ECG Screening in Athletes: Saving Lives and Opening Pandora's Box

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Disclosure

- I have no relevant financial relationships to disclose

The Standard PPE

- Various questionnaires across the US but most have 14 core questions
- Personal heart health questions about exercise-related symptoms: syncope, chest pain, palpitations, breathing problems, seizures
- Family health question: heart problems or sudden death in someone < 35 yo, specific genetic heart conditions (e.g., LQTS, HCM, Marfan Syndrome, etc), implanted defibrillator

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What SCD conditions are we looking for?

- HCM: an abnormal thickness of the heart that can cause dangerous arrhythmias (Sx of syncope, palpitations, shortness of breath, chest pain – almost all exertional)
- LQTS: a genetic problem of the rhythm system (Sx of syncope/seizures)
- ARVC: a heart muscle abnormality with arrhythmia manifestations (Sx of palpitations and syncope)
- WPW: a small, extra, electrical connection (Sx of palpitations and syncope)
- Anomalous coronary artery (Sx of exertional chest pain, syncope)

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Basics about an ECG

- Requires 10 stickers to be placed on someone's chest
- Takes ~5 minutes total to complete
- Good at detecting some "rhythm problems" but not so good at "structural problems" (eg- cardiomyopathy, "hole in the heart")
- Problems found in children are fairly different than adults
- Some groups (athletes, African-Americans) have distinctive ECG patterns
- Cardiac problems identified may or may not carry a risk for sudden cardiac arrest (SCA)

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Making the ECG a better test

- ECG problems include false-positives and false-negatives
- Revisions by the European Society of Cardiology and then a US group (“Seattle Criteria”) have reduced false-positives
- Conditions that may be identified by an ECG:
  - SCA-associated: Long QT Syndrome, WPW, Hypertrophic Cardiomyopathy, Compete heart block
  - Not SCA-associated: ASDs, other CHD, lesser heart blocks
- Conditions often missed by an ECG:
  - ARVC, Anomalous coronary artery, Myocarditis, CPVT
- ECG Screening programs likely find:
  - ~3% ECGs that lead to further workup

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Arguments for ECG screening

- The current pre-participation examination likely misses a lot of patients at risk for SCA
- A person at risk for SCA may not have prior symptoms
- Italian studies showed that implementation of a comprehensive screening program with an ECG helped exclude 2% of athletes from sports and reduced the incidence of athletic SCA
- ECGs can be easily performed

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So why is this even debated?

- False-positives creates anxiety for that person/family
- False-negatives (although this is hard to escape)
- SCA is dramatic but not a population health problem
- Italian results have not been reproduced (homogenous population?)
- The management for many conditions identified is not clear cut especially when they are asymptomatic
  - Do we restrict asymptomatic children from sports?
  - Treat them with medications?
  - Perform procedures on them?
- When the specter of SCA is raised it's impossible to pretend it doesn't exist

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WHO criteria for a good screening test

- An important health problem
- A recognizable latent or early symptomatic stage
- The natural history of the condition should be adequately understood
- Accepted treatment for patients with disease
- The test has a high level of accuracy
- The test should be acceptable to the population
- There should be an agreed policy on whom to treat as patients
- Facilities for diagnosis and treatment should be available
- The cost (including diagnosis and treatment) should be economically balanced in relation to possible expenditure on medical care as a whole
- Screening should be a continuing process

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How do screening programs perform?

