In a patient with symptoms consistent with an intermediate pretest probability, is imaging warranted?

What are the indications for imaging vs standard stress test?
3 Steps for Evaluation

• Step 1: What is patients pre-test probability of ischemia (i.e. is a stress test indicated)?
• Step 2: If yes (typically intermediate probability), then ask if they can exercise?
• Step 3: Is an imaging test indicated?
Angina Features

1. Substernal chest pain or discomfort
2. Provoked by exertion or emotional stress
3. Relieved by rest and/or nitroglycerin

Typical angina is all 3 features.
Atypical angina is 2 of 3 features.
Non anginal chest pain is 1 of 3 features.
Pretest Probability

• History, Risk factors, ECG findings.

• Low, Very Low:
  – Absence of risk factors
  – Atypical sx (chronic, unusual character, no relation to activity)

• Intermediate:

• High:
  – Risk Factors
  – Typical angina or probable
<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Typical Angina</th>
<th>Atypical Angina</th>
<th>Non-Anginal Chest Pain</th>
<th>Asympt.</th>
</tr>
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<tbody>
<tr>
<td>30-39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very Low</td>
<td></td>
<td></td>
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<tr>
<td>40-49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
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<td></td>
<td>Very Low</td>
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<td>50-59</td>
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<td>Intermediate</td>
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<tr>
<td></td>
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<td>Low</td>
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<tr>
<td>60-69</td>
<td>Men</td>
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<td>Intermediate</td>
<td>Intermediate</td>
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</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>
Which Patients Need Imaging?

- Significant baseline (> 1mm) ST segment changes
- Digitalis (they have to be off of medication for 7 days to qualify for routine treadmill stress testing)
- Left Ventricular Hypertrophy
- Pre-excitation (WPW)
- LBBB
- Ventricular Paced Rhythm
Since none of the noninvasive tests correlate perfectly with coronary angiography, none are truly “diagnostic”

Instead, CAD probability simply shifts according to the test results
Diagnostic Accuracy of ETT, SPECT, and Echo

- ETT: Sensitivity 68%, Specificity 77%
- SPECT: Sensitivity 87%, Specificity 73%
- Echo: Sensitivity 86%, Specificity 81%
Bayes Theorem
ETT has its maximal diagnostic value in patients with intermediate (10-90%) pretest probability (Class I indication)

ETT is of little value in very low (<10%) or very high (>90%) pretest probability. (Class IIb indication)
Mayo Clinic Study
AIM 1994;121:825-32

• Comparison of clinical, ETT, and nuclear imaging variables

• Patients classified as low, medium, and high risk

• Only 3% (14 out 411) were correctly reclassified by the addition of imaging

• Most reclassified from intermediate to low risk by addition of imaging
“The standard ETT is the procedure of choice, rather than stress imaging, for noninvasive assessment of CAD in a patient without prior coronary revascularization who is capable of adequate exercise and who has a normal or near normal resting ECG.”

ACCSAP8: Exercise Testing
ACC/AHA guidelines recommend stress imaging for:

• Inability to exercise requiring pharmacologic stress
• Significant abnormalities of the resting ECG that preclude interpretation of the stress ECG
• Prior revascularization where localization of ischemia is frequently an important clinical issue
Stress Testing in Patients with CAD History

Are there any indications for annual or periodic stress testing in an asymptomatic patient?
“For asymptomatic individuals, the ETT, with or without imaging to screen for CAD, is generally discouraged by ACC/AHA guidelines”

2010 ACC/AHA guideline for assessment of cardiovascular risk in asymptomatic adults. JACC 2010;56:e50-103
Stable Ischemic Heart Disease

2012
ACC/AHA/ACP/AATS/PCNA/SCAI/STS
Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease

J Am Coll Cardiol. 2012;60(24):e44-e164
Four-Year Risk of Cardiovascular Death, Myocardial Infarction, or Stroke in the REACH Registry

![Graph showing cumulative incidence of CV death, MI, or stroke over time for different groups.]

<table>
<thead>
<tr>
<th>No. at Risk</th>
<th>Time, Months</th>
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</thead>
<tbody>
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<td>Total population</td>
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<td>45,227</td>
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<td>44,038</td>
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<td>25,417</td>
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<td>21,890</td>
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<tr>
<td>21,159</td>
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<td>13,977</td>
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<tr>
<td>12,210</td>
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<td>Stable atherosclerosis without ischemic event at baseline</td>
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<td>4,372</td>
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</tbody>
</table>

The graph illustrates the cumulative incidence of cardiovascular death, myocardial infarction, or stroke over a four-year period for different subgroups within the REACH Registry.
# Noninvasive Risk Stratification

