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EDUCATIONAL PAPER

Acute Heart Failure in the 2021 ESC Heart Failure Guidelines: a scientific statement from the Association for Acute CardioVascular Care (ACVC) of the European Society of Cardiology

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The current European Society of Cardiology (ESC) Heart Failure Guidelines are the most comprehensive ESC document covering heart failure to date; however, the section focused on acute heart failure remains relatively too concise. Although several topics are more extensively covered than in previous versions, including some specific therapies, monitoring and disposition in the hospital, and the management of cardiogenic shock, the lack of high-quality evidence in acute, emergency, and critical care scenarios, poses a challenge for providing evidence-based recommendations, in particular when by comparison the data for chronic heart failure is so extensive. The paucity of evidence and specific recommendations for the general approach and management of acute heart failure in the emergency department is particularly relevant, because this is the setting where most acute heart failure patients are initially diagnosed and stabilized. The clinical phenotypes proposed are comprehensive, clinically relevant and with minimal overlap, whilst providing additional opportunity for discussion around respiratory failure and hypoperfusion.

Keywords Acute heart failure • Heart failure guidelines • Acute cardiac care • Emergency department

The views and opinions expressed in this article are those of the ACVC study group on acute heart failure.

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Introduction

This review by the Acute Heart Failure (AHF) Study group of the Association for Acute CardioVascular Care of the European Society of Cardiology (ESC) focuses on how AHF is addressed in the 2021 ESC Heart Failure (HF) Guidelines,[1] highlighting what is new, the potential impact on clinical practice, and stressing areas that might benefit from more in-depth discussion. The essence of this review is to complement, in an educational way, the content of the HF guidelines, and provide a more extensive exploration of the available evidence related to the acute, emergency, and critical care settings.

History of acute heart failure in the guidelines

The concept of AHF syndromes was primarily introduced in the first ESC AHF Guidelines, developed by the Task Force of AHF of the ESC and endorsed by the European Society of Intensive Care Medicine in 2005.[2] The proposed classification for AHF was mainly established by defining clinical forms as 'de novo' or 'chronic decompensated', and encompassing six clinical scenarios (*Table 1*). These included some potentially confusing definitions and significant overlaps. Other classifications such as Killip, Forrester, and Nohria were also briefly presented in the first document. The six phenotypes were prospectively assessed in the EuroHeart Failure Survey II.[3] Both these documents comprised an initial and major contribution to the knowledge of AHF.

The next version of the ESC HF Guidelines published in 2008 included chronic heart failure (CHF) and AHF integrated into a single document.[4] The content dedicated to AHF was significantly reduced (*Figure 1*). The six clinical scenarios were maintained, although 'high-output HF' (with very low incidence) was replaced by 'AHF with acute coronary syndromes'. The next iteration in 2012,[5] did not contain this phenotype-based classification. The section of AHF was further reduced, being mainly focused on the treatment, with no additional text dedicated to cardiogenic shock (CS).

In the following ESC HF guideline updates (2016,[6] 2021[1]) the AHF section was extended in parallel with the CHF text, comprising around 20% of the document content (see *Figure 1*). Although the burden of AHF in HF overall may be debateable, for those working in the acute field, this proportion of the guidelines dedicated to AHF may benefit from more in-depth detail. Acute heart failure is the leading cause of hospital admissions in the population > 65 years,[7] is associated with substantial health care costs and many patients with CHF will have admissions for acute decompensation.

Table 1 ESC acute heart failure guidelines since 2005

ESC Guidelines	Definition	Main classifications
Acute HF 2005[2] Endorsed by ESICM	Rapid onset of symptoms and signs secondary to abnormal cardiac function.	• Clinical conditions: ADHF, HT-HF, PE, CS, HO-HF, IRVF. • Killip, Forrester, Nohria. • Backward and forward (left and right) failure
Chronic and Acute HF 2008[3] Endorsed by ESICM	Rapid onset or change in the signs and symptoms of HF, resulting in the need for urgent therapy.	• Clinical presentation: DCHF, PE, HT-HF, CS, IRVF, ACS-HF • Congestion/Hypoperfusion as an extension of Forrester class.
Chronic and Acute HF 2012[4]	Rapid onset of, or change in symptoms and signs of HF. It is a life-threatening condition that requires immediate medical attention and usually leads to urgent admission to hospital.	• De novo or chronic. • Special forms: AHF with ACS, IRVF, AHF and Cardiorenal syndrome, Perioperative, Peripartum.
Chronic and Acute HF 2016[5]	Rapid onset or worsening of symptoms and/or signs of HF. It is a life-threatening medical condition requiring urgent evaluation and treatment, typically leading to urgent hospital admission.	• 'De novo' or chronic. • Congestion/hypoperfusion • SBP groups • Killip in AMI • Precipitants (CHAMP).
Chronic and Acute HF 2021[6]	Rapid or gradual onset of symptoms and/or signs of HF, severe enough for the patient to seek urgent medical attention, leading to an unplanned hospital admission or an ED visit.	• Clinical presentation: ADHF, APE, IRVF, CS. • Precipitants (CHAMPIT)