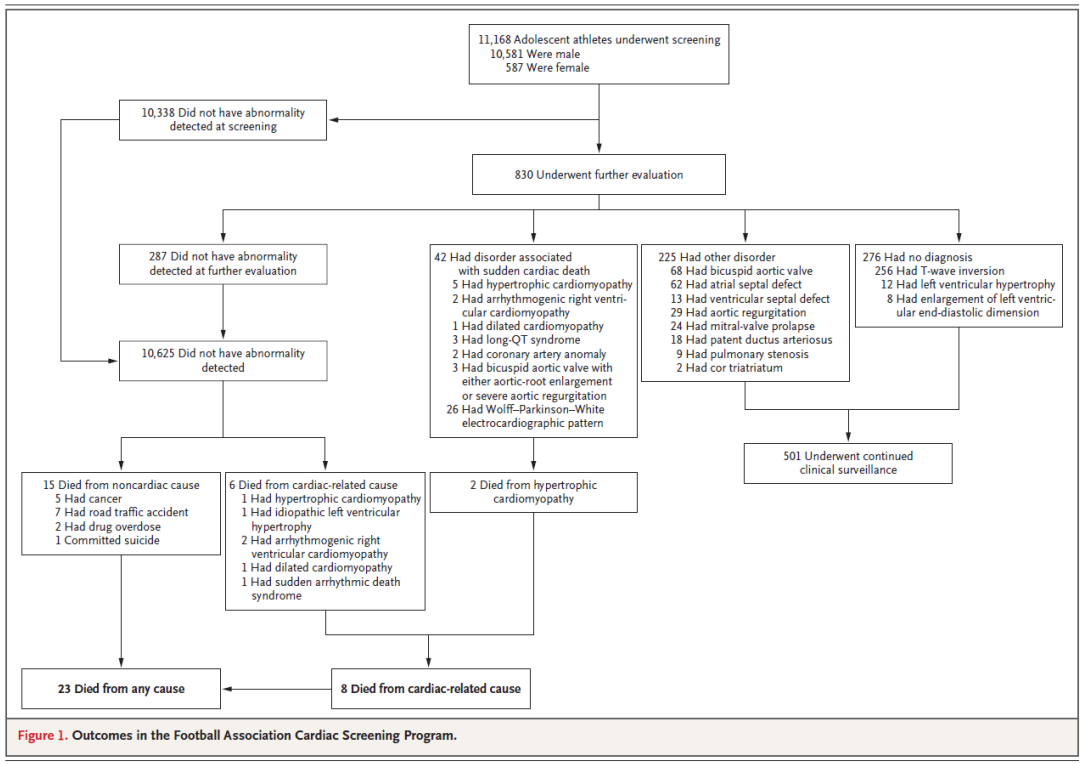

Figure 1. **Outcomes in the Football Association Cardiac Screening Program.**

- English soccer screening program over 20-year period
- Screening included history, exam, ECG, and **echocardiogram**
- 23 died during study
- 8 died from SCA including 6 who were cleared

Malhotra A, Dhutia H, Finocchiaro G, Gati S, Beasley I, Clift P, Cowie C, Kenny A, Mayet J, Oxborough D, Patel K, Pieles G, Rakhit D, Ramsdale D, Shapiro L, Somauroo J, Stuart G, Varnava A, Walsh J, Yousef Z, Tome M, Papadakis M, Sharma S. Outcomes of Cardiac Screening in Adolescent Soccer Players. N Engl J Med. 2018 Aug 9;379(6):524-534. doi: 10.1056/NEJMoa1714719. PMID: 30089062.

