MERCYHEALTH

Preventing Sudden Cardiac Death in Young Athletes: A Multi-Strategy Approach

Jason Hageman, MD, ATC

Primary Care Sports Medicine Physician

Medical Director of Sports Medicine at Mercy Health St. Rita's

Objectives

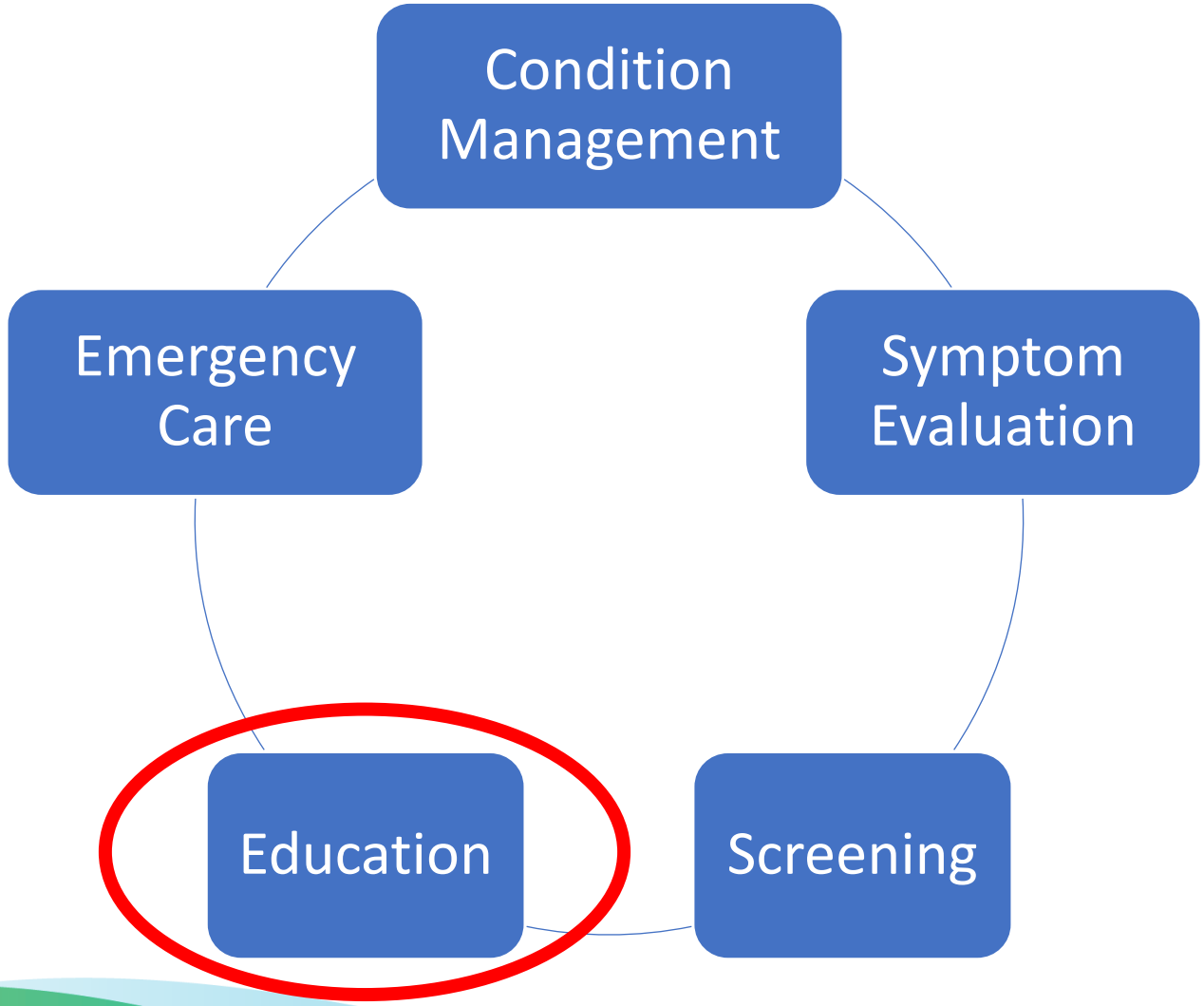
1. Identify higher risk athlete subgroups for having sudden cardiac death.
2. Identify the cardiac conditions that lead to sudden cardiac death in young athletes.
3. Discuss an appropriate diagnostic evaluation for an athlete with symptoms that may be due to a cardiac etiology.

Disclosures

- None

Roles

- Medical Director of Sports Medicine at Mercy Health St. Rita's
- Head Team Physician at Ohio Northern University
- Team Physician at University of Northwestern of Ohio
- Team Physician at Delphos St. John's High School
- Assistant Clinical faculty at Ohio University
- Community clinical faculty for St. Rita's Family Medicine and Podiatry Residencies


Condition Management
Symptom Evaluation
Screening
Education
Emergency Care

How and who do we educate on sudden cardiac arrest?

- Lindsay's Law: Educational requirements for parents, athletes, and coaches regarding sudden cardiac arrest (SCA) and guidelines for recognizing and managing SCA and its signs and symptoms.

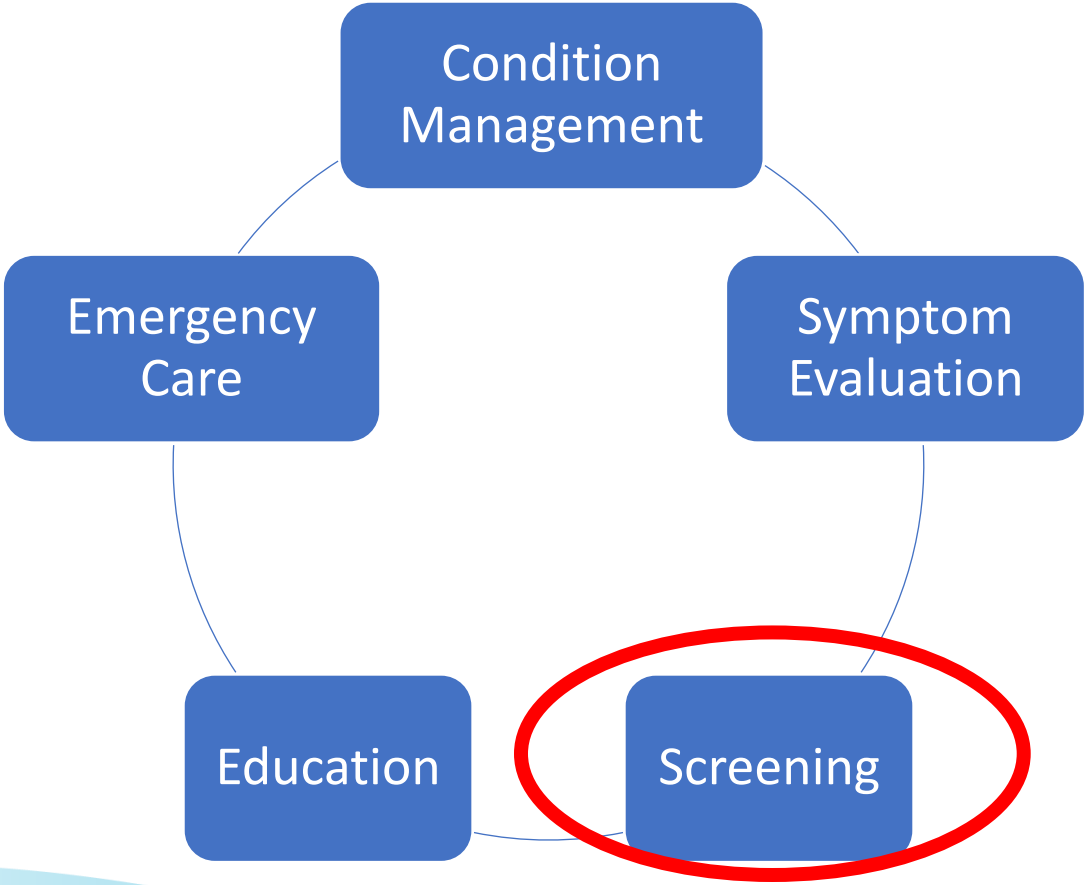
- Ohio Revised Code 3313.5310, 3707.58 and 3707.59.
- Effective August 1, 2017.

Lindsay Davis
DX: HCM
Syncope at Ballet practice

Lindsay's Law

- Youth sports (19 yrs old and younger) and school sports.
- Parent & Athlete: video, SCA handout, and signature form
- Coaches: video, CPR/AED certification (schools)
- Administrator: ensures form completion by parent/athlete, coaches' education, coaches CPR/AED, and OHSAA physical form for athletes.

What is the risk for sudden cardiac arrest in youth athletes?



