The Appropriate Use of Cardiac Imaging: What, Why, and How

Provided by the American Society of Nuclear Cardiology in Collaboration with AIM Specialty Health

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Disclosure

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CME Information

- Physicians who participate in today’s webinar are eligible to earn up to 1.0 AMA PRA Category 1 Credit™
- Information on the evaluation and the CME certificate process will be given at the end of this presentation
- Only registered attendees will be able to receive CME credit
The Appropriate Use of Cardiac Imaging: What, Why, and How

AUC INTRODUCTION

Robert C. Hendel, MD, FACC, FAHA, FASNC
Professor of Medicine and Radiology
Chief, Cardiovascular Division (Interim)
Director, Cardiac Care Unit
Director, Cardiac Imaging

IMAGING UTILIZATION AND A NEED FOR GUIDANCE

Background

- Unprecedented focus on assessment and improving quality
- Explosive growth of CV imaging
- Substantial regional variation
- True nature of utilization unknown
  - Overuse/Under-use/Appropriate
- Clinicians, patients, and especially payers seeking guidance

ACCF APPROPRIATENESS USE CRITERIA

- Literature-based (when possible) approach to improve utilization of resource-intensive tests and procedures
  - Developed by physicians/providers
  - Initial focus on cardiac imaging
  - Expansion to revascularization, potential for other procedures
- Serves as a method for focused reduction of procedures based on clinical value, not indiscriminant volume reduction
- Preserves patient/provider relationship
- Provides for continued patient access
DEVELOPMENT OF CLINICAL PRACTICE GUIDELINES, PERFORMANCE MEASURES, AND APPROPRIATE USE DOCUMENTS

1. Increase use of effective therapies
2. Decrease use of inappropriate, unnecessary, potentially harmful therapies

CLINICAL PRACTICE GUIDELINES

PERFORMANCE MEASURES

APPROPRIATE USE CRITERIA

Balancing the Risks and Benefits

Benefit of imaging needs to guide patient management decision making

Radiation exposure and stress test risk is less than potential CV risk reduction following targeted treatment

No clear benefit of imaging to guide patient management decision making

Lack of benefit

Radiation exposure and stress test risk is less than potential CV risk reduction following targeted treatment

Future sources of evidence:
- Comparative effectiveness
- Patient preference

EVIDENCE

RCTs*, REGISTRIES

APPROPRIATE USE CRITERIA

Balancing the Risks and Benefits

Benefit of imaging needs to guide patient management decision making

Radiation exposure and stress test risk is less than potential CV risk reduction following targeted treatment

No clear benefit of imaging to guide patient management decision making

Lack of benefit

Radiation exposure and stress test risk is less than potential CV risk reduction following targeted treatment


Appropriate Use Criteria for Stress RNI

Appropriate Use Criteria for Stress RNI

An appropriate diagnostic or therapeutic procedure is one in which the expected clinical benefit exceeds the risks of the procedure by a sufficiently wide margin such that the procedure is generally considered acceptable or reasonable care.
EXAMPLE OF MULTIMODALITY RATING

Indication:...

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Exercise</th>
<th>Stress</th>
<th>Treadmill</th>
<th>Calcium</th>
<th>QRS</th>
<th>HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>M</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>M</td>
<td>R</td>
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</tr>
<tr>
<td>3.</td>
<td>A</td>
<td>A</td>
<td>M</td>
<td>W</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>A</td>
<td>A</td>
<td>M</td>
<td>W</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>A</td>
<td>A</td>
<td>M</td>
<td>W</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>A</td>
<td>A</td>
<td>M</td>
<td>W</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

Wolk MJ et al., 2014
J Am Coll Cardiol 63: 380

80 Indications
Similar format to prior documents
MULTIMODALITY AUC
Key Points

- Guided by pre-test probability, exercise ability, ECG interpretability
  - Stress radionuclide and echo imaging are appropriate for most categories
- For asymptomatic patients, only exercise ECG is appropriate for high-risk patients who can exercise and had an interpretable ECG
- Follow-up testing is largely inappropriate in asymptomatic patients or those stable symptoms*
- Among asymptomatic patients who have undergone revascularization, only those with incomplete revascularization should be tested
- For preoperative assessment, testing is indicated only for high risk surgery in patients with poor or unknown functional capacity who also have ≥1 risk factor

