

JACC INTERNATIONAL

Cardiac Arrhythmias in Africa

Epidemiology, Management Challenges, and Perspectives



Aimé Bonny, MD, MSc,^{a,b,c} Marcus Ngantcha, MSc,^c Wihan Scholtz, MSc CAND,^d Ashley Chin, MD, MBChB,^e George Nel, MSc,^f Jean-Baptiste Anzouan-Kacou, MD,^g Kamilu M. Karaye, BMBCCh, PhD,^h Albertino Damasceno, MD, PhD,ⁱ Thomas C. Crawford, MD^j

ABSTRACT

Africa is experiencing an increasing burden of cardiac arrhythmias. Unfortunately, the expanding need for appropriate care remains largely unmet because of inadequate funding, shortage of essential medical expertise, and the high cost of diagnostic equipment and treatment modalities. Thus, patients receive suboptimal care. A total of 5 of 34 countries (15%) in Sub-Saharan Africa (SSA) lack a single trained cardiologist to provide basic cardiac care. One-third of the SSA countries do not have a single pacemaker center, and more than one-half do not have a coronary catheterization laboratory. Only South Africa and several North African countries provide complete services for cardiac arrhythmias, leaving more than hundreds of millions of people in SSA without access to arrhythmia care considered standard in other parts of the world. Key strategies to improve arrhythmia care in Africa include greater government health care funding, increased emphasis on personnel training through fellowship programs, and greater focus on preventive care. (J Am Coll Cardiol 2019;73:100-9)
© 2019 by the American College of Cardiology Foundation.

Many countries face growing, unmet health care needs, and pressures on health systems are expected to increase as a result of demographic, epidemiological, and health transitions (1). Health care delivery across the African continent is heterogeneous, with few countries providing universal health coverage. Among 55 countries in Africa, only 8 provide universal health coverage through a national health insurance program: Algeria, Botswana, Gabon, Ghana, Mauritius, Rwanda, Tunisia, and Zambia (2). In most countries, health care services are primarily paid out of pocket by household incomes rather than by public or commercial health insurance programs (3). In 2014, between 40% and 60% of total health expenditures

were funded by households in one-half of Sub-Saharan Africa (SSA) countries (3). Although most governments have committed to increasing their public health spending to at least 15% of the government's budget in line with the African Union's 2001 Abuja Declaration (3), government health expenditures diminished in one-half of the African countries between 2002 and 2014 (1).

Cardiovascular diseases, including cardiac arrhythmias, are a major public health problem in low- and middle-income countries, to which almost all SSA countries belong. There is a huge disparity in cardiovascular standard of care between the developed countries and the low- and middle-income countries. Because of the high cost of diagnostic



Listen to this manuscript's audio summary by Editor-in-Chief Dr. Valentin Fuster on JACC.org.

From the ^aHôpital de District de Bonassama, Douala, Cameroon; ^bUniversity of Douala, Douala, Cameroon; ^cCameroon Cardiovascular Research Network, Douala, Cameroon; ^dDepartment of Physiology, School of Medicine, Faculty of Health Sciences, University of Pretoria, Pretoria, South Africa; ^eThe Cardiac Clinic, Department of Medicine, Groote Schuur Hospital and University of Cape Town, Cape Town, South Africa; ^fPan-African Society of Cardiology (PASCAR), Department of Medicine, University of Cape Town, Cape Town, South Africa; ^gCardiology Institute of Abidjan, Felix Houphouët Boigny University of Abidjan, Abidjan, Ivory Coast; ^hDepartment of Cardiology, Bayero University/Aminu Kano Teaching Hospital, Kano, Nigeria; ⁱFaculty of Medicine, Eduardo Mondlane University, Maputo, Mozambique; and the ^jUniversity of Michigan, Ann Arbor, Michigan. The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received June 20, 2018; revised manuscript received September 12, 2018, accepted September 13, 2018.

and therapeutic interventions in electrophysiology, cardiac arrhythmia may possibly be the most neglected area of cardiology. To address this situation, we review the current state of arrhythmia burden and care, identify critical needs, and suggest some potential solutions. We recommend a hierarchy of cooperative goals, which can be set across African countries, starting with education and care less dependent on high-cost items.

EPIDEMIOLOGY

ATRIAL FIBRILLATION. Atrial fibrillation (AF) is the most common arrhythmia worldwide, including Africa (4,5). From 1990 to 2013, deaths from AF increased 196% (4). According to some projections, there will be more people with AF in Africa than in either China, the United States, or India by 2050 (Figure 1).

Rheumatic heart disease and endomyocardial fibrosis are still prevalent in Africa, affecting mainly adolescents and young adults. They are associated with a high prevalence of AF (4-6). AF is found in >30% of the chronic cases of endomyocardial fibrosis (6). In the REMEDY (Global Rheumatic Heart Disease Registry), AF was present in 21.8% of patients with rheumatic heart disease (7), which is consistent with the findings of the Heart of Soweto study, which showed a 13% prevalence of AF among patients with valvular heart disease (8).

A study from urban Cameroon was the first attempt to describe the clinical characteristics, treatment, and prognosis of patients with AF in Africa (9). Of 172 patients with AF, 22.7% were paroxysmal, 21.5% were persistent, and 55.8% were permanent. In this 1-year follow-up study, patients experienced extremely high mortality and morbidity rates: 26 of 88 patients (30%) died; among the survivors, 16% had a nonfatal stroke and 26% developed decompensated heart failure (HF).

In African HF registries, 16% of acute HF patients in THESUS-HF (Sub-Saharan Africa Survey on Heart Failure) (10) and 18% of chronic HF patients in TaHeF (Tanzanian Heart Failure Study) (11) had AF. Both studies present a lower prevalence of AF compared with that reported in developed countries (5). The reason for this is not clear and may be related to improved survival and increased chronicity of HF in patients in the high-income countries or perhaps because the African patients were younger than their Western counterparts. In the international RE-LY (Randomized Evaluation of Long-Term Anticoagulation Therapy) registry, patients presented with AF or atrial flutter to an emergency department.

African patients had about 3 times more hospital readmissions (34%) than others; their 1-year stroke rate was 8% compared with 2% in North America, Western Europe, and Australia; and the 1-year death rate was 20% compared with 10% on the other continents (12).