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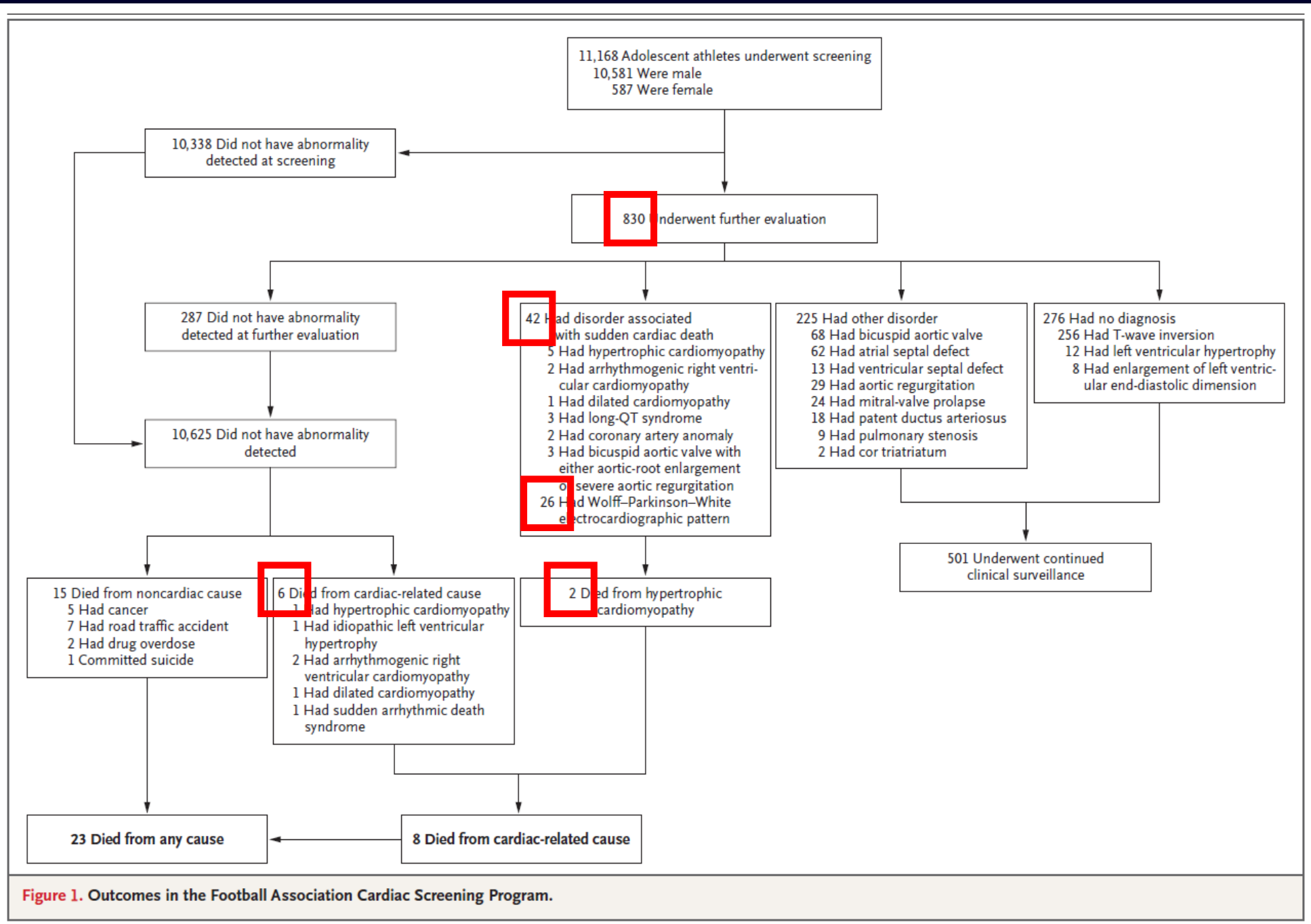

Figure 1. Outcomes in the Football Association Cardiac Screening Program.

What are we considering in Wisconsin?

- SB 95: “information about sudden cardiac arrest during youth athletic activities”
- Piggybacking on the concussion law of 2012 that informed students and parents – requiring a signature
- SB 95 aims to provide an information sheet to students and parents about SCA that should include:
  1. Signs and symptoms of SCA
  2. Benefits and risks of an ECG
  3. How to access ECG testing
- The proposed bill looks promising as it strikes the balance between lack of information and mandating ECG screening

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Just athletes?

- New AAP statement looks to broaden scope to focus on SCA prevention in all kids (not just athletes)
- Discusses both primary and secondary prevention:
  - Primary: Screening that aims to prevent SCA
  - Secondary: The response to SCA that can save a life
- Highlights 4 questions for all PCPs to ask regarding SCA risk
- Recommends an ECG as the first test if concerns present
- Strongly recommends ECG interpretation by pediatric cardiologists/electrophysiologists

Erickson CC, Salerno JC, Berger S, Campbell R, Cannon B, Christiansen J, Moffatt K, Pflaumer A, Snyder CS, Srinivasan C, Valdes SO, Vetter VL, Zimmerman F; SECTION ON CARDIOLOGY AND CARDIAC SURGERY, PEDIATRIC AND CONGENITAL ELECTROPHYSIOLOGY SOCIETY (PACES) TASK FORCE ON PREVENTION OF SUDDEN DEATH IN THE YOUNG. Sudden Death in the Young: Information for the Primary Care Provider. Pediatrics. 2021 Jun 21:e2021052044. doi: 10.1542/peds.2021-052044. Epub ahead of print. PMID: 34155130.