Incidence

- SCD incidence rate
  - 1:50,000 college athletes
  - 1:50,000-1:80,000 high school athletes
  - Traditional teaching: 1:200,000-300,000 athletes
- Possible higher risk
  - Males
  - African-Americans
  - Basketball athletes

Incidence of SCA/SCD

Table 2 Comparison of incidence studies of SCA in young athletes

Study	Location	Population	Age (y)	Event type	Reporting system and methodology	Incidence (per 100,000)
Marijon et al[4]	France	Competitive athletes during sport	10–35	SCA	Prospective study using an EMS database and media reports	9.8
Corrado et al[15]	Italy (Veneto)	Competitive athletes (1979–1982)	12–35	SCD	Prospective study using a mandatory forensic database	3.8
Steinvil et al[33]	Israel	Athletes	10–44	SCA	Retrospective study using reports from 2 newspapers	2.6
Harmon et al[10]	United States	College student athletes	17–23	SCD	Retrospective study using NCAA database, media reports, and insurance claims	2.3
Corrado et al[2]	Italy (Veneto)	Athletes	12–35	SCD	Prospective study using a mandatory forensic database	2.2
Holst et al[14]	Denmark	Athletes	12–35	SCD	Retrospective study using media reports, hospital and autopsy databases	1.2
Maron et al[9]	United States	Competitive athletes	<40	SCA	Retrospective study using media reports and other electronic databases	0.6
Maron et al[6]	United States (Minnesota)	High school student athletes	13–19	SCD	Retrospective study using catastrophic insurance claims	0.5
Van Camp et al[5]	United States	High school and college athletes	13–24	SCD	Retrospective study of media reports	0.3
Roberts et al[11]	United States (Minnesota)	High school student athletes	12–19	SCD	Retrospective study using catastrophic insurance claims	0.2

Toresdahl et al. *Heart Rhythm* 2014.

Incidence of SCD in Collegiate Athletes

Author	Year Published	Country	Numerator	Denominator	Exertional Deaths of All?	Years studied	Incidence	Age range	Number of Cardiac Deaths
Drezner	2005	U.S.	survey	atheltes at surveyed schools	All		1:67,000		5
Harmon	2011	U.S.	media database internal NCAA list insurance claims	participation data from NCAA	All	2004-2008	1:43,770	18 - 26	37
Maron	2014	U.S.	USRSDA internal NCAA list for (cardiac cases)	participation data from NCAA	All	2002 - 2011	1:62,500	17-26	64
Harmon	2015	U.S.	media database internal NCAA list insurance claims	participation data from NCAA	All	2003 - 2013	1:53,703	17 - 26	79

Which athlete groups are at higher risk of sudden cardiac arrest?

NCAA Incidence
10 Year Data

Group	10 year incidence
Overall	1 in 53,703
Males	1 in 37,790
Females	1 in 121,593
African-American	1 in 21,491
Caucasian	1 in 68,354
Basketball	1 in 15,462
Men's basketball	1 in 8,978

Harmon, Circulation, 2015

NCAA Risk by Sport

Sport	Incidence
Men's basketball	1 in 8,978
Men's soccer	1 in 23,689
Men's Football	1 in 35,951
Men's Swimming	1 in 42,784
Men's Cross-country	1 in 42,857
Men's Lacrosse	1 in 45,850
Women's Cross-country	1 in 47,089
Women's Volleyball	1 in 49,217
Men's Baseball	1 in 50,023
NCAA Athletes	1 in 53,703
Women's Swimming	1 in 57,611
Women's basketball	1 in 77,061
Men's track	1 in 120,521

Harmon 2014

Risk in Collegiate Basketball Athletes

Group	Incidence African American	Incidence Caucasian	Total
Division I Male	1 in 4,380	1 in 5,230	1 in 5,200
Division II Male	1 in 8,241	1 in 18,016	1 in 15,843
Division III Male	1 in 4,906	1 in 46,368	1 in 14,266
Overall	1 in 5,348	1 in 15,994	1 in 8,978

Harmon 2014

Cardiac Arrest in High School Students 2009-2011

Table 1 Incidence of SCA in high school students

Population	Cases of SCA over 2 y	Population (per year)	Annual incidence (per 100,000)	95% confidence interval
Male student athletes	16	462,269	1.73	0.99–2.81
Student athletes	18	788,683	1.14	0.68–1.80
Students	26	2,069,487	0.63	0.41–0.92
Male student nonathletes	4	572,474	0.35	0.10–0.89
Students nonathletes	8	1,280,804	0.31	0.13–0.62
Female student athletes	2	326,414	0.31	0.04–1.11
Female student nonathletes	4	708,330	0.28	0.08–0.72

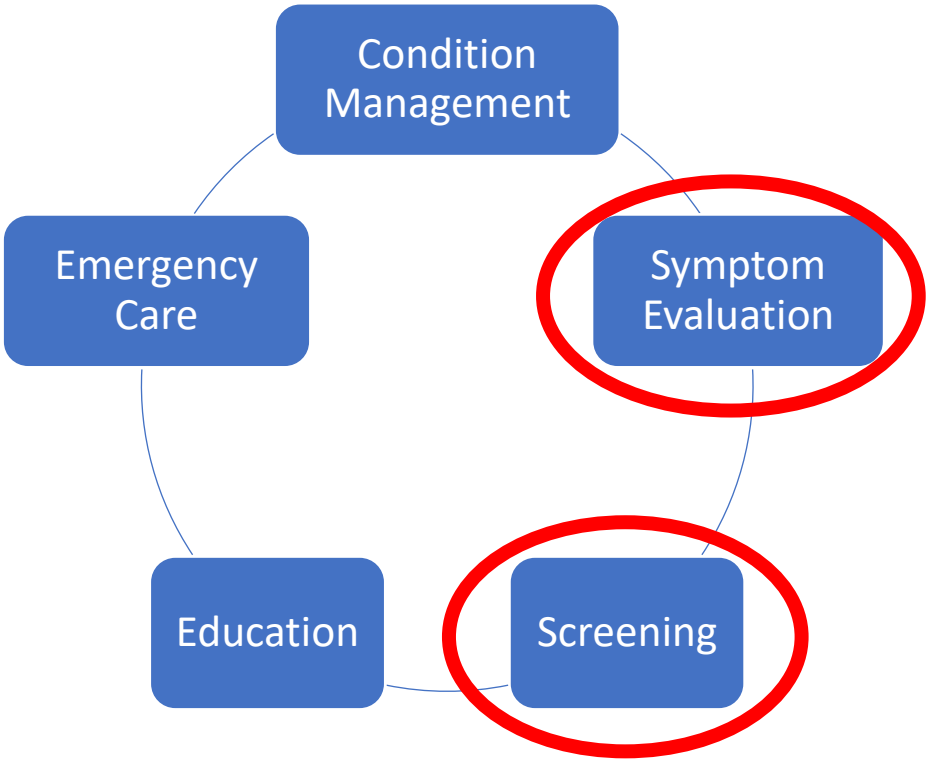
SCA = sudden cardiac arrest.

Toresdahl et al. *Heart Rhythm* 2014.

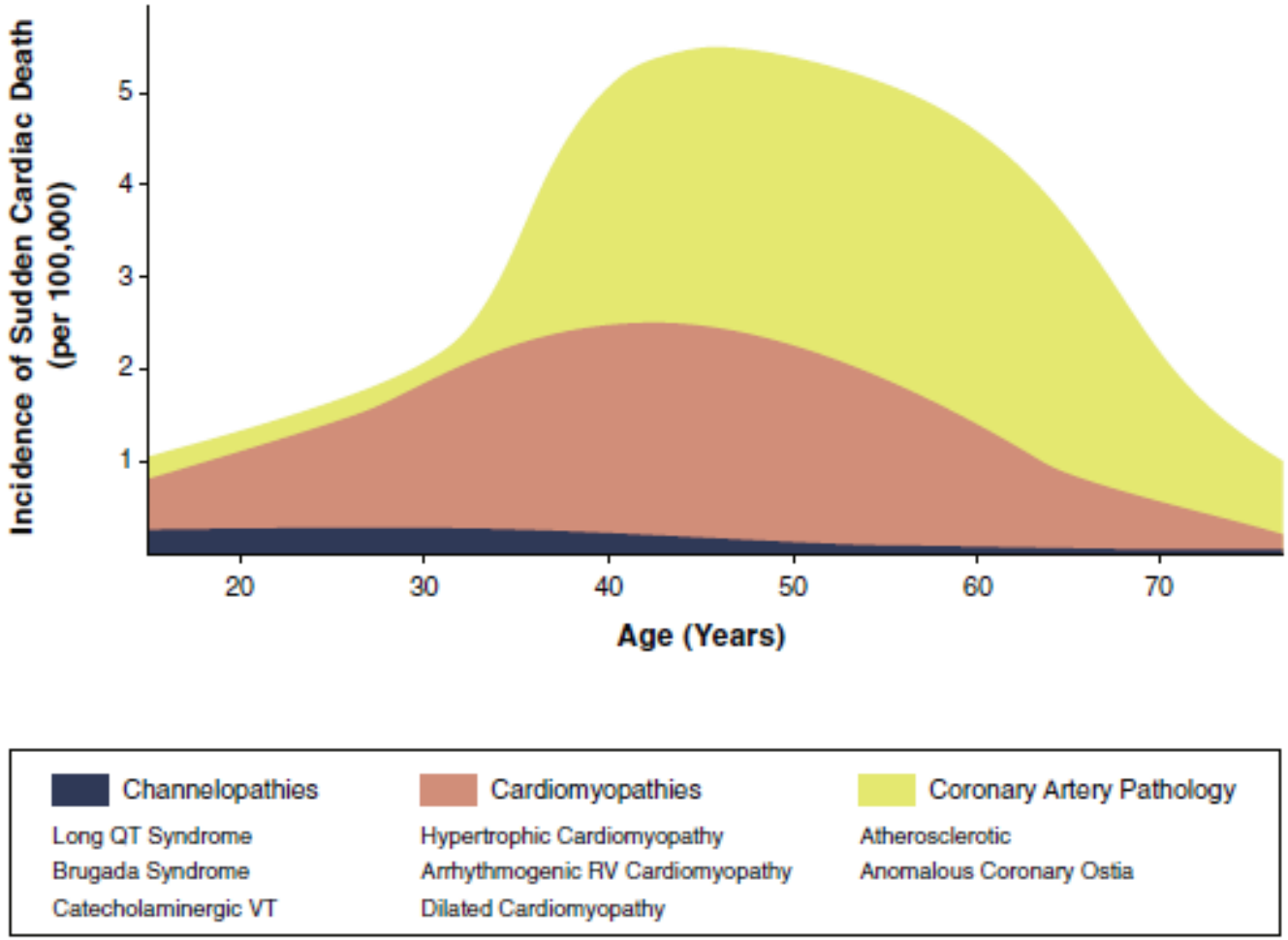
What types of conditions cause SCA in young athletes?

