Appropriate Use Criteria for Echocardiography

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Outline

• Background
  – Increase in non-invasive imaging / echocardiography
• Response to Increased Utilization
  – Appropriate Use Criteria (AUC)
• AUC to Impact Physician Behavior
• AUC Challenges
• Future Directions

Growth in Cardiac Services

Why So Many Echoes?

Drivers of Growth

- **Growth of Medicare population**
  - Increase total use even if practice patterns remained unchanged.
- **New technology**
  - Adoption of new treatments (CRT, LVAD, etc.) requiring more precise quantification of cardiac function and follow up exams.
- **Economic motives**
- **Consumer-savvy patients**
- **Threat of malpractice and litigation**
  - “Defensive” medicine.


Repeat Testing

[Bar chart showing percentage of repeat testing within 3 years]

Response to Increased Utilization

- Pre-authorization requirements.
- Reduced reimbursement for individual tests.
- Refusal of reimbursement for inappropriate studies.
- Payment reform (i.e. bundled payments).
- Maintenance of physician autonomy and self-regulation?
  - Efforts to empower physicians in their decision making.

Appropriate Use Criteria (AUC)

- Developed by the American College of Cardiology Foundation (ACCF) with sub-specialty organizations.
- Goals:
  - Curb the growth of cardiac imaging.
  - Opportunity for physicians to continue the privilege of self-regulation.
  - True nature of utilization not well known.
  - Overuse / Underuse
  - Focus on efficiency and improving quality.

AUC Timeline

**Indication Ratings**

- **7-9:** Appropriate test for specific indication
  - Test is generally acceptable and is a reasonable approach for the indication

- **4-6:** Uncertain or unclear if appropriate for specific indication
  - Test may be generally acceptable and may be a reasonable approach for the indication

- **1-3:** Inappropriate test for specific indication
  - Test is not generally acceptable and is not a reasonable approach for the indication

**Structure of Indications**

- 5 general clinical scenarios for each main disease category.
  1. Initial diagnosis.
  2. To guide therapy or management, regardless of symptom status.
  3. To evaluate a change in clinical status or cardiac exam.
  4. Early follow-up without change in clinical status.
  5. Late follow-up without change in clinical status.

- Timing of follow-up attempts to follow practice guidelines when possible.

**AUC Case Example**

- 86-year-old woman with non-ischemic cardiomyopathy on a standard medical regimen.
- Admitted with dyspnea and fatigue from a rehabilitation facility following recent non-cardiac surgery.
- Clinical signs of heart failure on exam.
- Lasix inadvertently not restarted following surgery.
- Prior TTE three months ago (LVEF 30%).
  - LVEF 30%, mild to moderate MR.
  - Mild TR, estimated RVSP 41 mmHg. Normal RV function.
AUC Case Example

- Is repeat TTE indicated?

AUC

- TTE:
  - Initial evaluation of known or suspected heart disease or abnormal test results.
  - $AUC = 0.90$
  - Initial evaluation of known or suspected heart disease or abnormal test results with a change in clinical status or cardiac event.
  - $AUC = 0.89$
  - Initial evaluation of known or suspected heart disease or abnormal test results with a change in clinical status or cardiac event within a week of previous TTE.
  - $AUC = 0.91$
  - Evaluation of known or suspected heart disease or abnormal test results.
  - $AUC = 0.85$
  - Evaluation of known or suspected heart disease or abnormal test results with a change in clinical status or cardiac event.
  - $AUC = 0.81$

- Need for practice improvement greater than initially thought.

