PREPARTICIPATION SCREENING

Dimosthenis Avramidis, MD.
Consultant Mitera Children’s Hospital Athens Greece
S. Associate 1st Cardiology Dpt Evangelismos Hospital Athens Greece
Conflict of interest

* NONE
DEFINITION

Organized and sanctioned competitive sports participation, such as most commonly found in middle school, high school, and college and not with purely recreational physical activities.
In many European countries, screening of athletes is largely limited to those performing at the elite level (e.g., in international, Olympic, or professional sports).
Universal Screening: ECGs Versus History and Physical Examination

- 14-point history and physical examination elements proposed by the
- American Heart Association (AHA)
AHA’s 14-point screening guidelines

<table>
<thead>
<tr>
<th>Medical history*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal history</strong></td>
</tr>
<tr>
<td>1. Chest pain/discomfort/tightness/pressure related to exertion</td>
</tr>
<tr>
<td>2. Unexplained syncope/near-syncope†</td>
</tr>
<tr>
<td>3. Excessive and unexplained dyspnea/fatigue or palpitations, associated with exercise</td>
</tr>
<tr>
<td>4. Prior recognition of a heart murmur</td>
</tr>
<tr>
<td>5. Elevated systemic blood pressure</td>
</tr>
<tr>
<td>6. Prior restriction from participation in sports</td>
</tr>
<tr>
<td>7. Prior testing for the heart, ordered by a physician</td>
</tr>
<tr>
<td><strong>Family history</strong></td>
</tr>
<tr>
<td>8. Premature death (sudden and unexpected, or otherwise) before 50 y of age attributable to heart disease in ≥1 relative</td>
</tr>
<tr>
<td>9. Disability from heart disease in close relative &lt;50 y of age</td>
</tr>
<tr>
<td>10. Hypertrophic or dilated cardiomyopathy, long-QT syndrome, or other ion channelopathies, Marfan syndrome, or clinically significant arrhythmias; specific knowledge of genetic cardiac conditions in family members</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Heart murmur†</td>
</tr>
<tr>
<td>12. Femoral pulses to exclude aortic coarctation</td>
</tr>
<tr>
<td>13. Physical stigmata of Marfan syndrome</td>
</tr>
<tr>
<td>14. Brachial artery blood pressure (sitting position)§</td>
</tr>
</tbody>
</table>
ΦΥΛΛΟ ΙΑΤΡΙΚΗΣ ΕΞΕΤΑΣΗΣ ΓΙΑ ΤΟ ΑΤΟΜΙΚΟ ΔΕΔΟΜΕΝΟ ΥΓΕIAS ΜΑΘΗΣ
(Φυλάσσεται στο αρχείο του ιατρού ή της Μονάδας Υγείας)

ΙΑΤΡΙΚΗ ΕΞΕΤΑΣΗ

1. Έχει ή έχει ποτέ κάποιο συμπτώματα;
2. Έχει νευτήκει περί την κατάρα (με διαλύμανση);
3. Έχει κάποια περιοδική γίνος;
4. Πίνει ή έχει ποτέ κάποιο φαρμακευτικό προϊόν;
5. Έχει κάποιο ολοένα, φυτικά, φυτικά,
6. Έχει διανύσει ποτέ προβλήματα κατά νησί;
7. Έχει σπάει ποτό να μάθει την οστεοσκληρώσεως;
8. Έχει ποτέ παρασκευάσει για πύρινα, ανάλεγα, διάτρητα ή έναλτα.
9. Κοιμάται με ακρίβεια κατά την απογείωση;
10. Έχει παρατηθεί ποτό ή έχει αναγειρθεί από άλλους;
11. Έχει την ποσότητα της συνεχής;
12. Όσα έχει πάνε, μπορεί να αποκτήσει ή χρησιμοποιήσει;
13. Πώς έχει κάνει κάθε άλλη άλλη συνημμένη ιχνών;
14. Πώς έχει την πάροδο;
15. Πώς έχει την παραγωγή;
16. Πώς έχει την παραγωγή;
17. Πώς έχει την παραγωγή;
18. Πώς έχει την παραγωγή;
19. Πώς έχει την παραγωγή;
20. Πώς έχει την παραγωγή;
21. Πώς έχει την παραγωγή;
22. Πώς έχει την παραγωγή;
23. Πώς έχει την παραγωγή;
24. Πώς έχει την παραγωγή;
25. Πώς έχει την παραγωγή;

Σωματικο-ψυχικές περιπτώσεις για ορμή σε Ν.Α.Γ.