- Structural
- Electrical
- Situational causes (such as a blow to the chest, drug use, or myocarditis).

- Genetics
- Drugs



Age-Dependent Changes in Incidence and Etiology of SCD

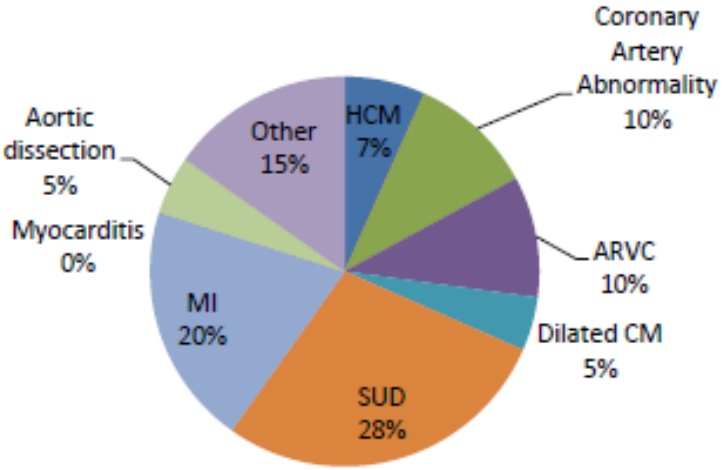


La Gerche, et al. *JACC: Cardiovascular Imaging*. 2013.

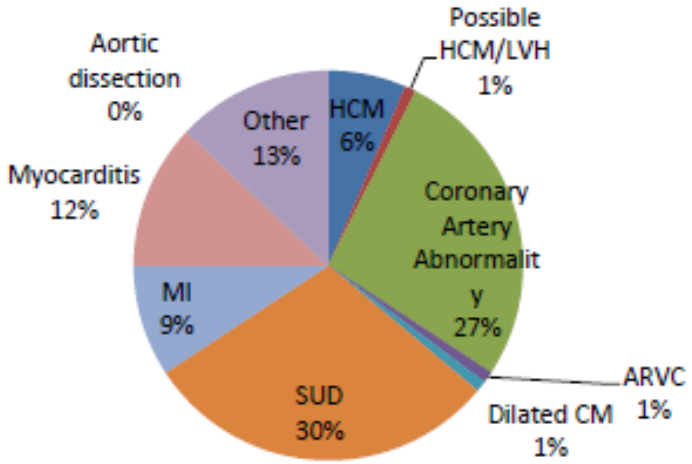
What cardiac conditions increase the risk of sudden cardiac arrest?

- Hypertrophic Cardiomyopathy
- Arrhythmogenic right ventricular cardiomyopathy (ARVD/C)
- Anomalous Coronary Artery
- Long QT Syndrome
- Wolff-Parkinson White Syndrome (WPW)
- Autopsy negative sudden unexplained death (AN-SUD)
- COVID-related??

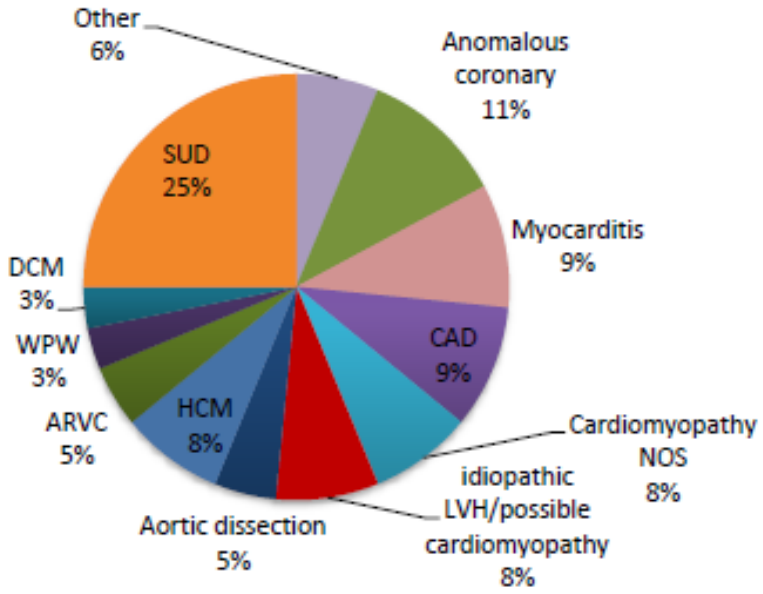
Corrado



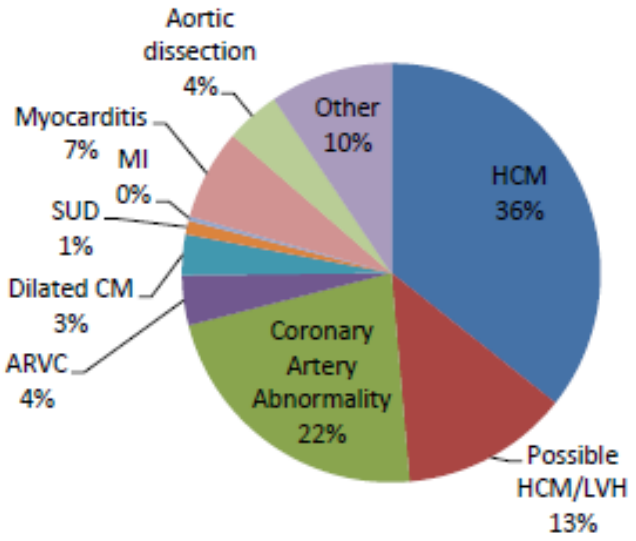
Eckart



NCAA 2003 - 2013



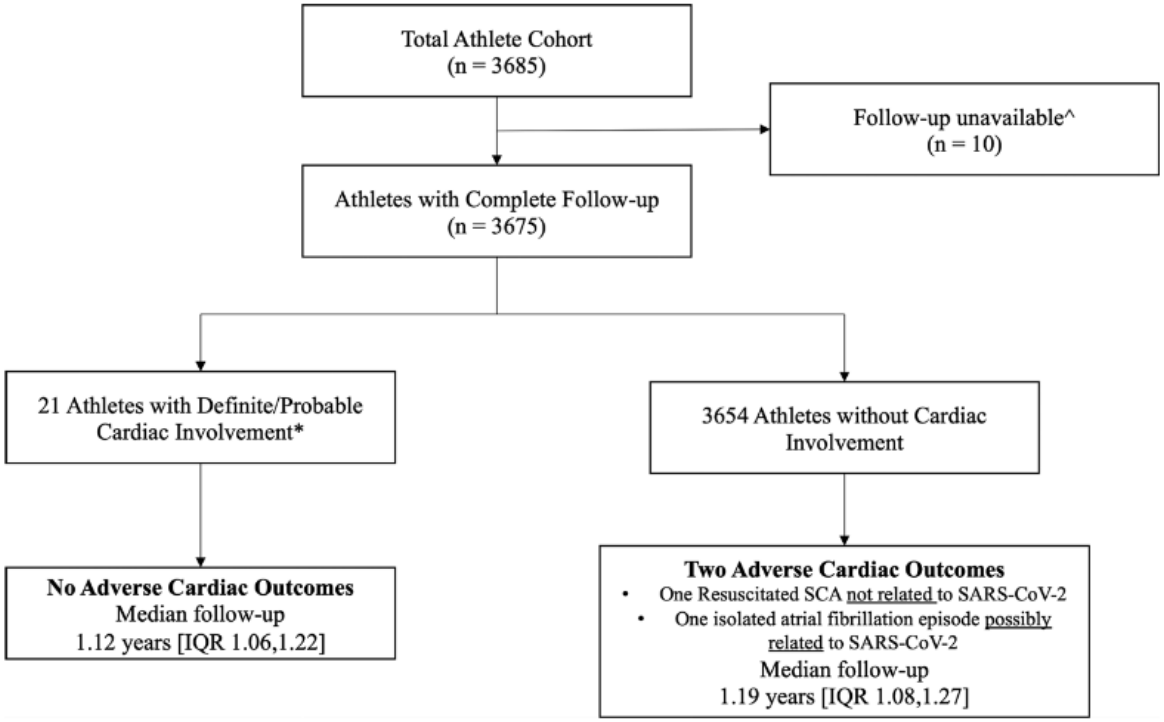
Maron -2003



Cardiovascular Outcomes in Collegiate Athletes After SARS-CoV-2 Infection: 1-Year Follow-Up From the Outcomes Registry for Cardiac Conditions in Athletes

