

Identifying Cardiac Decompensation

Using Evidence-Based Diagnostics to Assist Clinicians in Real Time

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CAROLINA HEALTH INFORMATICS PROGRAM

Improving Healthcare with Intelligence



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL



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**.



Vital
Signs



Physical
Exam



Lab
Data



Imaging/
Hemodynamics



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

End Organ Dysfunction

Hypoperfusion

Hypotension + EOD within 24 hours

New or ↑ dose of vasoactive meds given

Vasoactive Medication

Respiratory Decline

↑ Supp. O₂, oxygen sat < 91%

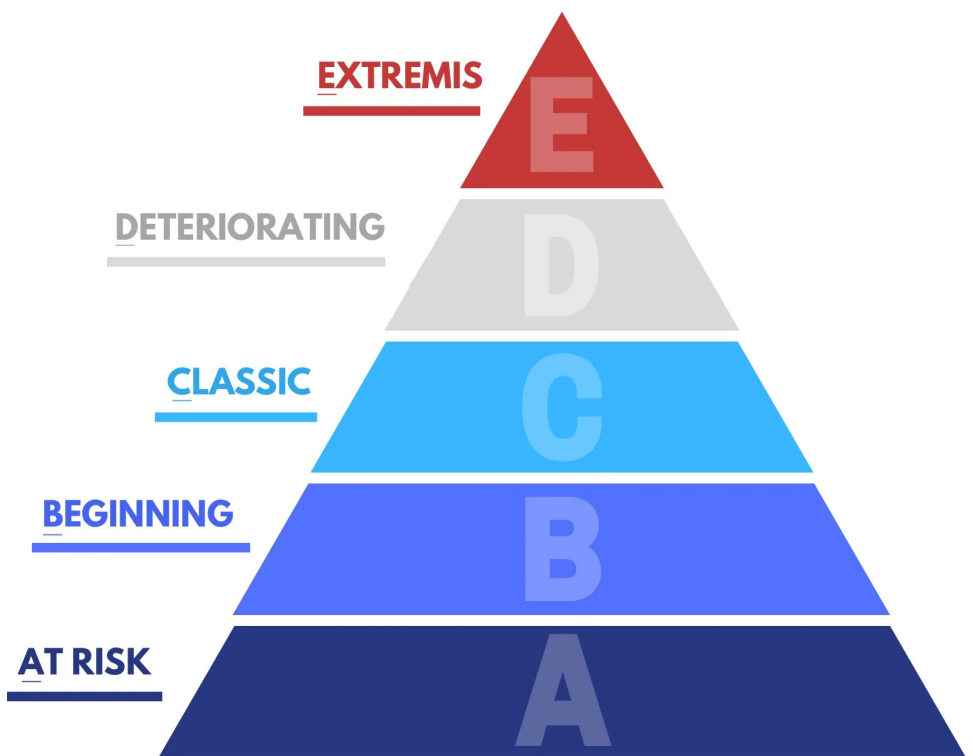
Escalation of resp. support

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



SCAI SHOCK STAGE	PHYSICAL EXAM	BIOCHEMICAL MARKERS	HEMODYNAMICS
A	Normal JVP Lung sounds clear Strong distal pulses Normal mentation	Normal renal function Normal lactic acid	Normotensive (SBP≥100 or normal for pt.) If hemodynamics done: ▪ Cardiac index ≥2.5 ▪ CVP <10 ▪ PA Sat ≥65%
B	Elevated JVP Rales in lung fields Strong distal pulses Normal mentation	Normal lactate Minimal renal function impairment Elevated BNP	SBP <90 OR MAP <60 OR >30mmHg drop Pulse ≥100 If hemodynamics done: ▪ Cardiac Index ≥2.2 ▪ PA Sat ≥65%
C	Ashen, mottled, dusky Volume overload Extensive Rales Killip class 3 or 4 BiPap or mechanical ventilation Acute alteration in mental status	Lactate ≥2 Creatinine doubling OR >50% drop in GFR Increased LFTs Elevated BNP Urine Output <30mL/h	Drugs/device used to maintain BP above stage B values. ▪ Cardiac Index <2.2 ▪ PCWP >15 ▪ RAP/PCWP ≥0.8 ▪ PAPI <1.85 ▪ Cardiac Power Output ≤0.6
D	Any of stage C	Any of stage C AND deteriorating	Any of stage C AND Requiring multiple pressors OR addition of mechanical circulatory support devices to maintain perfusion
E	Near pulselessness Cardiac collapse Mechanical ventilation Defibrillator used	Lactate ≥5 pH ≤7.2	No SBP without resuscitation PEA or Refractory VT/VF Hypotension despite maximal support