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Role of the Licensed Athletic Trainer

- Services include prevention, emergency care, and therapeutic intervention
- Helps determine an athlete's readiness to participate and, if necessary, consults with the supervising team physician and/or treating physician
- Helps identify unsafe facilities or playing environments
- Participates in developing and implementing an emergency action plan in collaboration with team physicians
- Can be important advocates for CPR and AEDs in public areas, including schools, athletic fields, and arenas

Erickson CC, Salerno JC, Berger S, Campbell R, Cannon B, Christiansen J, Moffatt K, Pflaumer A, Snyder CS, Srinivasan C, Valdes SO, Vetter VL, Zimmerman F; SECTION ON CARDIOLOGY AND CARDIAC SURGERY, PEDIATRIC AND CONGENITAL ELECTROPHYSIOLOGY SOCIETY (PACES) TASK FORCE ON PREVENTION OF SUDDEN DEATH IN THE YOUNG. Sudden Death in the Young: Information for the Primary Care Provider. Pediatrics. 2021 Jun 21:e2021052044. doi: 10.1542/peds.2021-052044. Epub ahead of print. PMID: 34155130.

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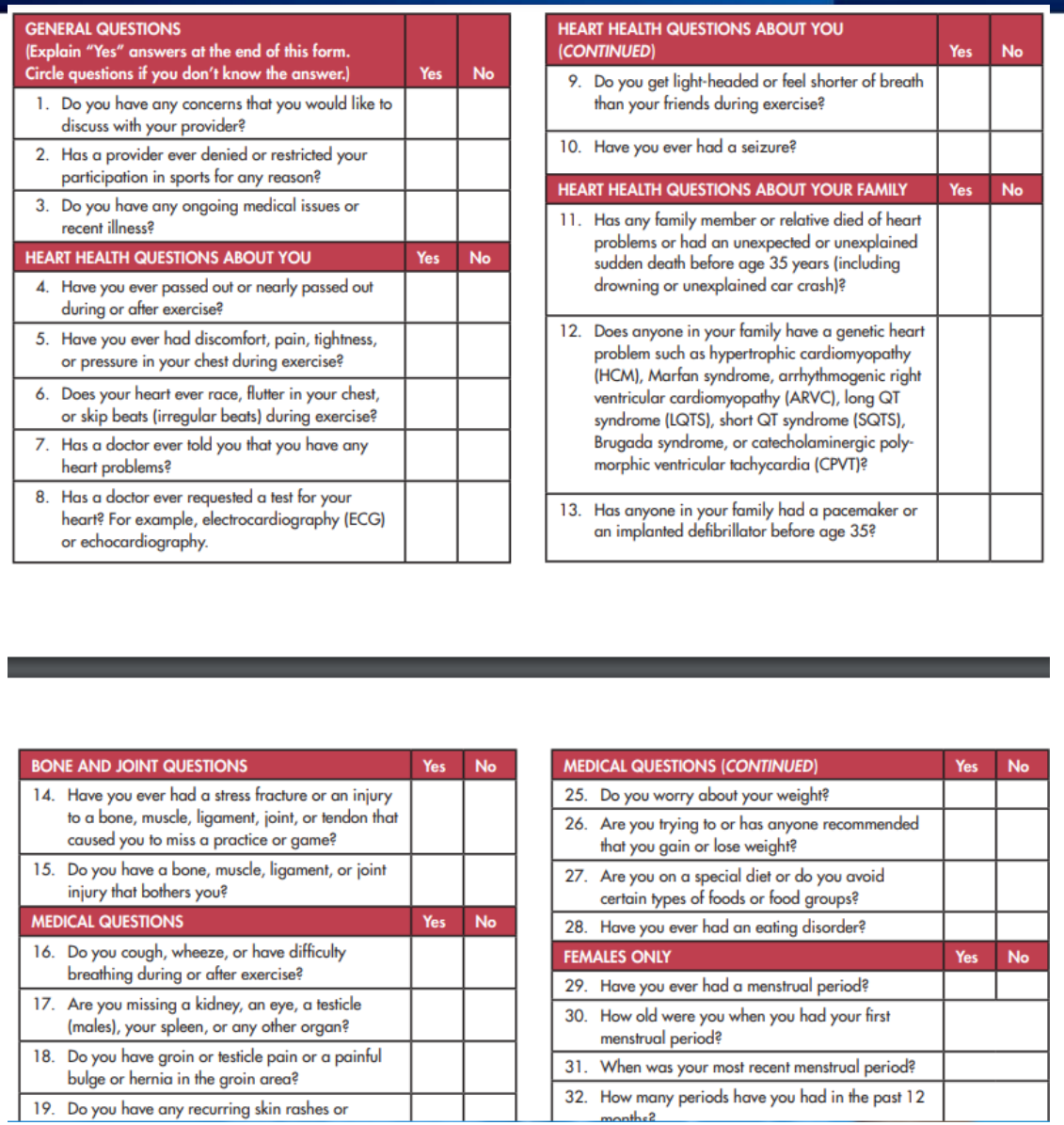
At a minimum …

