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SPORTS PHYSICALS

Preventing Sudden Cardiac Death in Athletes

4/11/2025

Dr. Bradford Chu

Disclosures

- None

Outline

- Describe the sports clearance process in Minnesota
- Questions to ask?
- Cardiac testing
- Levels of participation or restriction

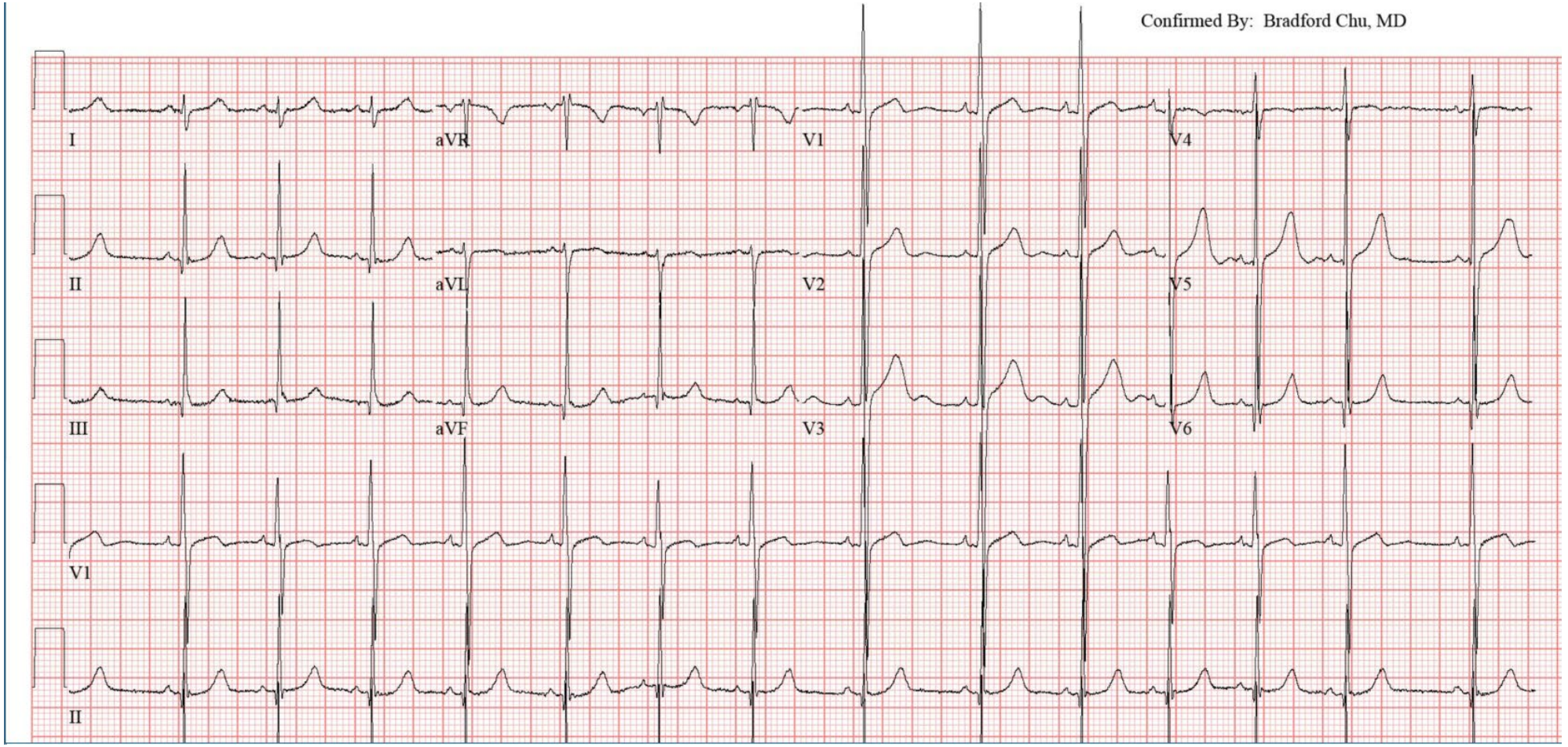
What's the problem?

