Update on the Management of Acute Heart Failure in the Emergency Department

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Disclosure

- I have no actual or potential conflict of interest in relation to this presentation

Objectives

- Review classification of Acute Heart Failure (AHF) syndromes
- Outline current recommendations for the management of AHF
- Discuss evolving decision rules for appropriate disposition of ED acute heart failure patients

Is Acute Heart Failure the Cinderella (neglected step-sister) of cardiovascular diseases…?

Importance of ED Heart Failure Management?

Common

- ~1% of patients > 65 have heart failure
- > 26 million people worldwide

Aging population is increasing prevalence

3-5 % of ED budgets

High Morbidity & Mortality

~50% 5-year mortality

~1 million ED visits/year in North America alone

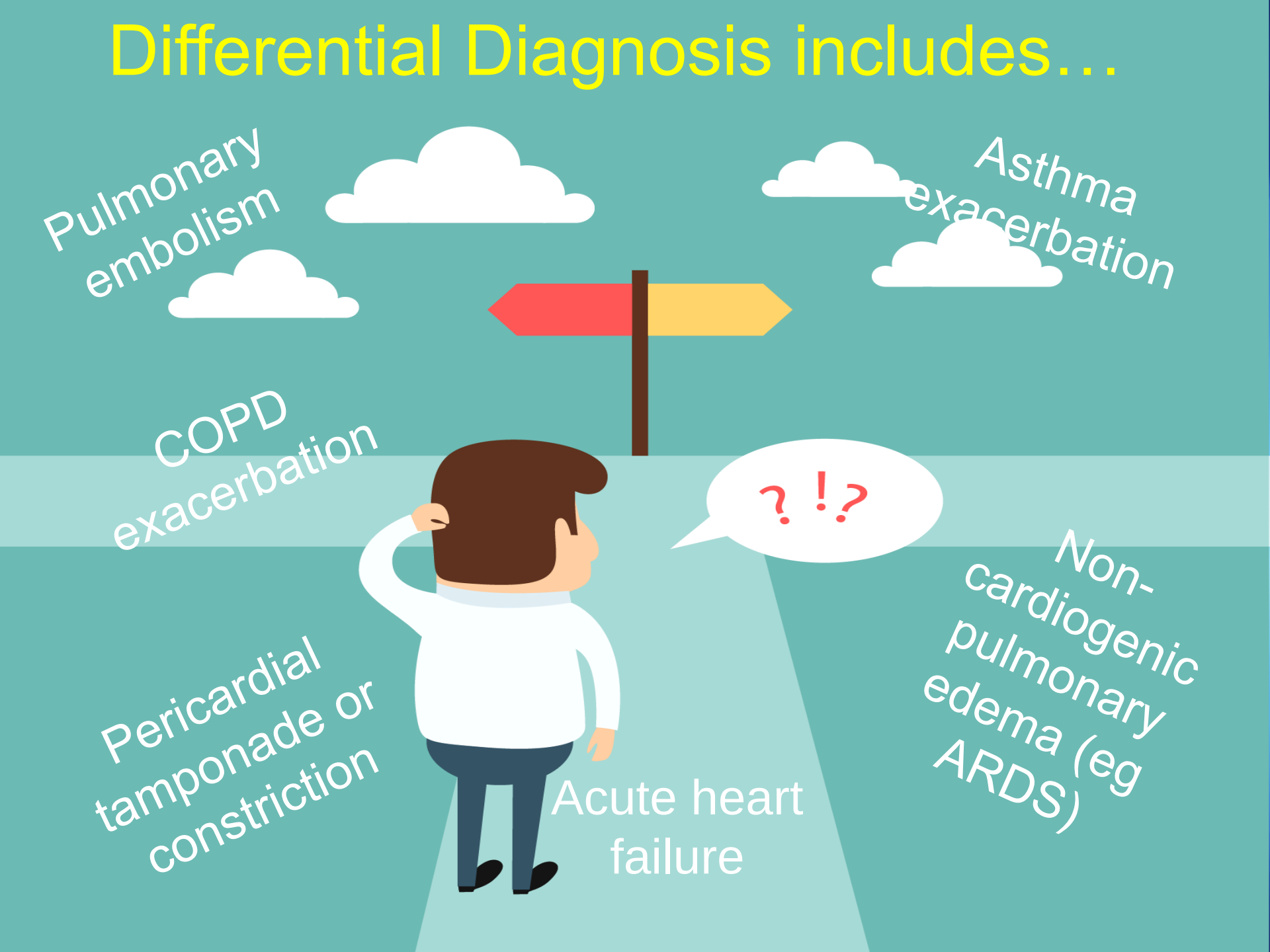
Costly

estimated $108 billion worldwide

mostly due to hospital admission

Acute dyspnea in the Emergency Department

Differential Diagnosis includes…



AHF ED Management Objectives

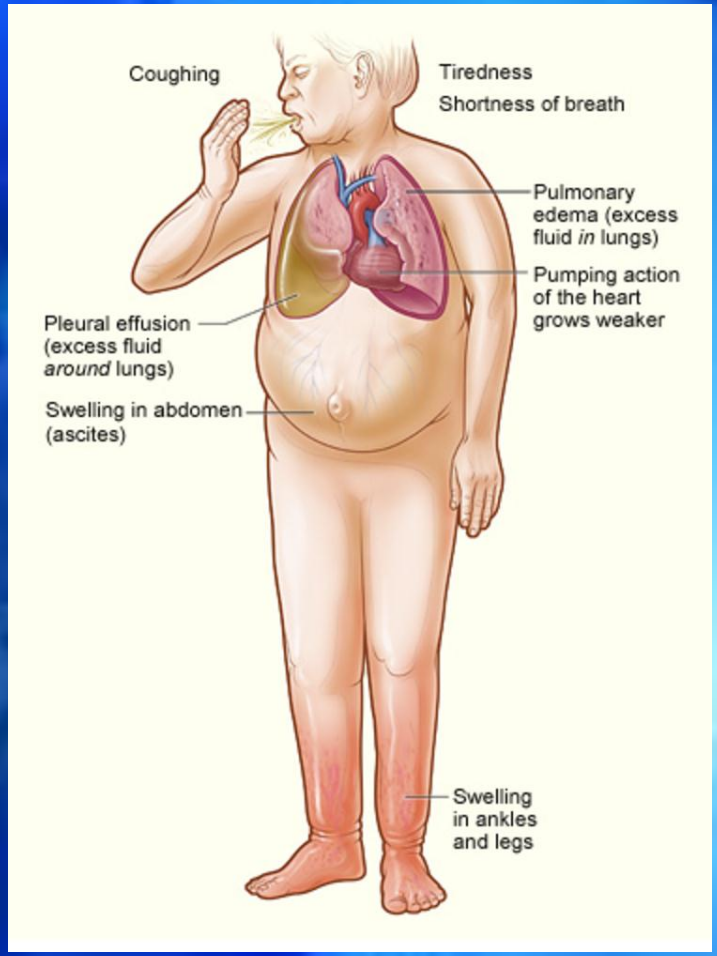
1) Diagnosis
   - Correctly identify AHF syndrome
2) Management
   - Treat symptoms and restore oxygenation
   - Address precipitating factors
3) Disposition