ACS, acute coronary syndrome; ADHF, acute decompensated heart failure; AHF, acute heart failure; AMI, acute myocardial infarction; CHAMPIT, acute coronary syndrome/hypertension emergency/arrhythmia/acute mechanical cause/pulmonary embolism/infections/tamponade; CS, cardiogenic shock; DCHF, decompensated chronic heart failure; ED, emergency department; HO-HF, high-output heart failure; HT-HF, hypertensive heart failure; IRVF, isolated right ventricular failure; PE, pulmonary oedema; SBP, systolic blood pressure.

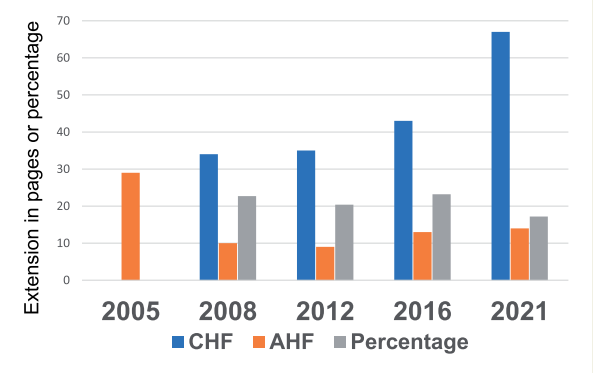

Figure 1 Weight of AHF in the guidelines. The extension of the HF guidelines has increased over the years. AHF, acute heart failure; CHF, chronic heart failure. The percentage is the proportion of the text addressing AHF in relation to the total text. The number of pages has been calculated excluding the preamble and the final paragraphs addressing key messages, gaps in evidence, quality indicators, and references.

In the ACC/AHA HF guidelines,[8–10] AHF is addressed only as 'the hospitalized patient', ignoring the more patient-centred pre-hospital and emergency department (ED) approach. Further, sequential versions of the ACC/AHA HF guidelines do not specifically address acute pulmonary oedema (APO), CS or right ventricular (RV) failure, and options including 'oxygen therapy' or 'ventilation' are not included, although AHA provided some guidance in a scientific statement published in 2010.[11]

Definition of acute heart failure

In the current ESC HF Guidelines 2021,[1] AHF is defined as a rapid or gradual onset of symptoms and/or signs of HF, severe enough for the patient to seek urgent medical attention, leading to an unplanned hospital admission or an emergency department (ED) visit.[1] This definition of AHF originates from previous ESC HF guidelines[2,4–6] (*Table 1*) but is made more precise by excluding mild episodes of decompensation, generally managed in an outpatient setting with adjustments in lifestyle or oral medication. These mild decompensations are nonetheless important and addressed within the scope of CHF. This differentiation is relevant since the term 'heart failure' implies decompensation and may result in confusion when considering stable CHF. For this reason, there have been suggestions of using the terminology 'stable' or 'compensated' cardiomyopathy or heart dysfunction, reserving the term HF for the decompensated states.[12]

Classifications based on pathophysiological mechanisms

In the 2016 ESC HF Guidelines,[6] AHF classification was mainly based on phenotypes derived from well-known interactions between congestion and hypoperfusion (wet and dry, cold and warm). Although this approach is appropriate from the pathophysiological point of view and has been assessed in advanced HF,[13] either in the emergency department (ED)[14] and hospitalized patients,[15] it may be less appropriate in AHF settings. First, conceptually it is not possible to have AHF (requiring urgent treatment) without congestion or hypoperfusion ('warm and dry'). Second, the incidence of each group is imbalanced (*Figure 2A*) and 'cold and dry' patients are exceptionally rare (<1%)[14,15] in this setting, possibly not justifying inclusion as a separate group. Third and more important, the term 'congestion' does not distinguish between pulmonary and systemic congestion, which may occur independently, thus precluding a unique treatment approach for 'congestive patients'. This is relevant because the 'wet and warm' group may account for nearly 80% of cases.[12,14,15] An alternative approach is to consider three main physiological alterations in AHF responsible for different clinical scenarios with diverse interactions among them: (i) pulmonary congestion resulting in acute respiratory failure; (ii) systemic congestion responsible for volume overload or maldistribution; and (iii) tissue hypoperfusion leading to shock and multi-organ failure (*Figure 2B*). This has been better addressed in the 2021 ESC Guidelines. Although the incidence of acute respiratory failure is not well known, data from some AHF registries analysing blood gases[16–18] suggest that more than half of the patients with AHF have this alteration; a finding useful for the definition of AHF phenotypes and their consequent management.

