



# Preparticipation Cardiac Evaluation

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Fars Pediatric Association

**چهارمین کنگره دوسالانه کودکان استاد امیر حکیمی**  
The 4<sup>th</sup> Pediatric Congress  
Professor Amirhakimi  
F.A.R.S SHIRAZ  
۱۴۰۳ اردیبهشت ۲۵ تا ۲۸

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مجری برگزاری  
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## WHAT IS THE PURPOSE OF PREPARTICIPATION EVALUATION?

- The purpose of preparticipation screening is to identify individuals who may be at risk for adverse health effects such as illness or injury secondary to sports participation.
- The most serious potential adverse event is sudden cardiac arrest (SCA) or sudden cardiac death (SCD).

# Case 1

- An 11-year-old boy presents for sports clearance to play high school basketball.
- He has a family medical history of hypertrophic cardiomyopathy (HCM) in his father. His father has not had genetic testing.



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by AM Reittinger · 2023 — A primary aim of the PPE is to screen for risk factors associated with sudden cardiac death. This article is designed to summarize the current thoughts on...



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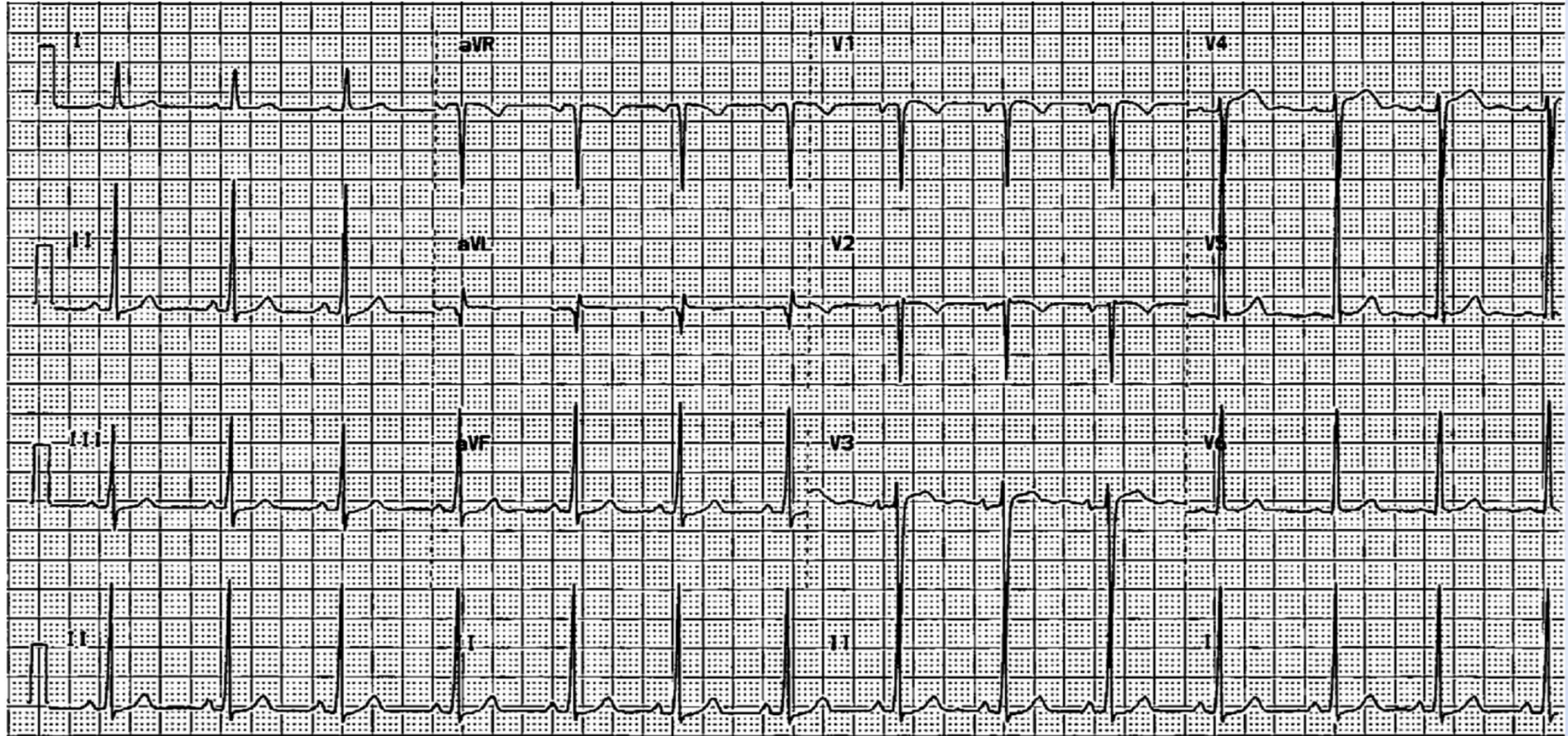
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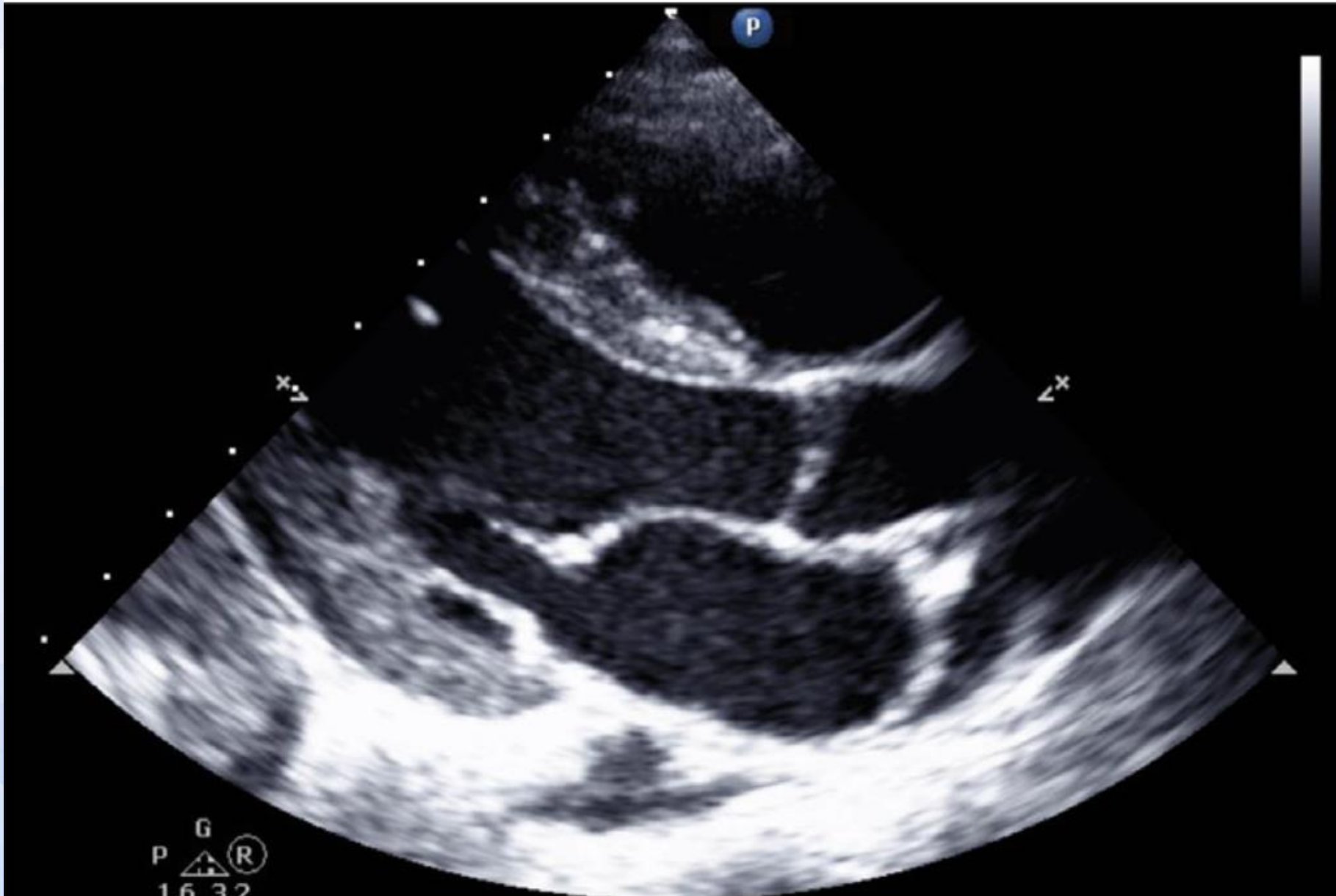
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What do you do next?