- Preparticipation screening for competitive athletics is routine in the United States
  - History and Physical
  - Other countries (e.g. Italy, Israel) require EKG screening
- Sudden cardiac death in young athletes is rare
  - Around 75 per year in United States
  - <1 per year in Minnesota high school athletes
- False negative rate is high
  - Sudden cardiac death can occur around 1/3 of the time even with normal screening history, physical and EKG!!

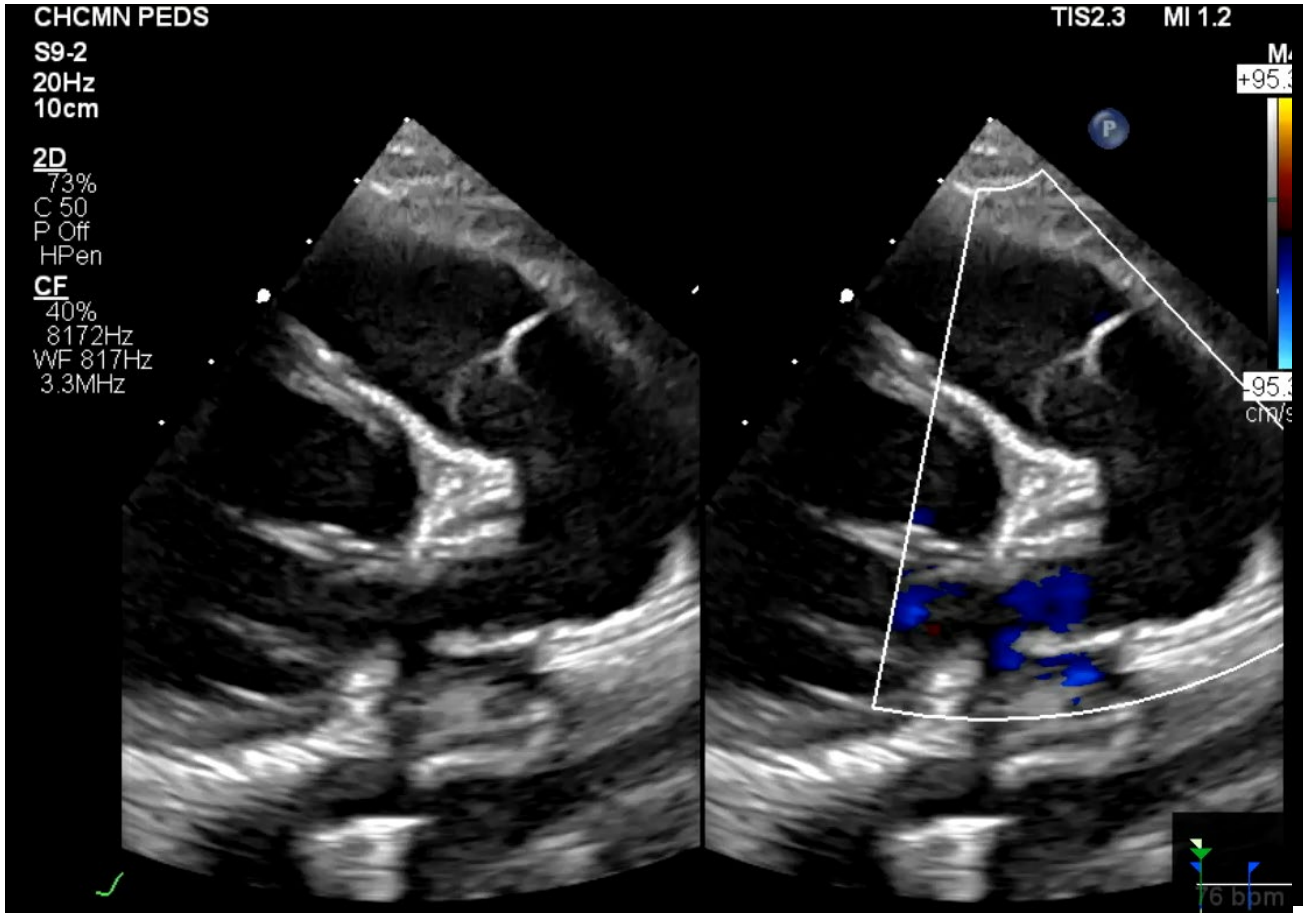
Case presentation (actual patient)