EVALUATION OF APPROPRIATENESS
FOR RADIONUCLIDE IMAGING

<table>
<thead>
<tr>
<th>Study</th>
<th>Appropriate</th>
<th>Uncertain</th>
<th>Inappropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hendel, 2006</td>
<td>83%</td>
<td>6%</td>
<td>11%</td>
</tr>
<tr>
<td>Mehta, 2006</td>
<td>78%</td>
<td>5%</td>
<td>8%</td>
</tr>
<tr>
<td>Ayyad, 2007</td>
<td>85%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Druz, 2007</td>
<td>57%</td>
<td>33%</td>
<td>10%</td>
</tr>
<tr>
<td>Gaziantep, 2007</td>
<td>55%</td>
<td>28%</td>
<td>17%</td>
</tr>
<tr>
<td>Al-Malik, 2007</td>
<td>75%</td>
<td>12%</td>
<td>13%</td>
</tr>
<tr>
<td>Glidden, 2008</td>
<td>64%</td>
<td>11%</td>
<td>14%</td>
</tr>
<tr>
<td>Hendel, 2009</td>
<td>71%</td>
<td>15%</td>
<td>14%</td>
</tr>
<tr>
<td>Glidden, 2010</td>
<td>66%</td>
<td>15%</td>
<td>7%</td>
</tr>
<tr>
<td>Koh, 2010</td>
<td>82%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Carryer, 2010</td>
<td>60%</td>
<td>16%</td>
<td>24%</td>
</tr>
<tr>
<td>Gupta, 2011</td>
<td>84%</td>
<td>5%</td>
<td>11%</td>
</tr>
<tr>
<td>Lin, 2013</td>
<td>53%</td>
<td>29%</td>
<td>15%</td>
</tr>
<tr>
<td>Lalude, 2014</td>
<td>77%</td>
<td>10%</td>
<td>13%</td>
</tr>
<tr>
<td>Madhukumar, 2014</td>
<td>84%</td>
<td>9%</td>
<td>7%</td>
</tr>
<tr>
<td>Singh, 2014</td>
<td>86%</td>
<td>7%</td>
<td>5%</td>
</tr>
</tbody>
</table>
ACCF/UNITED HEALTHCARE
Appropriateness Classification (n=5,928)

<table>
<thead>
<tr>
<th>INDICATION</th>
<th>% INAPPROPRIATE INDICATIONS</th>
<th>% TOTAL STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection of CAD: Asymptomatic, low CHD risk</td>
<td>44.5%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Asymptomatic, post-revascularization &lt; 2 years after PCI, symptoms before PCI</td>
<td>23.8%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Evaluation of chest pain post-procedure where interpretable ECG and able to exercise</td>
<td>18.1%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Hypertrophic cardiomyopathy, known CAD, &lt; 1 year after subintervention SPECT</td>
<td>3.9%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Pre-operative assessment of low risk surgery</td>
<td>3.6%</td>
<td>0.5%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>82.1%</td>
<td>12.4%</td>
</tr>
</tbody>
</table>

INAPPROPRIATE USE OF RADIONUCLIDE IMAGING BASED ON ORDERING CLINICIAN AND INSTITUTION

The Role of AUC

"Although this sounds onerous, is it not better for us to impose these controls on ourselves than what is done currently by payers to control costs and procedures."

PROFESSIONAL RESPONSIBILITY

The Privilege of Self-Regulation

"Although this sounds onerous, is it not better for us to impose these controls on ourselves than what is done currently by payers to control costs and procedures."