## Case 2

- A 10-year-old boy presents for clearance before youth league soccer.
- When asked about a history of syncope or unresponsive spells, his mother reports he had a recent syncopal episode. She reports that he was running to the school bus with his siblings when she noticed that he started to lag behind his siblings, fell to his knees, screamed, and then fell on his face. He was noted to be unconscious for a period of about 15 seconds and did not require any resuscitative measures. He was noted to have significant abrasions on his face. When he recovered, he apologized for the fact that “his legs stopped working.” His mother recounts that 2 months earlier she received a call from school after he fell while running on the track during gym class. This event was also associated facial abrasions. His mother attributed the inability to catch himself during his fall to prevent facial injury to what she described as general clumsiness and his history of mild gross motor delay.



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What do you do next?





## Case 3

- An 18-year-old male college baseball player presents to a mass preparticipation screening clinic. He reports a history of Kawasaki disease (KD) and is currently taking aspirin and dipyridamole. There is no access to outside medical records.



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What do you do next?

## DIFFERENCES IN INCIDENCE AND CAUSES OF SUDDEN CARDIAC ARREST (SCD)

- Is the Incidence of SCD higher in children or adult?
- Is SCD higher in male/ female?
- Which sports has highest rate of SCD?

1.Volleyball

2.Baseball

3.Basketball

4.Football

5.Karate

6.Kong foo

## DIFFERENCES IN INCIDENCE AND CAUSES OF SUDDEN CARDIAC ARREST

- the incidence of SCA in adults is approximately 135 per 100,000
- the incidence of sports-related sudden death in young athletes is 0.5 to 2.1 per 100,000 people per year
- The risk seems to be higher in **males** and **black** athletes. **Basketball** (male and female) was the sport with the highest rate of SCD, followed by men's **soccer** and **men's football**
- The common causes of SCD were autopsy-negative sudden unexplained death (25%), verified or suspected cardiomyopathy (24%; 8% confirmed HCM), coronary artery anomalies or disease (21%), and myocarditis (10%).



# Which age has lowest and highest incidence of SCD in children

- 1-5 y
- 1-12 mo
- 6-9
- 14-17

# DIFFERENCES IN INCIDENCE .....

- The 2020 study found the incidence of sudden death was 1.9 per 100,000 in children between 1 and 17 years of age.
- The **lowest** incidence was in 6 to 9 year olds (1.1/100,000 children), and the **highest** incidence was in 14 to 17 year olds (2.4/100,000).
- Unfortunately, it was difficult to determine the cause of sudden death in a significant number of cases (**43% of the cases were “unexplained”**).
- **Cardiac causes** accounted for **16%** of the “explained” cases and were the **second** most common cause (behind respiratory).
- Only a small percentage of all sudden death events occurred cases occurred during exertional activities(13%).

## Possible differences between pediatric and young adult/adult preparticipation cardiac screening

<b>Pediatric Specific Screening</b>	<b>Young Adult and Adult Screening</b>
More likely to have vague or unclear symptoms	Better able to communicate symptoms
Likely requires repeat screening as adolescent and/or young adult	More likely to have already expressed the phenotype of specific cardiac disease
Parents too young to demonstrate phenotype	Older parents with more detail about family history
Pediatric providers are less experienced in ECGs	Family physicians and adult providers more experienced interpreting ECGs
More likely to have undiagnosed congenital heart disease	Less likely to have undiagnosed congenital heart disease
More likely to have history of Kawasaki disease	
Suboptimal criteria for ECG abnormalities	





# What cardiac diseases are leading cause of SCD in children?

- 1.AS
- 2.COA
- 3.PS
- 4.VSD
- 5.HOCM
- 6.Marfan
- 7.AVRC

## HCM is a leading cause of sudden death

- HCM is a leading cause of sudden death in young athletes, but screening for HCM can be difficult at young ages because sometimes the phenotype is not present until adulthood.
- Patients at risk for developing HCM may have normal testing early in childhood and then develop HCM and be at risk for SCD later in adolescents. Owing to this, it is recommended that children who are asymptomatic who have a first-degree relative with HCM should be screened with an ECG and echocardiogram every 1 to 3 years.

# Marfan syndrome

- Marfan syndrome is similar to HCM in that individuals can have relatively normal physical examinations and normal sized aortic roots in childhood but develop significant aortic dilation throughout adolescence and young adulthood, predisposing them to aortic root dissection and rupture. Recent studies looking at the phenotypes of patients with pathologic genetic mutations for Marfan syndrome showed that **only 56% of 10 to 18** year olds will meet the clinical diagnostic criteria for Marfan compared with 79% of adults.