Βεβαιώσεις, σύμφωνα με άσε γνωρίζει για την ακρίβεια των παραπάνω

ΦΥΣΙΚΗ ΕΞΕΤΑΣΗ

1. Άρρενα ή πάνα;
2. Μήκος περιοδικού;
3. Πόσες εργασίες;
4. Ανάθεση καρδιο-νευρο-αναλύτικης;
5. Ανάλυση καταστού;
6. Κοιμική τετελεσμένη;
7. Νευρικά και μυϊκή ολοένα, αναλύτικη;
8. Αλλές εργασίες

ΓΡΙΒΑΔΑ ΣΤΟΧΕΙΑ ΙΑΤΡΙΚΟΥ ΕΔΙΚΙΚΟΥ ΦΥΣΙΚΗ ΕΞΕΤΑΣΗ – ΣΥΜΠΕΡΑΣΜΑΤΑ

Επιστημονικής επιστολής

Από την Υγεία του Παθολογίας, Διεύθυνση Κατανόησης και Αναπτυξιακής Πεδιατρικής, Οικογενικής Υγείας, Ταμείων Υγείας του Πανεπιστημίου Πατρών.
Athletes Screening

Relevance of Sudden Death Incidence to Screening

Indeed, the low frequency with which sudden deaths occur in the competitive athlete population negatively impacts the justification for broad-based screening in large populations of young people, as well as the weight that can be afforded to this issue as a public health problem. In this regard, there is now overwhelming evidence that these events are relatively uncommon, albeit exceedingly tragic in each case. Most data place these cardiovascular sudden deaths in the range of approximately 1 in 80,000 to 1 in 200,000 participants per year, much less common in relative terms than motor vehicle accidents (by 5000-fold), suicide, drugs, homicide, or cancer in the same age group and similar in frequency to that of fatal lightning strikes.\(^{11,25}\) In a college (National Collegiate Athletic Association) athlete population, drugs and suicide combined accounted for a similar number of deaths as confirmed cardiac disease,\(^{24}\) although a non-forensic system identified a higher incidence for sudden death.\(^{27}\)

Collegiate Athletic Association) athletes.\(^{24}\) Notably, false-negative screening results are a major concern, in which the system fails to identify the cardiac diseases for which it is in fact established. Indeed, a substantial proportion of athletes (≈30%-40%) may die suddenly of cardiovascular abnormalities that would not necessarily be reliably detected by screening even with ECGs.\(^{11,24,25}\)
Αθήνα, Σεπτέμβριος 2017

ΟΙ ΘΕΣΕΙΣ ΤΗΣ ΕΚΕ ΓΙΑ ΤΟΝ ΚΑΡΔΙΟΛΟΓΙΚΟ ΕΛΕΓΧΟ ΣΥΜΜΕΤΟΧΗΣ ΣΕ ΑΝΤΑΓΩΝΙΣΤΙΚΑ ΚΑΙ ΜΗ ΑΝΤΑΓΩΝΙΣΤΙΚΑ ΑΘΛΗΜΑΤΑ

“Ποιες είναι οι απαραίτητες εξετάσεις για τον πρωταγωνιστικό έλεγχο παιδιών, νέων και αθλουμένων;”.
Sudden Cardiac Death in Athletes

Introduction

- Athletes are seen as one of the **healthiest segments** of our society.
- Sudden cardiac death (SCD) in a young athlete is always **shocking** and profoundly **impacts** the schools and communities where it occurs.
- It has been suggested that the **prevalence** of these events is **not as high** as it may seem, given the considerable **media attention** that often accompanies SCD in a young person.

*Harmon et al SCD Incidence in the NCAA. Circulation. 2011;123:1594-1600*
Sudden Cardiac Death in Athletes