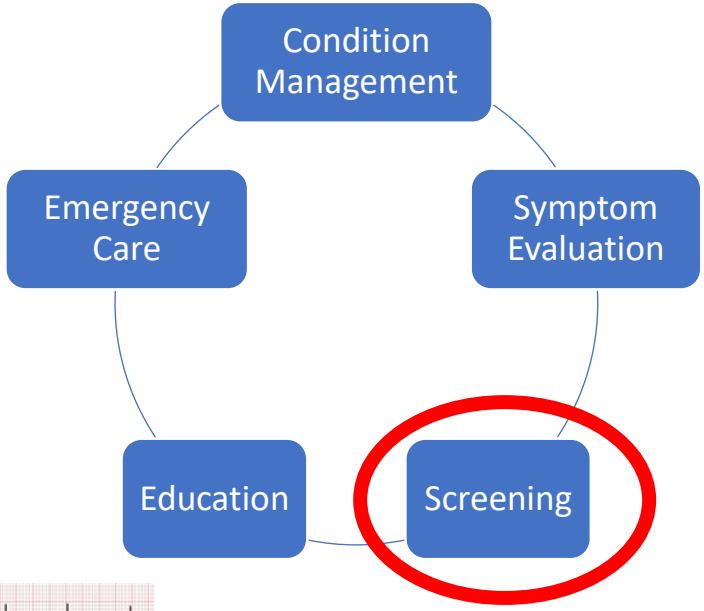
Bradley J. Petek, MD*; Nathaniel Moulson, MD*; Jonathan A. Drezner, MD; Kimberly G. Harmon, MD; Stephanie A. Kliethermes, PhD; Timothy W. Churchill, MD; Manesh R. Patel, MD; Aaron L. Baggish MD; for the ORCCA Investigators†

- "Cardiac events after SARS-CoV-2 infection are low among athletes with a normal workup and those with cardiac imaging abnormalities suggestive of SARS-CoV-2 cardiac involvement who were temporarily restricted from exercise."

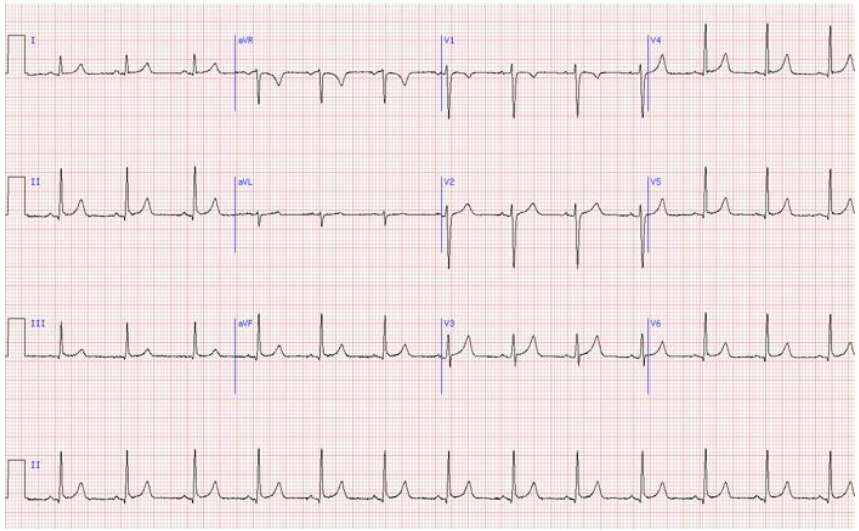


Circulation. XXX;145:00–00. DOI: 10.1161/CIRCULATIONAHA.121.058272

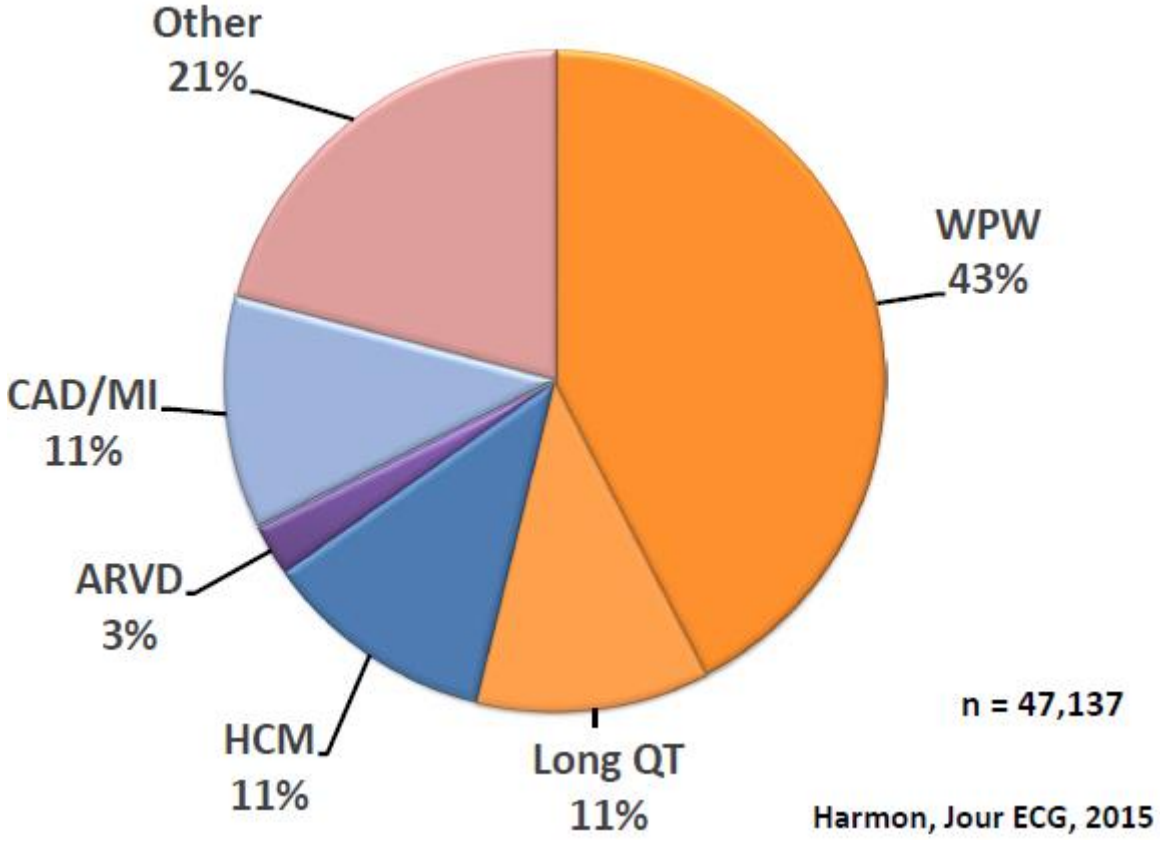
What screening is available for cardiac conditions?



- Nothing
- History and physical exam (14 Element AHA)
- + ECG
- + Echo



What cardiovascular diseases are identified at ECG screenings?