# Arrhythmogenic right ventricular cardiomyopathy (ARVC)

- Arrhythmogenic right ventricular cardiomyopathy (ARVC) is another cause of SCA that has variable ages of presentation.
- ARVC is particularly challenging to diagnosis in the pediatric population as there is typically a “concealed phase,” during which no structural or electrocardiographic abnormalities are identifiable but malignant arrhythmias with sports or physical activity can occur.
- Studies have demonstrated that pediatric patients are more likely than adults to have SCA as their presenting symptom for this reason.
- Unfortunately, diagnosis can be challenging. In a recent study, even pediatric patients who were thought to have definitive ARVC after a cardiac MRI rarely had abnormal ECGs (4%)



# IS there any need for repating screening? How often?

1. Every 2 year
2. No need
3. Every 4 year
4. Every 6 year

- This is highlighted by a recent article that showed that the rate of SCD in 11,168 adolescent **soccer players was still 6.8 per 100,000** despite extensive cardiac screening (history, examination, ECG, and echocardiogram) before participation. The reason for the relatively high number of SCD was related to **cardiomyopathies** that were not detected by screening. The mean age of screening was 16.4 ± 1.2 years, and the time between the screening and the episode of SCD was 6.8 years.
- they recommend **screening patients every 2 to 3 years** without any differentiation between athlete and nonathlete
- **English Football Association** has recently recommended initial screening at **16 years** of age as part of a fitness assessment before signing a professional contract and repeat screening **18, 20, and 25** year old



# WHERE DO PREPARTICIPATION EVALUATIONS OCCUR?

- School
- Clinic
- hospital



## WHERE DO PREPARTICIPATION EVALUATIONS OCCUR?

- Current PPE guidelines recommend **yearly screening at least 6 weeks** before the first sports practice or workout.
- The preferred provider is the patient's primary care provider.



# Mass screening?!!!

- Mass screening events such as those in a school gymnasium can be problematic
- These potential problems are
  - (1) difficulty maintaining patient privacy and a safe space for patient to bring concerns to physician,
  - (2) suboptimal environment for physical examination,
  - (3) lack of access to patient's medical records,
  - (4) lack of time and space for appropriate counseling
  - (5) difficulty ensuring appropriate follow-up/referrals when abnormalities are found.



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# What are THE COMPONENTS OF THE PREPARTICIPATION EVALUATION?

# History

- Cardiac symptoms with exercise should prompt further investigation.
- suspicious symptoms such as **seizures**, **syncope**, or **extensive breath holding** spells should be considered as potential signs of malignant arrhythmias.
- Any known or previously diagnosed cardiac pathology, including **congenital heart** disease, cardiac **arrhythmia** or **channelopathies**, **cardiomyopathy**, history of **myocarditis**, or coronary artery anomalies, including those caused by **KD**, should be evaluated by a cardiologist before clearance.

# Four specific questions

- 1. Have you ever fainted, passed out, or had an unexplained seizure suddenly and without warning, especially during exercise or in response to sudden loud noises, such as doorbells, alarm clocks, and ringing telephones?
- 2. Have you ever had exercise-related chest pain or shortness of breath?
- 3. Has anyone in your immediate family (parents, grandparents, siblings) or other, more distant relatives (aunts, uncles, cousins) died of heart problems or had an unexpected sudden death before age 50? This would include unexpected drownings, unexplained auto crashes in which the relative was driving, or sudden infant death syndrome (SIDS).
- 4. Are you related to anyone with HCM or hypertrophic obstructive cardiomyopathy, Marfan syndrome, arrhythmogenic cardiomyopathy, LQTS, short QT syndrome, Brugada Syndrome, or catecholaminergic polymorphic ventricular tachycardia or anyone younger than 50 year with a pacemaker or implantable defibrillator?



# What is Red flags for chest pain?

1. Rest chest pain
2. exertional pain
3. palpitations
4. syncope

# Chest pain

- **Red flags** for cardiac chest pain include **exertional pain** and pain associated with **palpitations or syncope**

## What are Red flags for cardiac-related syncope?

1. Vasovagal syncope
2. Visual syncope
3. auditory syncope

# Syncope

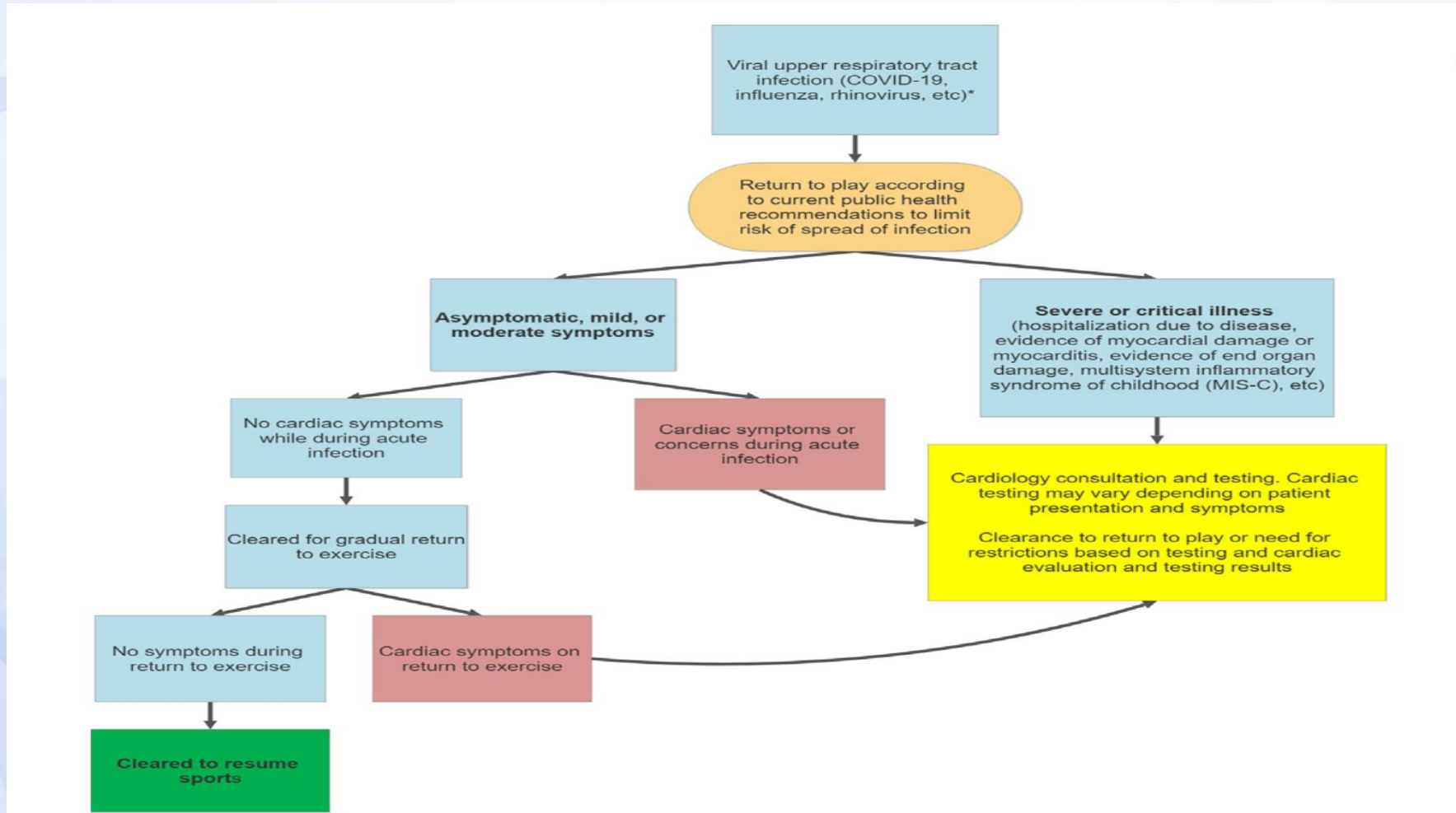
- **Red flags** for cardiac-related syncope are syncope with **exertion or exercise**, a **lack of prodromal** symptoms before the syncope, other associated cardiac symptoms, **head or body injury** at the time of syncope, and **abnormal examination** or **ECG findings**