Introduction
# Sudden Cardiac Death in Athletes

## Introduction

<table>
<thead>
<tr>
<th>Impact expected</th>
<th>Junior High School</th>
<th>High School/College</th>
</tr>
</thead>
<tbody>
<tr>
<td>American football</td>
<td>Ice hockey</td>
<td>American football</td>
</tr>
<tr>
<td>Ice hockey</td>
<td>Lacrosse</td>
<td>Ice hockey</td>
</tr>
<tr>
<td>Wrestling</td>
<td>Basketball</td>
<td>Wrestling</td>
</tr>
<tr>
<td>Karate/judo</td>
<td>Fencing</td>
<td>Karate/judo</td>
</tr>
<tr>
<td>Fencing</td>
<td>Boxing</td>
<td>Fencing</td>
</tr>
<tr>
<td>Boxing</td>
<td></td>
<td>Boxing</td>
</tr>
</tbody>
</table>

| Impact may occur | | |
|-----------------|-----------------|
| Soccer | Field hockey |
| Basketball | Equestrian |
| Field hockey | Cycling |
| Downhill skiing | Baseball/softball |
| Equestrian | Gymnastics |
| Squash | Figure skating |
| Cycling | |

| Impact not expected | | |
|---------------------|-----------------|
| Baseball/softball | Cricket |
| Cricket | Golf |
| Golf | Riflery |
| Riflery | Volleyball |
| Gymnastics | Swimming |
| Volleyball | Track and field |
| Swimming | Tennis |
| Track and field | Cross-country skiing |
| Tennis | Rowing |
| Figure skating | Sailing |
| Cross-country skiing | Archery |
| Rowing | Weightlifting |
| Sailing | Badminton |

1. The risk of bleeding with athletes receiving vitamin K antagonists or direct thrombin or factor Xa inhibitors is increased in sports in which impacts may occur, and athletes should be cautioned to avoid these sports (*Class IIb; Level of Evidence C*).  
2. Athletes taking vitamin K antagonists or direct thrombin or factor Xa inhibitors should not participate in sports with impact expected, because the risk of intracranial hemorrhage is increased (*Class III; Level of Evidence C*).
During the 5-year period, there were 273 deaths and a total of 1,969,663 athlete participant-years.

Harmon et al. SCD Incidence in the NCAA. Circulation. 2011;123:1594-1600
SCD is the most common cause of death of athletes during competition and training.

The incidence has been quoted as:
- 1:11,394 in basketball players,
- 1:21,293 for swimmers and
- 1:41,695 for cross-county athletes

Wide variation between male and female athletes
## Incidence of Sudden Cardiac Death - SCD

<table>
<thead>
<tr>
<th></th>
<th>No. of Athlete-Years</th>
<th>No. of Deaths</th>
<th>Death Rate (per Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCAA athletes</td>
<td>1 969 663</td>
<td>45</td>
<td>1:43 770</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1 126 557</td>
<td>34</td>
<td>1:33 134</td>
</tr>
<tr>
<td>Female</td>
<td>843 106</td>
<td>11</td>
<td>1:76 646</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>300 835</td>
<td>17</td>
<td>1:17 696</td>
</tr>
<tr>
<td>White</td>
<td>1 583 635</td>
<td>27</td>
<td>1:58 653</td>
</tr>
<tr>
<td><strong>By division</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Division I</td>
<td>788 023</td>
<td>27</td>
<td>1:29 186</td>
</tr>
<tr>
<td>Division II</td>
<td>424 572</td>
<td>10</td>
<td>1:42 457</td>
</tr>
<tr>
<td>Division III</td>
<td>760 258</td>
<td>8</td>
<td>1:95 032</td>
</tr>
</tbody>
</table>

SCD indicates sudden cardiac death; NCAA, National Collegiate Athletic Association.

Harmon et al SCD Incidence in the NCAA. Circulation. 2011;123:1594-1600
Sudden Deaths in Young Competitive Athletes

Barry J. Maron, MD; Joseph J. Doerer, BS; Tammy S. Haas, RN;
David M. Tierney, MD; Frederick O. Mueller, PhD

Background—Sudden deaths in young competitive athletes are highly visible events with substantial impact on the
physician and lay communities. However, the magnitude of this public health issue has become a source of controversy.

Methods and Results—To estimate the absolute number of sudden deaths in US competitive athletes, we have assembled
a large registry over a 27-year period using systematic identification and tracking strategies. A total of 1866 athletes who
died suddenly (or survived cardiac arrest), 19±6 years of age, were identified throughout the United States from 1980
to 2006 in 38 diverse sports. Reports were less common during 1980 to 1993 (576 [31%]) than during 1994 to 2006
(1290 [69%], P<0.001) and increased at a rate of 6% per year. Sudden deaths were predominantly due to cardiovascular
disease (1049 [56%]), but causes also included blunt trauma that caused structural damage (416 [22%]), commotio
cordis (65 [3%]), and heat stroke (46 [2%]). Among the 1049 cardiovascular deaths, the highest number of events in
a single year was 76 (2005 and 2006), with an average of 66 deaths per year (range 50 to 76) over the last 6 years; 29% occurred in blacks, 54% in high school students, and 82% with physical exertion during competition/training, whereas
only 11% occurred in females (although this increased with time; P=0.023). The most common cardiovascular causes were hypertrophic cardiomyopathy (36%) and congenital coronary artery anomalies (17%).