INHERITABLE ARRHYTHMOGENIC HEART DISEASES. There is a paucity of data on inherited arrhythmogenic cardiac diseases due to the advanced workup required to establish the diagnosis. Hence, the published data is relatively limited regarding this topic (Table 1).

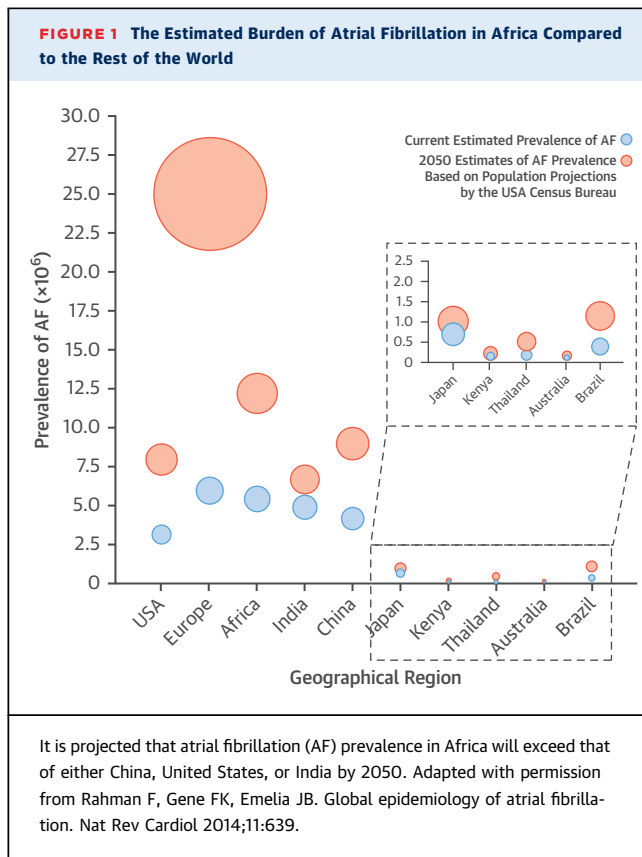
Arrhythmogenic right ventricular cardiomyopathy/dysplasia is a rare heart muscle disorder characterized by the presence of fibrofatty tissue and ventricular electrical vulnerability related to sudden death. In 2009, the largest cohort of 50 patients in Africa was reported by the Arrhythmogenic Right Ventricular Cardiomyopathy/Dysplasia Registry of South Africa (13,14). The disease was observed in all races and ethnic groups, patients usually became symptomatic by their third decade of life, and the 1- and 5-year mortality was 2.8% and 10%, respectively. The relatively high mortality was believed to be the result of underutilization of implantable cardioverter-defibrillators (ICDs) in the country (11). In Tunisia, 12 sudden cardiac death (SCD) patients with suspected arrhythmogenic right ventricular cardiomyopathy/dysplasia were studied (15). Autopsies revealed that 9 patients met the morphological criteria of the disease (adipocyte infiltration with fibrosis replacement) (15).

Long QT syndrome is one of the most common cardiac channelopathies, characterized by prolonged ventricular repolarization and life-threatening ventricular arrhythmias called “*torsades de pointe*,” which may lead to syncope and cardiac arrest. The first published case of long QT syndrome on the continent came from South Africa in 1992 (16). The case was a 7-year-old child from Senegal who presented with recurrent episodes of exercise-associated syncope, a QTc of 627 ms, and a Schwartz score of 6. Neither syncope nor ventricular arrhythmia recurred on propranolol until discharge 2 weeks later. Unfortunately, no genetic testing was done. Despite such scant case reports, there is no substantial understanding of the prevalence of this condition in Africa.

Brugada syndrome is an inherited arrhythmogenic disorder phenotypically manifested by syncope, malignant ventricular arrhythmias or SCD, and coved-type ST-segment elevation in the right precordial leads on the electrocardiogram (ECG). Although there

ABBREVIATIONS AND ACRONYMS

AF	= atrial fibrillation
CIED	= cardiac implantable electronic device
HF	= heart failure
ICD	= implantable cardioverter-defibrillator
IHD	= ischemic heart disease
PASCAR	= Pan-African Society of Cardiology
SCD	= sudden cardiac death
SSA	= Sub-Saharan Africa



are few data on the prevalence of Brugada syndrome in the general population of Africa, Ouali et al. (17) reported 24 confirmed cases in Tunisia and found that the patients had a clinical profile like those from Western countries. Bonny et al. (18) reported on 5 black African patients with similar phenotypic/genotypic features as non-Africans.

A few sporadic cases of *hypertrophic cardiomyopathy* in Africans have been reported (19). To our knowledge, other conditions such as *short QT syndrome*, *catecholaminergic polymorphic ventricular tachycardia*, *noncompaction cardiomyopathy*, and a malignant form of *early repolarization syndrome* have not been reported in Africa. Clearly there is a need for improved recognition and reporting of the incidence of the inherited arrhythmia syndromes in Africa.

SCD is defined as death from an unexpected circulatory collapse, usually because of a cardiac arrhythmia, occurring within an hour of symptom onset. SCD data from most African countries are generally single-center retrospective registries rather than prospective population-based studies (Table 1). The first population-based SCD study in SSA (20) showed an incidence similar to China (21) and higher than in Ireland (22). The crude incidence rate

in the Cameroonian population above age 18 years was 31.3/100,000 person-years, while the age-standardized rate across Africa was 33.6/100,000 person-years (20). Because of cultural misconceptions about unexpected deaths, which are seen as spiritual rather than medical events, post-mortem autopsy is rarely performed. Therefore, only speculations on the etiologies of SCD have been made. Inherited cardiac arrhythmias may be the cause of most of the SCD in areas where more than one-half of the population are age <25 years. In the Douala-SCD study, the number of deaths above age of 40 years was not greater than those under 40 years (20), suggesting that the proportion of patients with inherited arrhythmogenic diseases may be higher in the African populations compared with Western populations, in which ischemic heart disease (IHD) accounts for about 80% of all SCD in adults. Alternative conditions affecting such individuals under 40 years of age in Africa cannot be excluded.

The epidemiology of *sports-related SCD* is not well established in Africans. However, Allouche et al. (23) described 32 cases of SCD in athletes who underwent autopsies. The authors found a prevalence pattern similar to that reported in non-African populations: hypertrophic cardiomyopathy (41%) and arrhythmogenic right ventricular cardiomyopathy/dysplasia (13.6%) among those age <35 years, and ischemic heart disease (90%) in athletes age >35 years.

