THE LEARNER WILL:

• Identify the case factors, such as pretest probability, that contribute to this decision
• Become aware of local factors that may limit the quality of the test
• Be able to apply EBM to this decision (and to know when there is no evidence)
• See the ordering of the test as part of a strategy
Commonly Ordered Tests

Clinical setting: outpt, non-newborn

- EKG
- Echocardiogram
- Chest x-ray
- Holter monitor, event detector
- Exercise stress test
- Cardiac MR
Common indications for cardiac tests in kids

- Chest pain
- Syncope
- Heart murmur
- Risk of sudden cardiac death
  - Sports participation; ADHD meds
- + Family history
- “Routine,” “Pre-op,” etc.
Questions to ask yourself

• What is the purpose?
  – Looking for specific dx? Ruling out? Screening?
• What are the alternatives?
  – no test, different test, consultation
• Where/who to do the test?
  – Quality control--operator dependent
  – Peds lab v. general lab
  – Who will interpret it?
EKGs—sources of error

- **Poor technique**
  - Incorrect lead placement
  - Switcheroo
  - Touching leads

- **Artifact**
  - Noise
  - Movement—e.g., vent, hiccups, butt-pat
Echoes—sources of error

TNTC!

• Especially false negatives
• Important variables
  – Highly operator-dependent
  – Highly equipment-dependent
  – Highly interpreter-dependent
• What are you looking for?
Questions to ask yourself

• What is the purpose?
  – Looking for specific dx? Ruling out? Screening?

• Where to do the test?
  – Quality control--operator dependent
  – Peds lab v. general lab
  – Who will interpret it?

• What are the alternatives?
  – no test, different test, consultation

• What is the pretest probability? Likelihood ratio? Cost? Accessibility?
Likelihood Ratio

Change in probability of disease after a positive test, LR = 6.4

Change in probability of disease after a negative test, LR = 0.33
Questions to ask yourself

- What will I do with the results?
  - Explain them?
  - Explain the limitations of the test?
  - Next steps?
% Yield of Echo by Ordering MD

<table>
<thead>
<tr>
<th>Indication</th>
<th>PCP</th>
<th>PedCard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murmur</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>Palpitations</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Systemic d/o</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Chest pain</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Syncope</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Lang, *Pediatr Cardiol* 2017
Common indications for cardiac tests in kids

- Chest pain
- Syncope
- Heart murmur
- Risk of sudden cardiac death
  - Sports participation; ADHD meds
- + Family history
- “Routine,” “Pre-op,” etc.
Heart Murmur as Indication

- EKG has low sensitivity and specificity
- Echo has high sensitivity and specificity but is expensive/resource-heavy
  - Do you really need it to answer the question?
  - Don’t assume the cardiologist would do one.
Murmur Evaluations—consult v. echo

<table>
<thead>
<tr>
<th>Referral Group, %</th>
<th>Echocardiography Group, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>&lt;2 mo</td>
<td>15</td>
</tr>
<tr>
<td>2–3 mo</td>
<td>14</td>
</tr>
<tr>
<td>4–12 mo</td>
<td>13</td>
</tr>
<tr>
<td>13–36 mo</td>
<td>20</td>
</tr>
<tr>
<td>3–6 y</td>
<td>24</td>
</tr>
<tr>
<td>≥7 y</td>
<td>14</td>
</tr>
<tr>
<td>Male/female</td>
<td>56/44</td>
</tr>
<tr>
<td>Asymptomatic</td>
<td>87</td>
</tr>
<tr>
<td>Had echocardiogram</td>
<td>40</td>
</tr>
<tr>
<td>Innocent</td>
<td>63</td>
</tr>
<tr>
<td>Trivial</td>
<td>24</td>
</tr>
<tr>
<td>Significant</td>
<td>13</td>
</tr>
</tbody>
</table>

Danford, *Pediatrics* 1993
Danford 1993 Results

• “Echocardiography-first strategy costs were $257/pt greater than referral-strategy costs.”

• To even it out, hypothetically:
  – Echo cheap (but still as accurate)
  – Consult expensive
  – Cardiologists not selective in ordering echoes

Danford, *Pediatrics* 1993
Echo Yield for Murmurs

Lang, Pediatr Cardiol 2017
Appropriate Use Criteria

• Echocardiogram for Murmurs
  – Presumptively innocent murmur, asx, rest of PE normal, FH unremarkable: RARE
  – Presumptively innocent murmur with s/s of heart dz: APPROPRIATE
  – Pathologic murmur: APPROPRIATE

ACC/AAP/AHA/ASE…
Campbell, JACC 2014
Effect of Teaching Appropriate Use Criteria

Bhatia, JACC 2014
So much easier than parenting.

RITALIN
Cardiac Events and ADHD Rx

Figure 1. Adjusted Rates of Serious Cardiovascular Events, According to the Use of ADHD Drugs.

Cooper, NEJM 2011
Screening practices in ADHD Pts: most recent patient seen

Leslie, *Pediatrics* 2012
“High School Star Dies Soon After Hitting Winning Shot”

THE ASSOCIATED PRESS       MARCH 4, 2011
Screening for SCDY

“The broad ethical challenge is to balance the potential benefits and risks of preventing SCD in an environment in which there is uncertainty about its causes, measures to evaluate risk, and the effectiveness of interventions to reduce risk.”

Kaltman, Circulation 2011
Pre-participation Screening
AHA recommendations

• Personal history
  – Exertional chest pain
  – Unexplained syncope
  – Excessive fatigue
  – History of murmur
  – History of HTN

• Family history
  – Premature death
  – Cardiac disability <50y
  – Syndromes (~LQTS)

• Physical exam
  – Murmur
  – Femoral pulses
  – Marfan stigmata
  – BP

• EKG???
  Only if above is positive!

Maron, Circulation 2007
Examples:

• EKG in infant whose mother has lupus

• Echocardiogram in baby with Down syndrome
Bad Ideas for Cardiac Tests

- EKG in ADHD patient with CV evaluation and FH both negative
- Repeat EKG in ADHD patient with CV evaluation and FH both negative for Rx change
- Echocardiogram for recurrent chest pain at rest
When you DO order the test...

Ask yourself

• What is the purpose?
• What are the alternatives?
• Where/who to do the test?
• Who will interpret it?
• What will I do with the results?
rdorosho@childrensnational.org  (no W!)

Subject line: “References from CNHN 2017”