Chest Pain Wave I
Risk Stratification Scores and Shared Decision Making
Presenters

Simon A. Mahler, MD, MS

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Be Sensitive!

Improving chest pain care using risk stratification tools

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Wake Forest School of Medicine
Disclosures

- Research funding:
  - NIH: Heart Lung and Blood Institute
  - NCATS: National Center for Advancing Translation Sciences
  - Donaghue Foundation/Association of American Medical Colleges
  - Duke Endowment
  - Abbott Laboratories
  - Siemens Healthcare
  - Roche Diagnostics

- Author for Up-to-Date

- Chief Medical Officer: Impathiq, Inc.
Question 1.

What is the impact of care variability on the quality of chest pain care?
Staggering Chest Pain Numbers

- > 8 M ED Chest Pain Visits
- > 50% Patients Admitted
- $13 B Chest Pain Evaluation
- < 10% Diagnosed with ACS
- 2-4% Missed ACS

U.S., per year
Care Variability

Providers:
- Experience/Training
- Risk tolerance
- Fear of malpractice
- Use of gestalt or old and unreliable tools for risk stratification

Pines et al. AJEM 2010:
- Measured providers risk aversion using a risk taking scale (RTS)
- The most risk-averse quartile of providers had higher admission rates compared to the least risk-averse quartile. (P < 0.001)
Problem with Clinician Gestalt

- Multiple studies show gestalt is inaccurate:
  - Most clinicians overestimate risk
  - Some underestimate risk
    - Atypical presentations
    - Women

Body et al. *EMJ*. 2014

458 chest pain patients

**Gestalt:**
- Probable ACS = 77% had NO MACE
- Definite ACS = 47% NO MACE
- Definitely Not ACS = 9% HAD MACE
Outdated Risk Stratification Tools

TIMI and GRACE

- Developed and initially validated in patients with ACS
- Not designed for ED use
- Low scores not sufficiently sensitive to identify patients that can be discharged from the ED.
- 2-4% adverse event rates seen in the lowest risk groups.

Over-Testing and Provider Variability

- Data from 1731 Chest Pain Observation Unit admissions 2008-2011 WFBMC.
- Avoidable = Age <35 years, TIMI 0-1, & normal or non-diagnostic ECG
- 0% MACE at 30 days among Avoidable admissions

Impact of Massive Over-Triage

- Crowding
- Radiation exposure
- False-positive and non-diagnostic tests
- Increased costs
- Not patient-centered
- Low Quality
- Low Value
Consequences of Under-Triage

- 2-4% of myocardial infarctions are inappropriately discharged from the ED every year
- Patients with missed MI have an increase in short-term mortality
- Missed ACS is a top cause of malpractice claims
  - Malpractice fear drives over-testing
- Low Quality
- Low Value
Optimal Risk Stratification

- Identify patients unlikely to benefit from hospitalization or stress testing/cardiac imaging for early discharge
- Focus hospitalization and stress testing/cardiac imaging on patients likely to benefit
Question 2.

How do you standardize care?
Commonwealth fund for Hospital Quality Improvement:
Protocols and practices, including evidence-based policies and procedures, clinical pathways and guidelines, error-reducing software, and patient flow management techniques, leading to . . .

greater uniformity in practice and…

improved outcomes in process and health-related measures (e.g., patient flow, errors, complications, mortality), satisfaction and work environment, and “bottom line” indicators such as reduced length of stay and increased market share.
Risk Stratification Decision Aids & ADPs

Decision Aids:
Tools that objectively combine data to risk stratify a patient:
• History
• Risk factors
• ECG
• Biomarker data (troponin)

Accelerated Diagnostic Pathways (ADPs):
Decision aid + serial troponins
What’s the ideal tool?

- Safe
- Reduces admissions
- Reduces hospital length of stays
- Reduces unnecessary testing
- Validated in a US patient population
Stakeholders

Am I having a heart attack?
What tests do I need?
How long do I have to stay here?
When can I go home safely?

Is this patient at serious risk?
What tests should I order?
Do I need to admit them?
Can they be safely sent home?

Can we improve patient outcomes?
Can we reduce unnecessary tests?
Can we reduce length of stay?
Can we cut costs?
Validated Tools

TIMI
GRACE
ADAPT
EDACS
HEART score
HEART Pathway
HEART Score

Designed to identify chest pain patients for early discharge without stress testing.

Validated in >5000 patients.

>98% negative predictive value,
>96% sensitivity for ACS.