SECONDARY ARRHYTHMOGENIC HEART DISEASES. *Ischemic heart disease.* Historically, IHD has been considered uncommon in Africa (4). Despite the epidemiological transition, IHD continues to be responsible for a minority of SCDs in SSA (24-27). In North Africa, IHD was much more prevalent and accounted for almost 60% of 361 autopsied SCD fatalities in Tunisia (28).

Parasitic-related cardiac arrhythmias. Some parasitic infections may affect the myocardium, pericardium, and pulmonary vasculature and produce cardiac manifestations and rhythm disturbances. *Human African Trypanosomiasis* is caused by *T. brucei gambiense* (in West and Central Africa, predominantly in the Democratic Republic of Congo) and *T. brucei rhodesiense* (in East and South Africa, predominantly in Tanzania and Uganda). These flagellate parasites can cause myocarditis and prolongation of the PR, QRS, and QT intervals, with the associated risk of fatal ventricular arrhythmias. Cysticercosis, caused by *T. solium*, is a cestode parasite most commonly found in Southern Africa that can cause conduction abnormalities and trigger arrhythmias. *Schistosomiasis* (*Schistosoma mansoni* and *S. Haematobium* in West Africa) causes pulmonary hypertension, cardiac

TABLE 1 Nonexhaustive List of Published Data on Sudden Cardiac Death in Africa

Main Etiology	First Author (Ref. #)	Title	Country	Journal, Year
Unknown	Bonny, et al. (20)	Epidemiology of sudden cardiac death in Cameroon	Cameroon	Int J of Epidemiology, 2017
Brugada Syndrome	Bonny, et al. (18)	Brugada syndrome in pure black Africans	Ivory Coast, Benin, RDC	J Cardiovasc Electrophysiol, 2008
	Ouali, et al. (17)	Clinical and electrophysiological profile of Brugada Syndrome in the Tunisian population	Tunisia	Pacing Clin Electrophysiol, 2011
IHD	Rotimi, et al.	Sudden unexpected death from cardiac causes in Nigerians: a review of 50 autopsied cases	Nigeria	Int J Cardiol, 1998
Pediatric sample	Arthur, et al.	Sudden deaths: cardiac and noncardiac in children in Accra	Ghana	West J Africa, 1995
IHD and rheumatic heart disease	Schneider, et al.	Causes of sudden death in Addis Ababa, Ethiopia	Ethiopia	Ethiop Med J, 2001
Hypertension	Akinwusi, et al.	Pattern of sudden death at Ladoke Akintola University of Technology Teaching Hospital, Osogbo, South West Nigeria	Nigeria	Vasc Health Risk Manag, 2013
IHD, PPCM, DCM	Talle, et al.	Sudden Cardiac Death: Clinical Perspectives from the University of Maiduguri Teaching Hospital, Nigeria	Nigeria	World J Cardiovasc Dis, 2015
Long QT Syndrome	Kolo, et al.	Prognostic significance of QT interval prolongation in adult Nigerians with chronic heart failure	Nigeria	Niger J Clin Pract, 2008
HCM	El-Saiedi, et al.	Hypertrophic cardiomyopathy: prognostic factors and survival analysis in 128 Egyptian patients	Egypt	Cardiol Young, 2014

CMP = cardiomyopathy; DCM = dilated cardiomyopathy; HCM = hypertrophic cardiomyopathy IHD = ischemic heart diseases; LQTS = long QT syndrome; PPCM = postpartum cardiomyopathy; RDC = République démocratique du Congo.

arrhythmias, and SCD. The pathogenesis of parasitic-related arrhythmias is poorly understood, but inflammation, myocarditis, and cell death with fibrosis replacement have been postulated (29). The true impact of parasitic disease in the genesis of arrhythmias in Africa may be much higher than in other parts of the world, and merits further exploration as part of a more general registry on cardiac rhythm disturbances on the continent.