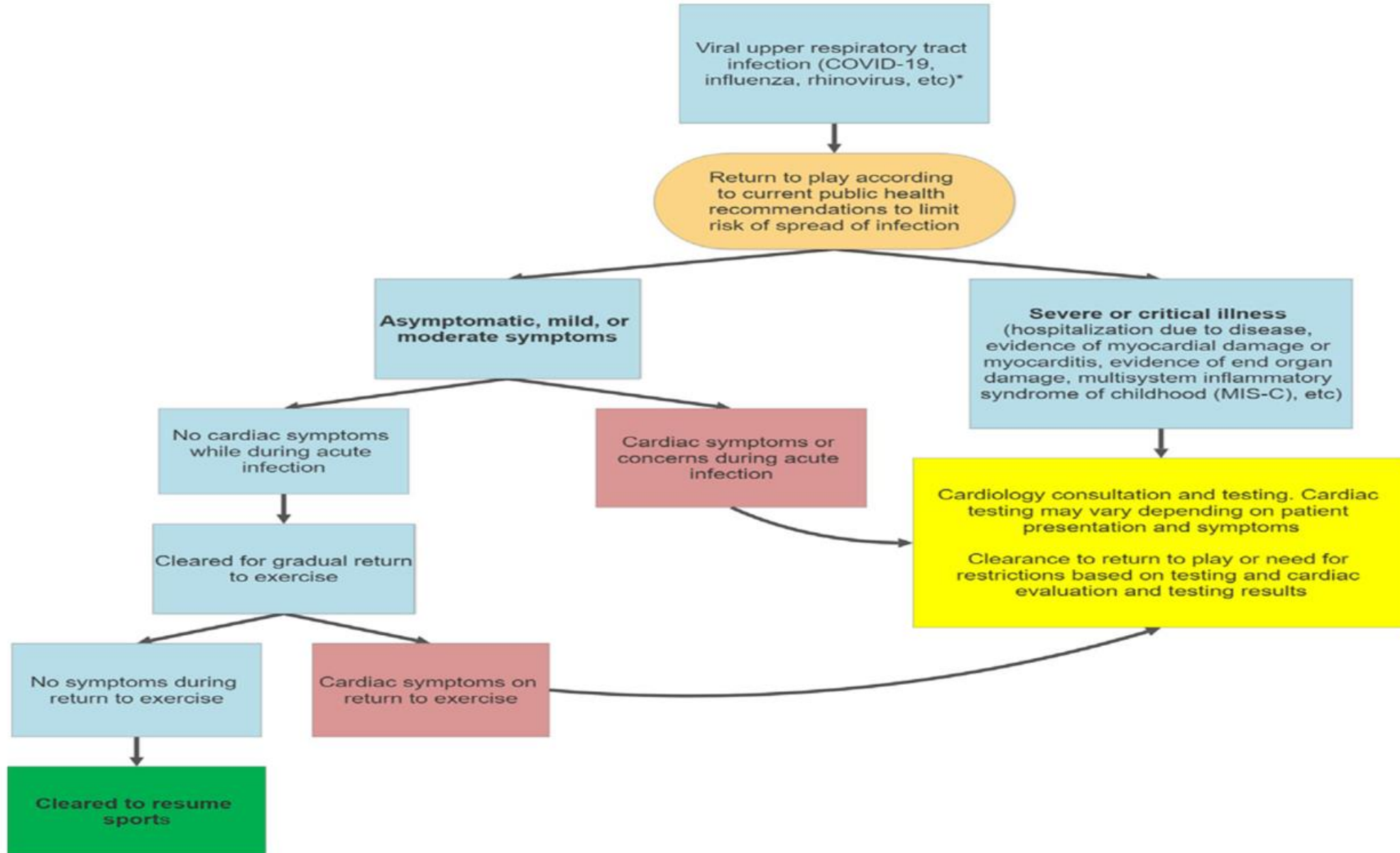
# Palpitations

- Children will often describe their heart as “pounding,” “racing,” “fluttering,” “starting and stopping,” or “beeping.”
- **Palpitations with exercise** raise the level of concern. Typically, patients require an ECG and exercise stress test if the symptoms occur with exercise.

## History of viral upper respiratory tract infection (COVID-19, influenza, rhinovirus, and so forth)



F  
V  
(



F  
V  
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# Family Medical History

- cardiomyopathies, channelopathies, conduction abnormalities, and congenital heart disease
- sudden premature death (SIDS, unexplained drowning, or single-car accident of unknown cause)

# Physical Examination

- The importance of vital signs, specifically **blood pressure**, should not be ignored. Elevated blood pressure is common. It can be a sign of underlying cardiac disease (eg, coarctation of the aorta)
- **physical stigmata of Marfan syndrome**, such as abnormalities of **spinal curvature**, **pectus** deformities, **hyperextensible** joints, **arm span to height** ratio, **myopia**, and other characteristic facial features.
- **Turner syndrome** such as neck webbing, short stature, a low hairline, or low-set ears should also be evaluated with an echocardiogram given their risk of bicuspid aortic valve, coarctation
- heart murmurs, abnormal or extra heart sounds, or rhythm irregularity.