## High Risk (>3% annual mortality rate)

1. Severe resting LV dysfunction (LVEF <35%)
2. High-risk Duke treadmill score (score ≤ -11)
3. Severe exercise-induced LV dysfunction (exercise LVEF <35%)
4. Stress-induced large perfusion defect (particularly if anterior)
5. Stress-induced multiple perfusion defects of moderate size
6. Large, fixed perfusion defect with LV dilation or increased lung uptake (thallium-201)
7. Stress-induced moderate perfusion defect with LV dilation or increased lung uptake (thallium-201)
8. Echocardiographic wall-motion abnormality (involving >2 segments) developing at a low dose of dobutamine (≤10 mg/kg/min) or at a low heart rate (<120 bpm)
9. Stress echocardiographic evidence of extensive ischemia

## Intermediate Risk (1-3% annual mortality rate)

1. Mild/moderate resting LV dysfunction (LVEF 35-49%)
2. Intermediate-risk Duke treadmill score (-11 < score < 5)
3. Stress-induced moderate perfusion defect without LV dilation or increased lung intake (thallium-201)
4. Limited stress echocardiographic ischemia with a wall-motion abnormality only at higher doses of dobutamine involving ≤2 segments

## Low Risk (<1% annual mortality rate)

1. Low-risk Duke treadmill score (score ≥5)
2. Normal or small myocardial perfusion defect at rest or with stress
3. Normal stress echocardiographic wall motion or no change of limited resting wall motion abnormalities during stress
“Stress testing, both by exercise or pharmacologic stress, provides an enormous amount of prognostic information, and unless contraindicated, should be performed in all patients with suspected or known SIHD to evaluate the presence and burden of ischemia”

“Whenever possible, exercise stress testing is preferred to pharmacologic stress testing because exercise capacity and recovery provide significant incremental prognostic information beyond the assessment of ischemia, and because it is the more cost-efficient option”

(ACC/AHA 2002 guideline update for exercise testing)
Appropriate Use Criteria for Cardiac Radionuclide Imaging for Patients with Ischemic Symptoms or Prior Revascularization

**Acute Equivalent**
- **Acute**: Inappropriate
- **Definite**
  - ACS
    - **Inappropriate**
    - Possible
      - Low: ECG Interpretable AND Able to Exercise?
        - Yes
          - Appropriate
        - No
          - Inappropriate
      - Intermediate/High
        - Pretest Probability
          - Low
          - Intermediate/High

**Post-Revascularization**
- Symptomatic?
  - Yes: Appropriate
  - No
    - Incomplete Revascularization?*
      - Yes: Appropriate
      - No
        - Prior PCI or prior CABG?
          - Yes
            - Prior PCI <2 years?
              - Yes
                - Appropriate
              - No: Uncertain
          - No: Uncertain
          - Prior CABG <5 years?
            - Yes: Appropriate
            - No: Uncertain
Why Would You?

• Symptoms? No
• Assess Prognosis
• Assess adequacy of medical therapy (BP, HR, rhythm)
• Exercise prescription, safety
• Main reason: Prevent coronary events through revascularization
4 Categories of Risk Stratification
(Stable Ischemic Heart Disease ACC/AHA SAP 8)

• Clinical evaluation and assessment of comorbidities
• Functional capacity/stress test
• Ventricular function
• Coronary anatomy
Risk Stratification
(Stable Ischemic Heart Disease ACC/AHA SAP 8)

• “In general, the goal is to identify patients at the highest risk who will benefit from the most intense therapy while reassuring and sparing invasive procedures in those at lower risk”

• A low risk patient may only require clinical evaluation and stress test or echo while a high risk patient may need to go directly to cardiac catheterization
Clinical predictors of Prognosis in CAD

- Age
- Smoking
- HTN
- Hyperlipidemia
- Obesity
- Sedentary
- DM
- COPD
- Extent of CAD
- Depression
- Poor functional status
- Angina (severity)
- CHF/LVEF
- CKD
- OSA
- PVD
- Poor social support
Close clinical f/u and aggressive secondary prevention

• Adherence to evidence-based medical regimen
• Exam, BP, HR, Lipids, Glucose, HbA1C
• Review of records/procedures
• TLC – exercise, diet, smoking cessation
• Functional status/capacity
• Comorbidities
• Symptoms/limitations
Goals

• What is the incremental benefit?
• What is the harm?
• Is the patient a candidate for revascularization?
• Do they want it?
• Shared decision-making
Echocardiograms

Which patients with murmurs require an echocardiogram, both for surveillance of existing murmurs and newly diagnosed murmurs?
Choosing Wisely
An initiative of the ABIM Foundation

American Society of Echocardiography

Five Things Physicians and Patients Should Question

1. Don’t order follow up or serial echocardiograms for surveillance after a finding of trace valvular regurgitation on an initial echocardiogram.
   Trace mitral, tricuspid and pulmonic regurgitation can be detected in 70% to 90% of normal individuals and has no adverse clinical implications. The clinical significance of a small amount of aortic regurgitation with an otherwise normal echocardiographic study is unknown.