Conclusions—In this national registry, the absolute number of cardiovascular sudden deaths in young US athletes was
somewhat higher than previous estimates but relatively low nevertheless, with a rate of <100 per year. These data are
relevant to the current debate surrounding preparticipation screening programs with ECGs and also suggest the need for
systematic and mandatory reporting of athlete sudden deaths to a national registry. (Circulation. 2009;119:1085-1092.)

Key Words: cardiomyopathy ■ death, sudden ■ cardiovascular diseases
Causes of Sudden Cardiac Death - SCD

Number of cardiovascular (CV), trauma-related, and other sudden death events in 1866 young competitive athletes, tabulated by year

Causes of Sudden Cardiac Death - SCD

Causes of Sudden Cardiac Death - SCD

Causes of Sudden Cardiac Death - SCD

✓ An estimated 30% of these causes of death cannot be identified reliably by preparticipation screening, even with ECG.

  (eg, congenital coronary anomalies of wrong sinus origin and some cases of hypertrophic cardiomyopathy, aortic dilatation, atherosclerotic coronary artery disease, and dilated cardiomyopathy).

✓ A mandatory national preparticipation screening strategy with routine ECGs has been promoted vigorously by the ESC, International Olympic Committee, and some investigators, although the AHA has been more conservative in its recommendations.
Causes of Sudden Cardiac Death - SCD

under 35 year olds

HCM

over 35 year olds

ARVC

Atherosclerotic CAD accounts for 80% of SCD in over 35 year olds

Spontaneous conversion to LV hypertrophy in this subset appears to occur most often in adolescence between 12 and 20 years of age.
Causes of Sudden Cardiac Death - SCD

Coronary Artery Anomalies

Congenital coronary artery abnormalities have been reported in 12–33% of athletes
The pathogenesis of myocarditis consists of 3 overlapping phases: acute injury, often caused by a virus; the host innate and acquired immunologic response; and finally, recovery or a transition to scar and DCM.

1. Before returning to competitive sports, athletes who initially present with an acute clinical syndrome consistent with myocarditis should undergo a resting echocardiogram, 24-hour Holter monitoring, and an exercise ECG no less than 3 to 6 months after the initial illness (Class I; Level of Evidence C).
2. It is reasonable that athletes resume training and competition if all of the following criteria are met (Class IIa; Level of Evidence C):
   a. Ventricular systolic function has returned to the normal range.
   b. Serum markers of myocardial injury, inflammation, and heart failure have normalized.
   c. Clinically relevant arrhythmias such as frequent or complex repetitive forms of ventricular or supraventricular ectopic activity are absent on Holter monitor and graded exercise ECGs.
3. Athletes with probable or definite myocarditis should not participate in competitive sports while active inflammation is present. This recommendation is independent of age, gender, and LV function (Class III; Level of Evidence C).
* Arrhythmogenic right ventricular cardiomyopathy (ARVC) is a cause of sudden death in young people and athletes, particularly in the northeastern (Veneto) region of Italy
Ventricular arrhythmias associated with long-term endurance sports: what is the evidence?

Hein Heidbuchel,¹ David L Prior,² André La Gerche¹,²

Myocardium

Desmosomal mutations
- ↓ Desmosomal strength
- Normal mechanical stress ± environmental modifiers
- Myocardial damage, fibrous replacement ± fat infiltration
- Potentially severe changes in RV function, structure and arrhythmic potential

Repeated bouts of extreme exercise
- Normal desmosomal strength
- ↑ Mechanical stress ± genetic modifiers
- Accumulation of very small amounts of myocardial damage & fibrosis
- Mild to moderate change in RV function, structure and arrhythmic potential

Healthy athletes hear Balanced hypertrophy
Little or no fibrosis

Ideal training stimulus and recovery Physiological adaptation

Exercise-induced ARVC

Familial ARVC

Exercise-induced ARV

RV structural & functional remodelling
Interstitial fibrosis Arrhythmogenicity

Excessive training stimulus with insufficient recovery Cumulative microscopic injury