DIAGNOSTIC AND THERAPEUTIC RESOURCES

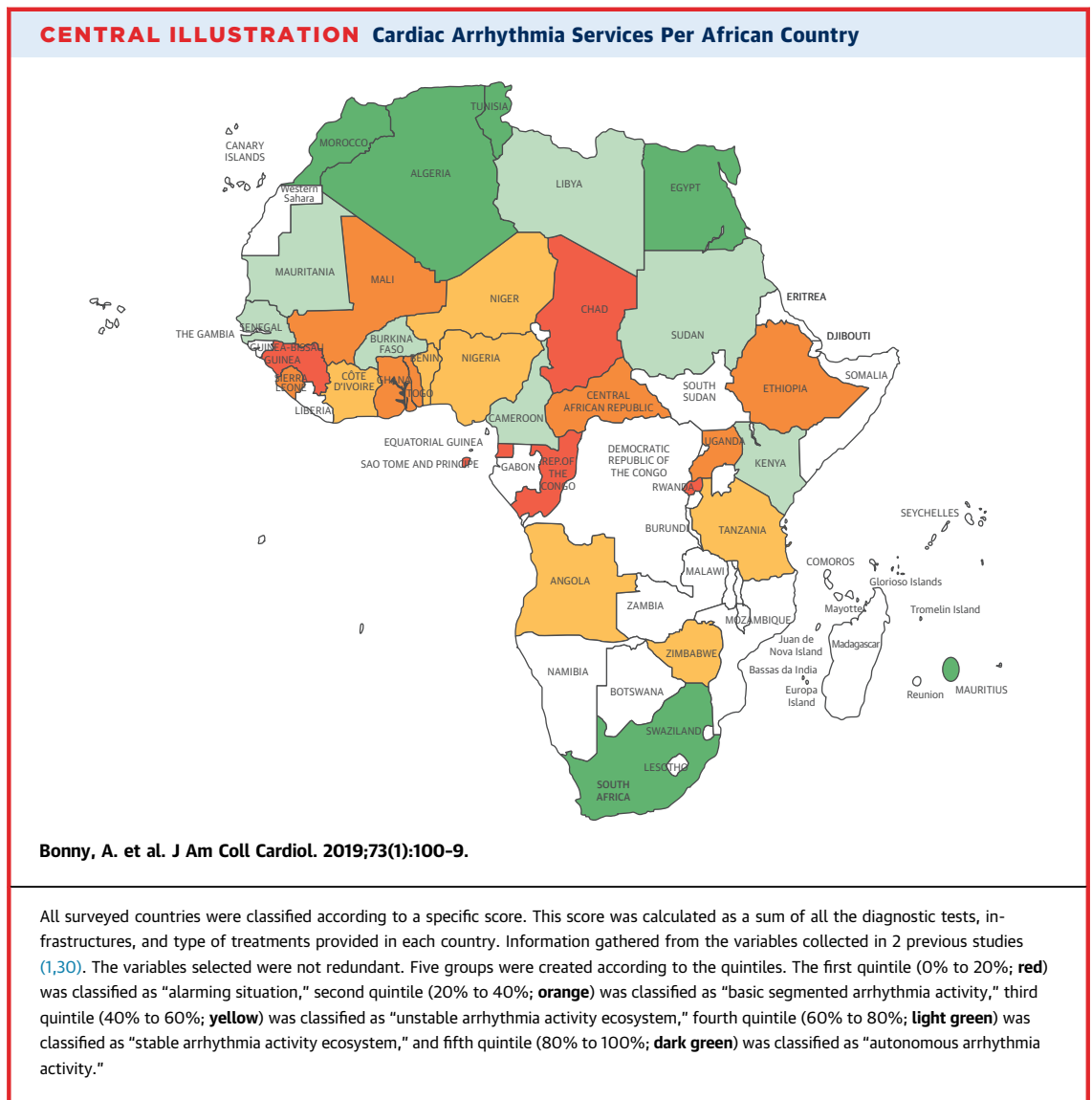
Accurate diagnosis and treatment of cardiac arrhythmias are facilitated by ambulatory rhythm monitoring, noninvasive imaging, pharmacotherapy, and invasive electrophysiological (EP) procedures. To ascertain how patients are managed across the continent, the Pan-African Society of Cardiology (PASCAR) Task Force on SCD conducted 2 online surveys from 2011 to 2017 (1,30). Cardiologists were invited to answer questions regarding the availability of diagnostic tools and treatments in their respective countries. Device manufacturers contributed data as well. Data from 33 of 55 African countries were analyzed and showed considerable heterogeneity of cardiac arrhythmia management across the continent (Central Illustration). A total of 5 countries (15%) did not have a single cardiologist, 10 (30%) had no pacemaker implantation services, and 18 (54.5%) had no electrophysiology laboratory (30). ECG, signal-averaged ECG, echocardiography, ambulatory ECG monitoring, exercise stress testing and head-up tilt-testing, and drugs are largely unavailable outside the major cities.

PHARMACOTHERAPY. As shown in the second PASCAR survey (30), intravenous anti-arrhythmic drugs are available only in a few teaching centers in the more developed countries, i.e., the North Africa region and South Africa. Digoxin is the most commonly used oral agent, mainly for AF rate-control and HF treatment. Rhythm-control strategy is rarely employed, with amiodarone used as the first line anti-arrhythmic medication.

INVASIVE TREATMENTS. Considerable heterogeneity in the access to invasive arrhythmia care was observed across Africa (Table 2). About one-third of African countries do not perform pacemaker implantations, leaving hundreds of millions of people without adequate access to the treatment of bradycardia and especially heart block (30).

In 2014, the median pacemaker implantation rate in Africa was 2.66 per million population per country, which is 200-fold lower than in Europe (1). Extreme variation in medical charges (up to 1,000-fold) was observed across countries with an inverse correlation between implantation rates and the procedural fees standardized to the gross domestic product per capita (1).

The lack of national registries on cardiac implantable electronic devices (CIEDs) makes it difficult to evaluate the impact of ICD implantation on primary prevention of SCD, or the role that cardiac resynchronization therapy (CRT) plays in HF management in Africa. HF is a major cause of hospitalization in Africa. HF mortality rate is high due to inadequate treatment (9-31). Indeed, as reported in



the PASCAR surveys (1,30), the implantation rate of ICDs is extremely low in all countries where this service is available, accounting for 12.8 and 11.7 devices per million population in Tunisia and South Africa, respectively. To the best of our knowledge, there are no published data on the indications for nonischemic ICD implantations in Africa, even though Cabral et al. (19) reported the first ICD placement in Central Africa in a hypertrophic cardiomyopathy patient in 2016. However, in the Eurosurvey CRT 2, data from Algeria corroborates the trend reported in the first PASCAR survey (1) showing that CRT-P were more frequently implanted than CRT-D.

As shown in Figure 2, EP studies including complex catheter ablations are rarely available in Africa except

in South Africa and the North African countries (1). Cryoablation was available in a few countries (i.e., Algeria, Egypt, Morocco, Namibia, South Africa, and Tunisia).

REASONS BEHIND INADEQUATE STATE OF CARDIAC ARRHYTHMIA MANAGEMENT

SOCIOECONOMIC CONDITIONS. Comprehensive management of cardiac arrhythmias in African countries is limited by the following challenges:

1. *Lack of political will by many governments of the region to establish and support hospitals, train the workforce, and purchase and maintain equipment necessary to provide comprehensive EP services*

TABLE 2 Availability of Diagnostic Tools, Medications, and Invasive Treatment Across Africa