Backus, et al., Int J Cardiol, 2013

Six, et al., Crit Path Cardiol, 2013
## HEART Score

<table>
<thead>
<tr>
<th>HEART Score</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>History</strong></td>
<td></td>
</tr>
<tr>
<td>Highly Suspicious</td>
<td>2</td>
</tr>
<tr>
<td>Moderately Suspicious</td>
<td>1</td>
</tr>
<tr>
<td>Slightly Suspicious</td>
<td>0</td>
</tr>
<tr>
<td><strong>ECG</strong></td>
<td></td>
</tr>
<tr>
<td>Significant ST-depression</td>
<td>2</td>
</tr>
<tr>
<td>Non-specific repolarization abnormality</td>
<td>1</td>
</tr>
<tr>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>&gt; 65</td>
<td>2</td>
</tr>
<tr>
<td>45-65</td>
<td>1</td>
</tr>
<tr>
<td>≤ 45</td>
<td>0</td>
</tr>
<tr>
<td><strong>Risk factors</strong></td>
<td></td>
</tr>
<tr>
<td>3 or more risk factors</td>
<td>2</td>
</tr>
<tr>
<td>1-2 risk factors</td>
<td>1</td>
</tr>
<tr>
<td>No risk factors</td>
<td>0</td>
</tr>
<tr>
<td><strong>Troponin</strong></td>
<td></td>
</tr>
<tr>
<td>&gt; 3x normal limit</td>
<td>2</td>
</tr>
<tr>
<td>1-3x normal limit</td>
<td>1</td>
</tr>
<tr>
<td>≤ normal limit</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
</tr>
</tbody>
</table>

Low risk; total score 0-3  
High risk; total score 4 or more
Acceptable Miss Rate?

HEART Score  \( \sim 1.7\% \) missed MACE rate at 6 weeks

Is that acceptable?
What is the acceptable miss rate in the United States?

\(< 1\%\)

US HEART score validation

- 1,070 observation unit patients at Wake Forest
- Only 12 patients (1.1%) with MACE
- HEART Score identified 904 (84%) for early discharge with a NPV of 99.4%
- 5 pts with index visit NSTEMIs had low-risk HEART scores
  - Positive serial troponins

Mahler et. al, Crit Path Cardiol, 2011
The HEART Pathway is born

Addition of serial troponin at 0 and 3 hours to HEAR score

- 100% sensitive for ACS, could have decreased observation stays by 80%
- Improved sensitivity and NPV compared to HEART Score

Mahler et. al, Crit Path Cardiol, 2011
HEART Pathway Care Algorithm

ADP version of the HEART score

- Low risk = HEAR(t) score: 0-3
- Negative serial troponins
- No ischemic ECG changes
- No known CAD
  (prior AMI, revascularization, >70% coronary stenosis)

Improved sensitivity and NPV compared to HEART score

Mahler et. al, Crit Path Cardiol, 2011
Mahler et. al, Int J Cardiol, 2013
Mahler et al, JMIR, 2016
HEART Pathway Validation

- 1,005 patients with possible ACS from 18 US EDs
- Higher-risk cohort (22% ACS events)
- HEART Pathway >99% sensitive for ACS, could have decreased admissions by >20%

Mahler et. al, Int J Cardiol, 2013
HEART Pathway RCT

282 patients

RCT arms:
- HEART Pathway
- Usual Care: ACC/AHA guidelines

HEART Pathway increased the early discharge rate by 21% (p=0.0002).

Decreased median length of stay by 12 hours (p=0.013).

Decreased median total cost over 30 days by $216 (p=0.042)
Safety Events: MACE

MACE = death, acute myocardial infarction, or coronary revascularization

No MACE events among patients low-risk by the HEART Pathway.

No difference between groups \( (p=1.0) \)
Cardiac-Related Recurrent Care

Cardiac related non-index hospitalizations
HEART Pathway arm: 3.6% (5/141)
None in low risk patients
Usual care arm: 2.8% (4/141)
$\rho = 1.0$

Cardiac-related ED visits
HEART Pathway arm: 2.8% (4/141)
None in low-risk patients
Usual care arm: 4.3% (6/141)
$\rho = 0.75$
Interpretation:

The HEART Pathway reduces healthcare utilization outcomes

- Objective cardiac testing
- Hospitalizations
- Length of stay
- Cost

These important efficiency gains occurred without any increase in MACE or recurrent cardiac-related care.
HEART Pathway Demonstrated Success

- 3 Emergency Departments within the medical center
- Experience in >10,000 patients with chest pain
- Improves quality of care while cutting costs
Unmeasured Benefits

- Everyone is on the same page
- Decreased disagreements
- Better workflow
- Provider Efficiency
  
  Decreased time spent on unnecessary consults, wasted writing notes, and spent on unnecessary testing
Improving patient-centered care through shared decision making

Erik P. Hess MD MSc
Professor of Emergency Medicine
What is Shared Decision Making?