Desmosomal Proteins
- Desmoglein
- Plakoglobin
- Desmoplakin
- Intermediate filament
It is reasonable for athletes with Marfan syndrome to participate in low and moderate static/low dynamic competitive sports (classes IA and IIA; see definition of sports classification in Task Force 1 report31) if they do not have ≥1 of the following (Class IIa; Level of Evidence C):

* a. Aortic root dilatation (ie, z score > 2, or aortic diameter >40 mm, or >2 standard deviations from the mean relative to BSA in children or adolescents <15 years old
* b. Moderate to severe mitral regurgitation
* c. Left ventricular systolic dysfunction (ejection fraction <40%)
* d. Family history of aortic dissection at an aortic diameter <50 mm
Causes of Sudden Cardiac Death - SCD

Commotio Cordis

Footballer dies while practising

Howrah: Twenty-seven-year-old footballer Sukanta Nandi died while practising at the Arati Cotton Mill ground in Howrah on Thursday morning.

Fellow-players, who were practicing with him, said Nandi looked in utter discomfort after trapping a high ball with his chest. He was rushed to a nursing home in central Howrah after he collapsed while walking out of the ground. The doctors pronounced him dead on arrival.
Causes of Sudden Cardiac Death - SCD

Commotio Cordis

Fatal commotio cordis in a 14-year-old boy during a karate match.

N Engl J Med 2003;349:11
Causes of Sudden Cardiac Death - SCD

Distribution of Commotio Cordis Events According to Age and Activity

Causes of Sudden Cardiac Death - SCD

Means of Protection from Commotio Cordis

Causes of Sudden Cardiac Death - SCD

Means of Protection from Commotio Cordis
Causes of Sudden Cardiac Death - SCD

Increasing survival from commotio cordis
The Chain of Survival

Early recognition and call for help
- to prevent cardiac arrest
- to buy time

Early CPR
- to restart the heart

Early Defibrillation
- to restore quality of life

Post resuscitation care
Access of the Medical Team

✓ The medical team should gain immediate access to the field of play.

✓ It is important that the field of play officials will recognize or be alerted to the collapsed athlete and halt play so that it is safe to approach the competitor.

✓ Where there is no medical team, during informal competition or in practice, it is the responsibility of the referee, the coach or of the athletes’ colleagues to recognize the collapse and to initiate a call for help and resuscitation.
Resuscitation

✓ If the athlete is unresponsive and not breathing normally, **commence BLS**.

✓ Seizure-like activity, and abnormal breathing or gasping must be accepted as SCA until proven otherwise.

✓ If available **attach an AED** and follow the instructions;

✓ if this is SCD then the rhythm will **probably be ventricular fibrillation** and will respond to defibrillation.
AHA/ACC Scientific Statement

Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Task Force 12: Emergency Action Plans, Resuscitation, Cardiopulmonary Resuscitation, and Automated External Defibrillators

A Scientific Statement From the American Heart Association and American College of Cardiology

Mark S. Link, MD, FACC, Chair; Robert J. Myerburg, MD, FACC; N.A. Mark Estes III, MD, FACC; on behalf of the American Heart Association Electrocardiography and Arrhythmias Committee of the Council on Clinical Cardiology, Council on Cardiovascular Disease in the Young, Council on Cardiovascular and Stroke Nursing, Council on Functional Genomics and Translational Biology, and the American College of Cardiology
Recommendations

1. **Schools and other organizations** hosting athletic events or providing training facilities for organized competitive athletic programs should have an emergency action plan that incorporates basic life support and AED use within a broader plan to activate EMS *(Class I; Level of Evidence B)*.

2. **Coaches and athletic trainers** should be trained to recognize cardiac arrests and to implement timely and AHA guideline–directed CPR (100 to 120 beats per minute and compression depth of 2 inches) along with AED deployment *(Class I; Level of Evidence B)*.

3. **AEDs** should be available to all cardiac arrest victims within 5 minutes, in all settings, including competition, training, and practice *(Class I; Level of Evidence B)*.