The 2021 heart failure guidelines: an overview

The current guidelines are the most comprehensive ESC document covering HF thus far, with the incremental information regarding AHF presented mainly in the Supplementary material online (~25%). In the summary, four changes in AHF are highlighted: two upgrades [combination of diuretics and short-term mechanical circulatory support (MCS) from Class IIb to Class IIa]; and two downgrades (vasodilators from Class IIa to IIb, and opiates from Class IIb to III). There are three key messages for AHF: (i) the four clinical forms; (ii) the main features of treatment (diuretics for congestion, and inotropes and short-term MCS for hypoperfusion); and (iii) the importance of assessing congestion during hospitalization and optimize oral treatment before discharge.

Diagnosis

The new guidelines show one table (20) and one figure (6) with an algorithm for the diagnosis of new-onset AHF, different than the one for 'general' HF (1). In the algorithm for AHF, natriuretic peptides play a crucial role, but likely should precede in their timing more sophisticated diagnostic test such as echocardiography in most institutions. Natriuretic peptides, troponin, creatinine, and electrolytes are recommended to be measured in all patients, whereas other blood tests and biomarkers such as procalcitonin, D-dimer, TSH, lactate, and iron, would be recommended based on the clinical scenarios. Regarding the optimal cut-offs of natriuretic peptides for the rule-out and/or rule-in of AHF as being the main cause of acute dyspnoea, the important role of obesity as a confounder requires additional focus. Consistent evidence for both BNP and NT-proBNP suggests that the optimal cut-off concentrations should be reduced