		North Africa			West Africa			East Africa			Central Africa			South Africa			
		n	Surv.	Avail.	n	Surv.	Avail.	n	Surv.	Avail.	n	Surv.	Avail.	n	Surv.	Avail.	
Diagnostic tools	CT scan	6	3 (50.0)	3 (100)	16	12 (75.0)	2 (16.7)	11	5 (45.5)	2 (40.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	2 (28.6)	
	CMR	6	3 (50.0)	3 (100)	16	12 (75.0)	3 (25.0)	11	5 (45.5)	1 (20.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	2 (28.6)	
	Nuclear imaging	6	3 (50.0)	3 (100)	16	12 (75.0)	3 (25.0)	11	5 (45.5)	2 (40.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	2 (28.6)	
	Electrophysiology studies	6	3 (50.0)	2 (66.7)	16	12 (75.0)	1 (8.3)	11	5 (45.5)	1 (20.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	1 (14.3)	
	Drug challenges	6	3 (50.0)	0 (0.0)	16	12 (75.0)	10 (83.3)	11	5 (45.5)	5 (100)	9	7 (77.8)	7 (100)	11	7 (63.6)	5 (71.4)	
SA-ECG	6	3 (50.0)	3 (100)	16	12 (75.0)	0 (0.0)	11	5 (45.5)	0 (0.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	1 (14.3)		
Medications	Antiarrhythmics (IV)	Digoxin	6	3 (50.0)	3 (100)	16	12 (75.0)	12 (100)	11	5 (45.5)	4 (80.0)	9	7 (77.8)	5 (71.4)	11	7 (63.6)	5 (71.4)
		Beta-blockers	6	3 (50.0)	3 (100)	16	12 (75.0)	6 (50.0)	11	5 (45.5)	3 (60.0)	9	7 (77.8)	1 (14.3)	11	7 (63.6)	2 (28.6)
		Amiodarone	6	3 (50.0)	3 (100)	16	12 (75.0)	8 (66.7)	11	5 (45.5)	4 (80.0)	9	7 (77.8)	2 (28.6)	11	7 (63.6)	5 (71.4)
		Atropine	6	3 (50.0)		16	12 (75.0)		11	5 (45.5)		9	7 (77.8)		11	7 (63.6)	
	Anticoagulants	Xylocaine	6	3 (50.0)	2 (66.6)	16	12 (75.0)	4 (25.0)	11	5 (45.5)	1 (20.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	4 (57.1)
		Procainamide	6	3 (50.0)	0 (0.0)	16	12 (75.0)	0 (0.0)	11	5 (45.5)	0 (0.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	1 (14.3)
		Vitamin K antagonist	6	3 (50.0)	3 (100)	16	12 (75.0)	11 (91.7)	11	5 (45.5)	4 (80.0)	9	7 (77.8)	5 (71.4)	11	7 (63.6)	5 (71.4)
		Non-vitamin K oral anticoagulants	6	3 (50.0)	2 (66.7)	16	12 (75.0)	4 (33.3)	11	5 (45.5)	2 (40.0)	9	7 (77.8)	2 (28.6)	11	7 (63.6)	4 (57.1)
Invasive treatment	CIED	Pacemaker	6	3 (50.0)	3 (100)	16	12 (75.0)	9 (75.0)	11	5 (45.5)	3 (60.0)	9	7 (77.8)	2 (28.6)	11	7 (63.6)	5 (71.4)
		CRT	6	3 (50.0)	3 (100)	16	12 (75.0)	3 (25.0)	11	5 (45.5)	2 (40.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	2 (28.6)
		ICD	6	3 (50.0)	3 (100)	16	12 (75.0)	4 (33.3)	11	5 (45.5)	2 (40.0)	9	7 (77.8)	1 (14.3)	11	7 (63.6)	2 (28.6)
	Ablation	Simple	6	3 (50.0)	2 (66.6)	16	12 (75.0)	1 (8.3)	11	5 (45.5)	1 (20.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	1 (14.3)
		Complex	6	3 (50.0)	2 (66.6)	16	12 (75.0)	0 (0.0)	11	5 (45.5)	0 (0.0)	9	7 (77.8)	0 (0.0)	11	7 (63.6)	1 (14.3)

Values are n or n (%).

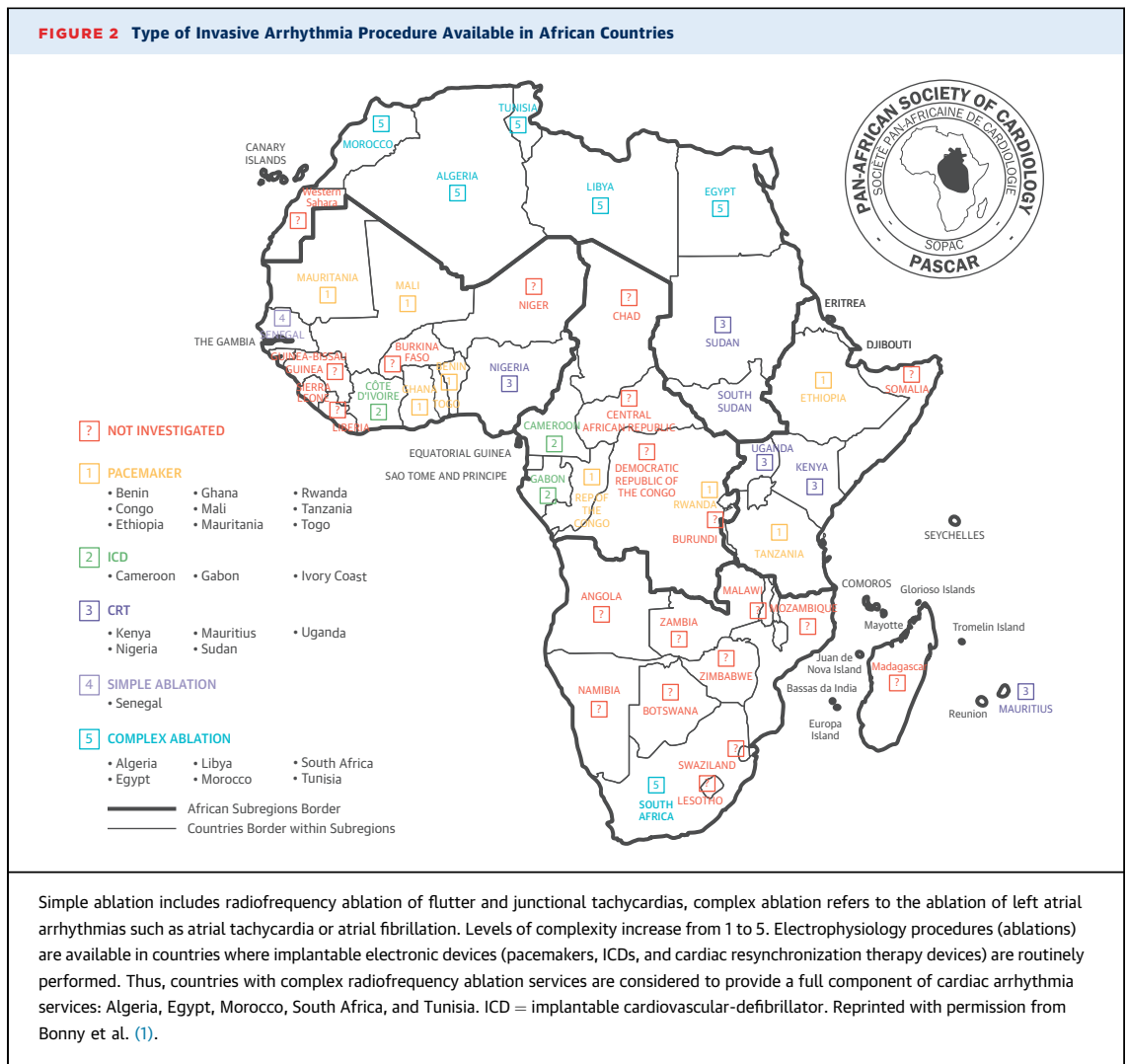
% Surv = number of countries surveyed in the region; % Avail = number of countries within the region where the diagnostic test, medication or interventional treatment is available; CIED = cardiac implantable electronic device; CMR = cardiac magnetic resonance imaging; CRT = cardiac resynchronization therapy; ICD = implantable cardioverter-defibrillator; IV = intravenous; n = number of countries present in the region; SA-ECG = signal-averaged electrocardiogram.