Involving the patient in making decisions to the extent they desire.

Edwards and Elwyn 2006
### What's Next?

#### 1. Your Chest Pain Diagnosis

Your initial test results are **NEGATIVE** for a heart attack. These included:

- **Blood tests** to look for an enzyme called troponin that is released when the heart muscle is damaged. Additional troponin tests may be done to monitor you for heart attack during your emergency visit.
- **An electrocardiogram** to check whether your heart is getting enough oxygen and blood.

The chest pain you are experiencing today may be a warning sign of a FUTURE heart attack.

#### 2. What You Can Do

Examining your risk will help you and your clinician decide together whether or not you should have additional heart testing.

Additional tests\(^1\) may include:

- **A stress test** which views blood flow to your heart at rest and under stress.
- **A coronary CT angiogram** which takes pictures of the arteries in your heart to check for a blockage in the flow of blood.

---

#### 3. Your Personal Risk Evaluation

Your risk of having a heart or pre-heart attack within the next 45 days can be determined by comparing you to people with similar factors who also came to the Emergency Department with chest pain.

- **Of every 100 people like you who came to the Emergency Department with chest pain...**
  - 1 had a heart or a pre-heart attack within 45 days of their Emergency Department visit.
  - 99 did not.

#### 4. Would you prefer to have additional heart testing during this emergency visit or decide later during an outpatient appointment?

- I would like to have a stress test or coronary CT angiogram during my emergency visit. I realize that this may increase the cost of my care and/or lengthen my stay.
- I would like to be seen by a heart doctor within 24-72 hours and would like assistance in scheduling this appointment.
- I would like to schedule an appointment on my own to consult with my primary care physician.
- I would like my Emergency Department doctor to make this decision for me.

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\(^1\) Stress test options include nuclear stress testing, ultrasound stress testing, or exercise ECG (electrocardiogram) stress testing. Nuclear stress testing and coronary CT angiography include exposure to radiation which has been shown to be related to increased cancer risk over a lifetime. Your doctor can help you explore which option may be best for you.
**What's Next?**

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2 Age
- Gender
- Race
- If chest pain is made worse when manual pressure is applied to the chest area
- If there is a history of coronary artery disease
- If the chest pain causes palpitation
- Findings on electrocardiograms (electronic tracings of the heart)
- Initial cardiac troponin result.
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4 Factors are
   - Age
   - Gender
   - Race
   - If chest pain is made worse when manual pressure is applied to the chest area
   - If there is a history of coronary artery disease
   - If the chest pain causes perspiration
   - Findings on electrocardiograms (electrocardiograms of the heart)
   - Initial cardiac troponin result
What’s Next?

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Your risk of having a heart or pre-heart attack within the next 45 days can be determined by comparing you to people with similar factors\(^2\) who also came to the Emergency Department with chest pain.

Of every 100 people like you who came to the Emergency Department with chest pain...
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4 Would you prefer to have additional heart testing during this emergency visit or decide later during an outpatient appointment?
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\(^2\) Age
- Gender
- Race
- If chest pain is more severe when manual pressure is applied to the chest area
- If there is a history of coronary artery disease
- If the chest pain causes perspiration
- Findings on electrocardiograms (electrocardiograms of the heart)
- Initial cardiac troponin result
Objective

Test the effectiveness of Chest Pain Choice in a pragmatic multicenter RCT
Methods
Design

Patient level RCT

Allocation concealed by password-protected, web-based randomization scheme

Dynamic randomization

1:1 ratio
Eligibility criteria

• **Inclusion**
  • Adults with chest pain considered for EDOU admission for stress testing or coronary CTA

• **Exclusion**
  • Ischemic ECG
  • Elevated troponin
  • Known CAD
  • Cocaine use within 72 hours
  • Unable to provide informed consent or use DA
Outcome measures

• **Decision quality**
  Patient knowledge**
  Degree of patient participation (OPTION scale)
  Acceptability