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.

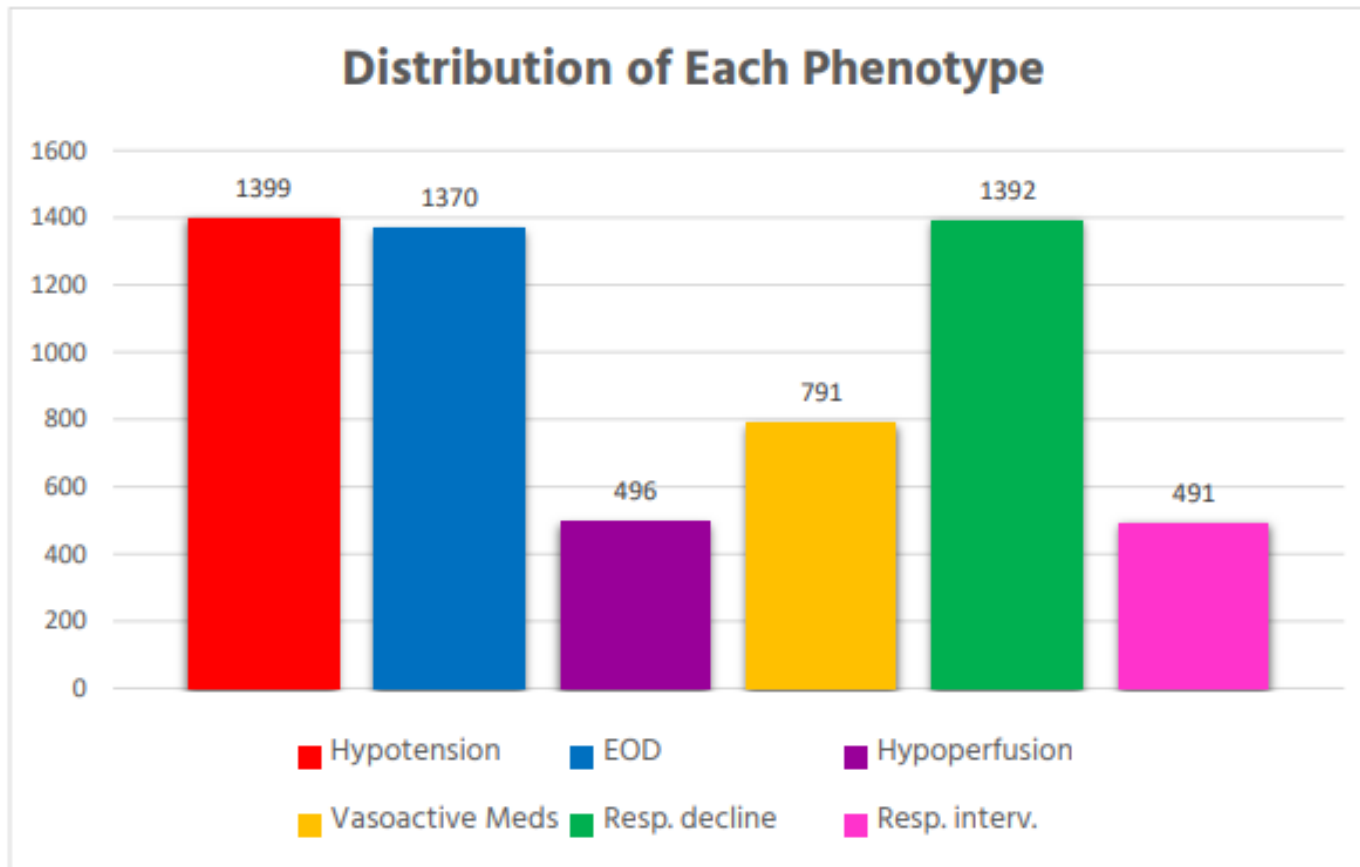
Cardiac Decompensation Dashboard
A DIHI and Heart Center Collaborative Solution