2. Don’t repeat echocardiograms in stable, asymptomatic patients with a murmur/click, where a previous exam revealed no significant pathology.
   Repeat imaging to address the same question, when no pathology has been previously found and there has been no clinical change in the patient’s condition, is not indicated.

3. Avoid echocardiograms for preoperative/perioperative assessment of patients with no history or symptoms of heart disease.
   Perioperative echocardiography is used to clarify signs or symptoms of cardiovascular disease, or to investigate abnormal heart tests. Resting left ventricular (LV) function is not a consistent predictor of perioperative ischemic events; even reduced LV systolic function has poor predictive value for perioperative cardiac events.

4. Avoid using stress echocardiograms on asymptomatic patients who meet “low risk” scoring criteria for coronary disease.
   Stress echocardiography is mostly used in symptomatic patients to assist in the diagnosis of obstructive coronary artery disease. There is very little information on using stress echocardiography in asymptomatic individuals for the purposes of cardiovascular risk assessment, as a stand-alone test or in addition to conventional risk factors.

5. Avoid transesophageal echocardiography (TEE) to detect cardiac sources of embolization if a source has been identified and patient management will not change.
   Tests whose results will not alter management should not be ordered. Protocol-driven testing can be useful if it serves as a reminder not to omit a test or procedure, but should always be individualized to the particular patient. While TEE is safe, even the small degree of risk associated with a procedure is not justified if there is no expected clinical benefit.

These items are provided solely for informational purposes and are not intended as a substitute for consultation with a medical professional. Patients with any specific questions about the items on this list or their individual situation should consult their physician.
Appropriate Use Criteria in Echocardiography

- Expert panel
- Echo indications are scored 1-9
- Appropriate, 7-9
- Uncertain, 4-6
- Inappropriate, 1-3
- (Idiotic, 0)
Appropriate Use Criteria in Echocardiography

- Retrospective review of medical records, 535 consecutive TTEs.
- 80 to 91.8% appropriate as judged by the 2011 appropriate use criteria (AUC)
- Only 31.8% resulted in active change in care
Murmur or Click With TTE

• Initial evaluation when there is a reasonable suspicion of valvular or structural heart disease A (9)
• Initial evaluation when there are no other symptoms or signs of valvular or structural heart disease I (2)
• Re-evaluation in a patient without valvular disease on prior echocardiogram and no change in clinical status or cardiac exam I (1)
• Re-evaluation of known valvular heart disease with a change in clinical status or cardiac exam or to guide therapy A (9)

Appropriate Use Criteria for Echocardiography, JASE March, 2011
Native Valvular Stenosis With TTE

• Routine surveillance (<3 y) of mild valvular stenosis without a change in clinical status or cardiac exam I (3)
• Routine surveillance (>3 y) of mild valvular stenosis without a change in clinical status or cardiac exam A (7)
• Routine surveillance (<1 y) of moderate or severe valvular stenosis without a change in clinical status or cardiac exam I (3)
• Routine surveillance (>1 y) of moderate or severe valvular stenosis without a change in clinical status or cardiac exam A (8)

Appropriate Use Criteria for Echocardiography; JASE March, 2011
Native Valvular Regurgitation With TTE

- Routine surveillance of trace valvular regurgitation I (1)
- Routine surveillance (<3 y) of mild valvular regurgitation without a change in clinical status or cardiac exam I (2)
- Routine surveillance (>3 y) of mild valvular regurgitation without a change in clinical status or cardiac exam U (4)
- Routine surveillance (<1 y) of moderate or severe valvular regurgitation without a change in clinical status or cardiac exam U (6)
- Routine surveillance (>1 y) of moderate or severe valvular regurgitation without change in clinical status or cardiac exam A (8)

Appropriate Use Criteria for Echocardiography, JASE March, 2011
Bottom Line – Stenosis

• Mild: follow symptoms and exam. OK to recheck at ≥3 yrs or with a clinical change

• Moderate or Severe: follow symptoms and exam. OK to recheck at ≥1 yr or with a clinical change

• Stenosis is more predictable, less risk of missing surgical window, symptoms are the main indication for surgery.
Bottom Line – Regurgitation

• Mild: Mild regurgitation is COMMON. Uncertain if ANY echo f/u is appropriate absent a clinical change.

• Moderate or Severe: Repeat echo may be appropriate (sometimes <1 yr), even without clinical change.

• Less predictable, more risk of missing surgical window, may progress and require surgery without symptoms