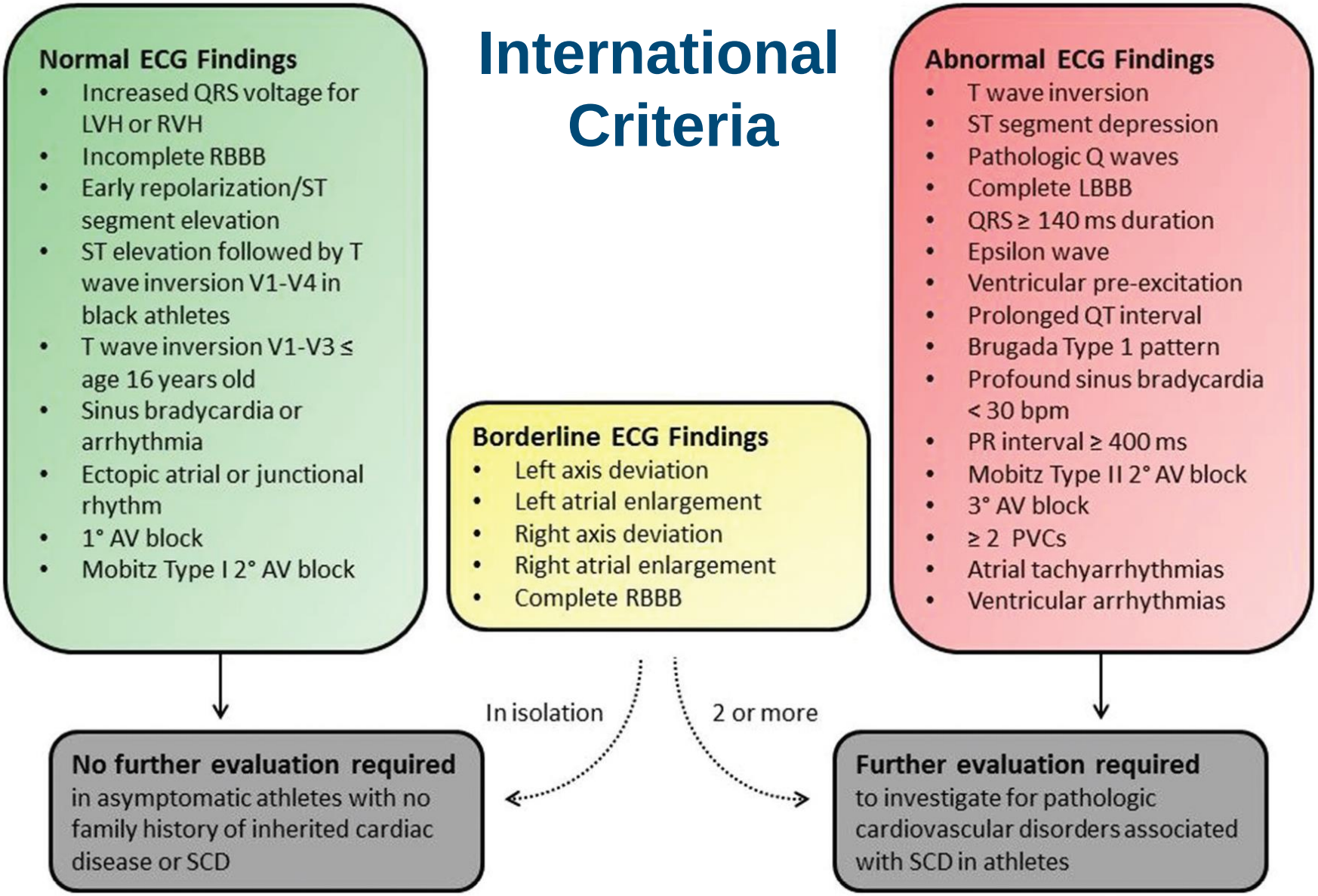


High-Risk Cardiovascular Conditions in Sports-Related Sudden Death

- 5169 school-children had H&P, EKG, and cardiac MRI.
- 76 high risk Cardiovascular conditions (1.47%) were identified.
  - Anomalous coronary: 23 athletes
  - Cardiomyopathy: 14 athletes
  - ECG: Brugada, WPW, QTc >470: 39 athletes

Angelini et al. Texas Heart Institute Journal • August 2018, Vol. 45, No. 4

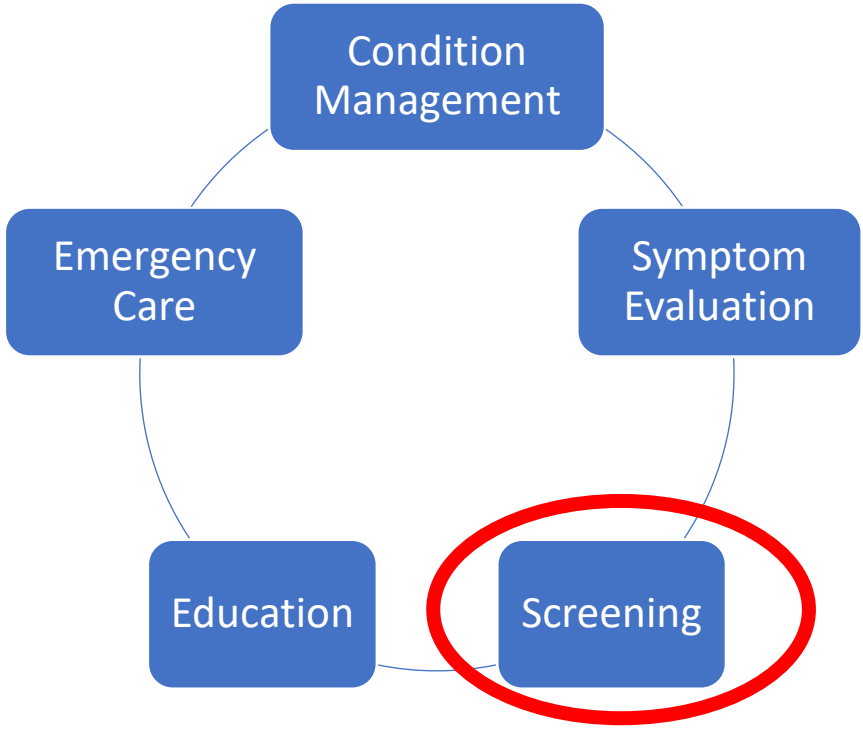
International Criteria



Drezner JA, et al. Br J Sports Med 2017;**1:1–28.**

Is cardiac screening effective in reducing sudden cardiac death in youth?

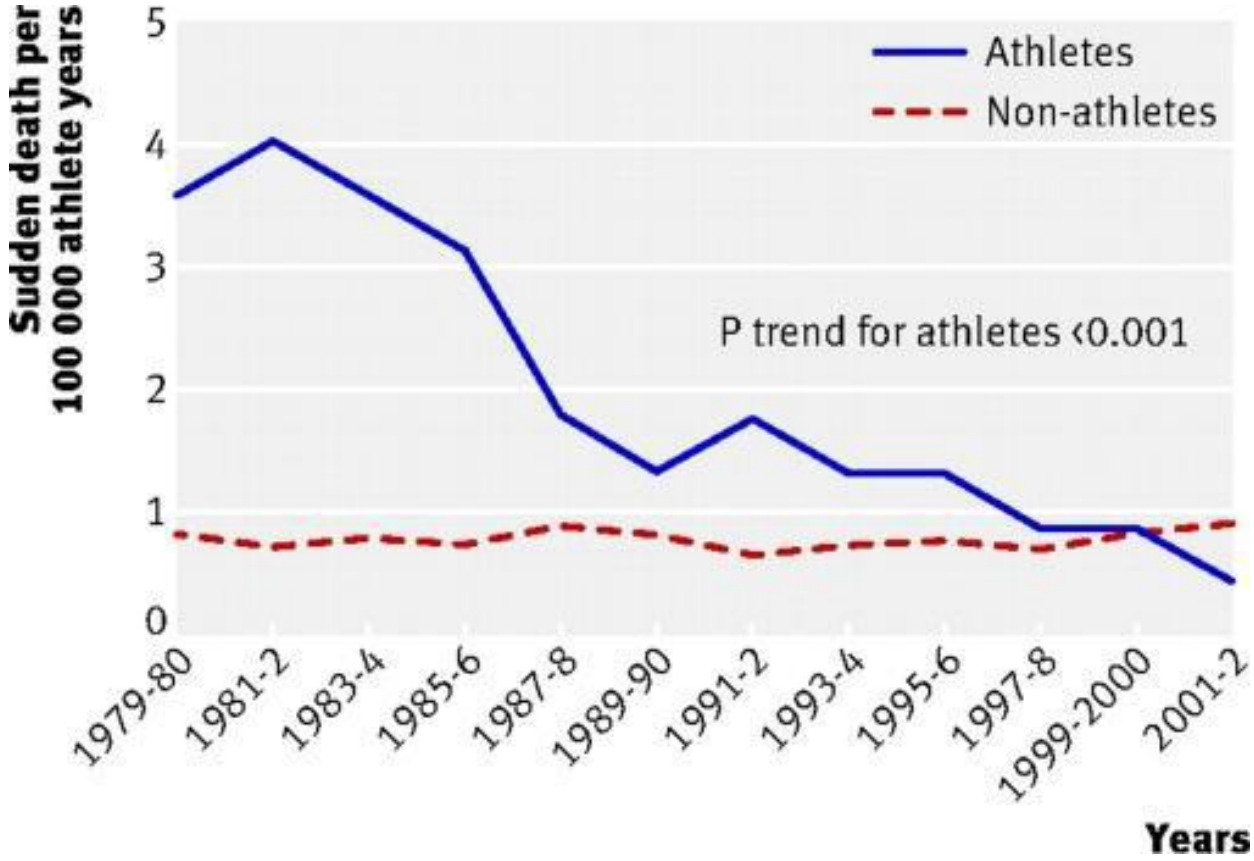
- There is currently no study that demonstrates the effectiveness of the history and physical alone for the prevention of sudden death.