# Electrocardiogram Screening

- The most recent guidelines from the American College of Cardiology (ACC), AHA, and AMSSM suggest that ECG may be performed but did not recommend universal ECG screening.
  - 1. Adequate training and experience of interpreting physicians
  - 2. Appropriate privacy for performing of ECG and counseling (of patient and family) after ECG
  - 3. An avenue for cardiologist evaluation and cardiac testing to be performed quickly and fully (ideally at the time of the screening, but if not, a few days later)

# Other Nonroutine Modalities of Cardiac Evaluation

- There have been studies evaluating the use of **echocardiograms** and exercise stress testing in PPEs. There has also been suggestion of using genetics and **MRIs** in preparticipation screening. These modalities certainly have advantages over the history, physical examination, and ECG, but given the cost and resources required for this type of testing and interpretation, widespread use of these modalities seems unlikely

# Case 1

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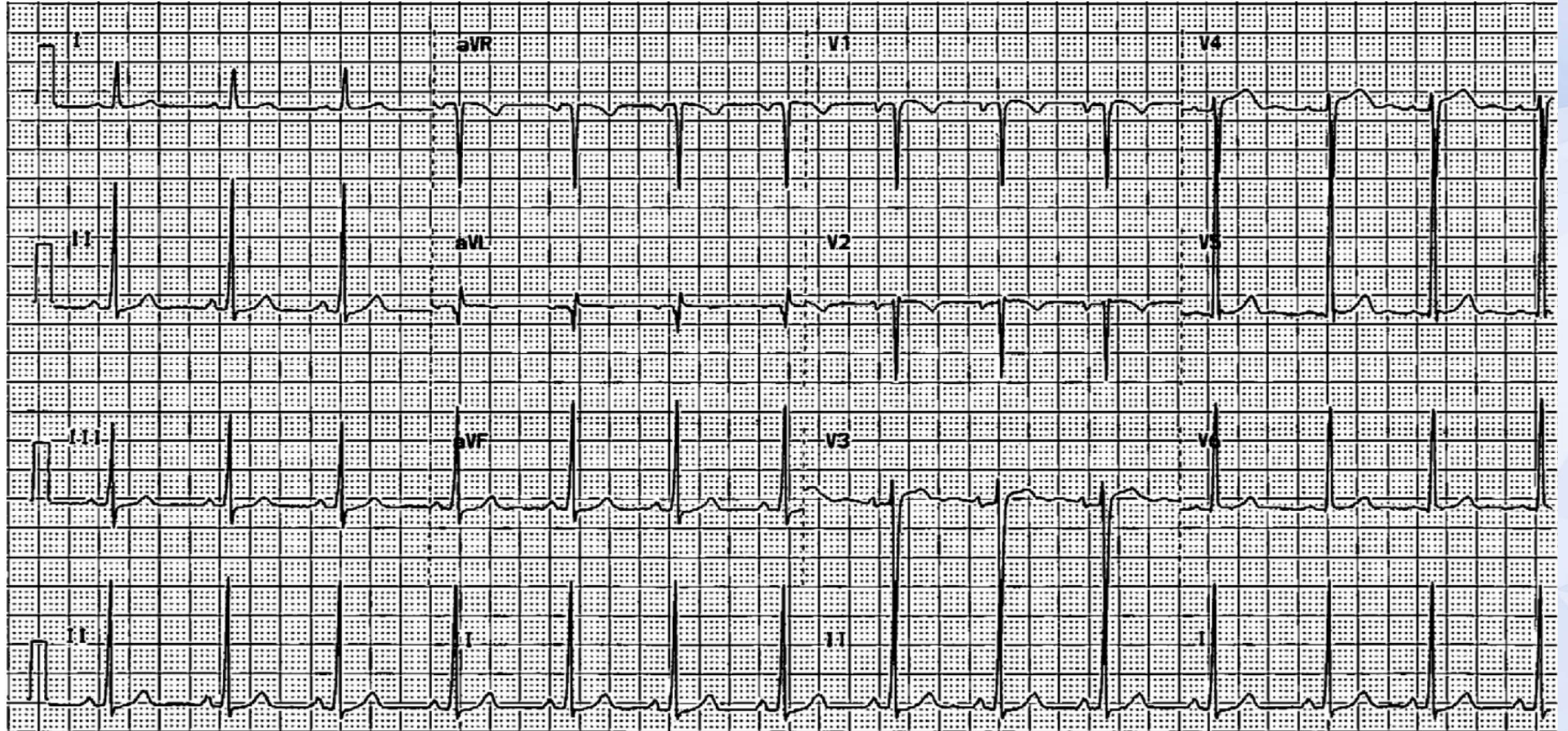
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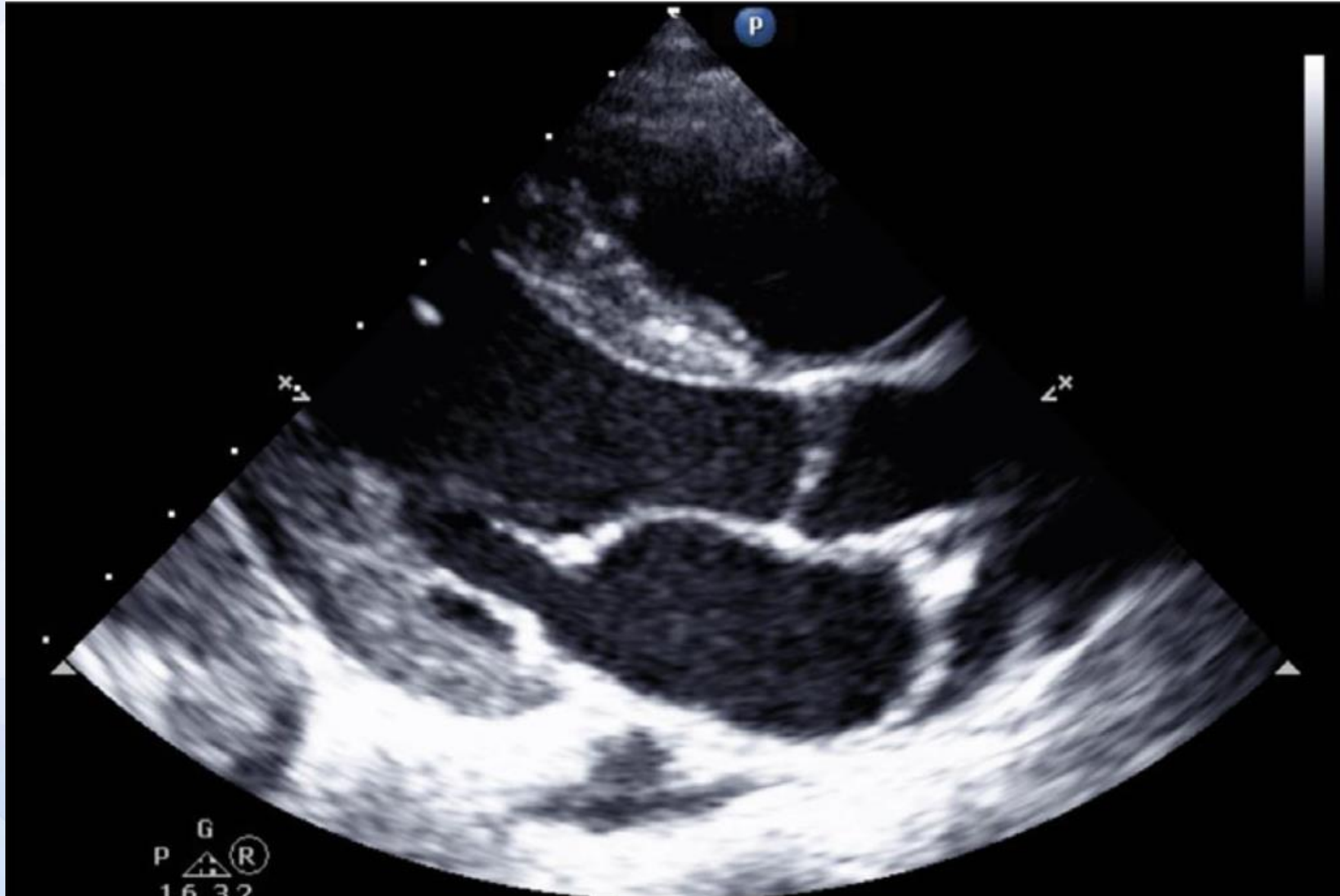
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What do you do next?