• **CV endpoints**
  Safety: 30-day MACE
  Resource use
    • Admitted to EDOU for stress testing or coronary CT
    • 30-day rate of stress testing/coronary CT
Results
## Baseline characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control (n=447)</th>
<th>Intervention (n=451)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>50.6</td>
<td>50.0</td>
<td>0.57</td>
</tr>
<tr>
<td>Female</td>
<td>58%</td>
<td>56.7</td>
<td>0.41</td>
</tr>
<tr>
<td>HTN</td>
<td>55%</td>
<td>1.0</td>
<td>0.70</td>
</tr>
<tr>
<td>Dislipidemia</td>
<td>69%</td>
<td>56.9</td>
<td>0.07</td>
</tr>
<tr>
<td>Family history of premature CAD</td>
<td>59%</td>
<td>25.4</td>
<td>0.62</td>
</tr>
<tr>
<td>Mean PTP of ACS</td>
<td>3.8%</td>
<td>3.6</td>
<td>0.46</td>
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## Knowledge and Engagement

<table>
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<tr>
<th>Variable</th>
<th>Control (n=447)</th>
<th>Intervention (n=451)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge [Mean (SD)]</td>
<td>3.56 (1.50)</td>
<td>4.23 (1.54)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Engagement (Option scale)</td>
<td>8</td>
<td>18</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Decision aid acceptability (patient)

- Amount of information (just right): Control 90%, Intervention 95% (P=0.01)
- Clarity of information (extremely clear): Control 70%, Intervention 80% (P=0.004)
- Helpfulness (extremely helpful): Control 60%, Intervention 70%
- Would recommend to others: Control 80%, Intervention 90%
Decision aid acceptability (clinician)

- Helpfulness (extremely helpful)
  - Control: [value]
  - Intervention: [value]
  - P<0.001

- Would recommend to others
  - Control: [value]
  - Intervention: [value]
  - P<0.001

- Would want to use for other decisions
  - Control: [value]
  - Intervention: [value]
  - P<0.001
## Safety

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control (n=451)</th>
<th>Intervention (n=447)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI</td>
<td>1 (0%)</td>
<td>4 (1%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Revascularization</td>
<td>4 (1%)</td>
<td>7 (2%)</td>
<td>0.37</td>
</tr>
<tr>
<td>Death</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1.0</td>
</tr>
<tr>
<td>MACE within 30 days of discharge</td>
<td>0 (0%)</td>
<td>1 (0%)</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Resource Use

- Admitted to EDOU for stress test or coronary CT: P<0.013
- Stress test within 30 days: P<0.001
- Coronary CT within 30 days: P=0.12

Control
Intervention

%
Shared decision making in Chest Pain

(n=898)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient knowledge</td>
<td>↑</td>
</tr>
<tr>
<td>Patient engagement</td>
<td>↑</td>
</tr>
<tr>
<td>Admitted for stress testing</td>
<td>↓ (15%)</td>
</tr>
<tr>
<td>Stress testing within 30 days</td>
<td>↓ (7%)</td>
</tr>
<tr>
<td>Provider experience</td>
<td>↑</td>
</tr>
<tr>
<td>Outpatient follow-up</td>
<td>↑</td>
</tr>
<tr>
<td>Safety</td>
<td>↔</td>
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</table>
What is the effect of SDM on ED clinician’s perceived compassion?

Point of service ratings of ED providers’ concern and sensitivity
Patient Centered Chest Pain Pathway
Clinical scenario: “I developed left-sided chest pain at home while playing outside with my kids. It scared me – my dad died of a sudden cardiac death last year, when he was just 49 years old! I called my wife at work, and we decided to go to the emergency department to get checked out, leaving our kids with my wife’s coworkers. My initial tests are negative – the ECG and blood work show no signs of a heart attack. My doctor tells me I am “low risk” but recommends I stay overnight for monitoring and further testing “just to be sure.” But I need to go back to my kids! If I am “low risk,” then why am I staying overnight? What is “low risk?” Based on my doctor’s recommendation to stay overnight, my risk feels like 50/50.”

— Michel Demers, patient representative and co-author, the Chest Pain Choice multicenter randomized trial.
Patient arrival w/ complaint: chest pain

CCU consult/admit

ECG testing

Ongoing active ischemia

STEMI? Yes

ACS considered? No

Cash lab

Usual care for suspected cause

No

ACS testing

Positive

ACS primary cause?

Yes

Cardiology Consult

Duke score < +5

Follow-up +/- advanced stress testing

Yes

Cardiology Consult

No

ED Observation

Treadmill stress testing

Duke score ≥ +5

Observation

Low risk (HEART ≤ 3)

Risk stratification

Mod/High

Shared decision making

Discharge

Serial troponin testing

Positive

Discharge w/ primary care follow-up

Negative

Risk communication

Positive

Risk communication

Negative
What’s Next for Sepsis Wave II?

• E-QUAL Portal
  Activate your portal account by the end of June

• Questions? Contact the E-QUAL team at equal@acep.org