.5%. *De novo* AHF patients were more likely to have ventricular tachycardia/fibrillation requiring therapy (5.5% vs. 3.6%), to require NIV (10.5% vs. 8.5%), and to be on an intra-aortic balloon pump (IABP) (2.4% vs. 1.0%). On the other hand, ADCHF patients were more likely to develop AF requiring therapy (7.3% vs. 5.0%) and infection requiring antibiotics (26% vs. 22%).

Table 4 outlines pre-admission and discharge medications of the Gulf CARE cohort. Among the pre-admission medications, and besides aspirin at 62% and statins at 51%, the three most prescribed medications were diuretics 58%, ACE inhibitors/ARBs 56%, and beta-blockers 44%. In-hospital i.v. frusemide and nitrates were administered in 93% and 20% of the patients, respectively. With regard to discharge medications, and besides aspirin at

Table 5 Gulf CARE in-hospital, 3- and 12-month follow-up outcomes

Outcome	All ($n = 5005$)	*De novo* AHF ($n = 2276$)	ADCHF ($n = 2729$)	*P*-value
In-hospital outcomes				
Died	313 (6.3)	153 (6.7)	160 (5.9)	0.093
Discharged home	4454 (89)	2006 (88)	2448 (90)	
Transferred to other hospital	88 (1.8)	50 (2.2)	38 (1.4)	
LAMA	150 (3.0)	67 (2.9)	83 (3.0)	
LOS, median (IQR), days	7 (3–10)	7 (4–10)	6 (4–11)	0.689
3-month outcomes				
Losses to follow-up	75 (1.5)	39 (1.7)	36 (1.3)	0.253
Died	629 (12.6)	322 (11.8)	307 (13.2)	0.171
Hospitalization for HF	903 (18.0)	343 (15.1)	560 (20.5)	<0.001
LOS, median (IQR), days	6 (4–10)	6 (4–9)	6 (4–10)	0.942
Device therapy	114 (2.3)	20 (0.9)	94 (3.4)	
CRT	41	4	37	<0.001
ICD	73	16	57	
PCI/CABG	626 (13)	441 (19)	185 (6.8)	<0.001
12-month outcomes				
Losses to follow-up	76 (1.5)	39 (1.7)	37 (1.4)	0.303
Died	1012 (20.2)	390 (17.1)	622 (22.8)	<0.001
Hospitalization for HF	1978 (40)	770 (34)	1208 (44)	<0.001
LOS, median (IQR), days	6 (3–10)	5 (3–8)	6 (4–11)	<0.001
Device therapy	162 (3.2)	35 (1.5)	127 (4.7)	<0.001
CRT	55	6	49	
ICD	107	29	78	
PCI/CABG	1006 (20)	650 (29)	356 (13)	<0.001

The frequencies and percentages for mortality, hospitalization, device therapy, as well as PCI/CABG were cumulative. All values are given as *n* (%) unless specified.
ADCHF, acute decompensated chronic heart failure; AHF, acute heart failure; CABG, coronary artery bypass graft; HF, heart failure; ICD, implantable cardioverter-defibrillator; IQR, interquartile range; LAMA, left against medical advice; LOS, length of hospital stay;

81% and statins at 72%, the most prescribed medications were diuretics 94%, ACE inhibitors/ARBs 78%, beta-blockers 71%, and aldosterone antagonists 43%. Generally, ADCHF patients were prescribed more medications than *de novo* AHF patients, both pre-admission and at discharge.

Table 5 shows the in-hospital outcome, and 3- and 12-month follow-up data. There were a total of 313 (6.3%) in-hospital deaths within the study cohort, with no significant differences between the two types of HF patients (6.7% vs. 5.9%; $P = 0.211$). Follow-up status was complete in 98.5% of patients at 3 and 12 months. At the 3-month follow-up, hospitalization for HF was 18%, with ADCHF patients admitted more often than those with *de novo* AHF (20.5% vs. 15.1%). This higher rate of hospitalization in the ADCHF cohort persisted at the 12-month follow-up (44% vs. 34%). The cumulative 3-month mortality was 12.6% and increased to 20% at 12 months, with significantly more deaths in ADCHF patients than in those with *de novo* AHF at 12 months (22.8% vs. 17.1%; $P < 0.001$). At 12 months, cumulative coronary revascularization and device therapy remained low (20% and 5.0%, respectively).