   - Determine which patients can be safely discharged, after a period of observation, vs high risk who will benefit from admission
   - Determine which patients will need Critical Care

1) Diagnosis

- Correctly identify AHF syndrome

Symptoms & Signs of Heart Failure

- Acute dyspnea
- Orthopnea
- Tachypnea
- Tachycardia
- Hypertension
- Crackles
- ~Wheezes
- ~S3
- Elevated JVP
- Peripheral edema



Diagnostic studies

- ECG: ischemia, rhythm, LVH
- Portable **CXR**
- CBC, troponin, electrolytes, BUN & creatinine
- +/- ABGs, lactate
- BNP or NT-proBNP (+/- helpful in ED diagnosis)
- Ultrasound for B-lines
- CT scan
- Bedside echo if available & concern for valvular heart disease

Acute Heart Failure Syndrome(s)

- Definition: Rapid onset or change in the signs & symptoms of HF, requiring urgent treatment
- Symptoms due primarily to:
  - ++pulmonary congestion due to
  - ⬆ left ventricular filling pressures +/- low cardiac output
- Ejection fraction may be normal or decreased

Acute Heart Failure Scenarios in ED

- ~70-80% exacerbation of chronic heart failure
- ~ 20% “first episode”
- ~ 5% ‘end stage’ HF’’
- < 3% shock

Acute Heart Failure Syndromes

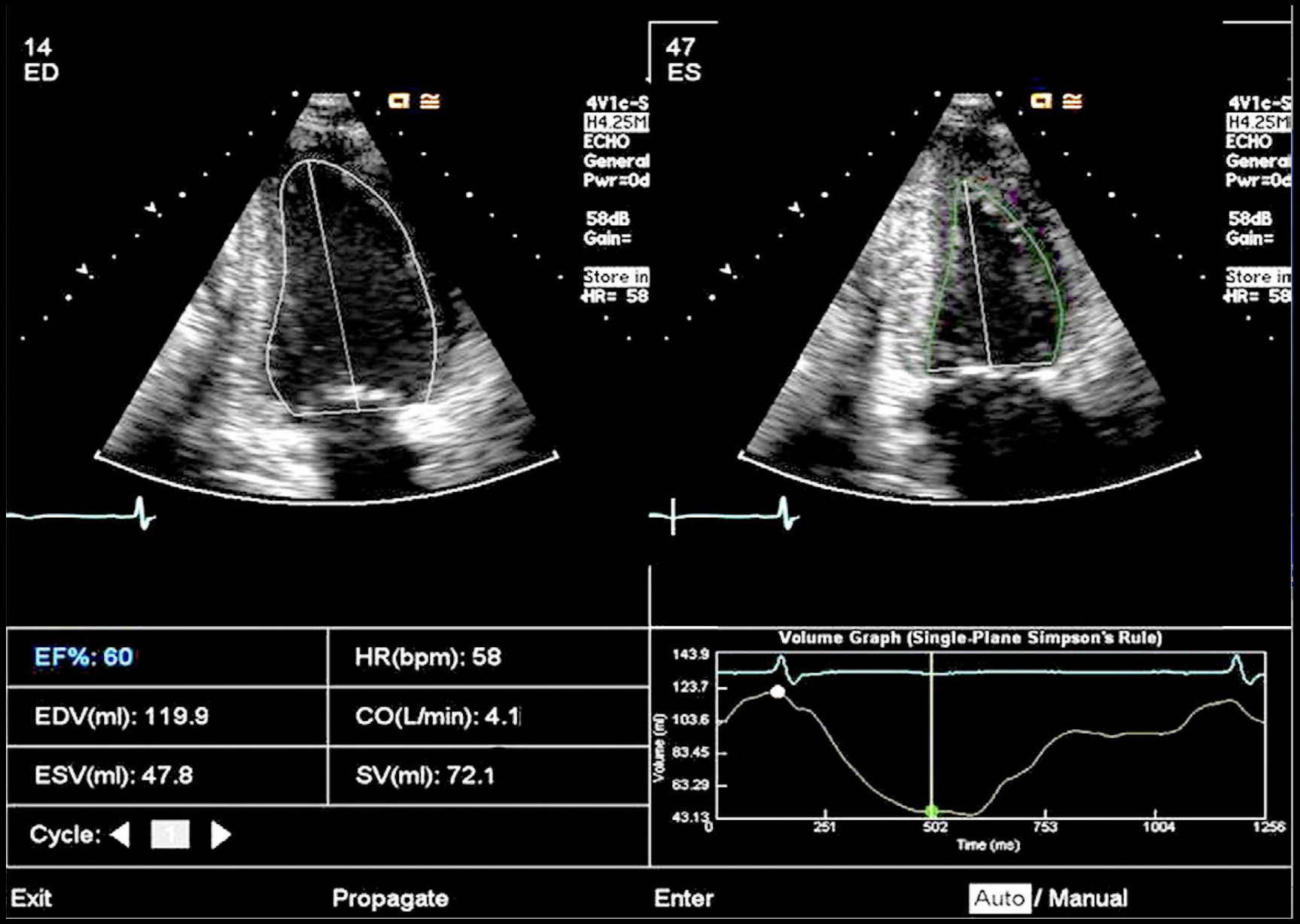
HFpEF: Heart Failure with **preserved** ejection fraction

