CAEP Acute Heart Failure Best Practices Checklist

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A. Assessment

1. What is acute heart failure (AHF)?

- **Heart failure (HF)** is a syndrome that results from the structural or functional impairment of ventricular filling or ejection of blood.
- **Cardinal manifestations** include dyspnea, fatigue, pulmonary and/or splanchnic congestion, peripheral edema.
- **Acute heart failure** is a common condition that frequently results in poor outcomes or death.[1,2]
  - patients typically present to the emergency department (ED) with **increased shortness of breath**.
  - may be the first episode of HF (**new onset**) or, more frequently, be due to acute decompensation of **chronic HF**.
- **Diagnosis** is primarily clinical assisted by selected investigations.[3]

Left ventricular ejection fraction (LVEF) *in heart failure is classified as:*

HF with **preserved** ejection fraction	**(HFpEF)**	LVEF ≥50%
HF with **mildly reduced** ejection fraction	**(HFmrEF)**	LVEF 41%-49%
HF with **reduced** ejection fraction	**(HFrEF)**	LVEF ≤40%
HF with **improved** ejection fraction	**(HFimpEF)**	compared to baseline

2. How does acute heart failure present?

- There are four major clinical presentations with possible overlap:

A. **Acute decompensated heart failure** (ADHF)
   - onset of dyspnea ***over days***
   - pulmonary congestion, jugular venous distension, peripheral edema
   - the most common form, accounting for 50-70% of ED presentations

B. **Acute pulmonary edema** (aka "*flash pulmonary edema*")
   - onset of dyspnea ***over hours***
   - pulmonary congestion causes dyspnea with orthopnea, tachypnea, and hypoxia

C. **Isolated right ventricular (RV) failure**
   - caused by RV dysfunction, severe pulmonary hypertension or severe tricuspid valve disease
   - **symptoms** often nonspecific: exertional dyspnea, fatigue, early satiety, symptoms of right-sided volume overload
   - **physical findings** include jugular venous distension, often with a prominent V wave and positive Kussmaul sign, ascites, leg edema
   - often **poor outcomes**

D. **Cardiogenic shock**
   - due to **primary cardiac** dysfunction that results inadequate cardiac output and life-threatening tissue hypoperfusion, which can lead to multiorgan failure and has >30% mortality
   - may be precipitated by acute events (e.g. myocardial infarction (MI), myocarditis) or acute decompensation of chronic left ventricular (LV) dysfunction
   - diagnosis is based on evidence of hypoperfusion:
     - signs: cold wet extremities, mottling, oliguria, mental confusion, narrow pulse pressure
     - blood pressure Is often low (SBP < 90mmHg) but may be preserved by reflex vasoconstriction

- laboratory: metabolic acidosis with elevated serum lactate, creatinine, and/or liver enzymes

3. Diagnosis of acute heart failure

- **Etiology and precipitating factors** should be considered:
  - non-adherence with diet/sodium/water
  - non-adherence with or recent change in medication; chemotherapeutic agents
  - infections (*pneumonia, influenza, endocarditis, myopericarditis*)
  - arrhythmias (*atrial fibrillation* (*AF), atrial flutter (AFL), bradycardia, ventricular tachycardia*)
  - pulmonary embolism
  - MI, acute coronary syndrome (ACS)
  - hypertensive emergency
- **History** focuses on:
  - increasing symptoms (*dyspnea, orthopnea, paroxysmal nocturnal dyspnea*)
  - recent weight gain
  - history of heart failure and echocardiography results
  - history of coronary artery disease
  - medications

TIP: Consider alternative or precipitating diagnoses for acute severe dyspnea:

- *myocardial infarction (MI)*
- *pneumonia*
- *pulmonary embolism*
- *exacerbation of asthma/COPD*
- *pericardial tamponade*
- *pneumothorax*
- *acute valve regurgitation*
- *acute aortic syndrome*
- *arrhythmias: VT, SVT, AF, AFL*