Discussion

This is the first systematic multinational report of characteristics, treatment patterns, and outcomes of patients admitted with AHF in the Middle East. Patients with AHF from this region are relatively young (approximately a decade younger than Western patients) with a higher prevalence of diabetes mellitus and HFrEF, but lower prevalence of AF, and lower rate of interventional and device therapy, when compared with Western populations. Despite the relatively young patient age, recurrent admissions for HF were common, with nearly one in five re-admitted within 3 months and two in five within 12 months. In-hospital mortality was 6%, doubled to 13% at 3 months, and reached 20% at 1 year post-discharge.

The results from this registry with regard to baseline characteristics, presentation, management, and outcome to some extent overlap with Western registries, but with a few striking differences. These important differences are tabulated in *Table 6* and represented in *Figure 1A* and *B*. The overall mean age of the cohort at 59 years is a decade less than that in Western registries.[3–5,14,15] In the African AHF registry, mean age was 52.3 years.[16] This onset of AHF at an early age may be due to an overall younger population in the region along with a higher preponderance of cardiac risk factors at a younger age that was noted in previous ACS registries from the Middle East.[10,11]

Among the underlying diseases, the prevalence of diabetes mellitus was relatively high (50%) in this cohort of AHF patients when compared with Western registries. The predominant reason could be the very high prevalence rate of diabetes mellitus in the Middle East population.[10,11] Many factors contribute to HF

Table 6 Comparison of Gulf CARE with other registries

Registry	Gulf CARE	ADHERE[3,5]	EHFS II[14,15]	OPTIMIZE-HF[17,18]	AHEAD[19,29]	ALARAM-HF[21,22]	ESC HF Long-Term Registry[25]	ESC-HF PILOT[30]	THESUS[16]
No. of patients	5005	105 388	3580	48 612	4153	4953	5039	1892	1006
Region	Middle East	USA	Europe	USA	Czech republic	Europe, Turkey, Australia, and Mexico	Europe	Europe	Africa
Age (years)	59	72.4	69.9	73.1	71.5	66–70	71	70	52.3
Male	63	48	61.3	48	57.6	62.4	62.7	62.7	49.2
DM	50	44	32.8	41	42.6	45.3	38.9	35.1	11.4
AF	14	30	38.7	31	26.5	24.4	44	43.7	18.3
Median EF	35	34	38	39	37	37	38	38	38
HFpEF	31	46	34.3 (>45)	51	NA	NA	32.8 (>45%)	35.5	NA
ADCHF/*de novo* AHF	55/45	NA	62.9/37.1	NA	42/58.3	64/36.2	NA	75/25	NA
IHD aetiology	53	65	53	46	51	NA	54	50.7	7.7
ACS precipitating factor	27	NA	30.2	14.7	36.2	36.9	NA	NA	NA
Beta-blocker	71	59	61.4	83	76.7	NA	71.8	81	30
ACE inhibitor/ARB	78	69	81.5	83	79.5	NA	77	78	81
Aldosterone antagonists	48	NA	47.5	NA	56.8	NA	55.3	54	72
In-hospital mortality	6.3	4	6.7	3.8	12.7	12	NA	3.8	4.2
Coronary intervention	7.4	NA	10.2	27.5	29.5	15.8	NA	NA	NA
Device therapy	5	NA	3.9	NA	NA	NA	35	9.3	NA
Hospitalization 3-month/12-month	18/40	NA	NA	29.6 (3 month)	NA	NA	NA	24.8 (1 year)	NA
Mortality 3-month/12-month	12.6/20.2	NA	8.1/20.5	8.6 (3 month)	12.7/20.3	NA	NA	17.4 (1 year)	NA

ACS, acute coronary syndrome; ADCHF, acute decompensated chronic heart failure; AHF, acute heart failure; DM, daibetes mellitus; HFpEF, herat failure with preserved ejection fraction; IHD, ischaemic heart disease; NA, not available.