- LVEF > 50%
- Typically normal LV volumes
- (diastolic HF)
- Treat contributing factors & comorbidities

HFrEF: Heart Failure with **reduced** ejection fraction

- Increased LV volumes and reduced EF (LVEF < 40%)
- (systolic) HF
- Treat symptoms, slow/reverse decreased myocardial function, reduce mortality

Ejection Fraction Measurement by Cardiac Echo



Rahmouni, H.W., Ky, B., Plappert, T., Duffy, K., Wiegers, S.E., Ferrari, V.A., Keane, M., Kirkpatrick, J.N., Silvestry, F.E., & Sutton, M.G. (2008). Clinical utility of automated assessment of left ventricular ejection fraction using artificial intelligence-assisted border detection. American heart journal, 155 3, 562-

Distinguish

- Acute Heart Failure with Adequate Perfusion
- Acute Heart Failure with Decreased Perfusion = Shock

Causes/precipitants of Heart Failure

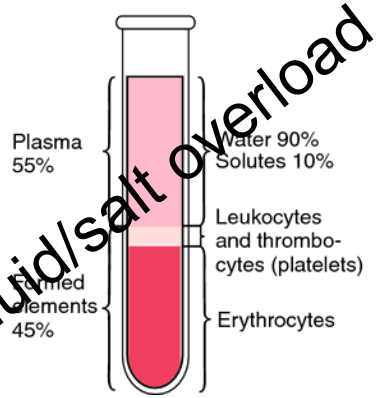
Acute Coronary Syndromes

Arrhythmias

Myocardial depression

Pulmonary embolism

Tension pneumothorax



Fluid/salt overload

Cardiomyopathy

Valvular dysfunction

Negative inotropes

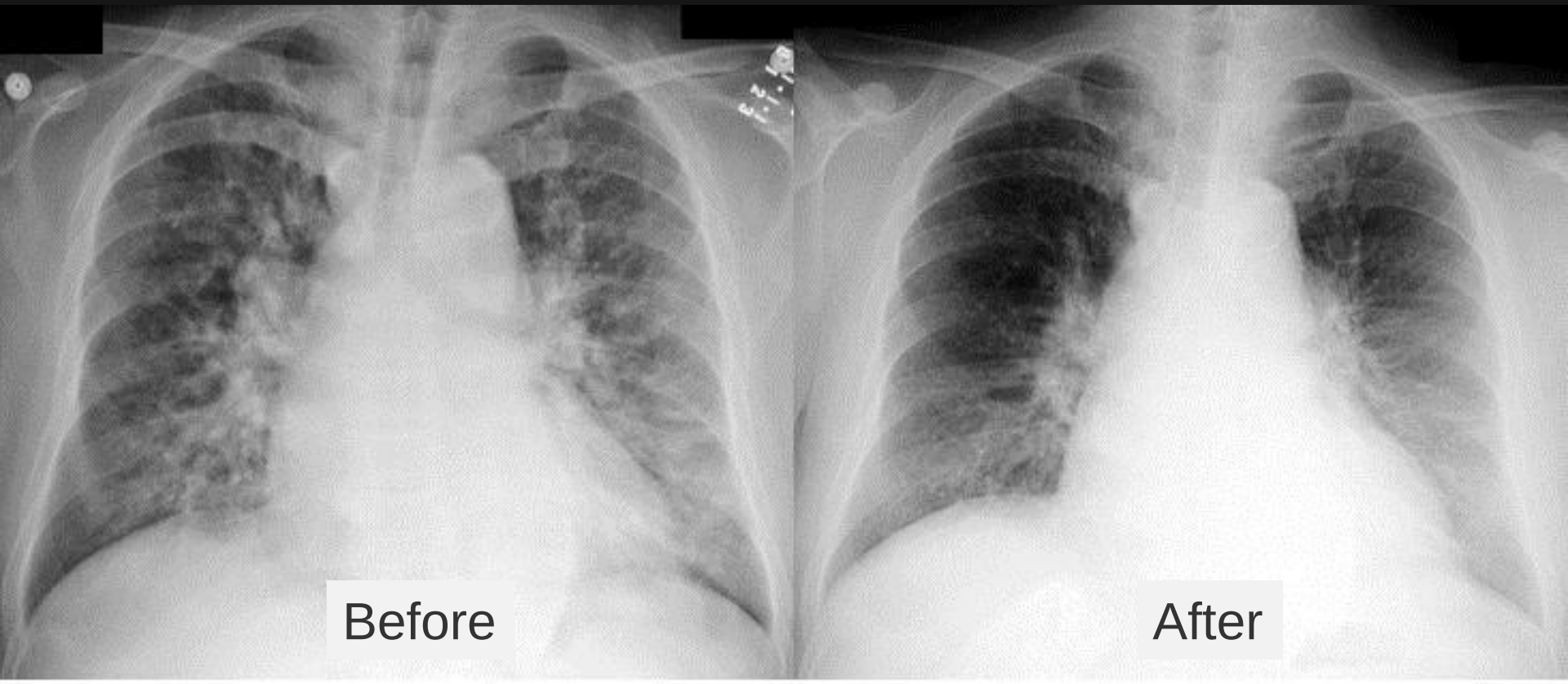
Hypertension

Anemia

Sepsis

2) Management

- Treat symptoms and restore oxygenation
- Identify and address precipitating factors



Successful treatment of AHF: symptom resolution

Major Society Guidelines

- 2018 National Institute for Health and Care Excellence (NICE): Guideline on chronic heart failure in adults- diagnosis and management
- 2018 National Heart Foundation of Australia (NHFA) and Cardiac Society for Australia and New Zealand (CSANZ): Guidelines for the prevention, detection, and management of heart failure in Australia
- 2017 Canadian Cardiovascular Society guidelines for the management of heart failure, comprehensive update
- 2017 American College of Cariology (AAC/AHA/Heart Failure Society of America (HFSA): Clinical practice guideline – Focused update of the 2013 American College of Cardiology Foundation (ACCF/AHA guideline for the management of heart failure.
- 2017 European Primary Care Cardiovascular Society (EPCCS): Practical guideline on heart failure diagnosis and management in primary care – Recent recommendations
- 2016 European Society of Cardiology (ESC) Guidelines for the diagnosis and treatment of acute and chronic heart failure
- 2015 NICE: Quality standard on acute heart failure
- 2014 NICE: Clinical guideline on acute heart failure
- 2013 American College of Cardiology / American Heart Association HF guidelines
- 2013 Japanese Circulation Society: Guidelines for treatment of acute heart failure, revised 2011 (published 2013)