- **Clinical exam** focuses on impact of lung congestion:
  - agitation, somnolence, confusion
  - poor perfusion, cyanosis, diaphoresis
  - breathless speech
  - inability to lie supine
  - usually afebrile, tachypnea, low oxygen saturation, tachycardia
  - peripheral/sacral edema
  - jugular venous distension (JVD), hepatojugular reflux (HJR)
  - crackles, wheezing
  - extra heart sounds, murmurs
- **Point of care ultrasound** (POCUS) can rapidly assess:
  - lung congestion (*pleural effusion, bilateral B-lines)*
  - qualitative LV function
  - JVD
  - RV filling pressure estimation by measurement of inferior vena cava (IVC)
  - pericardial effusion
- **ECG** helps identify:
  - rhythm abnormalities (*AF/AFL, heart block, bradycardia, ventricular tachycardia*)
  - acute myocardial ischemia
  - RV, LV, or atrial hypertrophy or strain
  - myopericarditis
  - use 15-lead ECG for posterior ischemia, if shock
- **Investigations** include hematology, chemistry, and troponin.
  - **NT-proBNP** strongly recommended:
    - **<300 pg/ml** – unlikely AHF
    - **300-900 pg/ml** (*age 50-75*) or **300-1800** (*age >75*) – consider use of **PRIDE HF Score**
    - **>900 pg/ml** (*age 50-75*) or **>1800** (*age >75*) – likely AHF
- **Chest x-ray** assesses cardiomegaly, lung congestion (redistribution, Kerley B lines, interstitial fluid), other conditions.
- **The PRIDE HF Scale** can be helpful when the diagnosis is uncertain:[4]

PRIDE Acute Heart Failure Score[4]

Predictor	Score
Interstitial edema on CXR	2
Orthopnea	2
Lack of fever	2
On loop diuretic	1
Age >75 years	1
Crackles/rales on lung exam	1
Lack of cough	1
Elevated NT-proBNP	4
▪ *> 450 pg/mL if age <50*	
▪ *> 900 pg/mL if age ≥50*	

Likelihood of HF	Total Score
Low	0-5
Intermediate	6-8
High	9-14

B. Treatment

1. Overall Approach

- **Treat underlying causes:**
  - infections, arrhythmias, pulmonary embolism, ACS, hypertension.
- **Oxygen** should be used cautiously in patients with normal oxygen saturation because of concerns of increasing systemic vascular resistance and reducing cardiac output.
  - **give oxygen** for patients who are hypoxemic, titrated to an oxygen saturation >90%.
- **Noninvasive ventilation (NIV)** through BiPAP or CPAP should be considered for patients with a high respiratory rate (*>25 breaths/min*), respiratory fatigue, and persistent hypoxemia despite high-flow oxygen.
  - **routine use** of NIV is not advisable due to risk of worsening right HF, hypercapnia, aspiration, and pneumothorax.
  - NIV may be useful in **hemodialysis patients** with acute HF.
- **Endotracheal intubation** should be used if less invasive modes of oxygen delivery and ventilation support fail.
- **IV diuretics** remain the mainstay of therapy and should be administered as early as possible.
  - use **bolus administration** as no advantage to continuous infusion.[5]
  - start with an initial **IV dose of furosemide:**
    - if patient already taking diuretics, give **1-2 times the daily oral dose** as the initial IV dose.
    - if patient **not on oral diuretics**, suggest:

      - **20 mg furosemide** for eGFR >60
      - **40 mg furosemide** for eGFR 30-60
      - **60-80 mg furosemide** for eGFR <30

    - assess for **satisfactory diuretic response**:
      - **urine output** >100-150 mL/h during the first 6 hours.
      - **urine sodium content** >50-70 mEq/L at 2 hours.
  - **if insufficient diuretic response**: confirm diagnosis of AHF and then **double the IV diuretic dose.**
  - **if response remains suboptimal** patient may be in **normotensive cardiogenic shock**.
- **IV morphine** should not be used as it increases morbidity and mortality.
- **Vasodilators and inotropic agents** should only be used in selected patients (*e.g. pulmonary edema, cardiogenic shock*) as they do not improve outcomes in most patients.
- **Beta-blockers and calcium-channel blockers** should be avoided in management of tachycardia and AF/AFL if LVEF is low or not known.

2. Acute Pulmonary Edema

- **Three treatments** should be commenced, if indicated, simultaneously:
    A. **Oxygen** should be given using NIV or high-flow nasal cannula.[6]
    B. **IV diuretics** should be administered, as above.
    C. **Nitroglycerin** should be given if systolic BP (SBP) ≥100 mmHg, to reduce LV afterload.
        - consider immediate **sublingual nitroglycerin spray** (400 µg) followed by IV.
        - give **IV nitroglycerin** in an initial dose of 5 to 10 µg/min increase by 5 to 10 µg/min every 3-5 minutes as required and tolerated (*dose range 10 to 200 µg/min*).
        - **high-dose nitrates** may be considered if SBP ≥160 mmHg:[7] [8]
            - **start at 100 µg/min** and rapidly titrate as tolerated to 200 µg/min (*maximum 400 µg/min*).
            - **decrease dose** as dyspnea and SBP improve.
        - **IV nitroprusside** may be used by experienced physicians.