- (1). Inadequate maintenance and frequent interruptions of electricity and other supplies are common in SSA (31).
2. *Lack of national health insurance coverage.* In a region where most households earn less than U.S. \$1/day (3), government-funded comprehensive health insurance programs would be the most optimal means to mitigate the financial impact on the families as a result of hospitalization, EP procedures, and other medical needs. Unfortunately, even in countries with national health insurance, the programs are underfunded and do not ordinarily cover EP services (1). In the INTER-CHF (International Congestive Heart Failure study) study, 5 African countries participated, and comprehensive health insurance was available to only 33% of the patients (24).
3. *The high cost of arrhythmia treatments relative to the overall public health budgets,* which lead to the lack of electrophysiology laboratories capable of managing cardiac arrhythmias (1).
4. *Lack of facilities and a low number of trained practitioners* to detect and manage cardiac arrhythmias is one of the main problems with EP services in Africa. The PASCAR surveys (1,30) highlighted the deficiencies in the human resources and facilities for arrhythmia. The number

of invasive cardiac physicians and technicians per population is quite low. Besides Mauritius and Tunisia, the number of pacemaker implantation centers is ≤ 1 per million population. In one-half of the countries, there were no CRT implants. Tunisia had the highest rate of arrhythmia center density with 0.81 centers per million population. Hence, millions of people live without access to cardiac arrhythmia treatment.

5. *Low level of clinical research and international collaboration* (32).
6. *Inefficient communication.* In the INTER-CHF study, 33% of African patients were illiterate. This may affect communication between patients and health practitioners challenging patient education and compliance (24) in case oral communication is broken.
7. *The widespread belief by many Africans in witchcraft as the cause of sudden death,* which leads to low rates of screening of first-degree relatives and underdiagnosis of conditions associated with preventable causes of death.

POOR ACCESS TO ANTIARRHYTHMIC DRUGS AND ANTICOAGULANTS. In the urban Cameroon study (8), rate control was the principal strategy for treatment of AF, chosen in 84% of patients, most of which



were treated with digitalis; the remaining 16% were treated by a rhythm-control approach with amiodarone or sotalol. Oral anticoagulants were prescribed in only 34% of eligible patients, despite high CHADS₂ scores and a high rate of rheumatic heart disease. This scenario is common on the continent. Several barriers limit appropriate management of AF in Africa: 1) *unavailability* of most antiarrhythmic drugs on the African market; 2) the relatively *high cost* of vitamin K antagonist follow-up using the international normalized ratio; 3) physician ambivalence toward prescribing vitamin K antagonist secondary to the perception of poor reliability of international normalized ratio results produced by the local laboratories; and 4) the high cost of non-vitamin K oral anticoagulants, and their lack of availability in many SSA countries (30,33). Educating general practitioners (who are the ones that manage cardiac arrhythmias in

poor-resource areas) and even cardiologists to become more familiar with antiarrhythmic drugs, anticoagulants, and rate-controlling agents other than digitalis should be a priority. The availability and appropriate use of external electrical cardioversion or defibrillation are suboptimal (Table 2).

INADEQUATE RESPONSE TO CARDIAC ARREST.

Out-of-hospital cardiac arrest is the most common presentation of sudden cardiac arrest according to the Douala SCD-study (20) and a Tunisian study (28), and it occurs mainly in the presence of a witness. However, cardiopulmonary resuscitation is rarely attempted, leading to the high rate of potentially preventable deaths (20,34). Reasons for the low cardiopulmonary resuscitation rate include: 1) a lack of basic knowledge about cardiopulmonary resuscitation in the general population; 2) a lack of

appreciation for the urgency of the situation; 3) a lack of external defibrillators in public places; 4) a lack of minimal resuscitation equipment and emergency drugs (e.g., parenteral antiarrhythmic drugs, atropine, and adrenaline) in ambulances; and 5) difficulties in reaching emergency medical service operators, partly because of an absence of toll-free emergency telephone services along with poor identification of the victim's physical address owing to lack of uniformly agreed upon administrative city plans. We call for the standardization of cardiopulmonary resuscitation training for medical staff and the general public in schools and government offices to address the growing incidence of sudden cardiac arrest.

NEEDS ASSESSMENT AND OPPORTUNITIES

BASELINE CARDIAC WORKUP. There is an enormous need to improve the availability of basic diagnostic tools (*electrocardiograms, ambulatory heart monitors, and echocardiograms*), as well as for training general physicians and nurses to recognize common cardiac arrhythmias such as AF and to manage their complications. The use of vitamin K antagonist (and international normalized ratio monitoring), non-vitamin K oral anticoagulants, beta-blockers, angiotensin-converting enzyme inhibitors, and angiotensin receptor blocker agents should be standardized and promoted through educational symposia (35).

CONNECTED CARDIOLOGY. The African cardiac community should work with other cardiac societies to develop an internet-based network to connect cardiologists and general practitioners in Africa and to also connect with experts outside the continent. A system of electronically accessible electrocardiography (e-ECG) might help to detect actionable arrhythmias. PASCAR should also develop and recommend simple strategies and algorithms for the management of common arrhythmias, taking into consideration the peculiarities of the African health-care system (2-4,33).