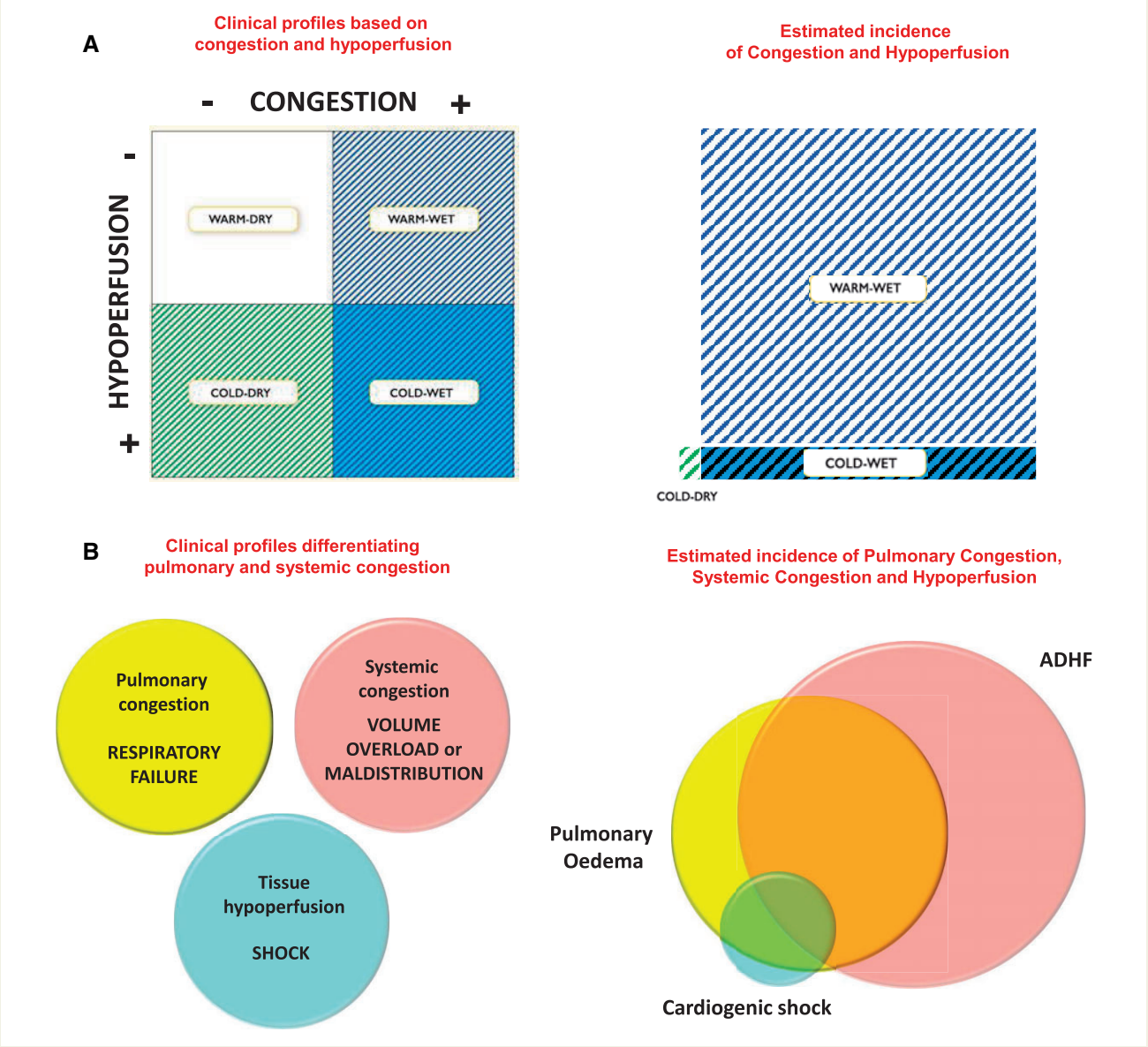

Figure 2 Acute heart failure phenotypes based on pathophysiological alterations. (*A*) Left: Four clinical forms proposed in the ESC HF guidelines 2016 based on two alterations: hypoperfusion and congestion. Right: Area of each square according to the estimated incidence (see text for explanations). (*B*) Left: Three main clinical profiles considering pulmonary congestion and systemic congestion separately. Right: Areas of the circles according to their incidence and interactions. The three main clinical forms proposed in the ESC HF Guidelines 2021 are projected on each circle.

by 50% in the presence of severe obesity (body mass index ≥ 35).[19] Although chest X-ray has been used for decades in all patients with AHF in the ED, it has been downgraded two steps, from Class I in 2016 to Class IIb ('may be considered'). The reason for this downgrade, not reported in the summary, merits discussion and debate; chest X-ray is a useful tool to confirm pulmonary congestion as well as detect or exclude other pulmonary diseases (as it was stated in the 2016 HF guidelines). The emergence of LUS with its continued Class IIb recommendation, possibly understates the utility of these techniques in practice, but respects the underlying evidence based. Specifically, LUS has been demonstrated to identify patients with pulmonary congestion due to AHF with higher sensitivity than clinical assessment or chest radiograph in a multi-centre observational study with >1000 patients,[20] as well as in a randomized clinical trial[21] and meta-analysis.[22] It is easy to learn with good reproducibility and allows for serial assessment of pulmonary congestion at the point-of-care.[23] Although it may not be as widely available as chest X-ray, point-of-care LUS is an emerging imaging modality that should be used when available for the assessment of pulmonary congestion in AHF.

General approach to acute heart failure patients

The text addressing the general approach and management for patients with suspected AHF (Guidelines figure 12) discusses three clinical settings: pre-hospital, in-hospital, and pre-discharge. However, there is not a specific paragraph addressing the management in the ED. This is relevant because the ED is the place where the majority of AHF patients are diagnosed and initially treated, and therefore, providing specific recommendations would be appreciated. *Figure 3* presents the common clinical pathway for patients with AHF.

Pre-hospital

A significant number of AHF patients (11–53%) arrive at hospital via ambulance and are generally the most severely unwell.[24,25] There is significant variation between countries and regions with regards to emergency medical services (EMS) as well as the equipment and resources for attending to and transferring these patients. This may be simplified into two levels: advanced life support units, often equipped as mobile ICUs, with physician, nurse or paramedic aboard ready to administer intravenous drugs, mechanical ventilation and, eventually, MCS; and basic life support units, without physician and limited staff and therapeutic resources (i.e. oxygen, oral-transdermal-inhaled medication).[25] The most common treatment in the pre-hospital setting is oxygen, which is administered in 57–73% of the cases.[24,25] The guidelines briefly describe what is essential in the EMS, but due to the paucity of randomized controlled trials, oxygen, and non-invasive ventilation (NIV) are the only treatments recommended. Randomized trials are challenging in the pre-hospital setting, but data from large registries, non-randomized trials, and case-controlled studies, have shown improved outcomes with the use of more extensive or early treatment by EMS[26] or ED staff, usually nitroglycerine or diuretics.[27–33] In addition to a limited provision of advance life support units in health systems, the main limitation for EMS is the diagnosis of AHF, which was considered 'easy to moderate difficulty' in a recent international EMS survey.[25] Management protocols are common[25] including simple algorithms guided by symptoms, blood pressure, and SpO_2 for the use of oxygen, continuous positive airway pressure, diuretics, or vasodilators. An algorithm for the pre-hospital management of these patients is shown in *Figure 4*.