2007 vs. 2011 Echo AUC

<table>
<thead>
<tr>
<th>Test</th>
<th>2007</th>
<th>2011</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>None available (%)</td>
<td>77</td>
<td>79</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Appropriate (%)</td>
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<td>12</td>
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<tr>
<td>Inappropriate (%)</td>
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<td>14</td>
<td>&lt; .01</td>
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<tr>
<td>Uncertain (%)</td>
<td>6</td>
<td>7</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>TTE</td>
<td>58</td>
<td>59</td>
<td>&lt; .10</td>
</tr>
<tr>
<td>None available (%)</td>
<td>11</td>
<td>12</td>
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<tr>
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<tr>
<td>Inappropriate (%)</td>
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<td>&gt; .05</td>
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<tr>
<td>Uncertain (%)</td>
<td>26</td>
<td>28</td>
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</tr>
<tr>
<td>TTE</td>
<td>73</td>
<td>72</td>
<td>&lt; .01</td>
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<tr>
<td>None available (%)</td>
<td>56</td>
<td>54</td>
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<td>Appropriate (%)</td>
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</tr>
<tr>
<td>Uncertain (%)</td>
<td>15</td>
<td>26</td>
<td>28</td>
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</tbody>
</table>

- Need for practice improvement greater than initially thought.

AUC: Tool to Change Clinical Practice

- AUC are not intended to be a “passive” process awaiting adoption by ordering providers.
- Opportunities for active implementation of AUC:
  - Decision support at the time of order entry.
  - “Hard-stop” of Inappropriate studies?
  - Electronic applications (i.e. smartphone apps).
  - Opportunity for physician education.
AUC-based Educational Interventions

- Limited, but evolving, literature base.
  - Different modalities have been studied.
    - Cardiac CT
    - Single-photon emission computed tomography (SPECT)
    - Stress echocardiography
    - TTE
- Varying intensity of interventions and methodology.
  - Mixed results.

Educational Intervention: Inpatient TTE

- Aim:
  - To prospectively evaluate whether an AUC-based educational intervention reduces the proportion of inappropriate TTEs ordered by medical residents on an inpatient academic medical service.
- Educational Intervention:
  - Informational session.
  - Pocket cards
  - Mid-rotation and end of rotation feedback reports via email.
    - Description of Inappropriate TTEs and reasons for classification.


Pocket Card

2011 Appropriate Use Criteria for Echocardiography
Tips for Ordering TTEs

INFECTIVE ENDOCARDITIS
- Reason for TTE: Diagnosis of endocarditis (either native or prosthetic valve)
  - Inappropriate TTE:
    - Transient fever with no bacteremia or no new murmur
    - Transient bacteremia from a documented non-endovascular source of infection (i.e. a urinary tract infection, skin abscess, etc.).
  - Appropriate TTE:
    - Fever and a positive blood culture or new murmur.
- Reason for TTE: Follow-up of known endocarditis
  - Inappropriate TTE:
    - Routine surveillance of a vegetation when patient management will not change.
  - Appropriate TTE:
    - Patient at high risk of developing a complication (i.e. abscess) or whose clinical status changes (i.e. heart failure, heart block).
Impact of Educational Intervention

<table>
<thead>
<tr>
<th>Table 2: TTE Ordering and Appropriateness Rating</th>
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<tbody>
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<td>Pre-intervention</td>
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<tr>
<td>------------------</td>
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<tr>
<td>TTE ordered</td>
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<tr>
<td>TTE per rotation block</td>
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<td>TTE per 100 admissions</td>
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<tr>
<td>TTE per day</td>
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<td>TTE per patient</td>
</tr>
<tr>
<td>Overall TTE</td>
</tr>
<tr>
<td>Appropriately TTE</td>
</tr>
<tr>
<td>Inappropriately TTE</td>
</tr>
</tbody>
</table>

Inpatient TTE Intervention

- Limitations:
  - Aimed at medical house staff.
  - Generalizability to other practice environments.
  - TTE inappropriate rate highest in outpatient setting (up to 30%).
  - Lack of randomized control trial design.

Outpatient TTE Intervention

- **Randomized control trial**
  - Investigate whether an AUC-based educational intervention reduces the proportion of inappropriate outpatient TTEs.