JACC 2011: 57:1557-59
IMPROVING APPROPRIATENESS

• Does education work?
  –Inconsistent results
  –Limited impact on sites with low inappropriate use

• What methods?
  –Multifaceted approach (cases, peer discussions)
  –Interactive
  –Longitudinal
  –Behavior reinforcement (feedback)
  –Integrated into workflow (clinical decision support)

J Nucl Cardiol 2008;15: 494
J Nucl Cardiol 2011; 18: 997
J Nucl Cardiol 2014
50% reduction in the inappropriate rate (10% to 5%) (p<0.0001)
Saifi S et al, 2013
JACC Imaging 6: 823
CONCLUSIONS

- CV tests and procedures have exhibited substantial growth and geographic variability, suggesting possible overuse.
- AUC have been developed/revised for cardiac imaging, coronary revascularization, ICD/pacemaker implantation and other procedures.
- Appropriate use can be measured and relative performance may be evaluated.
- Multiple educational tools have been developed with a goal of reducing inappropriate testing; provider feedback and clinical decision support appear essential for improvement.
- Goal of AUC “movement” is optimized patient care, with a consciousness of cost.

WHO WE ARE

Specialty Benefits Management Company
Assist providers in all 50 states

| 400K Covered lives (commercial, Medicaid, Medicare Advantage) |
| 50 Clients |
| 75M Exams reviewed per year |
| 1.4M Cardiac exams reviewed per year, 50% of which are from non-cardiologists |
| 215,000 Provider interactions per year |

HOW IT WORKS

What is AIM’s role in the determination of clinical appropriateness?

1. INTAKE
   - 75% of cardiac imaging requests are authorized based on intake information

2. NURSE REVIEW
   - About 75% of the remaining requests are authorized by nurses based on additional review

3. PHYSICIAN REVIEW
   - Physicians review the remainder of requests
   - Only physicians can make a “non-authorization” decision
   - Peer-to-peer discussion is offered before the case is closed
AIM Guideline Development

Evidence-based research and medical society consensus form the basis of AIM Guidelines

- Literature review
  - Practice guidelines
  - ACC Appropriate Use Criteria (AUC)
  - Randomized clinical trials
  - Independent physician expert panel
- Independent physician expert panel
  - Consistency with current practice
  - Expert opinion

OPPORTUNITY TO EDUCATE

Why did AIM and ASNC decide to offer this CME activity?

- Clinical appropriateness as a common goal
- Recurrent conversations with similar themes
- Re-enforce through education
- ASNC is a recognized leader in promotion of clinical appropriateness
- AIM is in a unique position to disseminate information

DISCLAIMER

The information presented is being provided for informational purposes only and is not meant to replace a physician’s independent judgment with respect to the physician’s patients.
RNI in Low Pretest of CAD

Manuel D. Cerqueira, MD
Professor of Radiology and Medicine
Cleveland Clinic Lerner College of Medicine of Case Western Reserve University
Chairman, Department of Nuclear Medicine, Imaging Institute
Staff Cardiologist, Heart and Vascular Institute
Cleveland Clinic

Clinical Case Study: JP

Clinical

• 49 yo female with recent onset of chest pain associated with emotional stress and at rest
• Risk factors: hypertension, elevated cholesterol, family Hx of CAD
• Medications: atorvastatin, lisinopril, BB, ASA
• Height: 5’ 5”; Weight: 275 lbs
Pretest Probability of CAD and Risk

Assessment

- Asymptomatic vs symptomatic?
- Pretest probability of CAD
- Global CAD risk
- Which probability and risk scoring system?
- Actual calculation vs gestalt?

Pretest Probability of CAD Models

- Validated Risk Assessment
- ACCF/AHA Guidelines for Stable Ischemic Heart Disease

ACCF/AHA Guidelines for Stable Ischemic Heart Disease

Table A. Diamond and Forrester Pre-Test Probability of Coronary Artery Disease by Age, Sex, and Symptoms

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Sex</th>
<th>Typical/Definite Angina Pattern</th>
<th>Asymptotic/Probable Angina Pattern</th>
<th>Nonanginal Chest Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-40</td>
<td>Man</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>41-50</td>
<td>Man</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>51-69</td>
<td>Man</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td>60 and over</td>
<td>Man</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
</tbody>
</table>

Wolk MJ http://dx.doi.org/10.1016/j.jacc.2013.11.009.
ACCF/AHA Guidelines for Stable Ischemic Heart Disease

- Low pre-test probability: <10% pre-test probability of CAD;
- Intermediate pre-test probability: Between 10% and 90% pre-test probability of CAD;
- High pre-test probability: >90% pre-test probability of CAD.