- 9 year old boy
- Preparticipation physical for soccer
  - Played since he was 6 years old, no symptoms
- Family history: maternal uncle and first cousins with cardiomyopathy
  - Mom “I am still getting checked out”
- PE:
  - Heart murmur heard since pre-school age: never evaluated
  - 2/6 systolic ejection murmur at the left upper sternal border

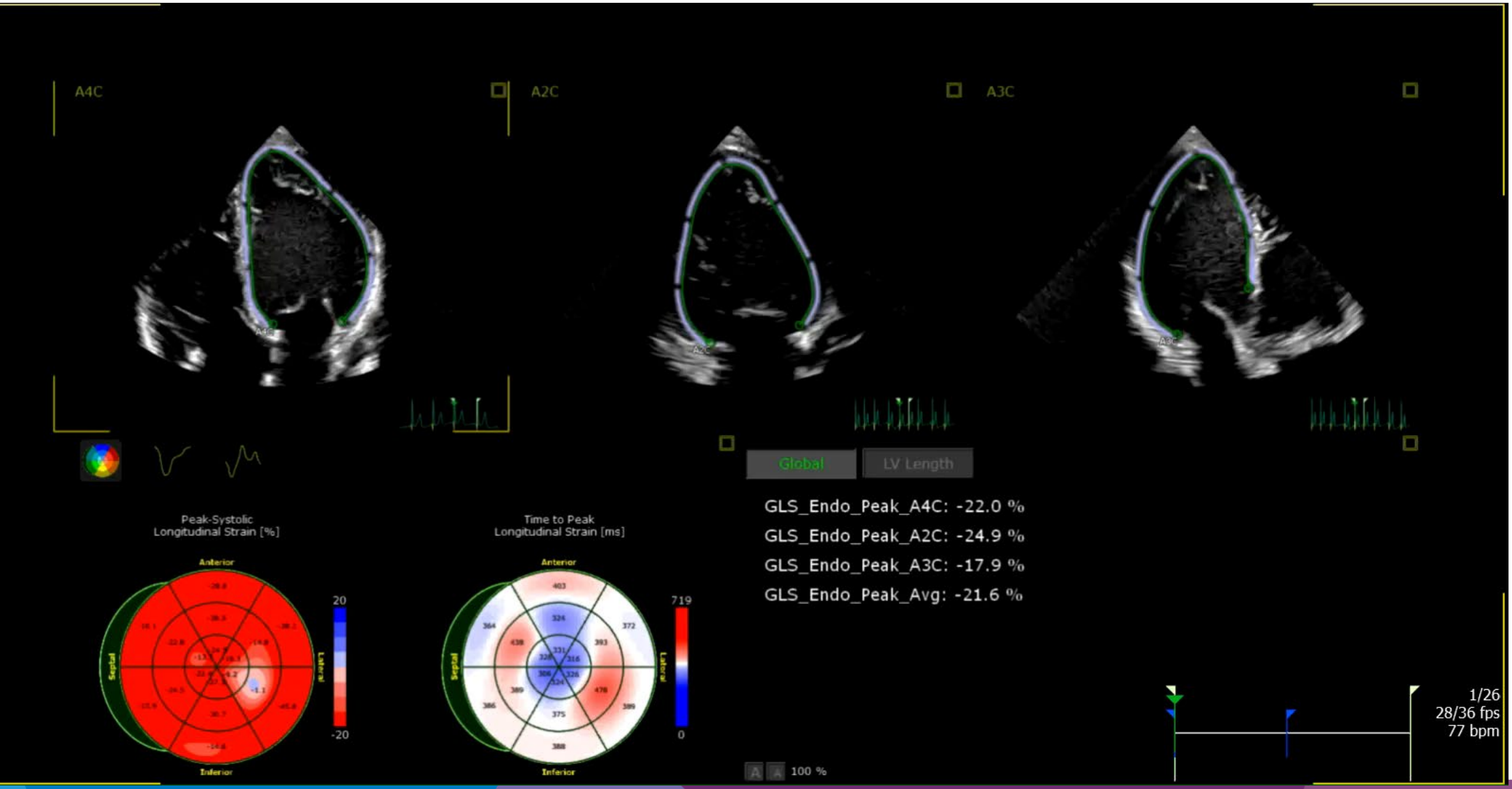
EKG


Confirmed By: Bradford Chu, MD
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II

Echo


CHCMN PEDS
TIS2.3 MI 1.2
S9-2
20Hz
10cm
2D
73%
C 50
P Off
HPen
CF
40%
8172Hz
WF 817Hz
3.3MHz
+95.3
-95.3
cm/s
76 bpm


CHCMN PEDS
TIS0.8
S9-2
59Hz
12cm
2D
70%
C 44
P Off
HPen
G
P
R
2.2
4.4


A4C
A2C
A3C
Global
LV Length
GLS_Endo_Peak_A4C: -22.0 %
GLS_Endo_Peak_A2C: -24.9 %
GLS_Endo_Peak_A3C: -17.9 %
GLS_Endo_Peak_Avg: -21.6 %
Peak-Systolic
Longitudinal Strain [%]
Time to Peak
Longitudinal Strain [ms]
Anterior
Septal
Lateral
Inferior
20
-20
719
0
100 %
1/26
28/36 fps
77 bpm

Diagnosis

- Mild pulmonary valve stenosis
- Left ventricular non-compaction cardiomyopathy
  - Dilated cardiomyopathy
  - Low ejection fraction heart failure
  - Ventricular arrhythmias; sudden death
- Familial mutation in MYH7 gene (beta myosin heavy chain)