Emergency department

Patients with AHF arriving at the hospital are triaged into different levels of care according to the degree of haemodynamic instability and AHF severity, with proportional monitoring and care. In the guidelines, in-hospital disposition decisions are emphasized. The algorithm for managing these patients (Guidelines figure 12) is clear, including the CHAMPIT rule for identifying specific triggers requiring urgent treatment. With respect to previous versions, the addition of the 'I' of infection appears appropriate since this is a frequent and relevant trigger for HF decompensation.[34,35] In the algorithm, patients with respiratory failure are candidates for in-hospital higher levels of care, but in the real-world practice, many patients with AHF and mild respiratory failure are managed in the ED or in the ward. To address this, we have expanded this algorithm to the general course of AHF patients in *Figure 3*, by including the different stages, and levels of care.

Some patients who stabilize in the ED may be considered for direct discharge. The proportion of patients directly discharged from EDs is variable, ranging from 16% in the USA to 36% in Canada.[25,36,37] The disposition of specific areas such as 'observation units', 'short stay units', or other disposition areas for monitoring (<24 h or up to 72 h, respectively), in proximity to ED, and generally managed by emergency physicians, allow to assess the response to initial treatment[38–40] and may avoid in-hospital admissions. As mentioned in the guidelines, the use of risk scores is useful for disposition decision-making[41] and this particularly applies to the ED (discharge home vs. hospitalization). A recent systematic review[41] highlighted two scores that were prospectively and externally validated, the EHFMRG score, from Canada[42] and the MEESSI score, from Spain.[43] The guidelines cite these scores and dedicate a part in the disposition section of Supplementary material online to the discharge from ED. Although risk scores are not adequately widely used, their implementation should be promoted. A recent multicentre study identified that half of the patients discharged from the ED were not in the low-risk categories.[44] The use of risk stratification scores and a checklist like that presented in *Table 2*, may be used to ensure discharging AHF patients safely from the ED. As recommended in the guidelines, patients discharged home must be followed up in the first week at the HF clinic or by a nurse call and should be enrolled in a disease management programme if available.

In-hospital

The guidelines provide some guidance for the management of patients during hospital admission and the general approach to AHF patients is presented in this section. Most of the content of sections on CHF, comorbidities and the section of AHF cover scenarios that are seen in-hospital, with more specific information on monitoring provided in the Supplementary material online (see *Table 3* addressing in-hospital monitoring in the present paper).

Clinical forms

Four clinical phenotypes of AHF are summarized, encompassing the majority of possible clinical scenarios and avoiding significant overlapping: acute decompensated heart failure (ADHF), APO, CS, and isolated RV failure. These phenotypes, with specific algorithms for each one, are useful for clinical and educational purposes. Although it is not explicitly stressed in the guidelines, every clinical form may present as 'de novo' (the first episode of AHF) or as acute decompensation of CHF.

Acute decompensated heart failure

Acute decompensated heart failure is the most frequent presentation and mostly due to patients with decompensated CHF. The guidelines merit further discussion regarding the management of this phenotype. A significant part of the management algorithm (Guidelines figure 7) is dedicated to hypoperfusion requiring inotropes, a finding that mainly occurs in patients with advanced HF. In a large national

