Identifying Cardiac Decompensation

Using Evidence-Based Diagnostics to Assist Clinicians in Real Time

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Intern at DIHI
Outline/Agenda

• Team description
• Project description and details
• Current work
• Future work plan
The Duke Institute for Health Innovation (DIHI) is a team of data scientists, data engineers and clinicians. The mission of the Duke Institute for Health Innovation (DIHI) is to catalyze transformative innovations in health and healthcare.

One project the team is currently engaged and working on aims to help clinicians identify patients with cardiac decompensation earlier, so that appropriate interventions can be used to improve patient outcomes.
What is Cardiac Decompensation?

Put simply, cardiac decompensation is an abnormal condition of the heart where it is no longer able to maintain efficient circulation.

Cardiac decompensation is a broad descriptor for a complex set of symptoms. Patients with cardiac decompensation are at risk of developing cardiogenic shock, a disease process which is associated with a **30% in-hospital mortality rate** and a **50% mortality rate after 1 year of diagnosis**.
How do we identify Cardiac Decompensation?

The Duke Cardiology team used a combination of their own clinical expertise with evidence-based practices to develop a set of six phenotypes to detect in patients within Duke University Hospital.

**Hypotension**
- 2 Low blood pressure readings
- ↑ Creatinine, lactate, AST/ALT, bilirubin
- New or ↑ dose of vasoactive meds given
- Escalation of resp. support

**End Organ Dysfunction**
- Hypotension + EOD within 24 hours

**Hypoperfusion**

**Vasoactive Medication**

**Respiratory Decline**
- ↑ Supp. O2, oxygen sat < 91%

**Respiratory Intervention**
### SCAI Stages of Cardiogenic Shock

Adapted from the SCAI Clinical Expert Consensus Statement on the Classification of Cardiogenic Shock

**Endorsed by ACC, AHA, SCCM, and STS**

<table>
<thead>
<tr>
<th>SCAI Shock Stage</th>
<th>Physical Exam</th>
<th>Biochemical Markers</th>
<th>Hemodynamics</th>
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</thead>
<tbody>
<tr>
<td><strong>A</strong> (Extremis)</td>
<td>Normal JVP, Lung sounds clear, Strong distal pulses, Normal mentation</td>
<td>Normal renal function, Normal lactic acid</td>
<td>Normotensive (SBP&gt;100 or normal for pt.) if hemodynamics done: • Cardiac index &gt;2.5 • CVP &lt;10 • PA Sat &gt;65%</td>
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<td><strong>B</strong> (Deteriorating)</td>
<td>Elevated JVP, Rates in lung fields, Strong distal pulses, Normal mentation</td>
<td>Normal lactate, Minimal renal function impairment, Elevated BNP</td>
<td>SBP &lt;90 OR MAP &lt;60 OR &gt;30mmHg drop Pulse &gt;100 if hemodynamics done: • Cardiac Index &gt;2.2 • PA Sat &gt;65%</td>
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<td><strong>C</strong> (Classic)</td>
<td>Ashen, mottled, dusky, Volume overload, Extensive Rales, Killip class 3 or 4, BiPap or mechanical ventilation, Acute alteration in mental status</td>
<td>Lactate ≥2, Creatinine doubling, OR &gt;60% drop in GFR, Increased LFTs, Elevated BNP, Urine Output &lt;50mL/h</td>
<td>Drugs/device used to maintain BP above stage B values: • Cardiac Index &lt;2.2 • PCWP &gt;15 • RAP/PCWP &gt;0.8 • PAP &lt;1.85 • Cardiac Power Output &lt;0.6</td>
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<td><strong>D</strong> (Beginning)</td>
<td>Any of stage C</td>
<td>Any of stage C AND deteriorating</td>
<td>Any of stage C AND Requiring multiple pressors OR addition of mechanical circulatory support devices to maintain perfusion</td>
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<td><strong>E</strong> (At Risk)</td>
<td>Near pulselessness, Cardiac collapse, Mechanical ventilation, Defibrillator used</td>
<td>Lactate ≥6, pH &lt;7.2</td>
<td>No SBC without resuscitation, PEA or refractory VT/VF, Hypotension despite maximal support</td>
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For more information, please visit: [www.scai.org/shockdefinition](http://www.scai.org/shockdefinition)
Detecting Cardiac Decompensation in Real Time

Using these phenotypes, the team at DIHI developed a tool for clinicians to monitor patients in real time. The Cardiac Decomp Dashboard began its pilot program in June 2021.

<table>
<thead>
<tr>
<th>Patient</th>
<th>MRN</th>
<th>Bed</th>
<th>Hypotension</th>
<th>End Organ Dysfunction</th>
<th>Hypoperfusion</th>
<th>Vaso Meds</th>
<th>Respiratory Decline</th>
<th>Respiratory Interv</th>
<th>Service (Caremap)</th>
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Cardiac Decompensation Dashboard
Results of CD Dashboard at a Glance

Total number of unique patient encounters with ≥ 1 phenotype: 2376

Distribution of Each Phenotype

- Hypotension: 1399
- EOD: 1370
- Hypoperfusion: 791
- Vasoactive Meds: 496
- Resp. decline: 491
- Resp. interv.: 491

749 RRT ENCOUNTERS

504 consults

249 events
Results of CD Dashboard at a Glance

Number of RRT Events by Month

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</table>

63% of patients met a phenotype before an RRT event

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<tr>
<th>Phenotype</th>
<th>Incidence of phenotype occurrence prior to RRT event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypotension</td>
<td>44.4%</td>
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<tr>
<td>End organ dysfunction</td>
<td>39.4%</td>
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<tr>
<td>Hypoperfusion</td>
<td>14.9%</td>
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<tr>
<td>Vasoactive medication admin.</td>
<td>24.5%</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>41.8%</td>
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<tr>
<td>Respiratory intervention</td>
<td>22.1%</td>
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</table>
Current work

The collaborative team was awarded a grant by the Gordon and Betty Moore Foundation to use this work to develop a clinical quality measure. Our current work plan involves:

• Using feedback and results of the pilot to improve the dashboard
• Interviewing stakeholders and convening a technical expert panel (TEP)
Measure Development Process

Step 1: Measure Conceptualization
- Identify ideas, address gap in measurement

Step 2: Measure Specification
- Determine measure specs., collect input + test findings

Step 3: Measure Testing
- Collect qualitative + quantitative data to test if measure meets evaluation criteria

Step 4: Measure Implementation
- Rulemaking processes, collect user input on initial measure specs., refine

Step 5: Measure Use, Continuing Evaluation & Maintenance
- Ongoing process with annual update + comp. reeval

We are around here -- focus is on convening TEP, collecting qualitative and quantitative data, and iterating as necessary.
Future work plan

• Collaboration with partners to develop a structural quality measure for patients with cardiac decompensation/early stages of cardiogenic shock
• Implementation of quality measure within DUH
• Reach out to organizations for validation and endorsement
• Apply for quality measure recognition through the Centers for Medicare & Medicaid Services (CMS)
Thanks for your time! Any questions?