- Study setting: Cardiology fellows and Internal Medicine resident outpatient clinics.
MURMUR/VALVE DISEASE
- Reason for TTE: Cardiac murmur or known valvular disease
- Inappropriate TTE:
  - No change in cardiac exam or clinical status with:
    - Prior TTE that did not reveal valvular disease
    - Known mild tricuspid regurgitation, mild mitral stenosis / regurgitation with a TTE ≥ 3 years ago or moderate/severe stenosis / regurgitation with a TTE ≥ 1 year ago
    - No other symptoms or signs of valvular disease on exam (i.e. flow murmur)
- Appropriate TTE:
  - Reasonable suspicion of valvular disease on exam (i.e. diastolic murmur, murmur ≥ 3/6, other finding on exam)
  - Known valvular disease with a change in clinical status (i.e. HF, syncope) or cardiac exam
  - No change in cardiac exam or clinical status with known mild stenosis / regurgitation with a TTE ≥ 3 years ago or moderate/severe stenosis / regurgitation with a TTE ≥ 1 year ago.

AUC Challenges
- Are AUC evidence-based?
- Need for automation to integrate AUC into decision support tools.
Evidence-Based AUC?


Scientific Evidence: Cardiology Guidelines


Need for Automation

- AUC Classification: Automated TTEs within 1 minute.
- Goal to incorporate decision support and feedback programs.

Future Directions: Research Needs

- Multicenter, randomized trials.
- AUC-based tools: decision support, educational interventions.
  - Adherence to AUC and the impact on patient outcomes and cost.
- Studies in various clinical settings and with various ordering providers (physicians in multiple specialties, physician extenders, etc.).

Multimodality AUC: Heart Failure

Conclusions

- AUC developed in response to overutilization of cardiac testing.
  - Represent a physician-driven attempt to address overuse.
- AUC may be used an educational tool in an effort to change physician behavior.
- Methods at automating AUC as a decision aid in clinical practice may increase their adoption.
- Future research is need to address how AUC adherence impacts patient outcomes and health care costs.
Need for Sustained Intervention

Each bar represents a 2-week period of TTE ordering.


AUC: Clinical Impact

Table 1: Clinical Impact Definitions

- Clinical change in care: Change in the diagnosis or treatment plan from TTE including diagnosis, modification, or confirmation, or a change in therapeutic management strategy or decision to include TTE.
- Improvement in care: Improvement in care including a change in treatment plan, change in diagnostic approach, or change in patient management due to TTE.
- No change in care: No change in care, treatment, or management from TTE.
- Appropriate TTE: TTE was performed for a specific clinical indication and was deemed appropriate by both reviewers.


AUC: Clinical Impact?

- Combination of care: Combination of both Appropriate and Improper TTEs.
- Improper TTE: TTE was performed without a specific clinical indication.
- Appropriate TTE: TTE was performed for a specific clinical indication and was deemed appropriate by both reviewers.

32% Appropriate TTEs lead to change in clinical care.

Appropriate TTE: Low Impact on Patient Care?

~30% of TTEs Indication #1: may reflect inaccuracies of medical documentation and subsequent AUC classification.


Impact of Appropriate TTEs

- Documentation and classification impacts results.
  - “Change in clinical care” may be challenging to abstract from the medical record.
- Appropriate may not always lead to active change in care.
  - Follow up evaluation in patients receiving cardiotoxic chemotherapy.
- Consideration of practice environment (inpatient vs. outpatient, etc.).
- Study limited to single center, retrospective study.
  - Need for prospective data.
- ASE response:
  - Appropriate does not always mean a TTE is necessary.
  - Incorrect to assume TTE offered no benefit even if therapy was not changed.

Appropriate TTEs: More Abnormalities

Appropriate TTEs had a greater % with new major TTE abnormality than uncertain or inappropriate studies (42% vs. 24% and 18%, p = 0.008)
### Common Inappropriate TTEs

#### IMNC
- Inappropriate indication
- Evaluation of ventricular function in patients with known CAD and no change in clinical status or cardiac examination (indication 11)

#### DMC
- Inappropriate indication
- Evaluation of ventricular function in patients with normal ventricular function evaluation showing normal function in patients without change in clinical status or cardiac examination (indication 12)

#### OMC
- Inappropriate indication
- Routine re-evaluation: surveillance
- Routine re-evaluation: surveillance
- Routine re-evaluation: surveillance
- Routine re-evaluation: surveillance
- Routine re-evaluation: surveillance
- Routine re-evaluation: surveillance

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