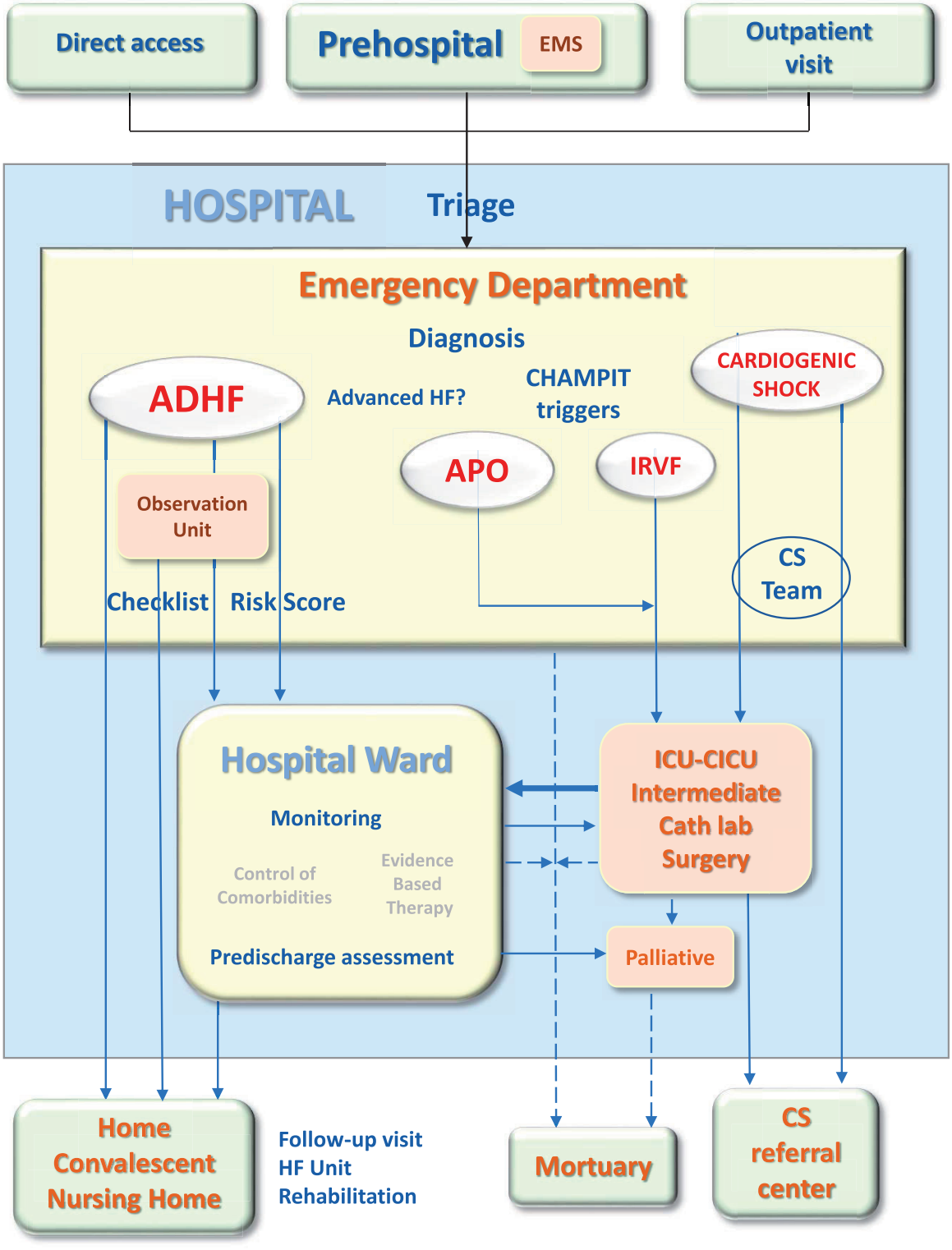

Figure 3 General course of AHF patients. The algorithm contents dispositions and crucial issues in the AHF attending process. See text for explanations. ADHF, acutely decompensated heart failure; APO, acute pulmonary oedema; CHAMPIT, acute coronary syndrome, *h*ypertension emergency, *a*rrhythmia, acute *m*echanical cause; *p*ulmonary embolism, *i*nfections; *ta*mponade; CICU, cardiovascular intensive care unit; CS, cardiogenic shock; EMS, emergency medical services; HF, heart failure; ICU, intensive care unit; IRVF, isolated right ventricular failure.