PEDIATRIC CARDIOLOGY. There is increasing realization that the lack of facilities for sustainable pediatric cardiac arrhythmia services in the developing world results in significant and potentially treatable morbidity and preventable deaths (36). Particularly in SSA, the high burden of rheumatic heart disease- and endomyocardial fibrosis-related AF and unexplained premature infant deaths threaten to worsen the life-expectancy rate of this young African population. While pediatric patients with congenital heart disease undergo surgery in few countries of all subregions of the Continent, to the best of our knowledge, pediatric

cardiac arrhythmia invasive procedures are available only in Algeria, Egypt, and South Africa. Children with repaired congenital heart disease-related arrhythmias do not have any access to specialized treatments elsewhere on the continent.

FELLOWSHIP INITIATIVES. PASCAR initiated a fellowship training program in cardiac pacing to provide the required expertise in SSA. The long-term objective of this program is to train a team for every country without a pacing service by 2030. Since the program was launched in 2015, 2 cardiologists from Sierra Leone and Kenya along with their nurses have been trained through a 6-month fellowship in Cardiac Pacing in Cape Town, South Africa. However, the program faces funding challenges. To attract funds and build additional capacity, PASCAR engaged in collaboration with the Heart Rhythm Society ([Online Appendix](#)) and CIED manufacturers.

Establishment of the Pan-African arrhythmia and pacing fellowship, endorsed by PASCAR and select African university medical centers, would provide physicians in Africa the opportunity to train locally at a lower cost. Further collaborations with the Asia-Pacific Heart Rhythm Society and European Heart Rhythm Association should also be encouraged. Collaborations with these professional groups should include donations of medical equipment as replacements along with appropriately recycled implantable devices (37).

USE OF RECONDITIONED CIEDs. CIEDs are one of the most cost-intensive treatments in the arrhythmia management armamentarium. CIED reuse has been proposed as a means of addressing the large disparity in access to this therapy. PASCAR has created a task force for pacemaker and ICD reuse. Along with the U.K.-based charity Pace 4 Life and the University of Michigan program My Heart Your Heart, PASCAR has worked to bring reconditioned CIEDs for patients in Africa. All reconditioned devices will be entered into a registry, and clinical outcomes will be reported periodically.

UNIVERSAL HEALTH CARE. Comprehensive universal health coverage and the development of health insurance policies should include coverage for arrhythmia care and SCD. Public-private partnership can be explored especially in bridging the existing gaps regarding facilities. Governments could develop policies to provide subsidies to make CIEDs available to patients who are at high risk of sudden death.

MEDICAL EVACUATIONS. A glaring example of misappropriation of resources and inequity in health care is medical evacuations. A concept unfamiliar to health professionals in high-income countries, many

African governments approve medical evacuations (i.e., transfers to tertiary health facilities abroad) for a small privileged segment of the society. This unseemly practice benefits the wealthy and government elites, is highly cost-ineffective, and misappropriates limited local resources that cannot be used for maximum benefit of very ill patients. As a health policy, such arbitrary allocation is unethical.

STUDY LIMITATIONS

The epidemiology of arrhythmia and its treatment has been understudied in Africa. There is lack of registries and cross-sectional and cohort studies. The published data available is of limited value, owing to its observational, single-center, or case report character. There is a great need for pan-African registries on cardiac rhythm disturbance management.

CONCLUSIONS

Public health strategies in many African countries do not adequately address the growing burden of cardiac arrhythmias. Millions of patients are left without access to treatments considered standard in high-income countries. The areas of focus should be: 1) increased health care financing and research for Africa-specific needs; 2) observational studies and

registries to ascertain the disease patterns specific to the continent; 3) training of nurses, general practitioners, and cardiologists; and 4) collaboration among PASCAR cardiologists and other cardiology and heart rhythm societies. Progress toward universal health coverage would further improve access to care and ensure equitable health improvement in the population.

ACKNOWLEDGMENTS The PASCAR Task Force on Cardiac Arrhythmias and Pacing is grateful to all contributors who participated in the data collection of PASCAR surveys that informed this review; appreciates Drs. Mahmoud Sani and Mohammed A. Talle for their input; and especially acknowledge the late Professor Bongani Mayosi, immediate past-President of PASCAR and Dean of the Faculty of Medicine of the University of Cape Town, who passed away unexpectedly on July 27, 2018. Prof. Mayosi actively participated in the conception and execution of both task force surveys, which provided the inspiration for this paper. He mentored the creation of the PASCAR Sudden Cardiac Death Task Force in 2011.

ADDRESS FOR CORRESPONDENCE: Dr. Aimé Bonny, Hôpital de District de Bonassama, Douala and University of Douala, Douala, Cameroon. E-mail: aimebonny@yahoo.fr. Twitter: @UPTuks, @UCT_news.