- 2010 Heart Failure Society of America guidelines for ADHF

Management

1) Decrease symptoms and signs of compensatory failure:
   - ✓Restore oxygenation
   - ✓Resolve dyspnea
   - ✓Resolve pulmonary edema
   - ✓Restore tissue perfusion

2) Identify & manage precipitating factors

Goals of Treatment of all Acute Heart Failure (+/- adequate perfusion)

- Increase O_2 sat to > 90% stepwise as needed:
  1) O_2 by nasal cannula
  2) O_2 by mask
  3) **Non-invasive ventilation**
  4) Endotracheal intubation

ADHF with Adequate Perfusion

1) Sit patient upright
2) Vasodilators (if hypertensive)
    - **Nitroglycerine** (unless contraindicated)
        - 0.4 mg SL q 5 mins OR transdermal patch
        - 5 – 10 µg/min IV to start, then ++increase

    (Niseritide NOT recommended)
    (Morphine 2-5 mg IV bolus, NOT recommended)
3) Loop diuretics* (if fluid overloaded)
    - Furosemide 40 mg IV
    - (Torsemide 20 mg IV)
    - (Bumetanide 1 mg IV)

    } increase dose if already on diuretic or renal failure

*Matsue Y, Damman K, Voors AA, et al. Time-to-Furosemide Treatment and Mortality in Patients Hospitalized With Acute Heart Failure. J Am Coll Cardiol 2017; 69:3042.

Only in ADHF with Hypoperfusion (shock)*

If HFrEF (known low EF):

1)Inotrope IV stepwise to achieve +MAP, temporary bridge therapy

- Dobutamine (0.5 – 1 µg/kg/min)
- (Milrinone 0.3 – 0.5 INOTROPES INµg/kg/min)

2)Consider mechanical support (intraaortic balloon counterpulsation)

If HFpEF (known preserved EF)

1)Consider small crystalloid boluses (eg 250 ml normal saline, unless pulmonary edema)

2)IV vasopressor

- Norepinephrine (8 – 12 µg/min) or phenylephrine
- Immediate echocardiogram as needed

If unknown EF

1) Inotrope IV +/- vasopressor

2) Assess need for mechanical support, obtain immediate echo, as needed

ADHF with Hypoperfusion – Consider:

1) Dialysis
   - renal failure or volume overload refractory to diuretics
2) Blood transfusion
   - if anemia is significant factor
3) Rate/rhythm control
   - if rate/rhythm are major precipitants (carefully consider pros and cons)
4) Coronary revascularization
   - if STEMI

For refractory ADHF syndromes, consider:

1) Extra Corporeal Membrane Oxygenation (hypoxia)
2) Intra-aortic balloon counterpulation (shock)

1) Shekar K, Mullany DV, Thomson B, et al. Extracorporeal life support devices and strategies for management of acute cardiorespiratory failure in adult patients: a comprehensive review. Crit Care. 2014;18(3):219.
2) Mizuno M, Sato N, Kajimoto K, et al. Intra-aortic balloon counterpulsation for acute decompensated heart failure. Int J Cardiol. 2014;176(3):1444-1446.