Assessing Global CAD Risk

10-yr Probability of Cardiac Death or MI


Assessing Global CAD Risk

10-yr Probability of Cardiac Death or MI

- Low global CAD risk
  Defined by an age-specific risk level that is below average. In general, low risk will correlate with a 10-year absolute CAD risk <10%. However, in women and younger men, low risk may correlate with 10-year absolute CAD risk <8%.

- Intermediate global CAD risk
  Intermediate risk is defined as a 10-year CAD risk from 10% to 20%. Among women and younger men, an expanded intermediate-risk range of 8% to 20% may be appropriate.

- High global CAD risk
  High risk is defined as a 10-year CAD risk of >20%. CAD equivalents (e.g., diabetes mellitus, peripheral arterial disease) can also drive high risk.
Cardiac Radionuclide Imaging Appropriateness 2009

A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the American Society of Nuclear Cardiology, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the Society of Cardiovascular Computed Tomography, the Society for Cardiovascular Magnetic Resonance, and the Society of Nuclear Medicine


RNI AUC 2009

25 Inappropriate Indications

<table>
<thead>
<tr>
<th>Indication</th>
<th>Appropriateness Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-scan for D-dimer</td>
<td>0.001</td>
</tr>
<tr>
<td>Detects of CAD</td>
<td>0.001</td>
</tr>
<tr>
<td>Pre-scan for D-dimer</td>
<td>0.001</td>
</tr>
<tr>
<td>Detects of CAD</td>
<td>0.001</td>
</tr>
<tr>
<td>Pre-scan for D-dimer</td>
<td>0.001</td>
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<tr>
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</tr>
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</tr>
<tr>
<td>Detects of CAD</td>
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<tr>
<td>Pre-scan for D-dimer</td>
<td>0.001</td>
</tr>
<tr>
<td>Detects of CAD</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Clinical Case Study: JP

Baseline ECG
Clinical Case Study: JP

Exercise
- Baseline ECG normal
- Exercised 9' 20" modified Bruce (7.5 METS)
- Rest: 81 bpm and 135/70 mmHg
- Peak Stress: 156 bpm (91% MPHR) and 218/100 mm Hg
- Termination: Fatigue and leg cramps; no CP

Clinical Case Study: JP

Perfusion Images

RNI in Low Pretest Population

Downside
- High false positive rate in low pretest population for all testing
- Artifacts often lead to false positives and additional testing
  - Motion, attenuation, scaling, GI
Stress testing for preoperative evaluation

Eugenie Komives, MD
Duke University

Clinical scenario

• 68-year-old female patient who is scheduled to undergo cataract surgery
• History of hypertension and hyperlipidemia both of which are controlled on medication
• Currently has no symptoms
• Participates in a group exercise program twice a week

Clinical scenario

• Physical examination: blood pressure 128/76, pulse 70s regular, cardiopulmonary examination is normal aside from S4

• The patient brought a recent EKG had been performed as part of a life insurance application. The trace was normal aside from a single PVC.
What (if any) preoperative cardiac testing is required?

Issues to be considered in preoperative assessment

- **Degree of urgency**
  - Emergent - threat to life/limb if not done in <6 hours
  - Urgent - threat to life/limb if not done in 6-24 hours
  - Time sensitive - delay of > 1 week may affect outcome
  - Elective - delay of > 6 weeks unlikely to affect outcome

- **Procedural risk assessment**
  - Low risk - <1% risk of MACE
  - Elevated risk - ≥1% risk of MACE

- **Patient risk assessment**
  - Symptoms
  - Physical exam abnormalities
  - Functional status
  - Established diagnoses - CAD, Heart failure/Cardiomyopathy, Valvular disease
  - Risk factors - Diabetes, hypertension, tobacco use, dyslipidemia etc.