- As the patient was 11 year old at the time of his initial normal cardiac evaluation, it was recommended that he return to clinic in 4 years for repeat evaluation.



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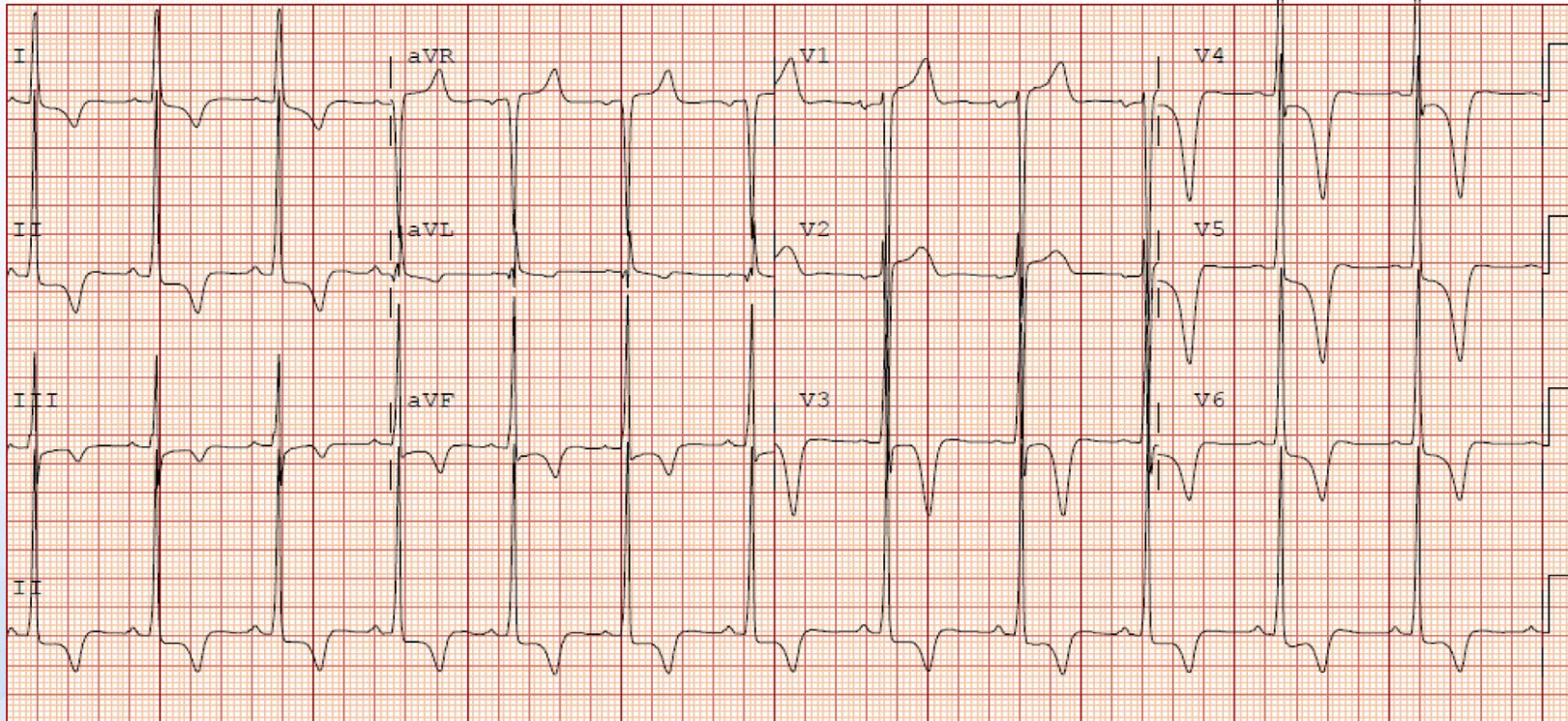
HR 73 [PED] . ----- Pediatric ECG interpretation -----  
 [SR] . Sinus rhythm  
 PR 159 [LVHRE] . LVH w/ secondary repolarization abnormalities  
 QRSD 95  
 QT 415  
 QTc 458

-- AXIS --  
 P 64  
 QRS 47  
 T 228

- ABNORMAL ECG -

Account #: 200041542947  
 Order #: 243662111  
 Enc ID: 200041542947  
 Reason: Screening for CV Con>

12 Lead; Standard Placement



Device: US61722818

Speed: 25 mm/sec

Limb: 10 mm/mV

Chest: 10 mm/mV

F 60~ 0.5-100 Hz W

PH100B b L P?