Identify & address precipitating factors

- Acute Coronary Syndrome - revascularization
- Hypertension
- Arrhythmia – rate control/cardioversion
- Acute aortic or mitral insufficiency
- Aortic dissection

} Cardiac surg consult

- Anemia
- Sepsis
- Renal failure
- Drugs

3) Disposition?

- Hospitalize vs discharge
  - Identify patients with low risk for serious adverse events who can be safely discharged
  - Identify patients at high risk for adverse events who require admission
- Identify higher risk patients who may benefit from a CCU admission

US vs Canadian Management & Outcomes of AHF

- Similar characteristics of patients
- US admission rate was 95.2% vs Canadian 50.6%, yet outcomes were similar:
  - relapse to the ED, MIs, and death within 30 days
- Findings question the need for routine admission of patients with AHF

Lai A et al. CJEM 2016; 18(2)81-89.

European Heart Journal
Acute Cardiovascular Care
EUROPEAN SOCIETY OF CARDIOLOGY®

Clinical Practice/Education

European Heart Journal: Acute Cardiovascular Care
2017, Vol. 6(4) 311–320

DOI: 10.1177/2048872616633853
journals.sagepub.com/home/acc
SAGE

European Society of Cardiology – Acute Cardiovascular Care Association position paper on safe discharge of acute heart failure patients from the emergency department

Òscar Miró[1], Frank W Peacock[2], John J McMurray[3], Héctor Bueno[4], Michael Christ[5], Alan S Maisel[6], Louise Cullen[7], Martin R Cowie[8], Salvatore Di Somma[9], Francisco J Martín Sánchez[10], Elke Platz[11], Josep Masip[12], Uwe Zeymer[13], Christiaan Vrints[14], Susanna Price[15], Alexander Mebazaa[16] and Christian Mueller[17] for the Acute Heart Failure Study Group of the ESC Acute Cardiovascular Care Association

Miró, Ò, Peacock, F. W., McMurray, et al. (2016). European Society of Cardiology - Acute Cardiovascular Care Association position paper on safe discharge of acute heart failure patients from the emergency department. European heart journal. Acute cardiovascular care, 6(4), 311–320. doi:10.1177/2048872616633853

Academic Emergency Medicine
Official Journal of the Society for Academic Emergency Medicine

ORIGINAL RESEARCH CONTRIBUTION

CME

A Risk Scoring System to Identify Emergency Department Patients With Heart Failure at High Risk for Serious Adverse Events

Ian G. Stiell, MD, MSc, Catherine M. Clement, RN, Robert J. Brison, MD, MPH, Brian H. Rowe, MD, MSc, Bjug Borgundvaag, MD, PhD, Shawn D. Aaron, MD, Eddy Lang, MD, Lisa A. Calder, MD, MSc, Jeffrey J. Perry, MD, MSc, Alan J. Forster, MD, MSc, and George A. Wells, PhD

Ottawa Heart Failure Risk Score

- To determine whether a retrospectively-derived clinical prognostic algorithm can be used more broadly to assist with decision-making in the ED
- Convenience sample of 559 patients – 38% of patients were admitted
- Patients excluded if “too sick” to consider discharge

Ottawa Heart Failure Risk Scale

Items	Points
1. History	
a) Stroke or TIA	1
b) Intubation for respiratory distress	2
2. Examination	
a) Heart rate on ED arrival ≥ 110	2
b) SaO_2 < 90% on arrival	1
c) Heart rate ≥ 110 during 3-minute walk test (or too ill to perform walk test)	1
3. Investigations	
a) ECG has acute ischemic changes	2
b) Urea ≥ 12 mmol/L	1
c) Serum CO_2 ≥ 35 mmol/L	2
d) Troponin I or T elevated to MI level	2
e) NT-proBNP ≥ 5,000 ng/L	1
Total Score (0 - 15):	____

Stiell et al. 2013. ACADEMIC EMERGENCY MEDICINE 2013; 20:17–26 Society for Academic Emergency Medicine

Heart Failure Risk Categories for Serious Adverse Events

Total Score	Risk	Category	Sensitivities
0	2.8%	Low	95%
1	5.1%	Medium	81%
2	9.2%	Medium	65%
3	15.9%	High	
4	26.1%	High	
5	39.8%	Very High	
6	55.3%	Very High	
7	69.8%	Very High	
8	81.2%	Very High	
9	89.0%	Very High	