Service	Patient	MRN	Bed	Phenotypes met in last 12 hrs [®]	Hypotension	End Organ Dysfunction	Hypoperfusion	Vaso Meds	Respiratory Decline	Respiratory Intervention		
Cardiology	[Redacted]	[Redacted]	[Redacted]	3		07:48 05-04		06:41 05-04	07:32 05-04			
Look back (hrs)				2		03:46 05-04		10:09 05-04			00:06 05-04	
16				2		05:51 05-04				05:25 05-04	22:00 05-03	
Unit				2		04:38 05-04					02:07 05-04	
(Multiple values)				1		08:30 05-04						
Hypotension				1		05:40 05-04						
(All)				1		05:42 05-04				22:51 05-03		
EOD				1			23:52 05-03		07:41 05-04			
(All)				1				07:50 05-04				
Hypoperfusion				1			08:05 05-04					
(All)				1					05:31 05-04			
Vaso Meds				1					06:13 05-04			
(All)				1				07:25 05-04	06:23 05-04			
Respiratory Decline				1				04:58 05-04				
(All)				1					07:35 05-04			09:54 05-04
	1							01:03 05-04				



Results of CD Dashboard at a Glance

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



749 RRT ENCOUNTERS

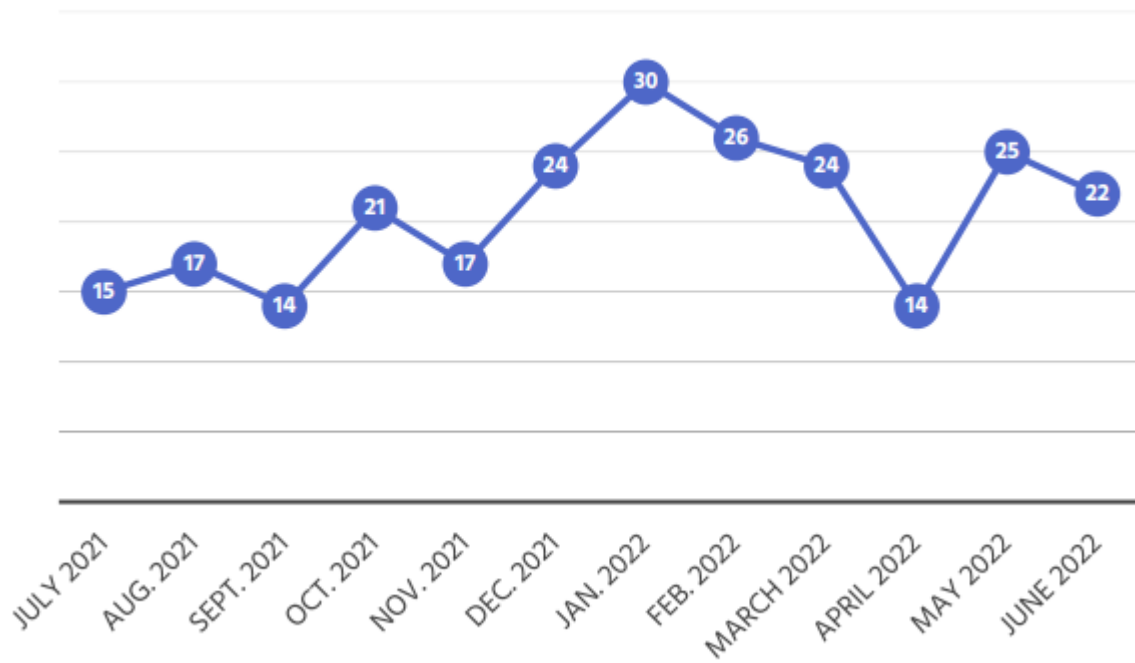
504 consults

249 events



Results of CD Dashboard at a Glance

Number of RRT Events by Month



63%
of patients met a phenotype before an RRT event

Phenotype	Incidence of phenotype occurrence prior to RRT event
Hypotension	44.4%
End organ dysfunction	39.4%
Hypoperfusion	14.9%
Vasoactive medication admin.	24.5%
Respiratory distress	41.8%
Respiratory intervention	22.1%



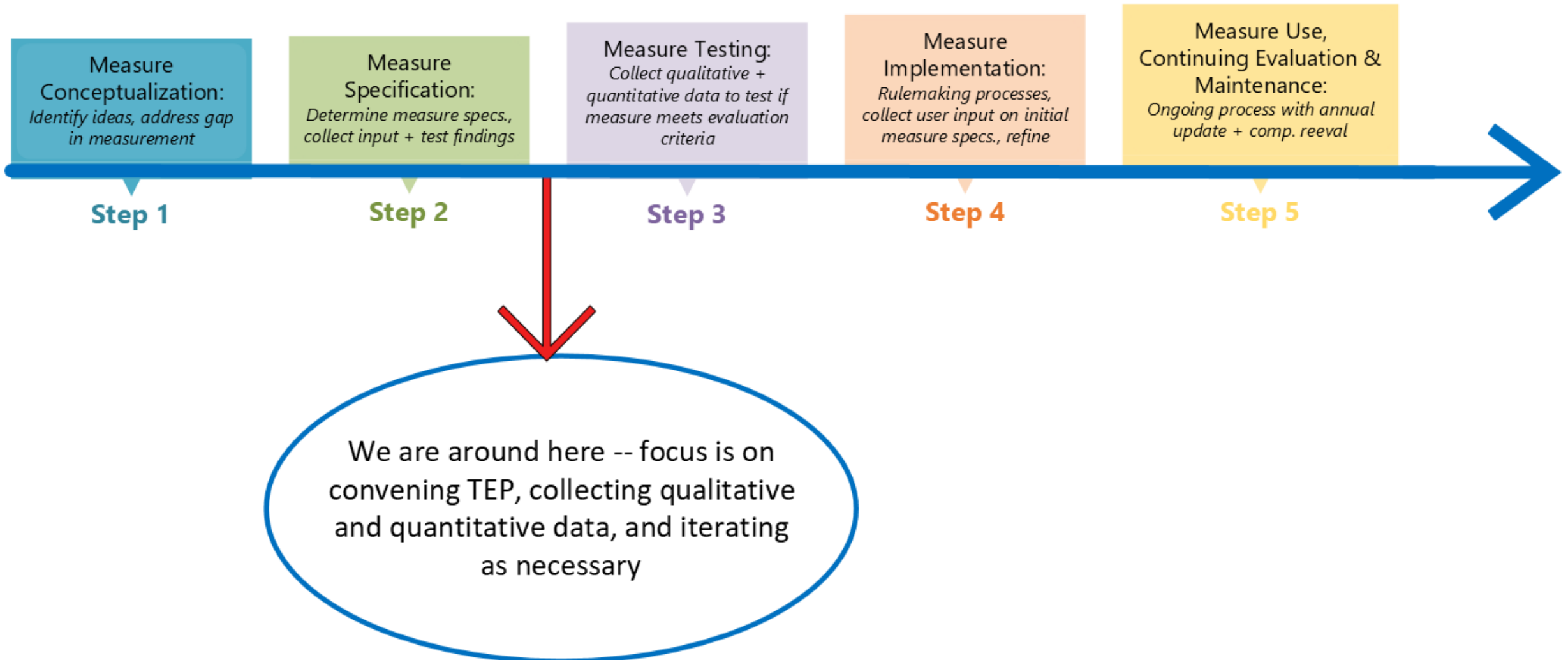
Current work

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





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?