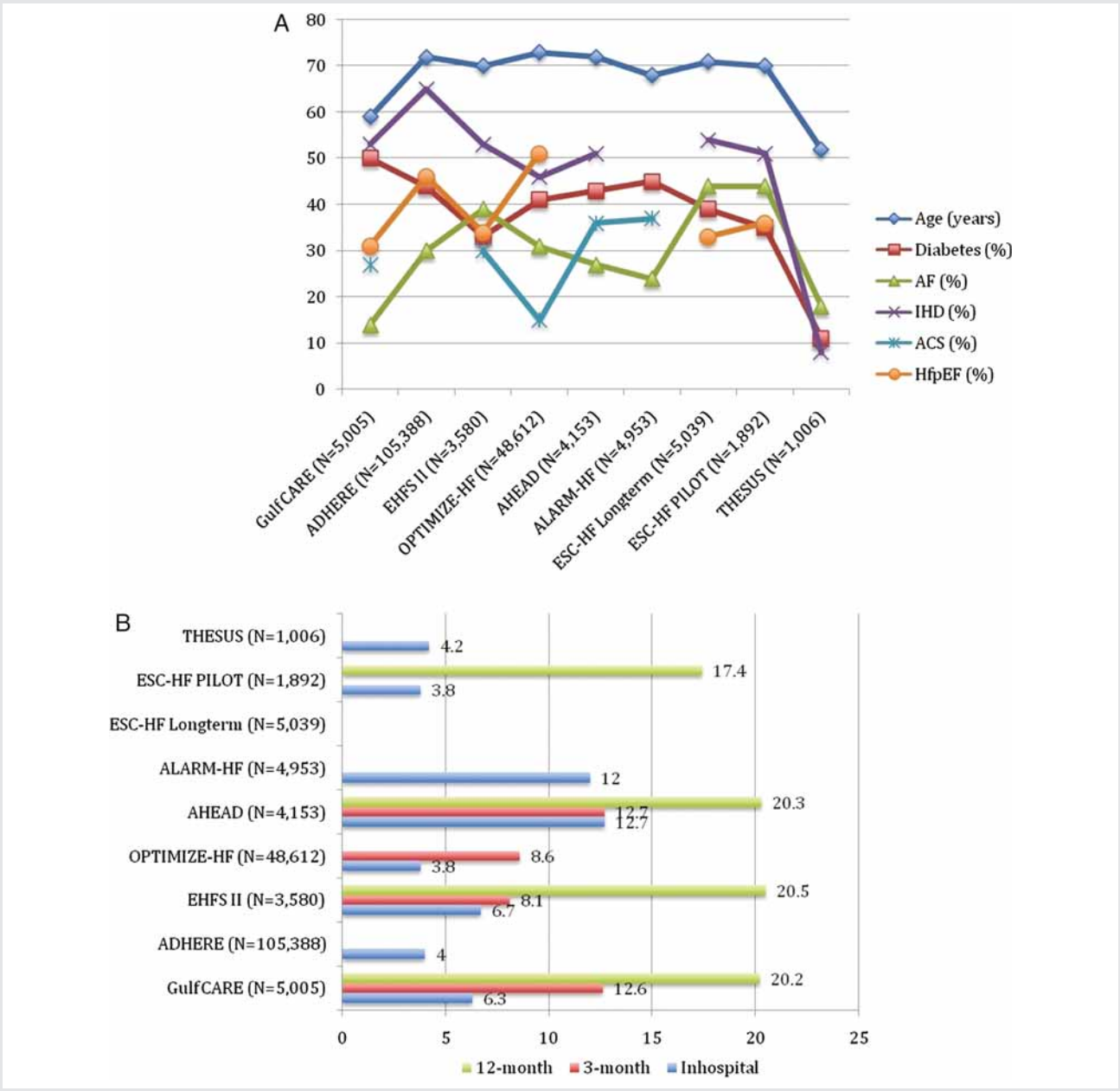

Figure 1 (*A*) Demographic and clinical characteristics of different published heart failure registries. (*B*) Mortality in the different published heart failure registries as a percentage. ACS, acute coronary syndrome; HfpEF, heart failure with preserved ejection fraction; IHD, ischaemic heart disease.