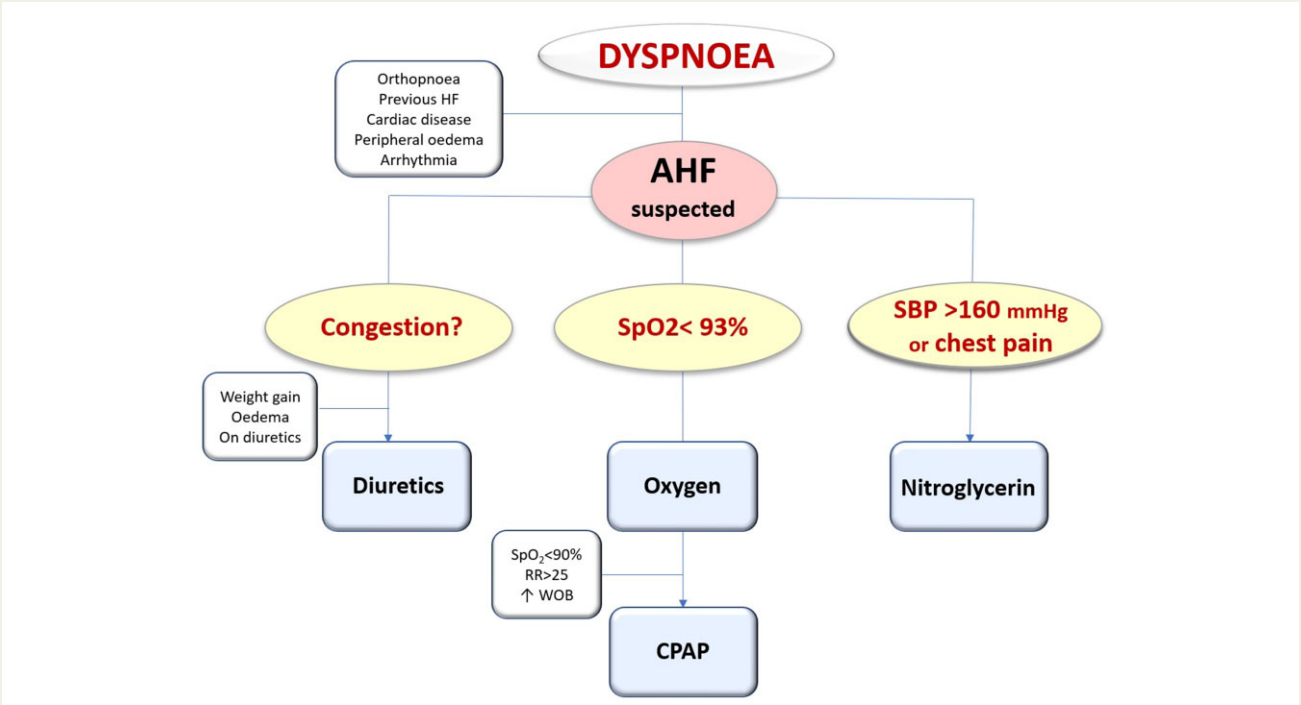

Figure 4 Algorithm for management of acute heart failure at the pre-hospital setting. AHF, acute heart failure; CPAP, continuous positive airway pressure; HF, heart failure; RR, respiratory rate; SBP, systolic blood pressure; SpO_2, oxygen saturation by pulse-oximetry; WOB, work of breathing.

registry, inotropes were administered just in 9.6% of all hospitalized patients with AHF.[45] Further, patients with ADHF who present persistent signs of hypoperfusion requiring inotropes/vasopressors should be considered as having CS (Class B or C, see later). There is no recommendation for treating hypertension, which may be seen in >50% of patients with AHF.[46] The differentiation of hypertensive from normotensive or hypotensive patients could provide an opportunity for the early use of vasodilators in hypertensive AHF patients.

Finally, it is not considered that nearly half of the patients with AHF have acute respiratory failure and, therefore, many patients with ADHF may show reduced SpO_2 or hypoxaemia[17] that would require supplemental oxygen therapy. Dyspnoea is the main complaint of patients with AHF, affecting nearly 90% of them.[47] In addition, some degree of interstitial and pulmonary oedema, as well as respiratory failure, is observed in more than half of the patients with AHF.[23,48]

Acute pulmonary oedema

Consistent with a recent paper from the two committees of AHF of the ESC,[49] the guidelines define the diagnosis of APO when there is a significant acute respiratory failure in the form of tachypnoea [respiratory rate (RR > 25)], hypoxaemia ($SpO_2 \leq 90\%$), and increased work of breathing in a patient with AHF. These restrictive criteria were proposed to define a population that would benefit from NIV, linking APO to this technique. Non-invasive ventilation improves acute respiratory failure faster than conventional oxygen therapy, by decreasing dyspnoea, acidosis, and the risk of endotracheal intubation and may reduce mortality in high-risk patients.[49] However, by using this definition, many patients with a milder degree of pulmonary oedema would not be included in this group and, consequently, should be integrated in the ADHF group. This is inherently difficult to implement in clinical practice. An alternative could be to include all patients with AHF showing acute respiratory failure (excluding CS) in a larger group of 'pulmonary oedema', adding the term 'severe' or 'acute' in those with criteria for NIV, accomplishing the current criteria. This would classify all candidates for oxygen therapy or NIV into the same group, in accordance with the main underlying pathophysiologic alteration.

Regarding the general management of APO, the guidelines recommend that patients should receive NIV and oxygen, loop diuretics,[50] and vasodilators in those with hypertension.[51] It has been shown that early treatment with IV vasodilators in patients with APE and hypertension improves outcomes.[50,52,53] In the algorithm, however, vasodilators are indicated with systolic blood pressure (SBP) >110 mmHg. It should be mentioned that hypoperfusion (confusion–agitation, marbled-cold skin, oliguria) may also be seen in patients with APO and severe hypertension (SBP > 200 mmHg) needing vasodilators rather than inotropes/vasopressors. Finally, oxygen and NIV were not included in the main treatments in the table 21 where were defined the general features of the four clinical scenarios of AHF.