  - Associated with various cardiomyopathies and congenital heart diseases

Things that can kill you

- Arrhythmias
  - Long QT syndrome, Arrhythmogenic RV cardiomyopathy (ARVC), catecholaminergic polymorphic VT (CPVT)
  - Rapidly conducted or pre-excited (WPW) atrial arrhythmias
- Cardiomyopathy
  - Hypertrophic/HOCM, dilated, restrictive, non-compaction
- Structural/congenital heart disease
  - Aortic stenosis
  - Coarctation of the aorta

COPY THIS PAGE for the student to return to the school. KEEP the complete document in the student's medical record.

2024-2025 SPORTS QUALIFYING PHYSICAL EXAMINATION MEDICAL ELIGIBILITY FORM

Minnesota State High School League

Student Name: _____ Birth Date: _____

Address: _____

Home Telephone: _____ - _____ - _____ Mobile

Sport Classification Based on Contact

Collision Contact Sports	Limited Contact Sports	Non-contact Sports
Basketball	Baseball	Badminton
Cheerleading	Field Events:	Bowling
Diving	❖ High Jump	Cross Country Running
Football	❖ Pole Vault	Dance Team
Gymnastics	Floor Hockey	Field Events:
Ice Hockey	Nordic Skiing	❖ Discus
Lacrosse	Softball	❖ Shot Put
Alpine Skiing	Volleyball	Golf
Soccer		Swimming
Wrestling		Tennis
		Track

parents:

_____

_____

☐ (4) Not medically eligible for: ☐ All Sports ☐ Specific Sports

Specify _____

Sport Classification Based on Intensity & Strenuousness

Increasing Static Component ↑	A. Low (<40% Max O_2)	B. Moderate (40-70% Max O_2)	C. High (>70% Max O_2)
III. High (> 50% MVC)	Field Events: ❖ Discus ❖ Shot Put Gymnastics*†	Alpine Skiing*† Wrestling*	
II. Moderate (20-50% MVC)	Diving*†	Dance Team Football* Field Events: ❖ High Jump ❖ Pole Vault*† Synchronized Swimming† Track — Sprints	Basketball* Ice Hockey* Lacrosse* Nordic Skiing — Freestyle Track — Middle Distance Swimming†
I. Low (<20% MVC)	Bowling Golf	Baseball* Cheerleading Floor Hockey Softball* Volleyball	Badminton Cross Country Running Nordic Skiing — Classical Soccer* Tennis Track — Long Distance

Increasing Dynamic Component → → → → →

I have examined the student named on this form and completed the Sports Qualifying Physical Exam as required by the Minnesota State High School League. The athlete does not have apparent clinical contraindications to practice and participate in the sport(s) as outlined on this form. A copy of the physical examination findings are on record in my office and can be made available to the school at the request of the parents. If conditions arise after the athlete has been cleared for participation, the physician may rescind the clearance until the problem is resolved and the potential consequences are completely explained to the athlete (and parents or guardians).

2024-2025 SPORTS QUALIFYING PHYSICAL HISTORY FORM (Z02.5)

Minnesota State High School League

Pages 2-5 of this document should be KEPT on file by the medical provider issuing the physical examination.

Note: Complete and sign this form (with your parents if younger than 18) before your appointment.

Name: _____ Date of birth: _____
Date of examination: _____ Sport(s): _____
Sex assigned at birth - F, M, or intersex (circle) How do you identify your gender? (F, M, non-binary, or another gender)
Have you had a COVID-19/Influenza/RSV vaccinations? Y / N
Past and current medical conditions: _____
Have you ever had surgery? If yes, list all past surgeries. _____
List current medicines and supplements: prescriptions, over-the-counter, and herbal or nutritional supplements.

HEART HEALTH QUESTIONS ABOUT YOU[a]

4. Have you ever passed out or nearly passed out during or after exercise? ..... Y / N
5. Have you ever had discomfort, pain, tightness, or pressure in your chest during exercise? ..... Y / N
6. Does your heart ever race, flutter in your chest, or skip beats (irregular beats) during exercise? ..... Y / N
7. Has a doctor ever told you that you have any heart problems? ..... Y / N
8. Has a doctor ever requested a test for your heart? For example, electrocardiography (ECG) or echocardiography. ..... Y / N
9. Do you get light-headed or feel shorter of breath than your friends during exercise? ..... Y / N
10. Have you ever had a seizure? ..... Y / N

HEART HEALTH QUESTIONS ABOUT YOUR FAMILY[a]

11. Has any family member or relative died of heart problems or had an unexpected or unexplained sudden death before age 35 years (including drowning or unexplained car crash)? ..... Y / N
12. Does anyone in your family have a genetic heart problem such as hypertrophic cardiomyopathy (HCM), Marfan syndrome, arrhythmogenic right ventricular cardiomyopathy (ARVC), long QT syndrome (LQTS), short QT syndrome (SQTS), Brugada syndrome, or catecholaminergic polymorphic ventricular tachycardia (CPVT)? ..... Y / N
13. Has anyone in your family had a pacemaker or an implanted defibrillator before age 35? ..... Y / N

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13. Has anyone in your family had a pacemaker or an implanted defibrillator before age 35? ..... Y / N

BONE AND JOINT QUESTIONS

14. Have you ever had a stress fracture or an injury to a bone, muscle, ligament, joint, or tendon that caused you to miss a practice or game? ..... Y / N
15. Do you have a bone, muscle, ligament, or joint injury that bothers you? ..... Y / N

MEDICAL QUESTIONS

16. Do you cough, wheeze, or have difficulty breathing during or after exercise? ..... Y / N
17. Are you missing a kidney, an eye, a testicle, your spleen, or any other organ? ..... Y / N