in diabetic patients, such as severe diffuse multivessel CAD, autonomic dysfunction, and diabetic cardiomyopathy with both systolic and diastolic dysfunction. The prevalence of AF was low (14%) in this population of AHF patients when compared with Western registries.[3,14,17–19] This low rate of AF can be attributed to the younger age of the cohort, the low prevalence of valvular heart disease, as well as the low prevalence of alcohol consumption in this region. In a systemic review of the global burden of AF, it was observed that AF occurrence is related to increasing age, presence of valvular heart disease, and ethnicity.[20]

Overall, the median LVEF of 35% in the Gulf CARE registry is similar to that of other registries.[3–5,14,15,21,22] HFrEF was seen in most of the patients (69%), which is similar to European registries, but higher compared with American registries.[3,5,14,15,17,18] This is most probably attributable to the high prevalence of underlying CAD as the aetiology for HF (53%) along with ACS (27%) as the most common precipitating factor. In the African AHF registry, CAD was the cause for AHF in 7.7%.[16] Furthermore, it is observed from previous Gulf ACS registries that ACS patients are noted to arrive late to hospitals probably due to low awareness and

poor emergency medical service systems, as well as low rates of utilization of catheterization and revascularization. All these factors may contribute to low EF in HF patients.[10,23,24]

With regard to cardiac procedures, even though CAD was the most frequent aetiology, in-hospital PCI or CABG was performed in 7.4% of the cohort, whereas in the AHEAD (Acute HEArt Failure Database) and OPTIMIZE-HF registries it was nearly five times more. This underutilization of coronary intervention was also noted in previous ACS registries from this region.[8,9,23] The two predominant reasons may be non-adherence to guidelines as well as the 'treatment-risk' paradox. Even though 60% of hospitals in this registry had catheterization facilities, very few patients were catheterized.[12] Guidelines recommend coronary intervention in high-risk patients, but in 'real-world' practice, low-risk patients are catheterized more.[23] In this cohort even though nearly 70% of patients had HFrEF, fewer than 5% underwent device therapy, which is low compared with the ESC Long-Term Registry, wherein 23% had an implantable cardioverter defibrillator (ICD) and 12% had CRT.[25] The causes of this relatively low utilization of device therapy may be poor awareness of indications for device therapy among physicians as well as apprehension about non-responders to CRT therapy, even though device therapy was available in 38% of the hospitals in this registry, and this is free to citizens.[26] In a retrospective analysis of a cohort of 10 148 HF patients admitted to 134 American Heart Association GWTG-HF (Get With The Guidelines-Heart Failure) hospitals with ICD implantation capability, only 20% of patients with an LVEF $\leq$30% were discharged with an ICD in place or with plans to receive one. This analysis went on to demonstrate significant interhospital variability in ICD utilization rates for appropriate patients.[27]

Among ADCHF patients, in comparison with admission, a significant increase in evidence-based medicines at discharge was noted, with increases in beta-blocker use from 57% to 71%, ACE inhibitor/ARB use from 69% to 78%, and aldosterone antagonist use from 27% to 48%. This prescribing pattern is similar to that reported in the recent large multinational 211 centre ESC Long-Term Registry of 5039 hospitalized HF patients (beta-blockers 55–72%, ACE inhibitoprs/ARBs 64–77%, and aldosterone antagonists 34–55%).[25]

The overall hospital mortality of 6.3% was comparable (may be interpreted as high when the younger age of the cohort is considered) with the mortality of the EHFS II (6.7%) registry, but more than the ADHERE (4.0%) and OPTIMIZE-HF (3.8%) registries.[3,5,14,15,17,18] However, this is in contrast to the AHEAD and ALARM-HF registries, with a 12% in-hospital mortality rate.[19,21,22] This may be due to the high occurrence of cardiogenic shock in these registries. In this study, 8% of the patients had cardiogenic shock, whereas 14.7% of the AHEAD registry and 11.7% of the ALARM-HF population had cardiogenic shock.[19,21]