Annals of Internal Medicine

ORIGINAL RESEARCH

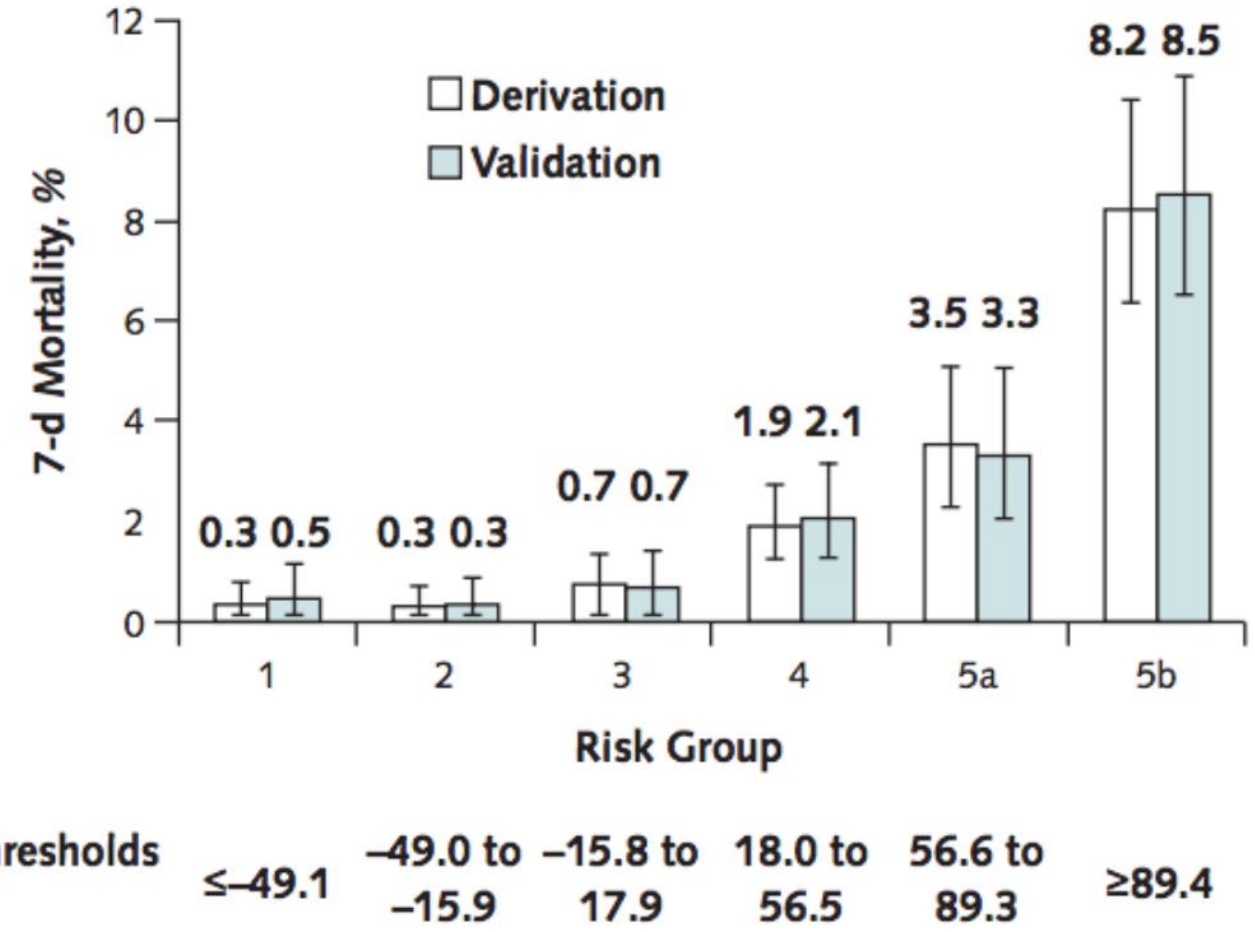
Prediction of Heart Failure Mortality in Emergent Care

A Cohort Study

Douglas S. Lee, MD, PhD; Audra Stitt, MSc; Peter C. Austin, PhD; Therese A. Stukel, PhD; Michael J. Schull, MD, MSc; Alice Chong, BSc; Gary E. Newton, MD; Jacques S. Lee, MD, MSc; and Jack V. Tu, MD, PhD