4. Advanced post–cardiac arrest care, including targeted temperature management, should be available at sites to which patients are taken by EMS *(Class I; Level of Evidence A)*.
Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Task Force 2: Preparticipation Screening for Cardiovascular Disease in Competitive Athletes

A Scientific Statement From the American Heart Association and American College of Cardiology

Barry J. Maron, MD, FACC, Chair; Benjamin D. Levine, MD, FAHA, FACC; Reginald L. Washington, MD, FAHA; Aaron L. Baggish, MD, FACC; Richard J. Kovacs, MD, FAHA, FACC; Martin S. Maron, MD, FACC; on behalf of the American Heart Association Electrocardiography and Arrhythmias Committee of the Council on Clinical Cardiology, Council on Cardiovascular Disease in the Young, Council on Cardiovascular and Stroke Nursing, Council on Functional Genomics and Translational Biology, and the American College of Cardiology
ESC Report

Cardiovascular pre-participation screening of young competitive athletes for prevention of sudden death: proposal for a common European protocol

Consensus Statement of the Study Group of Sport Cardiology of the Working Group of Cardiac Rehabilitation and Exercise Physiology and the Working Group of Myocardial and Pericardial Diseases of the European Society of Cardiology

Domenico Corrado¹*, Antonio Pelliccia², Hans Halvor Bjørnstad³, Luc Vanhees⁴, Alessandro Biffi², Mats Borjesson⁵, Nicole Panhuyzen-Goedkoop⁶, Asterios Deligiannis⁷, Erik Solberg⁸, Dorian Dugmore⁹, Klaus P. Mellwig¹⁰, Deodato Assanelli¹¹, Pietro Delise¹², Frank van-Buuren¹⁰, Aris Anastasakis¹³, Hein Heidbuchel⁴, Ellen Hoffmann¹⁴, Robert Fagard⁴, Silvia G. Priori¹⁵, Cristina Basso¹⁹, Eloisa Arbustini¹⁶, Carina Blomstrom-Lundqvist¹⁷, William J. McKenna¹⁸, and Gaetano Thiene¹⁹
The proposed screening protocol for young competitive athletes

1. Young competitive athletes
2. Family and personal history, physical examination, 12-lead ECG
   - Negative findings: eligible for competition
   - Positive findings: further examinations (echo, stress test, 24-h Holter, cardiac MRI, angio/EMB, EPS)
     - Diagnosis of cardiovascular disease: management according to established protocols

2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society

Developed in Collaboration With the Heart Failure Society of America

WRITING COMMITTEE MEMBERS
Sana M. Al-Khatib, MD, MHS, FACC, FAHA, FHRS, Chair
William G. Stevenson, MD, FACC, FAHA, FHRS, Vice Chair*
Michael J. Ackerman, MD, PhD*†
William J. Bryant, JD, LLM†
David J. Callans, MD, FACC, FHRS‡
Anne B. Curtis, MD, FACC, FAHA, FHRS‡
Barbara J. Deal, MD, FACC, FAHA†
Timm Dickfeld, MD, PhD, FHRS‡
Michael E. Field, MD, FACC, FAHA, FHRS‡
Gregg C. Fonarow, MD, FACC, FAHA, FHFSA*‡
Anne M. Gillis, MD, FHRS*‡
Mark A. Hlatky, MD, FACC, FAHA†
Christopher B. Granger, MD, FACC, FAHA*†
Stephen C. Hammill, MD, FACC, FHRS‡
José A. Joglar, MD, FACC, FAHA, FHRS†
G. Neal Kay, MD†
Daniel D. Matlock, MD, MPH†
Robert J. Myerburg, MD, FACC†
Richard L. Page, MD, FACC, FAHA, FHRS‡

ACC/AHA TASK FORCE MEMBERS
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Patrick T. O’Gara, MD, MACC, FAHA, Chair-Elect
Jonathan L. Halperin, MD, FACC, FAHA, Immediate Past Chair¶
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Kim K. Birtcher, MS, PharmD, AACC
Biykem Bozkurt, MD, PhD, FACC, FAHA¶
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Lesley H. Curtis, PhD, FAHA¶
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Federico Gentile, MD, FACC
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Laura Mauri, MD, MSc, FAHA
Barbara Riegel, PhD, RN, FAHA
Susan J. Pressler, PhD, RN, FAHA¶
Duminda N. Wijeysundera, MD, PhD

*Accredited for the following countries: Luxembourg, Switzerland, and the United Kingdom (UK)
10. VA and SCD Related to Specific Populations

10.1. Athletes

In general, management of arrhythmias in athletes follows that in nonathletes. In regard to interventions, it is now generally recommended that AEDs be available at training and facilities for competitive athletes (16), with less specific statements for AED availability at venues (e.g., tennis courts) or circumstances (e.g., jogging or small group runs) in which recreational athletics are occurring.