In this study, 3-month and 12-month mortality (12.6% and 20.2%), though high, is similar to that of other Western registries, but the 1-year re-hospitalization rate of 40% is very high compared with other registries.[14,15,28,29] In the ESC-HF Pilot registry, the 1-year re-hospitalization rate was 25%.[30] Even though AHF patients at discharge were treated with evidence-based medicines, there was a high prevalence of precipitating factors of HF such as ACS, non-compliance, systemic infection, and uncontrolled hypertension/arrhythmias, all of which could have contributed to this high rate of re-hospitalization. In addition, underutilization of coronary intervention and device therapy along with lack of HF clinics in this region can result in suboptimal treatment of HF resulting in recurrent admissions. This underscores the need for multiple preventive and therapeutic strategies in the Middle East region to reduce the burden of HF morbidity and mortality.

The limitation of this study is its nature of being a registry which may have introduced bias through confounding by variables not controlled for or measured. In some countries, only a few hospitals took part in the registry; hence, the results are not entirely generalizable. Reasons for underusage of medications or procedures were not known in this study. The recording of natriuretic peptides was optional as not all countries routinely measure them. Furthermore, echocardiographic interpretation was at the discretion of the echocardiographer performing the study; no centralized evaluation was performed.

In conclusion, Gulf CARE is the first prospective multinational, multicentre registry of AHF in the Middle East which shows that HF patients from the Middle East are a decade younger than their Western counterparts, with a high prevalence of diabetes, HFrEF, and lower prevalence of AF. Use of evidence-based medications is good, but not optimal; however, the use of coronary intervention and device therapy was low compared with other registries. Short- and long-term mortality rates were close to those reported from Western registries, but should be interpreted in the light of the younger age of Gulf CARE patients.

Funding

Gulf CARE is an investigator-initiated study conducted under the auspices of the Gulf Heart Association and funded by Servier, Paris, France; and (for centres in Saudi Arabia) by the Saudi Heart Association.

Conflict of interest: none declared.

References

1. Dickstein K, Cohen-Solal A, Filippatos G, McMurray JJ, Ponikowski P, Poole-Wilson PA, Strömberg A, van Veldhuisen DJ, Atar D, Hoes AW, Keren A, Mebazaa A, Nieminen M, Priori SG, Swedberg K; ESC Committee for Practice Guidelines (CPG). ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2008: the Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2008 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association of the ESC (HFA) and endorsed by the European Society of Intensive Care Medicine (ESICM). *Eur Heart J* 2008;**29**:2388–2442.
2. Hunt SA, Abraham WT, Chin MH, Feldman AM, Francis GS, Ganiats TG, Jessup M, Konstam MA, Mancini DM, Michl K, Oates JA, Rahko PS, Silver MA, Stevenson LW, Yancy CW. 2009 focused update incorporated into the ACC/AHA 2005 Guidelines for the Diagnosis and Management of Heart Failure in Adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines: Developed in collaboration with the International Society for Heart and Lung Transplantation. *Circulation*2009;**119**:e391–e479.
3. Adams KF Jr, Fonarow GC, Emerman CL, LeJemtel TH, Costanzo MR, Abraham WT, Berkowitz RL, Galvao M, Horton DP; ADHERE Scientific Advisory Committee and Investigators. Characteristics and outcomes of patients hospitalized for heart failure in the United States: rationale, design, and preliminary observations from the first 100,000 cases in the Acute Decompensated Heart Failure National Registry (ADHERE). *Am Heart J* 2005;**149**:209–216.