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Heart Health Questions

	Dangerous diagnosis	Most likely diagnosis
Have you ever passed out or nearly passed out during or after exercise?	Hypertrophic cardiomyopathy Aortic stenosis/insufficiency Inducible arrhythmia	Vasovagal syncope
Have you ever had discomfort, pain, tightness, or pressure in your chest during exercise?	Coronary artery abnormalities Cardiomyopathy	Asthma Vocal cord dysfunction
Does your heart ever race, flutter in your chest, or skip beats (irregular beats) during exercise?	Inducible arrhythmia (e.g. CPVT)	Sinus tachycardia
Do you get light-headed or feel shorter of breath than your friends during exercise?	See above	Poor conditioning (aka weak sauce)

Heart Health Questions About Your Family

	Dangerous diagnosis	Necessary Testing
Has any family member or relative died of heart problems or had an unexpected or unexplained sudden death before age 35 years (including drowning or unexplained car crash)?	Cardiomyopathy Arrhythmia syndrome (e.g. long QT)	**Good family history** (First degree relative?) EKG
Does anyone in your family have a genetic heart problem such as hypertrophic cardiomyopathy (HCM), Marfan syndrome, arrhythmogenic right ventricular cardiomyopathy (ARVC), long QT syndrome (LQTS), short QT syndrome (SQTS), Brugada syndrome, or catecholaminergic polymorphic ventricular tachycardia (CPVT)?	n/a	EKG Echo for cardiomyopathy
Has anyone in your family had a pacemaker or an implanted defibrillator before age 35?	Cardiomyopathy Arrhythmia syndrome (e.g. long QT)	As above

How do we screen?

- History
  - Symptoms early in exercise that are consistent or severe
  - Family history: first degree relatives (siblings or parents) or multiple affected family members
- Physical exam
  - Murmur, irregular rhythm, pulses, etc.
- EKG
  - Channelopathy (LQT, Brugada), HCM, ARVC
- Echo
  - Coronary artery abnormalities, CHD, cardiomyopathy
- Stress testing
  - CPVT

What about patients WITH heart disease?

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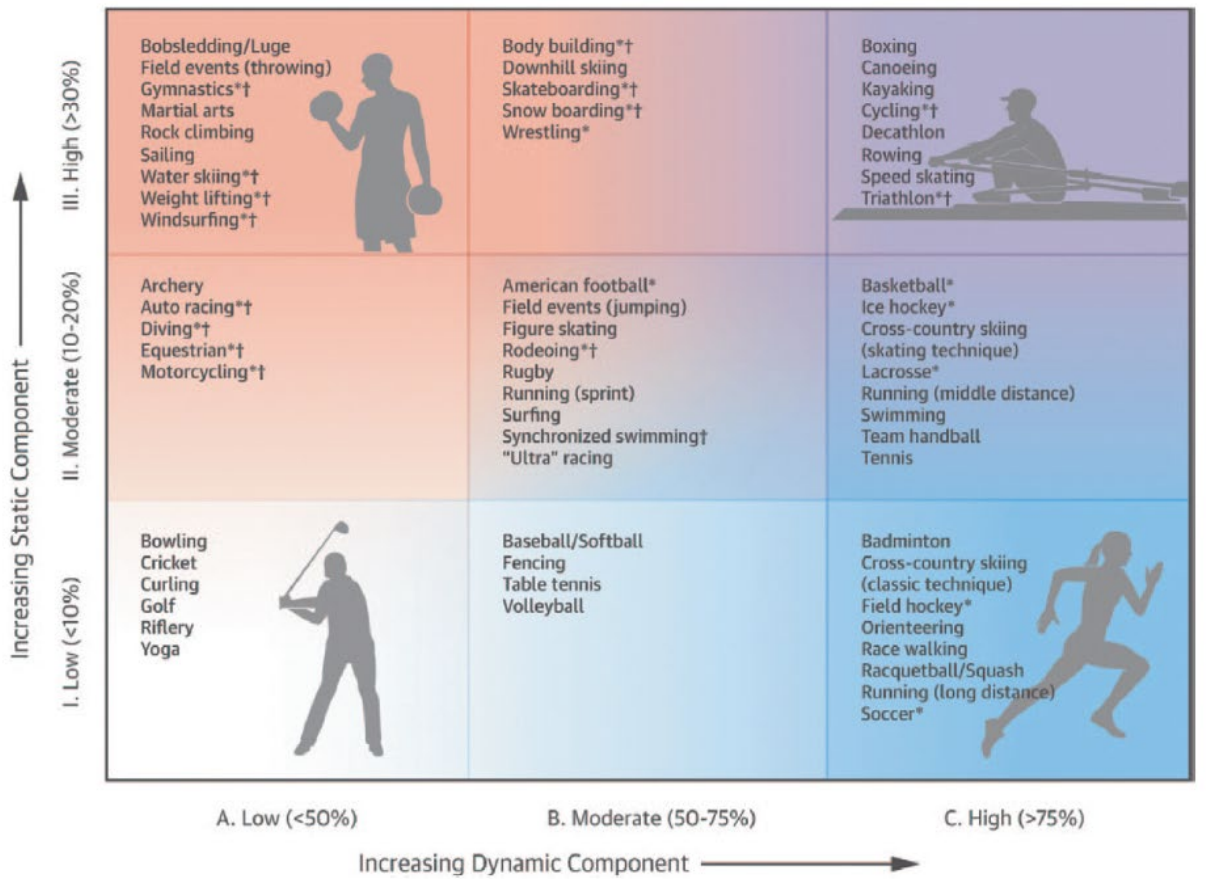
AHA/ACC SCIENTIFIC STATEMENT

Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Preamble, Principles, and General Considerations

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

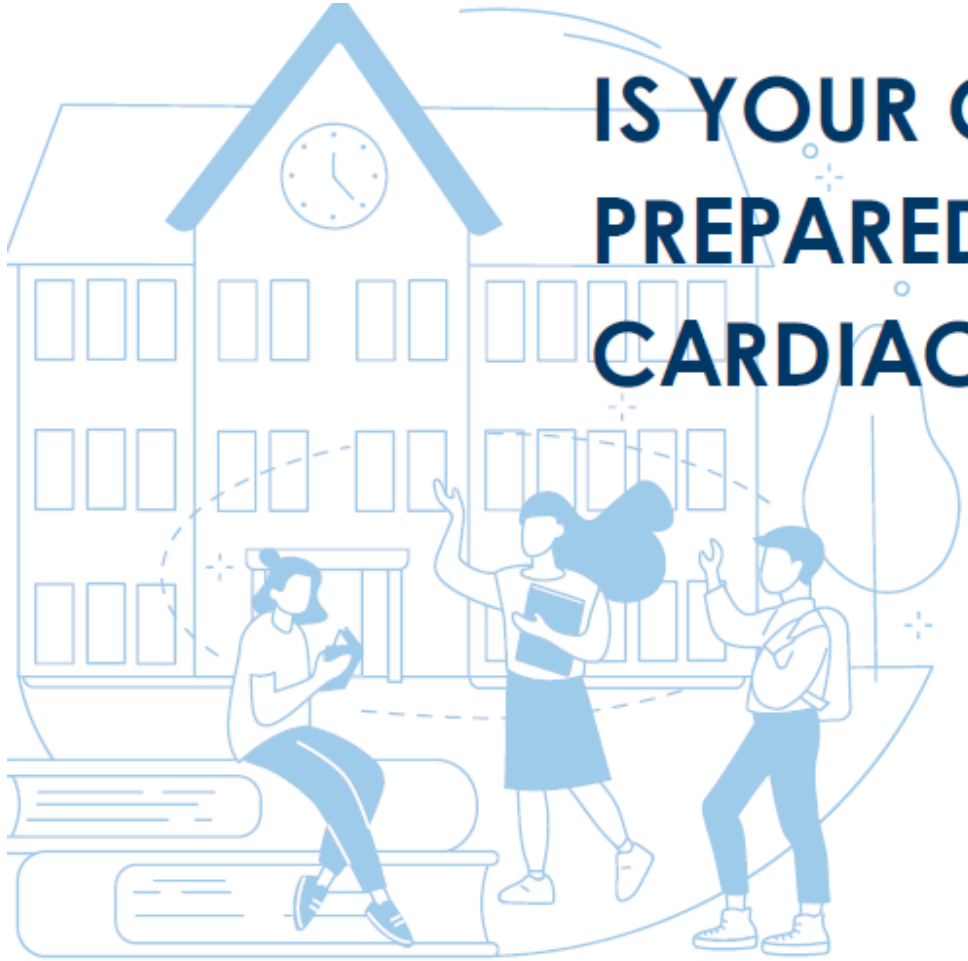
Barry J. Maron, MD, FACC, *Co-Chair** Douglas P. Zipes, MD, FAHA, MACC, *Co-Chair** Richard J. Kovacs, MD, FAHA, FACC, *Co-Chair**