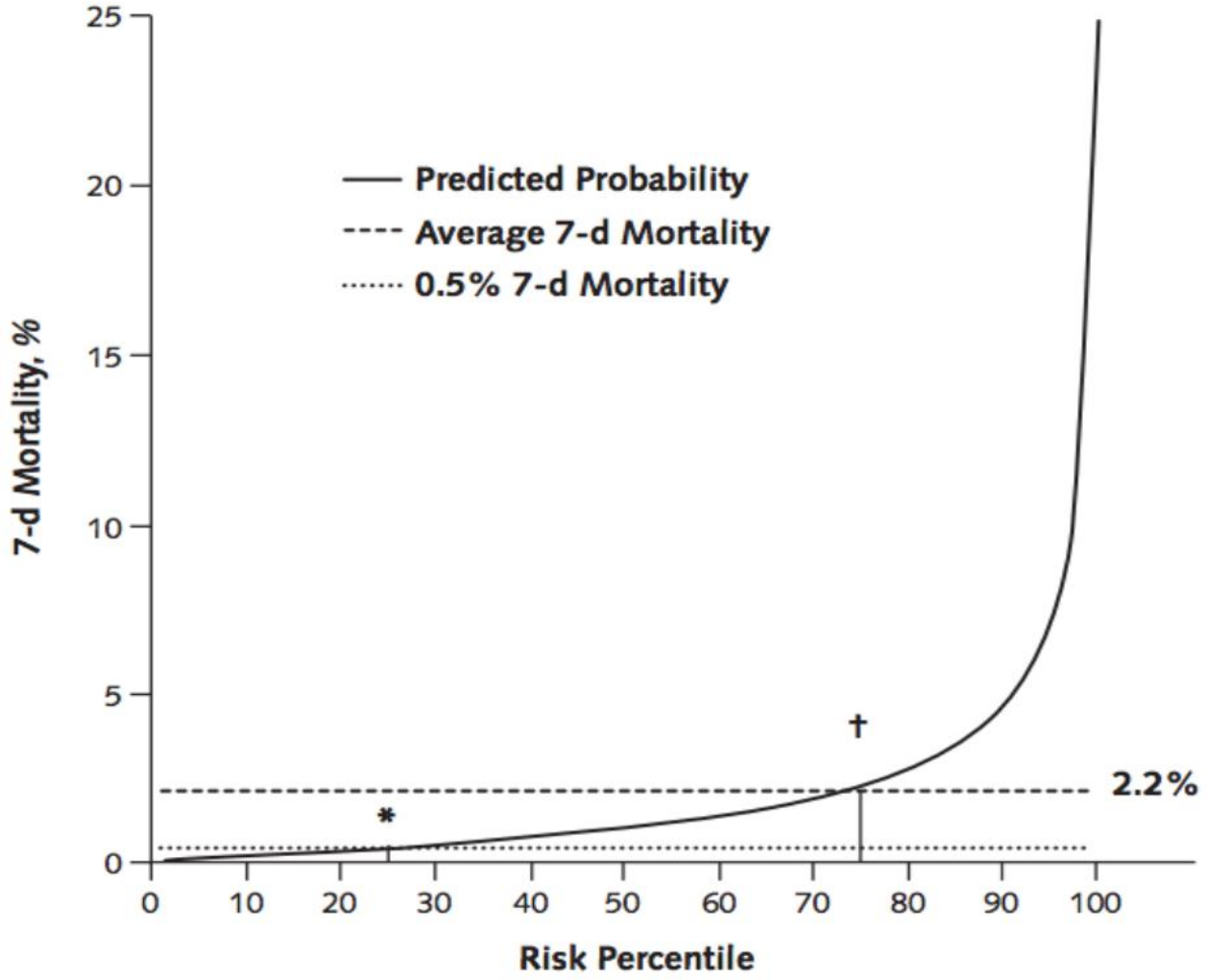
Ann Intern Med. 2012;156:767-775

Figure 2. **Absolute 7-day mortality rates and 95% CIs, by EHMRG score.**



Error bars are 95% CIs. EHMRG = Emergency Heart Failure Mortality Risk Grade.

Figure 3. **Predictiveness of the EMHRG showing ordered distribution of 7-day mortality risk.**



Vertical bars indicate 25th (*) and 75th (†) risk percentiles. EHMRG = Emergency Heart Failure Mortality Risk Grade.

EHMERG Scale
(Emergency Heart Failure Mortality Risk Guide)

Table 2. Variables included in the Emergency Heart Failure Mortality Risk Grade Model formulated by Lee et al.[41] Score calculation for a particular patient can be done through a web calculator (https://ehmrg.ices.on.ca/#/) which allocates patient in low (deciles 1 to 4), medium (deciles 5 to 7) or high (deciles 8 to 10) risk category.

Variable[a]	Unit of measurement
Age	Continuous in years
Transported by EMS	Categorical
Systolic blood pressure	Continuous in mmHg (max = 160 mmHg)
Heart rate	Continuous in beats/min (min = 80, max = 120 beats/min)
Oxygen saturation	Continuous as % (max = 92%)
Creatinine	Continuous as mg/dl
Potassium	Categorical:
	4.0 to 4.5 mmol/l
	$\geqslant$ 4.6 mmol/l
	$\leqslant$ 3.9 mmol/l
Troponin	Categorical
Active cancer	Categorical
Metolazone at home	Categorical

Online calculator: (https://ehmrg.ices.on.ca/#/)

Characterization of hemodynamically stable acute heart failure patients requiring a critical care unit admission: Derivation, validation, and refinement of a risk score

Ismail R. Raslan, MD,[a] Paul Brown, MSc,[a] Cynthia M. Westerhout, PhD,[a] Justin A. Ezekowitz, MBBCh, MSc,[a,b] Adrian F. Hernandez, MD, MHS,[c] Randall C. Starling, MD, MPH,[d] Christopher O'Connor, MD,[e] Finlay A. McAlister, MD, MSc,[a,f,g] Brian H. Rowe, MD, MSc,[h,i] Paul W. Armstrong, MD,[a,b] and Sean van Diepen, MD, MSc[a,b,j] *Alberta, Canada; Durham, NC; Cleveland, OH; Falls Church, VA; Edmonton, Alberta; and Edmonton, Canada*

Am Heart J 2017;188:127-35.

Table II. Variables independently associated with in-hospital outcomes or critical care-specific therapies in patients admitted with AHF in the ASCEND-HF derivation model