Screens broadly for:

- Cardiac
- Orthopedic
- Neurologic
- Eating disorder
- Psychiatric
- Supplement use
- And more



GENERAL QUESTIONS (Explain "Yes" answers at the end of this form. Circle questions if you don't know the answer.)	Yes	No
1. Do you have any concerns that you would like to discuss with your provider?		
2. Has a provider ever denied or restricted your participation in sports for any reason?		
3. Do you have any ongoing medical issues or recent illness?		
HEART HEALTH QUESTIONS ABOUT YOU	**Yes**	**No**
4. Have you ever passed out or nearly passed out during or after exercise?		
5. Have you ever had discomfort, pain, tightness, or pressure in your chest during exercise?		
6. Does your heart ever race, flutter in your chest, or skip beats (irregular beats) during exercise?		
7. Has a doctor ever told you that you have any heart problems?		
8. Has a doctor ever requested a test for your heart? For example, electrocardiography (ECG) or echocardiography.		

HEART HEALTH QUESTIONS ABOUT YOU (*CONTINUED*)	Yes	No
9. Do you get light-headed or feel shorter of breath than your friends during exercise?		
10. Have you ever had a seizure?		
HEART HEALTH QUESTIONS ABOUT YOUR FAMILY	**Yes**	**No**
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)?		
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)?		
13. Has anyone in your family had a pacemaker or an implanted defibrillator before age 35?		

BONE AND JOINT QUESTIONS	Yes	No
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?		
15. Do you have a bone, muscle, ligament, or joint injury that bothers you?		
MEDICAL QUESTIONS	**Yes**	**No**
16. Do you cough, wheeze, or have difficulty breathing during or after exercise?		
17. Are you missing a kidney, an eye, a testicle (males), your spleen, or any other organ?		
18. Do you have groin or testicle pain or a painful bulge or hernia in the groin area?		
19. Do you have any recurring skin rashes or		

MEDICAL QUESTIONS (*CONTINUED*)	Yes	No
25. Do you worry about your weight?		
26. Are you trying to or has anyone recommended that you gain or lose weight?		
27. Are you on a special diet or do you avoid certain types of foods or food groups?		
28. Have you ever had an eating disorder?		
FEMALES ONLY	**Yes**	**No**
29. Have you ever had a menstrual period?		
30. How old were you when you had your first menstrual period?		
31. When was your most recent menstrual period?		
32. How many periods have you had in the past 12 months?		