Italy National EKG Screening Program

89% reduction in sudden cardiac death

(arrhythmogenic right-ventricular cardiomyopathy)

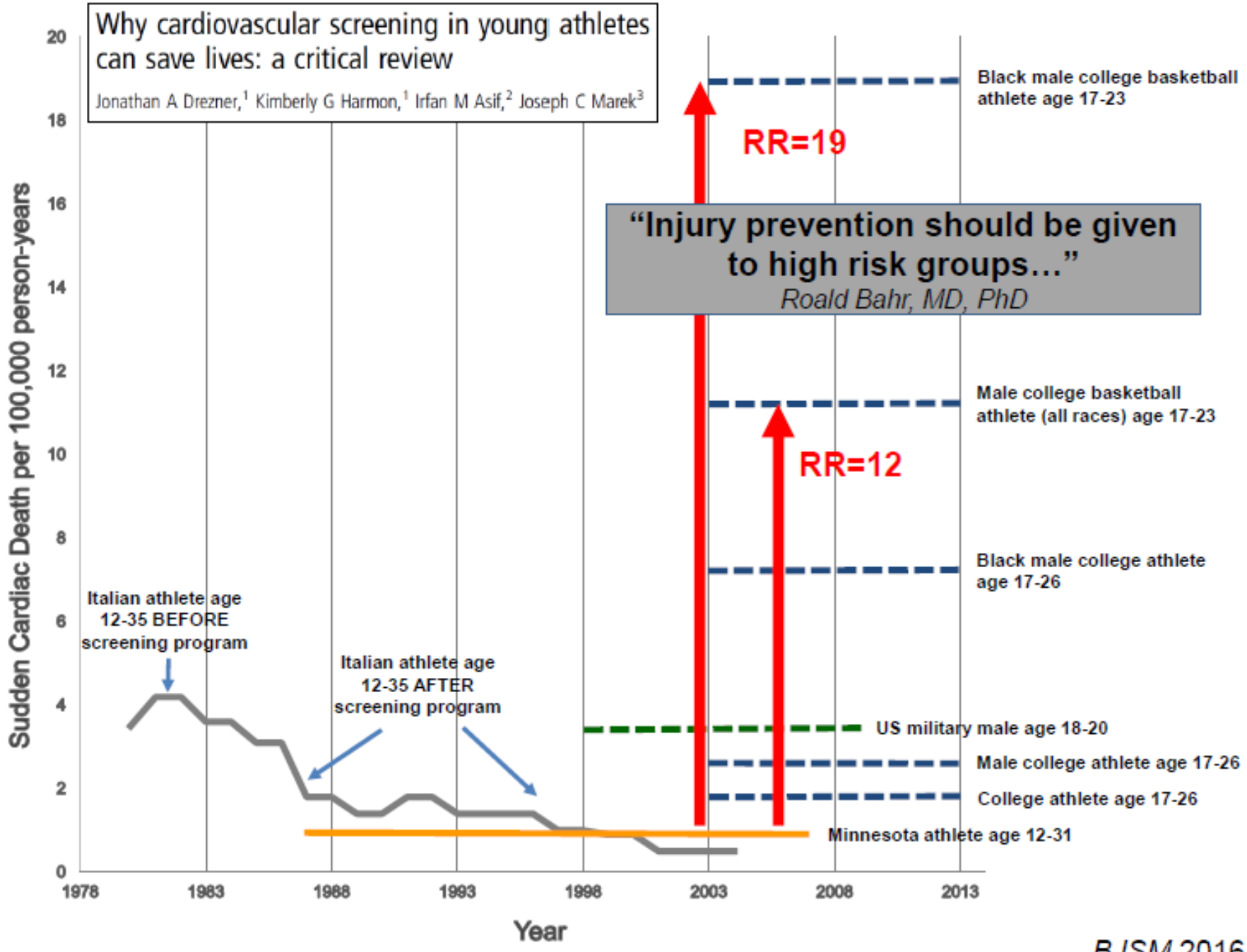


Corrado D, Basso C, Pavei A, Michieli P, Schiavon M, Thiene G. Trends in sudden cardiovascular death in young competitive athletes after implementation of a preparticipation screening program

The effectiveness of screening history, physical exam, and ECG to detect potentially lethal cardiac disorders in athletes: A systematic review/meta-analysis

- 47,000+ athletes in 15 articles
- ECG: sensitivity 94% and specificity 93%
- History: sensitivity 20% and specificity 94%
- PE: sensitivity 9% and specificity 97%
- 160 potentially lethal CV conditions detected for rate of 0.3% or 1 in 294.
- Conclusions: ECG is 5x more sensitive than Hx and 10x more sensitive than PE. ECG should be best criteria.

Journal of **Electrocardiology**. Volume 48, Issue 3, May–June 2015, Pages 329-338. Harmon et al.


Why cardiovascular screening in young athletes can save lives: a critical review
Jonathan A Drezner,[1] Kimberly G Harmon,[1] Irfan M Asif,[2] Joseph C Marek[3]
Sudden Cardiac Death per 100,000 person-years
20
18
16
14
12
10
8
6
4
2
0
1978
1983
1988
1993
1998
2003
2008
2013
Year
Black male college basketball athlete age 17-23
RR=19
"Injury prevention should be given to high risk groups…"
Roald Bahr, MD, PhD
Male college basketball athlete (all races) age 17-23
RR=12
Black male college athlete age 17-26
Italian athlete age 12-35 BEFORE screening program
Italian athlete age 12-35 AFTER screening program
US military male age 18-20
Male college athlete age 17-26
College athlete age 17-26
Minnesota athlete age 12-31
BJSM 2016

What factors need considered in implanting and ECG screening program in athletes?

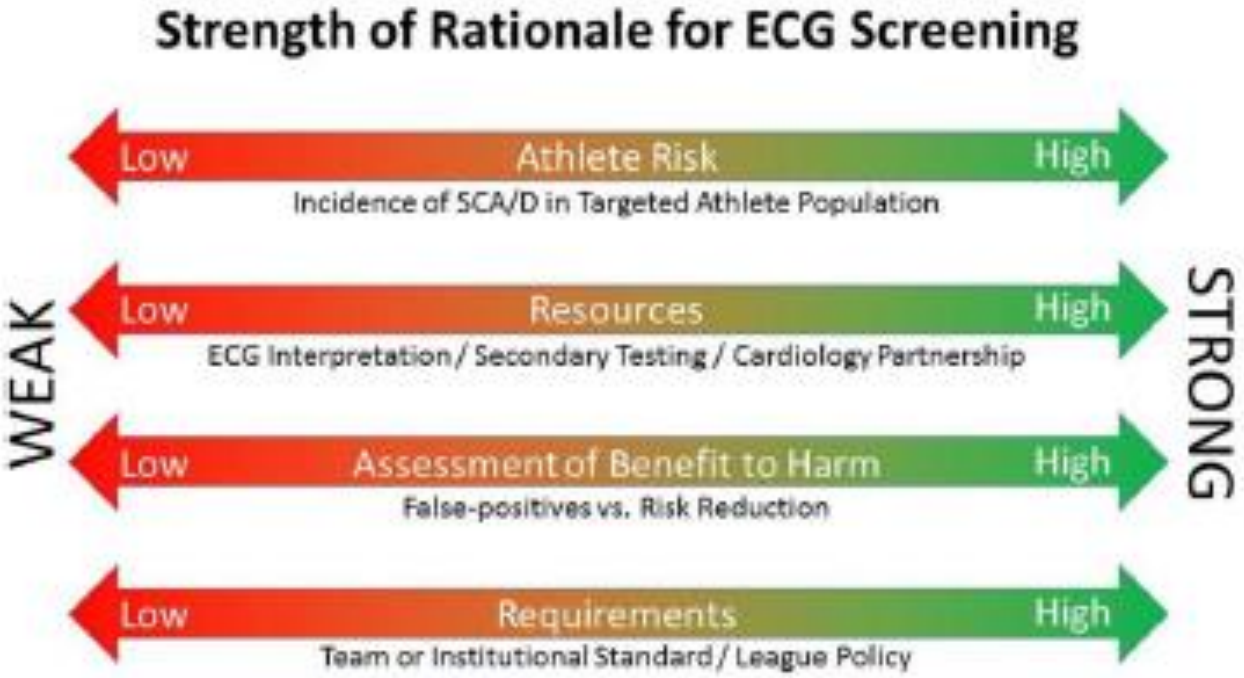
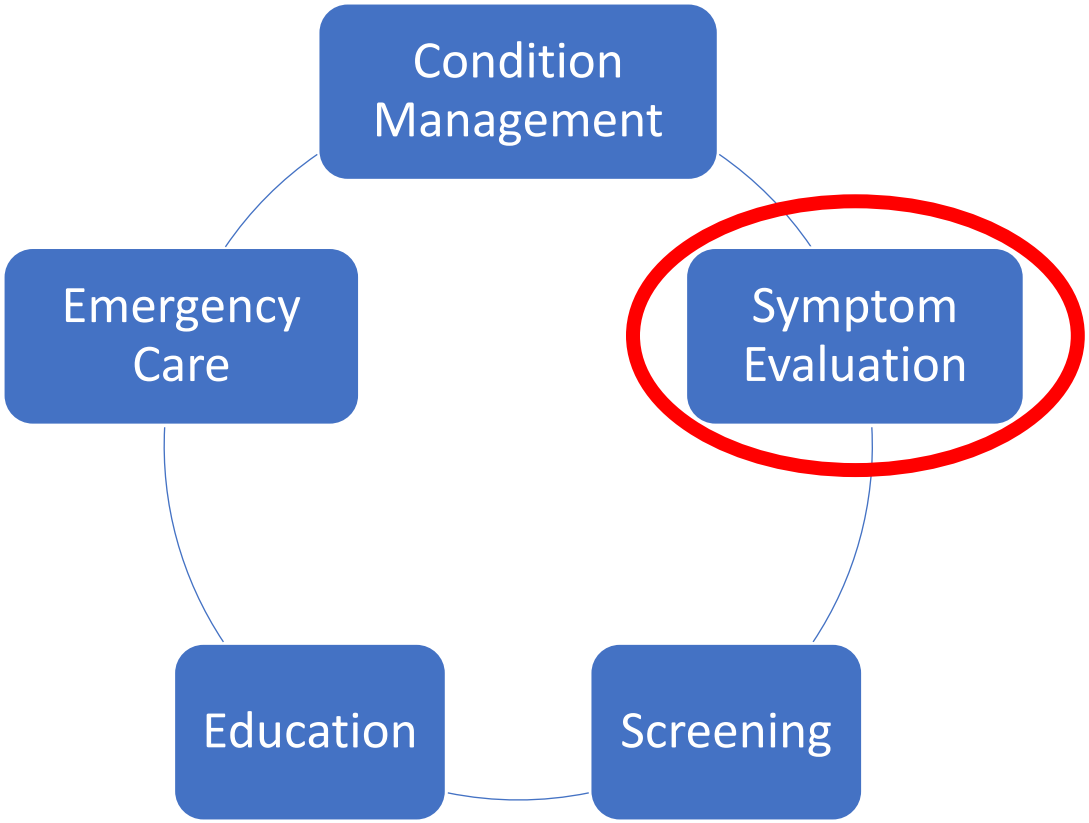