4. Fonarow GC1, Abraham WT, Albert NM, Gattis WA, Gheorghiade M, Greenberg B, O'Connor CM, Yancy CW, Young J. Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients with Heart Failure (OPTIMIZE-HF): rationale and design. *Am Heart J* 2004;**148**:43–51.
5. Fonarow GC, Adams KF Jr, Abraham WT, Yancy CW, Boscardin WJ, ADHERE Scientific Advisory Committee, Group Study, and Investigators. Risk stratification for in-hospital mortality in acutely decompensated heart failure. *JAMA* 2005;**293**:572–580.
6. Lindenfeld J, Albert NM, Boehmer JP, Collins SP, Ezekowitz JA, Givertz MM, Katz SD, Klapholz M, Moser DK, Rogers JG, Starling RC, Stevenson WG, Tang WH, Teerlink JR, Walsh MN, Heart Failure Society of America. HFSA 2010 Comprehensive Heart Failure Practice Guideline. *J Card Fail* 2010;**16**:e1–194.
7. Epstein AE, DiMarco JP, Ellenbogen KA, Estes NA 3rd, Freedman RA, Gettes LS, Gillinov AM, Gregoratos G, Hammill SC, Hayes DL, Hlatky MA, Newby LK, Page RL, Schoenfeld MH, Silka MJ, Stevenson LW, Sweeney MO, Smith SC Jr, Jacobs AK, Adams CD, Anderson JL, Buller CE, Creager MA, Ettinger SM, Faxon DP, Halperin JL, Hiratzka LF, Hunt SA, Krumholz HM, Kushner FG, Lytle BW, Nishimura RA, Ornato JP, Page RL, Riegel B, Tarkington LG, Yancy CW; American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the ACC/AHA/NASPE 2002 Guideline Update for Implantation of Cardiac Pacemakers and Antiarrhythmia Devices); American Association for Thoracic Surgery; Society of Thoracic Surgeons. ACC/AHA/HRS 2008 Guidelines for Device-Based Therapy of Cardiac Rhythm Abnormalities: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the ACC/AHA/NASPE 2002 Guideline Update for Implantation of Cardiac Pacemakers and Antiarrhythmia Devices): developed in collaboration with the American Association for Thoracic Surgery and Society of Thoracic Surgeons. *Circulation* 2008;**117**:e350–e408.
8. Zubaid M, Rashed WA, Al-Khaja N, Almahmeed W, Al-Lawati J, Sulaiman K, Al-Motarreb A, Amin H, Al-Suwaidi J, Al-Habib K. Clinical presentation and outcomes of acute coronary syndromes in the Gulf Registry of Acute Coronary Events (Gulf RACE). *Saudi Med J* 2008;**29**:251–255.
9. Alhabib KF, Sulaiman K, Al-Motarreb A, Almahmeed W, Asaad N, Amin H, Hersi A, Al-Saif S, AlNemer K, Al-Lawati J, Al-Sagheer NQ, AlBustani N, Al Suwaidi J; Gulf RACE-2 investigators. Baseline characteristics, management practices, and long-term outcomes of Middle Eastern patients in the Second Gulf Registry of Acute Coronary Events (Gulf RACE-2). *Ann Saudi Med* 2012;**32**:9–18.
10. Alhabib KF, Elasfar AA, Alfaleh H, Kashour T, Hersi A, Albackr H, Alshaer F, Alnemer K, Hussein GA, Mimish L, Almasood A, Alhabeeb W, Alghamdi S, Alsharari M, Chakra E, Malik A, Soomro R, Ghabashi A, Al-Murayeh M, Abuosa A. Clinical features, management, and short- and long-term outcomes of patients with acute decompensated heart failure: phase I results of the HEARTS database. *Eur J Heart Fail* 2015;in press..
11. Al Suwaidi J, Asaad N, Al-Qahtani A, Al-Mulla AW, Singh R, Albinali HA. Prevalence and outcome of Middle-eastern Gulf and South Asian patients hospitalized with heart failure: insight from a 20-year registry in a Middle-eastern country (1991–2010). *Acute Card Care* 2012;**14**:81–89.
12. Sulaiman KJ, Panduranga P, Al-Zakwani I, Alsheikh-Ali A, Al-Habib K, Al-Suwaidi J, Al-Mahmeed W, Al-Faleh H, El-Asfar A, Al-Motarreb A, Ridha M, Bulbanat B, Al-Jarallah M, Bazargani N, Asaad N, Amin H. Rationale, design, methodology and hospital characteristics of the first gulf acute heart failure registry (Gulf CARE). *Heart Views* 2014;**15**:6–12.