3. Isolated Right Ventricular Failure

- **Rule out** ACS with RV involvement or pulmonary embolism.
- **Diuretics** are the main therapy for venous congestion.
- **Involve cardiology** early if the patient has severe pulmonary hypertension or fails to respond to diuretics.

4. Cardiogenic Shock

- **Consult cardiology/critical care** urgently.
- Identify and treat **underlying causes**:
    - if **ACS**, consider percutaneous coronary intervention (PCI).
    - if **tamponade**, consider pericardiocentesis.
    - if **papillary muscle rupture**, consider surgery.
    - **other** (*acute valve regurgitation, pulmonary embolism, infection, myocarditis, arrhythmia).*
- Provide **oxygen** and consider **ventilatory support**.
    - if intubation is needed, choose a **sedative agent** with caution – consider ketamine or etomidate.
    - for ongoing sedation, consider IV midazolam and fentanyl and avoid propofol.
- Consider **inotropes/vasopressors**:[9]

    - **norepinephrine** is first line: start at 0.05 ug/kg/min and titrate up
    - **dobutamine** 2-10 ug/kg/min
    - **milrinone** 0.25-0.75 ug/kg/min

- Consider expert consultation for **mechanical circulatory support** (*percutaneous LV assist devices or ECMO*).

C. Disposition and Follow-up

1. How to Decide if Patient Can be Discharged Home

- **Disposition decision** to admit or discharge from the ED is complex.
  - ≥50% of ED acute HF patients are admitted in Canada.
- Use **shared decision making** with patient and family.
- **Factors to consider:**
  - **clinical classification** NYHA I or II at baseline
  - **not a new diagnosis** of heart failure
  - **response to ED treatment:** good diuresis, improved dyspnea approaching patient's baseline
  - **acceptable vital signs** at rest after treatment: *SpO_2 >92%, SBP >100mmHg, HR <90bpm, RR ≤20 breaths per minute*
  - **ability to walk** (or baseline level of mobility) without tachycardia, tachypnea, or hypoxia
  - **ECG** shows no ischemia or ventricular arrythmia; any atrial arrythmia has been controlled
  - **creatinine** at baseline after treatment
  - **troponin** not indicative of ACS
  - **no comorbid conditions** that independently require admission (*e.g. syncope, pneumonia*)
  - opportunity to **optimize medications –** *see below*
  - availability of **early follow-up** (<7 days) with clinician
  - **home support** is adequate

NYHA

Class	Definition
I	No symptoms
II	Symptoms with ordinary activity
III	Symptoms with less than ordinary activity
IV	Symptoms at rest or with minimal activity

2. What is the HEARTRISK6 Scale? [10]

- **The HEARTRISK6 Scale** is a concise and sensitive risk tool comprised of 6 simple variables that estimates the risk of poor outcomes.
- The scale was developed from prospectively collected data from **2,246 Canadian ED patients**.
- Physicians **may consider** incorporating the scale's information when making disposition decisions.
- Medium- and high-risk patients should likely be admitted.

HEARTRISK6 Acute Heart Failure Risk Scale

Items	Points
1. Initial Assessment	
a. History of valvular heart disease[1]	1
b. Heart Rate:	
i. HR > 100bpm to <120 bpm	2
ii. HR >120 bpm	3
c. Treated with non-invasive ventilation[2]	2
2. Investigations	
a. Creatinine:	
i. >150 umol/L to <300 umol/L	2
ii. > 300 umol/L	3
b. Troponin:	
i. > 3x or 4x upper limit of normal	1
ii. >5x upper limit of normal	2
(initial or repeat, local hospital assay)	
3. Falls reassessment after ED treatment (2-6 hours)	
a. Resting vital signs abnormal *(SpO2 <90% on RA or usual O2, or HR ≥ 110, or RR ≥28)*	1
OR	
b. Unable to start or complete 3-minute walk test *(vital signs become abnormal during walk)*[3]	1