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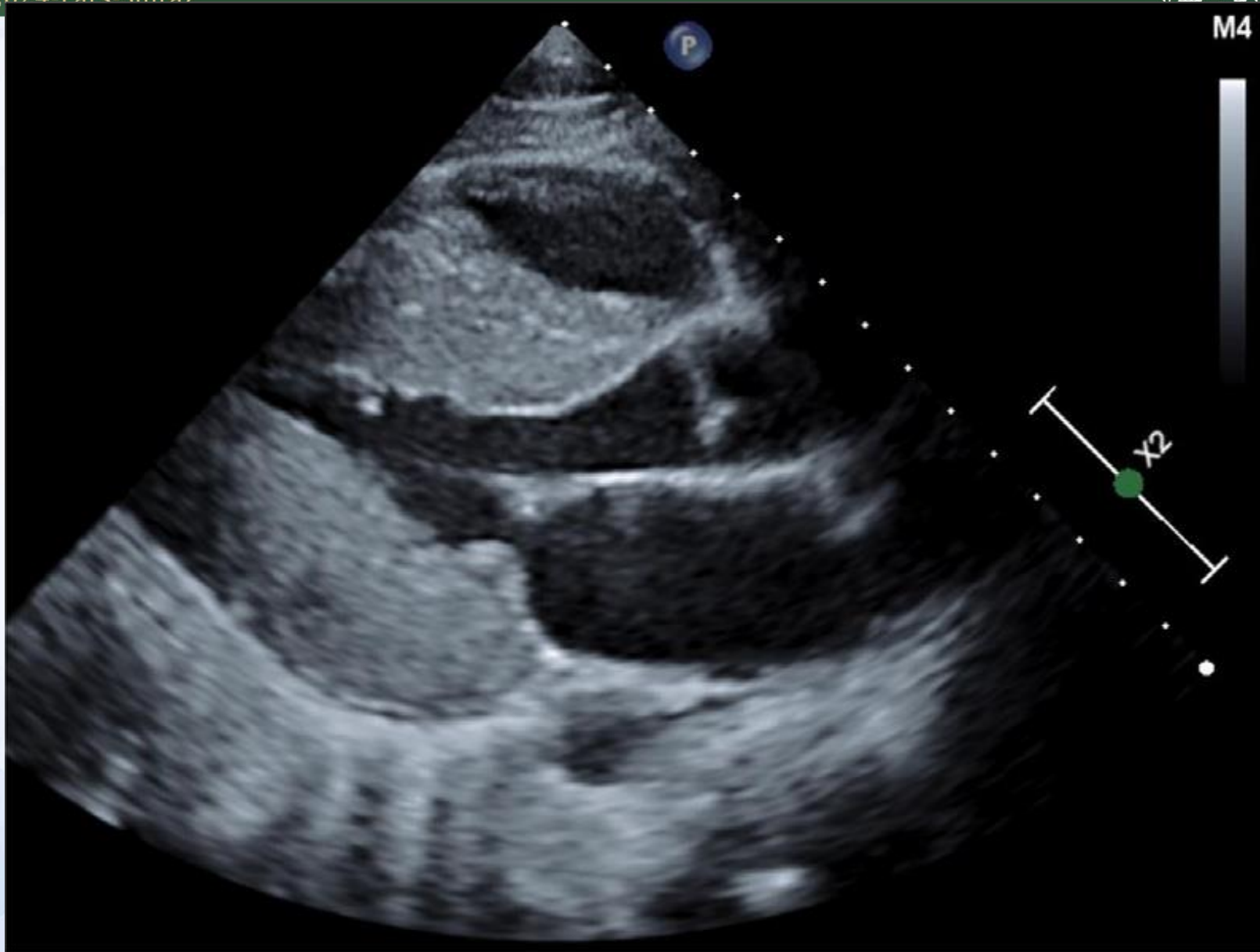
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This case highlights the importance of repeated screening in the pediatric population.

## Case 2

- A 10-year-old boy presents for clearance before youth league soccer. When asked about a history of syncope or unresponsive spells, his mother reports he had a recent syncopal episode. She reports that he was running to the school bus with his siblings when she noticed that he started to lag behind his siblings, fell to his knees, screamed, and then fell on his face. He was noted to be unconscious for a period of about 15 seconds and did not require any resuscitative measures. He was noted to have significant abrasions on his face. When he recovered, he apologized for the fact that “his legs stopped working.” His mother recounts that 2 months earlier she received a call from school after he fell while running on the track during gym class. This event was also associated facial abrasions. His mother attributed the inability to catch himself during his fall to prevent facial injury to what she described as general clumsiness and his history of mild gross motor delay.
- What do you do next?



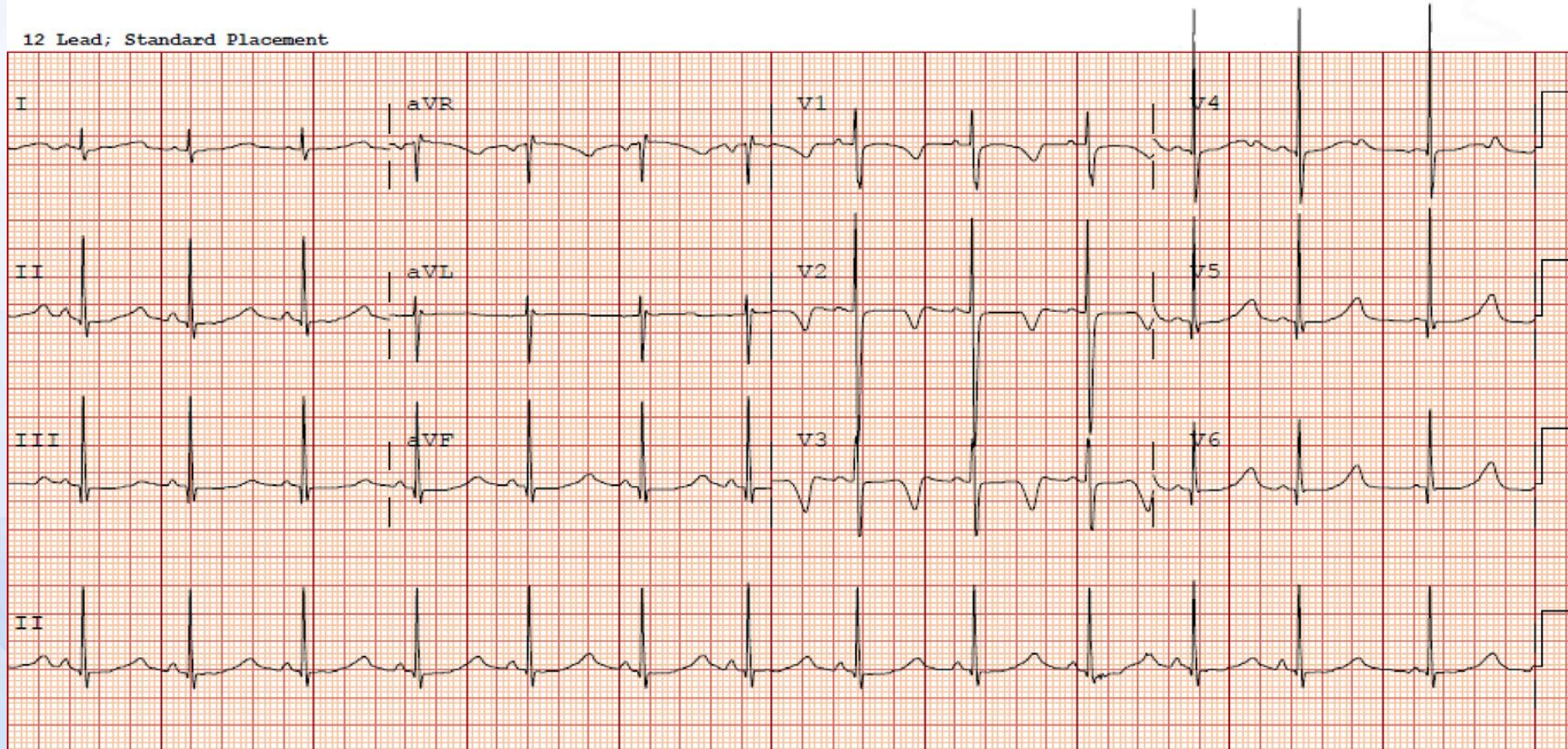
HR 82 [PED] . ----- Pediatric ECG interpretation -----  
[SR] . Sinus rhythm  
PR 120 [LQT] . Prolonged QT interval Oper: MB2BP  
QRSD 78  
QT 511  
QTc 597