My challenge

- 15 year-old girl presents with syncope
- 3 episodes of exertional syncope during cross country races
- While pushing herself in a race she collapses without warning
- Has two more events in a week – described as falling suddenly
- No other symptoms

Evaluation

- History of 5 seizures from 18 to 36 months – goes limp, foaming, convulsions
- Family history – nothing concerning
- Physical Exam – normal
- ECG – normal (QTc – 420 msec)
- Echo – normal
- Stress test – supine QTc of 445 msec goes to 520 msec with standing. Normal QTc with exercise and recovery.
- Putative diagnosis of Long QT Syndrome (LQTS) is made

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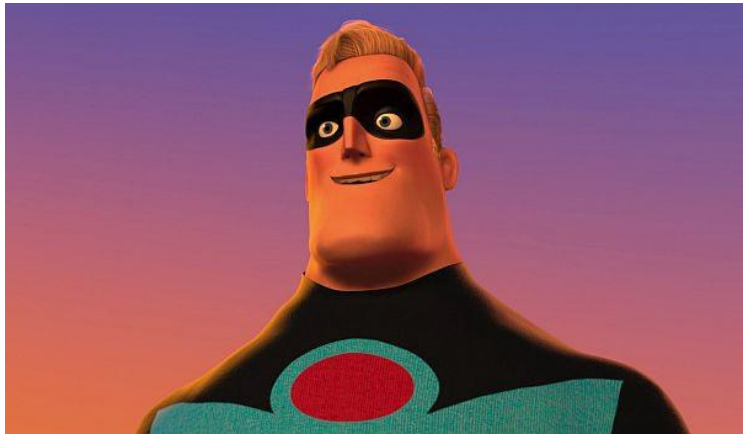
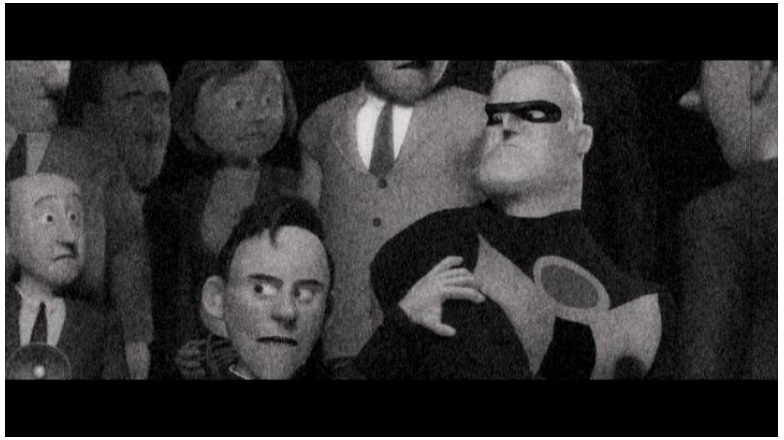
What next? (the next 3 months)

- Restricted from sports
- Started on a medicine (beta-blocker)
- Genetic testing sent for LQTS
- ECGs requested from parents and siblings
- Tilt-test – normal (no syncope)
- Tearful patient, scared parents, uncertain physician





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Follow up

- Normal 1st degree relative ECGs
- Normal genetic testing for LQTS
- Perform cardiac cath and EP study – both normal
- Implant loop recorder (small cardiac monitor)
- Stop beta-blockers
- Let her play sports
- 3 years later – no events and monitor is removed
- 5-6 years later patient is diagnosed with a benign brain tumor

My final thoughts

- Doing nothing is not an option with all that we know
- Forcing (mandating) ECG screening isn't correct either
- The best we can do is to educate people about the options that exist. This informed consent will be the tricky part.
- Regardless, the PPE is an opportunity for health screening
- Athletic SCA is dramatic but more SCA occurs with inactivity than during sports.
- An ECG is an unusual (and challenging) screening tool because it looks for so many different diseases.
- As an "expert" I struggle in many cases, trying to determining if someone has a risk for SCA or not.

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