Figure 1 Major considerations and strength of rationale for electrocardiogram screening. SCA/D, sudden cardiac arrest/death.

Drezner et al. AMSSM Position Statement on Cardiovascular Preparticipation Screening in Athletes. *BJSM 2017; 51:153-167.*

What are possible symptoms of a cardiac condition that may lead to cardiac arrest?



Possible CV Symptoms

- Syncope (1% is cardiac etiology in youth)
- Pre-syncope
- Chest pain/discomfort
- Palpitations
- Shortness of breath
- Fatigue
- Unusually fast or racing heart beat

- *The frequency and onset of symptoms prior to SCD are not well-known (less than 20%).*

What cardiac testing may be performed based on a young athlete (age <35) presenting with symptoms?

- Exertional Chest pain
  - ECG
  - Stress Test
  - Echo
  - Optional: Cardiac MRI and angiography

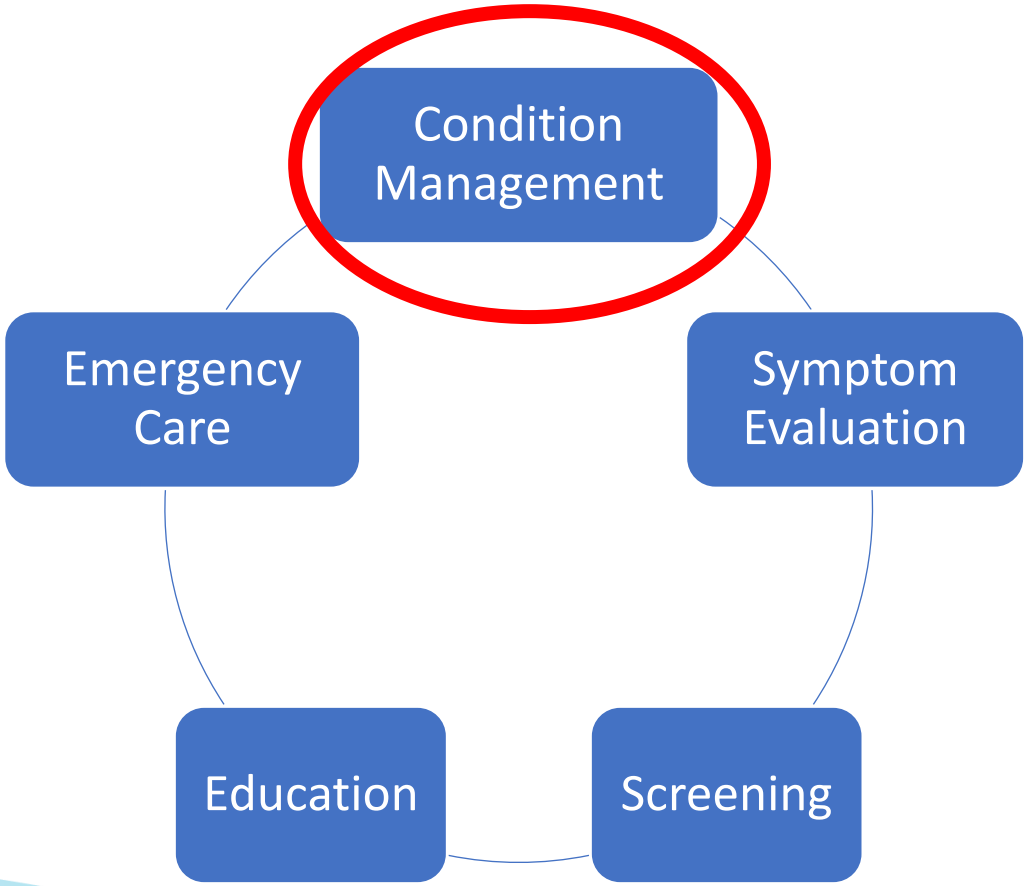
- Syncope
  - ECG
  - Echo
  - Cardiac MRI
  - (exertional is more concerning than post-exertional and at rest)

Incidence and Etiology of Sudden Cardiac Death: New Updates for Athletic Departments

- 60-80% of college athletes who have SCD are asymptomatic prior to their arrest.
  - Can not use symptom based screening.
- EKG: current false positive rate of 2.8%
- Primary barrier: development of infrastructure
  - Physician education on EKG interpretation criteria
  - Referral and secondary testing availability
  - Cost
  - Time

Asif and Harmon. Sports Health May-June 2017; 268-279.

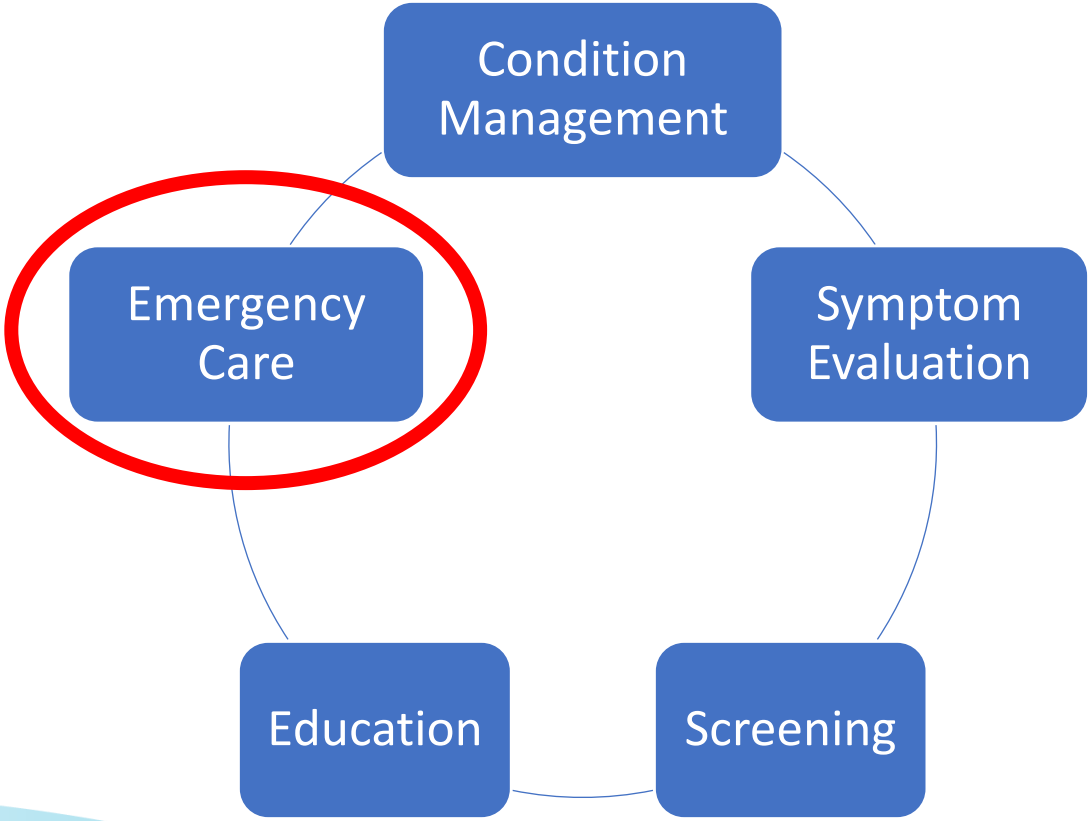
What guidelines are available when determining management of cardiac conditions in young athletes?