-- AXIS --

P 65  
QRS 87  
T 46

- ABNORMAL ECG -

12 Lead; Standard Placement





- An ECG is notable for a correct QT duration of 597 ms. Laboratory testing does not reveal a secondary cause of prolonged QT interval. There is no family history of LQTS or other dysrhythmia. His routine echocardiogram is normal.
- The patient will be started on a beta blocker to reduce the risk of cardiac events and genetic testing demonstrated a pathogenic mutation in the KCNQ1 gene, which is associated with LQTS type 1.



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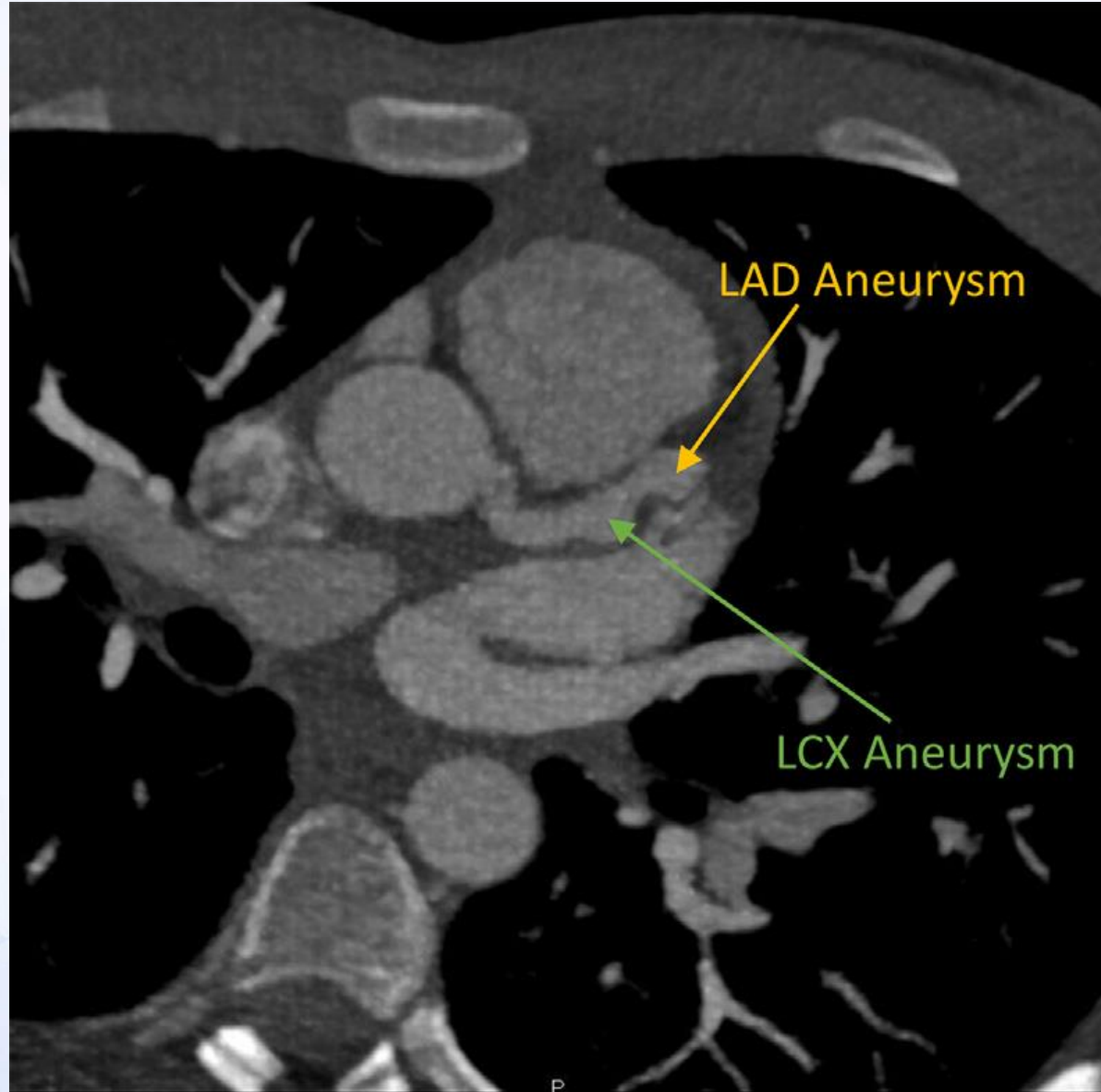
Syncope during exertion  
should always raise concern for  
cardiac  
pathology.

# Case 3

- An 18-year-old male college baseball player presents to a mass preparticipation screening clinic. He reports a history of Kawasaki disease (KD) and is currently taking aspirin and dipyridamole. There is no access to outside medical records.
- What do you do next?



- The fact that the athlete remains on aspirin and dipyridamole should be a sign that he has residual coronary artery pathology and review of his past medical records and possible repeat cardiac testing is required before “clearance.”





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- The persistent aneurysms place him at risk for thrombus, so he has continued antiplatelet therapy.
- Persistent coronary aneurysms related to KD require cardiology follow-up every 6 to 12 months and regular stress testing for inducible myocardial ischemia, both of which should be normal before sports clearance.
- As this patient enters adulthood, he should be considered for cardiac MRI to monitor for function and signs of ischemia and CT angiogram to monitor for coronary artery stenosis
- Baseball is not a collision sport so there should be no restrictions related to his antiplatelet medications.







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