Heart failure risk categories for short-term serious outcomes		
Total Score	**Absolute Risk**	**Category**
0	6.4%	Low
1	8.5%	
2	11.3%	Medium
3	14.9%	
4	19.4%	
5	24.8%	
6	31.2%	High
7	38.3%	
8	48.0%	
9	53.9%	
>10*	61.6%	

[1] moderate or severe valvular heart disease
[2] BiPAP within one hour of initial assessment
[3] score if patient SpO2 <90%, HR ≥110, RR ≥28 during walk test, or if unable to complete due to fatigue or dyspnea
** no patient scored > 11*

3. How to Optimize Discharge Medications

- **Diuretics** should be started or increased in patients presenting with volume overload.
    - consider a temporary increase of **2x current dose** for 5-10 days.
    - a typical starting dose is **furosemide 20 mg** once or twice daily, but should be based on IV diuretic requirements.
    - **electrolytes and creatinine** checked within 7 days.
    - for new prescriptions, provide at least **1 month supply**.
- **Other medications** may be prescribed by consultants:
    - **angiotensin-converting enzyme (ACE) Inhibitors /angiotensin-receptor blockers (ARB), or angiotensin neprilysin inhibitors (ARNI)** could be considered in patients with SBP>100 mmHg, with stable renal function, and in whom follow-up laboratory testing can be arranged.
    - **mineralocorticoid receptor antagonists (MRA)** could be considered in patients with stable renal function and in whom follow-up testing for hyperkalemia can be arranged.
    - in patients on **beta-blockers**, continuation of therapy is safe.
        - decisions **to start or increase** dose should consider the potential benefits and harms.
- **Sodium-glucose cotransporter-2 (SGLT2) inhibitors** may be continued if stable renal function.
- **Guideline-directed medical therapy (GDMT)** medications should be continued.

4. What is Appropriate Follow-up?

- Patients discharged home from the ED should **ideally be seen within 7 days** by their primary care practitioner or by a new referral to primary care/internist/cardiologist/HF clinic.
- Provide **written instructions** of diagnosis, results, medications, follow-up.
- Instruct patient to **return to the ED** if symptoms worsen.

Discharge Instructions (see French version in supplement)

You were treated on _____ at the emergency department of _____ Hospital for **acute heart failure**. Acute heart failure results from weakness of the heart muscle and causes shortness of breath due to fluid in the lungs.

The following **medication changes** have been recommended:

_____

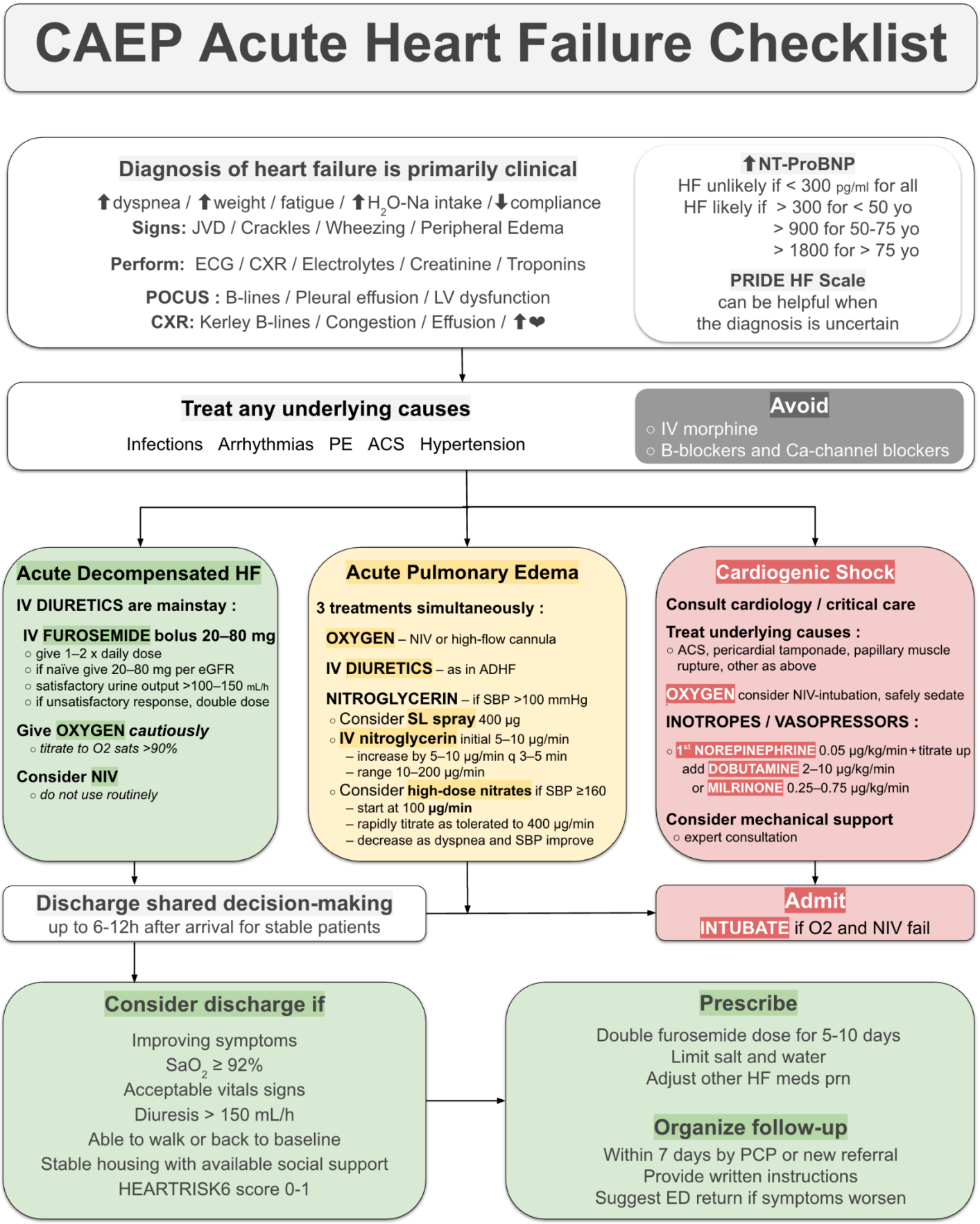
Please seek **medical follow-up** within 7 days at _____ (primary care practitioner, internist/cardiologist, hospital clinic).