Diagnosed Cardiac Condition Management

- Appropriate treatment (medication, procedures, ICD)
- Routine follow-up and testing
- Proper physical activity instruction/modification
  - 36th Bethesda Guidelines
  - 2015 ACC/AHA Guidelines on Competitive Athletes with Cardiovascular Abnormalities
  - European Society of Cardiology 2020 guidelines

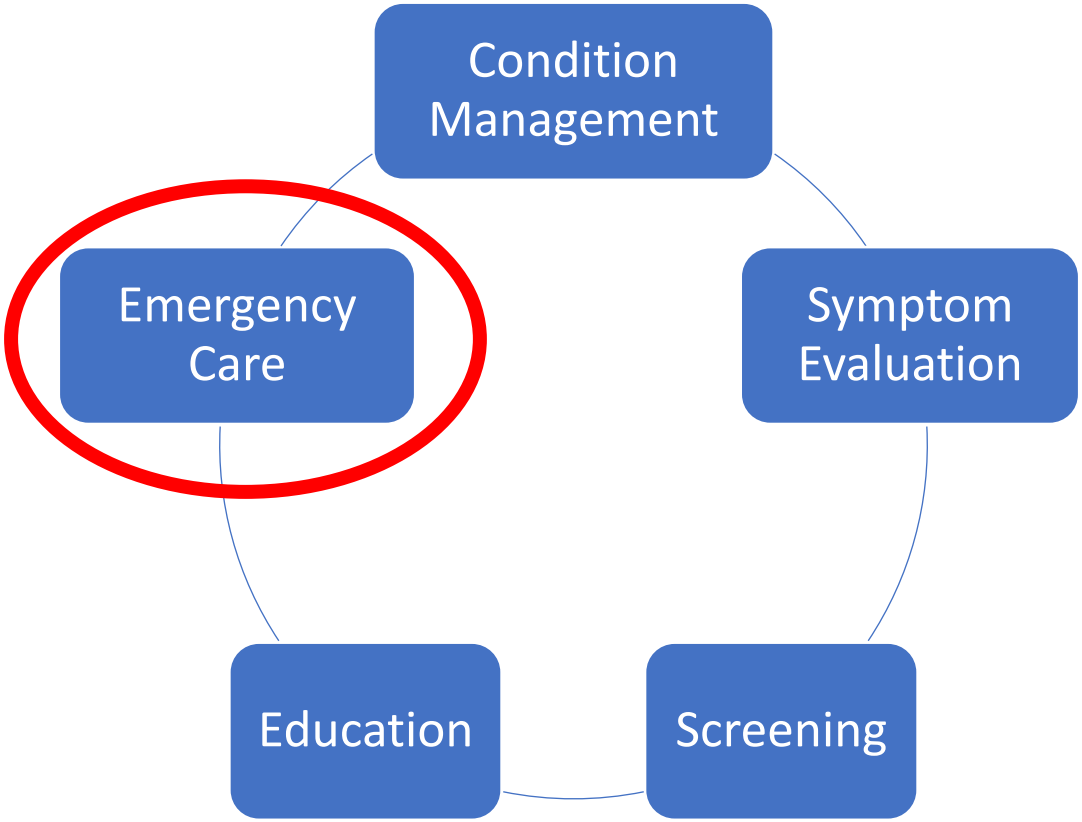
When does sudden cardiac arrest occur in young athletes?



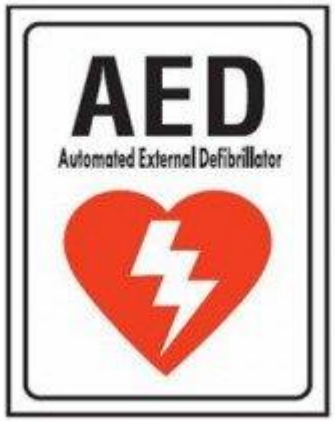
Activity at Time of Death

Study	Population	Sleep/non-exertion	Moderate/ vigorous physical activity
Harmon 2014	NCAA athletes 17-24	41%	59%
Winkle 2013	Children 1 - 18	32%	14%
Pilmer	Children 1- 19	41%	16%
2013	15-19	30%	23%
Margey 2011	People 14 – 35	45%	8%
Harmon 2011	NCAA athletes 17-24	33%	58%
Eckart 2011	US military 18-35	-	47%
Holst 2009	Persons 1 – 35	34%	

How do we improve survival when a sudden cardiac arrest occurs?



Keys to Survival



Preparation

- Advanced planning
- Emergency action plan
- Policies

Recognition

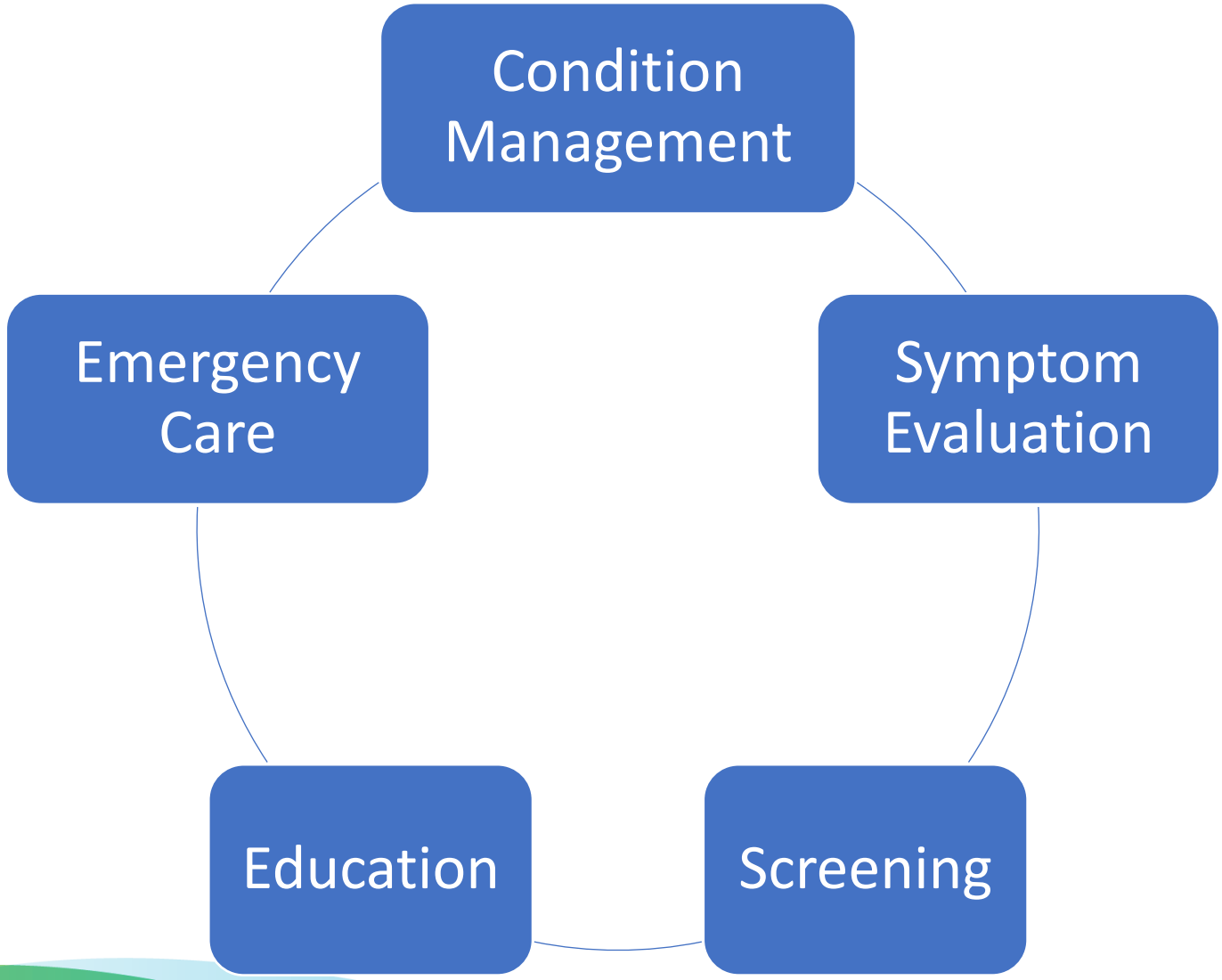
- Collapse, seizure, blow to chest, labored breathing.
- Required PPE
- Education (coaches)

Communication

- With EMS

Action

- CPR and AED (<3 min)
- Advanced airway
- Hypothermic protocol


Condition Management
Symptom Evaluation
Screening
Education
Emergency Care

MERCYHEALTH

Thank you

Questions: jhageman@mercy.com