This classification is based on peak static and dynamic components achieved during competition; however, higher values may be reached during training. The increasing dynamic component is defined in terms of the estimated percentage of maximal oxygen uptake ($\dot{V}o_{2max}$) achieved and results in an increasing cardiac output. The increasing static component is related to the estimated percentage of maximal voluntary contraction reached and results in an increasing blood pressure load. The lowest total cardiovascular demands (cardiac output and blood pressure) are shown in the palest color, with increasing dynamic load depicted by increasing blue intensity and increasing static load by increasing red intensity. Note the graded transition between categories, which should be individualized on the basis of player position and style of play. *Danger of bodily collision (see Table for more detail on collision risk).

Project ADAM Background

- Adam Lemel died while playing basketball at age 17 (1999)
  - AED was not available
- Project ADAM (Automated Defibrillators in Adam's Memory)
  - Aims to prevent sudden cardiac death in children and teens through education and life-saving programs
  - Founded by Adam’s parents Patty and Joe



IS YOUR CHILD'S SCHOOL PREPARED FOR A SUDDEN CARDIAC EMERGENCY?

Preparing for sudden cardiac arrest

Essential components for a school to be prepared for an emergency are:

- A cardiac emergency response plan recognition of SCA & plan initiation
- Appropriate number of AEDs based on school size (population & campus size)
- CPR and AED-trained staff & students
- Practice drills to prepare

Project ADAM Minnesota's goal is to have all schools in Minnesota adopt an effective cardiac emergency plan.

Project ADAM Minnesota

- Hospital-based community outreach program
- Supports implementation of written and practiced cardiac emergency response plans in schools
  - Achieve “Heart Safe School” status
- Nationwide program credited in saving >140 lives to date
  - Currently 44 affiliates in 32 states
- Project ADAM MN est 2021
  - One-on-one consultation
    - » Emergency response simulation

Common restrictions

- Bicuspid aortic valve or dilated aorta
  - Avoid high static load activities (e.g. football, wrestling)
  - Weight training: Avoid one-rep max
- Aspirin or systemic anticoagulation
  - Avoid collision sports (e.g. soccer, basketball)
- Pacemakers
  - Avoid collision sports
- Long QT1
  - Avoid swimming

Restrict or not?

- 9 year old
  - No symptoms
  - Confirmation with cardiac MRI
  - Normal Holter monitor
  - Normal exercise stress test
  - Follow-up after 1 year with normal ejection fraction
- Let him play!!

Role of the cardiologist

- Regular communication with sports leagues
- Education of family regarding risks
- Assessment of athlete's priorities and values
- Creation of safety plan to minimize risks
  - AED
  - CPR training for bystanders
- "Shared decision making" model
  - Allows families, athletes, and providers to come to a mutual agreement due to significant uncertainty regarding risks and outcomes
  - Recognition that pediatric patients cannot be expected to understand the risks by themselves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