Please **return to the emergency department** immediately if you become short of breath or develop chest pain.

Other recommendations:

- **Weigh yourself** and measure blood pressure and heart rate daily.
- Adhere to **low salt diet** (sodium <2 gram/day, e.g. 1tsp salt) and **restrict fluids** (< 2 Litres/day.
- Obtain **immunization** for influenza, RSV and pneumonia, if not already done.
- If a smoker, consider a **smoking cessation** program.
- Consider the **HeartLife toolkit** https://heartlife.ca/document/heartlife-toolkit/

Figure. Overall Management Scheme.



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Background and Methods

We created the *CAEP Acute Heart Failure Best Practices Checklist* to assist emergency physicians in Canada and elsewhere manage patients who present to the emergency department (ED) with acute heart failure. While there are several excellent cardiology society heart failure guidelines, there is nothing specific for ED management. The checklist attempts to fill that gap and focuses on patients presenting with one of four heart failure syndromes, acute decompensated heart failure, acute pulmonary edema, isolated right ventricular failure, and cardiogenic shock. There are detailed sections on diagnosis, treatment, disposition and follow-up.

The methodology and the format are similar to that of the *2021 CAEP Acute Atrial Fibrillation/Flutter Best Practices Checklist*.[11] We chose to adapt, for use by emergency physicians, existing high-quality clinical practice guidelines previously developed by the Canadian Cardiovascular Society (CCS).[1 12] These guidelines were developed and revised using a rigorous process that is based on the GRADE (Grading of Recommendations Assessment, Development and Evaluation) system of evaluation.[13] With the assistance of our PhD methodologist (IDG), we used the recently developed Canadian CAN-IMPLEMENT© process adapted from the ADAPTE Collaboration.[14 15] We also reviewed heart failure guidelines from the European Society of Cardiology and the American College of Cardiology/American Heart Association/Heart Failure Society of America.[2 9] We created an Advisory Committee consisting of 16 academic emergency physicians, three community emergency physicians, seven cardiologists, one general internist, three PhD methodologists, and two patient partners. The checklist was prepared and revised through a process of iterative feedback and discussions on all issues by all panel members. There were nine rounds of revisions until consensus was achieved. We then circulated the draft checklist for comment to approximately xxx Canadian emergency medicine and cardiology colleagues. Finally, the CAEP Standards Committee posted the Checklist online for all CAEP members to provide feedback. The following changes were made based on this feedback…xxxxx...

Our hope is that the *CAEP Acute Heart Failure Best Practices Checklist* will standardize and improve care of acute heart failure in large and small EDs alike.

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The following authors declare competing interests….

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