13. Radford MJ, Arnold JM, Bennett SJ, Cinquegrani MP, Cleland JG, Havranek EP, Heidenreich PA, Rutherford JD, Spertus JA, Stevenson LW, Goff DC, Grover FL, Malenka DJ, Peterson ED, Redberg RF; American College of Cardiology; American Heart Association Task Force on Clinical Data Standards; American College of Chest Physicians; International Society for Heart and Lung Transplantation; Heart Failure Society of America. ACC/AHA key data elements and definitions for measuring the clinical management and outcomes of patients with chronic heart failure: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Data Standards (Writing Committee to Develop Heart Failure Clinical Data Standards): developed in collaboration with the American College of Chest Physicians and the International Society for Heart and Lung Transplantation: endorsed by the Heart Failure Society of America. *Circulation* 2005;**112**:1888–1916.
14. Nieminen MS, Brutsaert D, Dickstein K, Drexler H, Follath F, Harjola VP, Hochadel M, Komajda M, Lassus J, Lopez-Sendon JL, Ponikowski P, Tavazzi L; EuroHeart Survey Investigators, Heart Failure Association, European Society of Cardiology. EuroHeart Failure Survey II (EHFS II): a survey on hospitalized acute heart failure patients: description of population. *Eur Heart J* 2006;**27**:2725–2736.
15. Harjola VP, Follath F, Nieminen MS, Brutsaert D, Dickstein K, Drexler H, Hochadel M, Komajda M, Lopez-Sendon JL, Ponikowski P, Tavazzi L. Characteristics, outcomes, and predictors of mortality at 3 months and 1 year in patients hospitalized for acute heart failure. *Eur J Heart Fail* 2010;**12**:239–248.
16. Damasceno A, Mayosi BM, Sani M, Ogah OS, Mondo C, Ojji D, Dzudie A, Kouam CK, Suliman A, Schrueder N, Yonga G, Ba SA, Maru F, Alemayehu B, Edwards C, Davison BA, Cotter G, Sliwa K. The causes, treatment, and outcome of acute heart failure in 1006 Africans from 9 countries. *Arch Intern Med* 2012;**172**:1386–1394.
17. Gheorghiade M, Abraham WT, Albert NM, Greenberg BH, O'Connor CM, She L, Stough WG, Yancy CW, Young JB, Fonarow GC; OPTIMIZE-HF Investigators and Coordinators. Systolic blood pressure at admission, clinical characteristics, and outcomes in patients hospitalized with acute heart failure. *JAMA* 2006;**296**:2217–2226.
18. Rossi JS, Flaherty JD, Fonarow GC, Nunez E, Gattis Stough W, Abraham WT, Albert NM, Greenberg BH, O'Connor CM, Yancy CW, Young JB, Davidson CJ, Gheorghiade M. Influence of coronary artery disease and coronary revascularization status on outcomes in patients with acute heart failure syndromes: a report from OPTIMIZE-HF (Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients with Heart Failure). *Eur J Heart Fail* 2008;**10**:1215–1223.
19. Spinar J, Parenica J, Vitovec J, Widimsky P, Linhart A, Fedorco M, Malek F, Cihalik C, Spinarová L, Miklik R, Felsoci M, Bambuch M, Dusek L, Jarkovsky J.. Baseline characteristics and hospital mortality in the Acute Heart Failure Database (AHEAD) Main registry. *Crit Care* 2011;**15**:R291.
20. Lip GY, Brechin CM, Lane DA.The global burden of atrial fibrillation and stroke: a systematic review of the epidemiology of atrial fibrillation in regions outside North America and Europe. *Chest* 2012;**142**:1489–1498.