REFERENCES

- Bonny A, Ngantcha M, Jeilan M, et al. Statistics on the use of cardiac electronic devices and interventional electrophysiological procedures in Africa from 2011 to 2016: report of the Pan African Society of Cardiology (PASCAR) Cardiac Arrhythmias and Pacing Task Forces. *EP Europace* 2018; 20:1513-26.
- Agyepong IA, Sewankambo N, Binagwaho A, et al. The path to longer and healthier lives for all Africans by 2030: The Lancet Commission on the Future of Health in Sub-Saharan Africa. *Lancet* 2018;390:2803-59.
- The World Bank. Universal Health Coverage (UHC) in Africa: A Framework for Action: Main Report (English). Report No.: 108008. Available at: <http://documents.worldbank.org/curated/en/735071472096342073/Main-report>. Accessed January 14, 2018.
- Mensah GA, Roth GA, Sampson UKA, et al. Mortality from cardiovascular diseases in sub-Saharan Africa, 1990-2013: a systematic analysis of data from the Global Burden of Disease Study 2013. *Cardiovasc J Afr* 2015;26:56-10.
- Chugh SS, Havmoeller R, Narayanan K, et al. Worldwide epidemiology of atrial fibrillation: a Global Burden of Disease 2010 Study. *Circulation* 2014;129:837-47.
- Barretto AC, Mady C, Nussbacher A, Ianni BM, Oliveira SA, Jatene A, Ramires JA. Atrial fibrillation in endomyocardial fibrosis is a marker of worse prognosis. *Int J Cardiol* 1998;67:19-25.
- Zühlke L, Engel ME, Karthikeyan G, et al. Characteristics, complications, and gaps in evidence-based interventions in rheumatic heart disease: The Global Rheumatic Heart Disease Registry (the REMEDY study). *Eur Heart J* 2015; 36:1115-22a.
- Sliva K, Wilkinson D, Hansen C, et al. Spectrum of heart disease and risk factors in a black urban population in South Africa (the Heart of Soweto Study): a cohort study. *Lancet Lond Engl* 2008; 371:915-22.
- Ntep-Gweth M, Zimmermann M, Meitz A, et al. Atrial fibrillation in Africa: clinical characteristics, prognosis, and adherence to guidelines in Cameroon. *Europace* 2010;12:482-7.
- Damasceno A, Mayosi BM, Sani M, et al. The causes, treatment, and outcome of acute heart failure in 1006 Africans from 9 countries. *Arch Intern Med* 2012;172:1386-94.
- Makubi A, Hage C, Lwakatere J, et al. Contemporary aetiology, clinical characteristics and prognosis of adults with heart failure observed in a tertiary hospital in Tanzania: the prospective Tanzania Heart Failure (TaHeF) study. *Heart Br Card Soc* 2014;100:1235-41.
- Oldgren J, Healey JS, Ezekowitz M, et al. Variations in cause and management of atrial fibrillation in a prospective registry of 15,400 emergency department patients in 46 countries: the RE-LY Atrial Fibrillation Registry. *Circulation* 2014;129:1568-76.
- Munclinger MJ, Patel JJ, Mitha AS. Follow-up of patients with arrhythmogenic right ventricular cardiomyopathy dysplasia. *South Afr Med J* 2000; 90:61-8.
- Watkins DA, Hendricks N, Shaboodien G, et al. Clinical features, survival experience, and profile of plakophilin-2 gene mutations in participants of the arrhythmogenic right ventricular cardiomyopathy registry of South Africa. *Heart Rhythm* 2009; 6:510-7.
- Haj NS, Mesrati MA, Hadhri R, et al. Arrhythmogenic right ventricular dysplasia and sudden death: an autopsy and histological study. *Ann Cardiol Angeiol (Paris)* 2015;64:249-54.
- Levin JSE, Harrisberg J, Govandrageloo K, et al. Idiopathic long Q-T syndrome in a black infant. *Cardiovasc J Afr* 1992;3(3):144-6.
- Ouali S, Boughzela E, Haggui A, et al. Clinical and electrophysiological profile of Brugada syndrome in the Tunisian population. *Pacing Clin Electrophysiol* 2011;34:47-53.
- Bonny A, Tonet J, Fontaine G, et al. Brugada syndrome in pure black Africans. *J Cardiovasc Electrophysiol* 2008;19:421-6.

19. Cabral TTJ, Budzee A, Butera G. The first cardioverter defibrillator implanted in Central Africa. Editorial. *Pan Afr Med J* 2016;23.
20. Bonny A, Tibazarwa K, Mbouh S, et al. Epidemiology of sudden cardiac death in Cameroon: the first population-based cohort survey in sub-Saharan Africa. *Int J Epidemiol* 2017;46:1230-8.
21. Hua W, Zhang L-F, Wu Y-F, et al. Incidence of sudden cardiac death in China: analysis of 4 regional populations. *J Am Coll Cardiol* 2009;54:1110-8.
22. Margey R, Roy A, Tobin S, et al. Sudden cardiac death in 14- to 35-year olds in Ireland from 2005 to 2007: a retrospective registry. *Europace* 2011;13:1411-8.
23. Allouche M, Boudriga N, Ahmed HB, et al. Sudden death during sport activity in Tunisia: autopsy study in 32 cases. *Ann Cardiol Angeiol* 2013;62:82-8.
24. Dokainish H, Teo K, Zhu J, et al. Heart failure in Africa, Asia, the Middle East and South America: the INTER-CHF study. *Int J Cardiol* 2016;204:133-41.
25. Talle MA, Anjorin CO, Buba F, et al. Spectrum of cardiovascular diseases diagnosed using transthoracic echocardiography: perspectives from a tertiary hospital in North-Eastern Nigeria. *Nig J Cardiol* 2016;13:39-45.
26. Shavadia J, Yonga G, Otieno H. A prospective review of acute coronary syndromes in an urban hospital in sub-Saharan Africa. *Cardiovasc J Afr* 2012;23:318-21.
27. Sani MU, Adamu B, Mijinyawa MS, et al. Ischaemic heart disease in Aminu Kano Teaching Hospital, Kano, Nigeria: a 5 year review. *Niger J Med* 2006;15:128-31.
28. Mesrati MA, Belhadj M, Aissaoui A, et al. La mort subite cardiovasculaire de l'adulte: étude autopsique de 361 cas. *Ann Cardiol Angéiologie* 2017;66:7-14.
29. Hidron A, Vogenthaler N, Santos-Preciado JI, Rodriguez-Morales AJ, Franco-Paredes C, Rassi A. Cardiac Involvement with Parasitic Infections. *Clin Microbiol Rev* 2010;23:324-49.
30. Talle MA, Bonny A, Scholtz W, et al. Status of cardiac arrhythmia services in Africa in 2018: a PASCAR Sudden Cardiac Death Task Force report. *Cardiovasc J Afr* 2018;29:115-21.
31. Chawla S, Kurani S, Wren SM, et al. Electricity and generator availability in LMIC hospitals: improving access to safe surgery. *J Surg Res* 2018;223:136-41.
32. Ettarh R. Patterns of international collaboration in cardiovascular research in sub-Saharan Africa. *Cardiovasc J Afr* 2016;27:194-200.
33. Carlson S, Duber HC, Achan J, et al. Capacity for diagnosis and treatment of heart failure in sub-Saharan Africa. *Heart Br Card Soc* 2017;103:1874-9.
34. Tobi KU, Amadasun FE. Cardio-pulmonary resuscitation in the intensive care unit: An experience from a tertiary hospital in Sub-Saharan Africa. *Niger Med J* 2015;56:132.
35. Arnar DO, Raatikainen MJP. Promoting cardiac arrhythmia care in Africa: a big challenge that begins with data. *EP Europace* 2018;20:1397-8.
36. Yacoub MH. Establishing pediatric cardiovascular services in the developing world: a wake-up call. *Circulation* 2007;116:1876-8.
37. Sani MU, Mayosi BM. The Pacemaker and ICD Reuse Programme of the Pan-African Society of Cardiology. *Heart* 2017;103:1844-5.

KEY WORDS Africa, cardiac arrhythmias, cardiovascular diseases, epidemiology, management

APPENDIX For the Heart Rhythm Society meeting minutes, please see the online version of this paper.