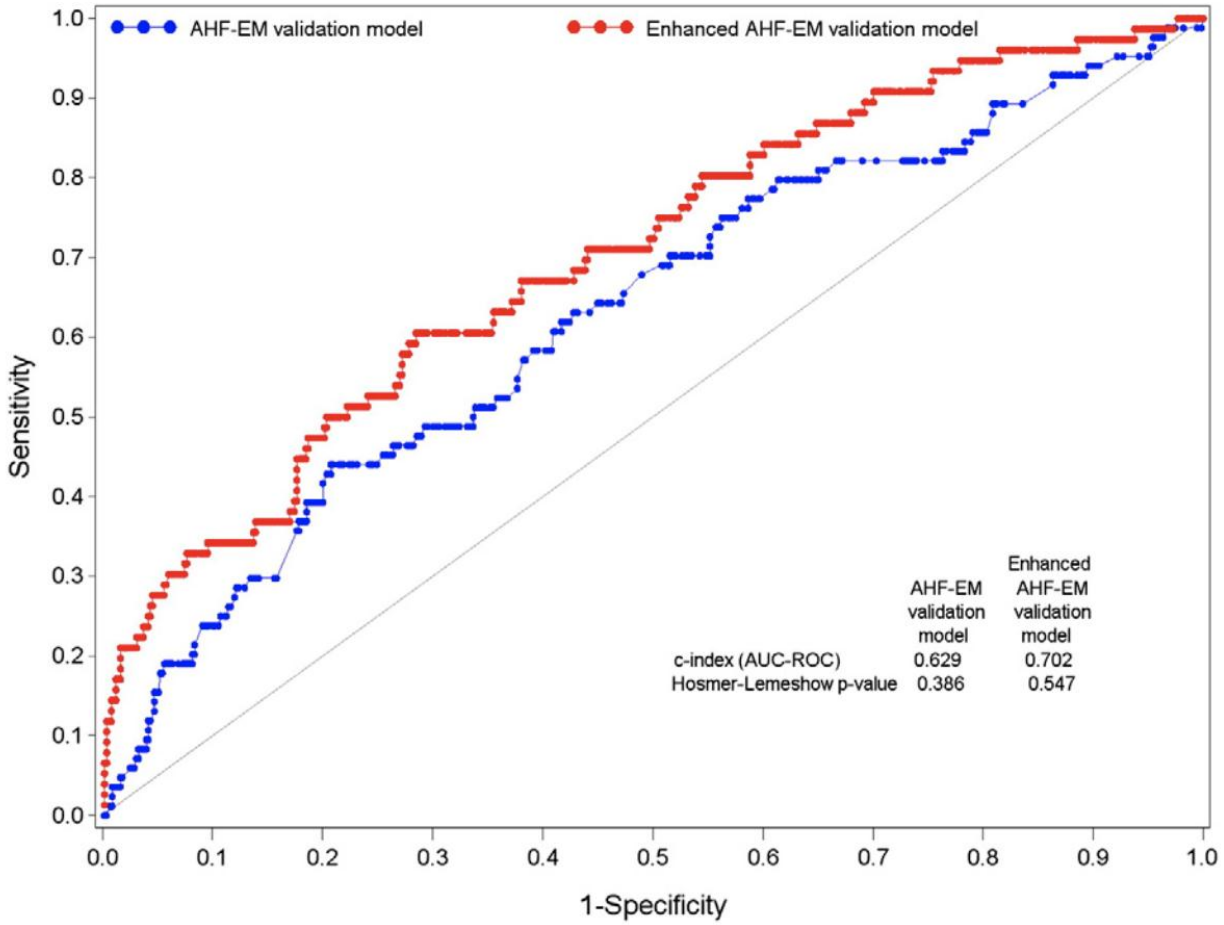
Variable	Wald χ^2	Odds ratio (95% CI)	*P*
Body mass index, per 5-kg/m^2 increase	6.842	1.077 (1.019-1.139)	.009
Chronic respiratory disease	15.139	1.542 (1.240-1.918)	<.001
Dyspnea at rest	10.878	1.378 (1.139-1.667)	.001
Respiratory Rate, per 5-breaths/min increase	10.037	1.203 (1.073-1.349)	.002
Hemoglobin ≥12 g/dL, per 1-g/dL increase	7.064	1.088 (1.022-1.158)	.008
BUN, per 1-mg/dL increase	42.111	1.013 (1.009-1.016)	<.001
Sodium <140 mmol/L, per 10-mmol/L decrease	21.950	1.721 (1.372-2.161)	<.001
Sodium ≥140, per 10-mmol/L increase	1.484	1.390 (0.818-2.361)	.223

Table III. Incremental prognostic contribution of ischemic heart failure, troponin, and BNP to AHF-EM validation model for in-hospital outcomes or the provision of critical care therapies

	c Index	Net reclassification improvement (95% CI)*	IDI (95% CI)
Baseline model†	0.627	Reference	Reference
Baseline model + ischemic etiology of heart failure	0.644	0.239 (0.010 to 0.467)	0.007 (–0.001 to 0.014)
Baseline model + BNP‡	0.648	0.213 (–0.0243 to 0.449)	0.012 (0.002 to 0.022)
Baseline model + troponin§	0.679	0.339 (0.113 to 0.564)	0.065 (0.030 to 0.099)
Baseline model + all 3 variables	0.701	0.279 (0.046 to 0.512)	0.014 (0.005 to 0.024)

* Category-free NRI.
† Baseline model variables: weight, chronic respiratory disease, respiratory rate, resting dyspnea, hemoglobin, sodium, and blood urea nitrogen.
‡ BNP analyzed categorically as follows: 0-500 (reference), 500-1500, and >1500 pg/mL.
§ troponin analyzed categorically as follows: 0 (reference), 0.01-0.15, 0.16-0.5, >0.5 pg/mL.

Figure



Receiver operating curves for baseline and refined clinical prediction models in the AHF-EM data set.

Rahan IR, Brown P. et al. Am Heart J 2017;188:127-35.

Conclusions

- AHF syndromes are common, and Emergency Physicians are key to reducing morbidity & mortality
- Early diagnosis and rapid management are key
- Oxygenation by escalating interventions, loop diuretics for volume overloaded patients, vasodilators for hypertensive patients and correction of precipitating factors are still mainstream treatments
- Evidence for risk-stratification is ongoing toward the development of decision tools to determine patient disposition

Questions?