21. Follath F, Yilmaz MB, Delgado JF, Parissis JT, Porcher R, Gayat E, Burrows N, McLean A, Vilas-Boas F, Mebazaa A. Clinical presentation, management and outcomes in the Acute Heart Failure Global Survey of Standard Treatment (ALARM-HF). *Intensive Care Med* 2011;**37**:619–626.
22. Parissis JT, Nikolaou M, Mebazaa A, Ikonomidis I, Delgado J, Vilas-Boas F, Paraskevaidis I, Mc Lean A, Kremastinos D, Follath F. Acute pulmonary oedema: clinical characteristics, prognostic factors, and in-hospital management. *Eur J Heart Fail* 2010;**12**:1193–1202.
23. Panduranga P, Sulaiman K, Al-Zakwani I, Zubaid M, Rashed W, Al-Mahmeed W, Al-Lawati J, Al-Motarreb A, Haitham A, Suwaidi J, Al-Habib K. Utilization and determinants of in-hospital cardiac catheterization in patients with acute coronary syndrome from the Middle East. *Angiology* 2010;**61**:744–750.
24. Almahmeed W, Arnaout MS, Chettaoui R, Ibrahim M, Kurdi MI, Taher MA, Mancia G. Coronary artery disease in Africa and the Middle East. *Ther Clin Risk Manag* 2012;**8**:65–72.
25. Maggioni AP, Anker SD, Dahlström U, Filippatos G, Ponikowski P, Zannad F, Amir O, Chioncel O, Leiro MC, Drozdz J, Erglis A, Fazlibegovic E, Fonseca C, Fruhwald F, Gatzov P, Goncalvesova E, Hassanein M, Hradec J, Kavoliuniene A, Lainscak M, Logeart D, Merkely B, Metra M, Persson H, Seferovic P, Temizhan A, Tousoulis D, Tavazzi L; Heart Failure Association of the ESC. Are hospitalized or ambulatory patients with heart failure treated in accordance with European Society of Cardiology guidelines? Evidence from 12 440 patients of the ESC Heart Failure Long-Term Registry. *Eur J Heart Fail* 2013;**15**:1173–1184.
26. Calvin JE, Shanbhag S, Avery E, Kane J, Richardson D, Powell L. Adherence to evidence-based guidelines for heart failure in physicians and their patients: lessons from the Heart Failure Adherence Retention Trial (HART). *Congest Heart Fail* 2012;**18**:73–78.
27. Shah B, Hernandez AF, Liang L, Al-Khatib SM, Yancy CW, Fonarow GC, Peterson ED; Get With The Guidelines Steering Committee. Hospital variation and characteristics of implantable cardioverter-defibrillator use in patients with heart failure: data from the GWTG-HF (Get With The Guidelines-Heart Failure) registry. *J Am Coll Cardiol* 2009;**53**:416–422.
28. O'Connor CM, Abraham WT, Albert NM, Clare R, GattisStough W, Gheorghiade M, Greenberg BH, Yancy CW, Young JB, Fonarow GC. Predictors of mortality after discharge in patients hospitalized with heart failure: an analysis from the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients with Heart Failure (OPTIMIZE-HF). *Am Heart J* 2008;**156**:662–673.
29. Parenica J, Spinar J, Vitovec J, Widimsky P, Linhart A, Fedorco M, Vaclavik J, Miklik R, Felsoci M, Horakova K, Cihalik C, Malek F, Spinarova L, Belohlavek J, Kettner J, Zeman K, Dušek L, Jarkovsky J; AHEAD Main investigators. Long-term survival following acute heart failure: the Acute Heart Failure Database Main registry (AHEAD Main). *Eur J Intern Med* 2013;**24**:151–160.
30. Maggioni AP, Dahlström U, Filippatos G, Chioncel O, Crespo Leiro M, Drozdz J, Fruhwald F, Gullestad L, Logeart D, Fabbri G, Urso R, Metra M, Parissis J, Persson H, Ponikowski P, Rauchhaus M, Voors AA, Nielsen OW, Zannad F, Tavazzi L; Heart Failure Association of the European Society of Cardiology (HFA). EURObservational Research Programme: regional differences and 1-year follow-up results of the Heart Failure Pilot Survey (ESC-HF Pilot). *Eur J Heart Fail* 2013;**15**:808–817.