*MACE=Major Adverse Cardiovascular Event

Risk Assessment Tools

- American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP)
  [http://www.riskcalculator.facs.org/PatientInfo/PatientInfo](http://www.riskcalculator.facs.org/PatientInfo/PatientInfo)

- Revised Cardiac Risk Index (RCRI)

- American College of Surgeons NSQIP MICA
  [http://www.surgicalriskcalculator.com/miorcardiacarrest](http://www.surgicalriskcalculator.com/miorcardiacarrest)
Assessing Functional Capacity by History

<table>
<thead>
<tr>
<th>Activity</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting out of bed</td>
<td>2.00</td>
</tr>
<tr>
<td>Rising from sitting to standing</td>
<td>1.00</td>
</tr>
<tr>
<td>Walking a block at a normal pace</td>
<td>2.00</td>
</tr>
<tr>
<td>Climbing 1 flight of stairs</td>
<td>2.00</td>
</tr>
<tr>
<td>Climbing 1 flight of stairs backward</td>
<td>2.00</td>
</tr>
<tr>
<td>Walking 2 flights of stairs</td>
<td>2.00</td>
</tr>
<tr>
<td>Running a flight of stairs</td>
<td>3.00</td>
</tr>
<tr>
<td>Running 2 flights of stairs</td>
<td>4.00</td>
</tr>
<tr>
<td>Running 3 flights of stairs</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Application of the guidelines to our case

Don’t perform cardiac imaging as a pre-operative assessment in patients scheduled to undergo low- or intermediate-risk non-cardiac surgery.

Non-invasive testing is not useful for patients undergoing low-risk non-cardiac surgery or with no cardiac symptoms or clinical risk factors undergoing intermediate-risk non-cardiac surgery. These types of testing do not change the patient’s clinical management or outcomes and will result in increased costs. Therefore, it is not appropriate to perform cardiac imaging procedures for non-cardiac surgery risk assessment in patients with no cardiac symptoms, clinical risk factors or who have moderate to good functional capacity.
Case #3

Robert C. Hendel, MD, FACC, FAHA, FASNC
Professor of Medicine and Radiology
Chief, Cardiovascular Division (Interim)
Director, Cardiac Care Unit
Director, Cardiac Imaging

72-Year-Old Male, F/U for Known CAD

- Asymptomatic
- Diabetes mellitus
- Hypertension
- Severe osteoarthritis
- History of MI
- S/P CABG 3 years ago
- Currently asymptomatic
- ECG: anterior MI, age indeterminate

Stress RNI?
- Appropriate
- May be appropriate
- Rarely appropriate

Table 4: Risk Assessment: Prognostic Evaluation for Coronary Angiography Without Action Active Coronary Conditions

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Appropriate Use</th>
<th>May be appropriate</th>
<th>Rarely appropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Asymptomatic</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Diabetes mellitus</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Hypertension</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Severe osteoarthritis</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. History of MI</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. S/P CABG 3 years ago</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. Currently asymptomatic</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. ECG: anterior MI, age indeterminate</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**2013 AUC: Postrevascularization (PCI or CABG)**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Green ✓</th>
<th>Yellow M</th>
<th>Red R</th>
</tr>
</thead>
<tbody>
<tr>
<td>66. Incomplete revascularization</td>
<td>✓</td>
<td>M</td>
<td>R²</td>
</tr>
<tr>
<td>67. Prior left main coronary stent</td>
<td>✓</td>
<td>M</td>
<td>R²</td>
</tr>
<tr>
<td>68. Prior left main coronary stent</td>
<td>✓</td>
<td>M</td>
<td>R²</td>
</tr>
<tr>
<td>69. &lt;5 years after CABG</td>
<td>✓</td>
<td>M</td>
<td>R²</td>
</tr>
<tr>
<td>70. ≥5 years after CABG</td>
<td>✓</td>
<td>M</td>
<td>R²</td>
</tr>
<tr>
<td>71. &lt;2 years after PCI</td>
<td>✓</td>
<td>M</td>
<td>R²</td>
</tr>
<tr>
<td>72. ≥2 years after PCI</td>
<td>✓</td>
<td>M</td>
<td>R²</td>
</tr>
</tbody>
</table>

A = appropriate; M = may be appropriate; R = rarely appropriate.

72-year-old male: asymptomatic, hypertension, diabetes, severe osteoarthritis, hx of MI, S/P CABG 3 years ago, ECG: anterior MI (age indeterminate)

**Q&A**

**Evaluation and Certificates**

- Registered participants will receive an email within 48 hours with a link to the online evaluation and CME certificate
- Participants of the webinar will be directed to complete a pre/post test in the portal prior to the access to your CME certificate