Isolated right ventricle failure

Patients with isolated RV failure may require more than ward-based care and should be considered for intensive or intermediate care units. The most frequent aetiology is *acute cor pulmonale* secondary to an increase in pulmonary arterial pressure/pulmonary vascular resistance due to high-risk pulmonary embolism or acute respiratory

Table 2 Criteria for directly discharge home from the Emergency Department

- Substantial subjective clinical improvement
- Respiratory rate <20/min
- Baseline SpO_2 > 90% (no home oxygen)
- SBP > 100 mmHg
- Heart rate < 100 beats/min
- Adequate diuresis[a] and signs of decongestion
- ACS disclosed[b]
- Normal renal function and electrolytes (or moderate worsening of renal function)
- Low risk score
- Scheduled citation to early follow-up

These checklist criteria may be used, in conjunction with clinical judgment, to consider a patient with AHF for discharge home directly from ED.
[a]Urinary output: 100–150 mL/h first 6 h, 3–4 L/24 h.
[b]No increase in troponin in patients observed during 12–24 h.
ACS, acute coronary syndrome; ED, emergency department; SBP, systolic blood pressure.

distress syndrome. Other causes are RV failure secondary to RV acute myocardial infarction or chronic pulmonary disease, mainly pulmonary arterial hypertension. Although each of these aetiologies requires a specific approach, *Figure 5* shows a general overview of the management of isolated RV failure based on different steps.[54]

Cardiogenic shock

The section dedicated to CS has now more extensive than previous versions, although much of the content is presented in Supplementary material online. Although CS affects only a minority of HF patients, it is one of the most challenging clinical scenarios requiring a large quantity of resources and technology, and is associated with a high mortality. Clinicians involved in the treatment of patients with CS will need to refer to additional sources to receive adequate guidance for clinical practice.[55–58] Nevertheless, the guidelines include several important and contemporary aspects including the syndromic nature of CS characterized by tissue hypoperfusion leading to multi-organ failure and death; the two scenarios of acute cardiac insult vs. progression of advanced HF and the normotensive variant of CS in case of compensatory vasoconstriction.

Table 3 Main tests and timing of monitoring in non-severe forms of acute heart failure

Standard parameters		
On arrival	**First 24–48 h**	**In-hospital stay**
Signs and symptoms	Signs and symptoms	Signs and symptoms
BP	BP/2–4 h	BP/8 h
HR-SpO_2-RR	HR-SpO_2-RR/4 h[a]	HR-SpO_2-RR/8 h
ECG rhythm	ECG rhythm	ECG rhythm[a]
	Echocardiography[b]	Echocardiography
Lung ultrasound		Lung ultrasound at discharge
X-ray film score	Coronary angiography[c]	Cardiac MRI[e]
Temperature	Temperature/8 h	Temperature/8 h
Body weight	Body weight	Body weight/24 h
	Urinary output/6 h	Diuresis/8 h
	Urinary sodium concentration (U_{Na}) after 2 h	
	24 h fluid balance	Daily and cumulated fluid balance
Haemogram, glycaemia, RF, iron status, electrolytes, VBG, other	RF, electrolytes, other[d]	RF, electrolytes/24–72 h
Troponin	Troponin	
BNP/NT-ProBNP		BNP/NT-ProBNP at discharge
ECG 12 leads	ECG 12 leads	ECG 12 leads[a]
	Factors of decompensation	Factors of decompensation

BP, blood pressure; HR, heart rate; RF, renal function; RR, respiratory rate; SpO_2, oxygen saturation by pulse-oximetry; VBG, venous blood gases.
Factors of decompensation may require specific monitoring like in infections: leucocyte, cultures, procalcitonin, C-reactive protein (CPR), etc.; in acute coronary syndromes: serial ECG, troponin, coagulation; in arrhythmias: HR and ECG are crucial.
[a]These parameters may require different timetable of monitoring according to the severity of presentation, the initial values and the resources available (i.e. Telemetry, Observation unit, etc.).
[b]Echocardiography should be performed in the first hours in 'de novo' and as soon as possible in haemodynamically unstable patients.
[c]In suspected acute coronary syndromes.
[d]Other parameters should be monitored according to initial values.
[e]In myocarditis or the novo cases with unclear aetiology.

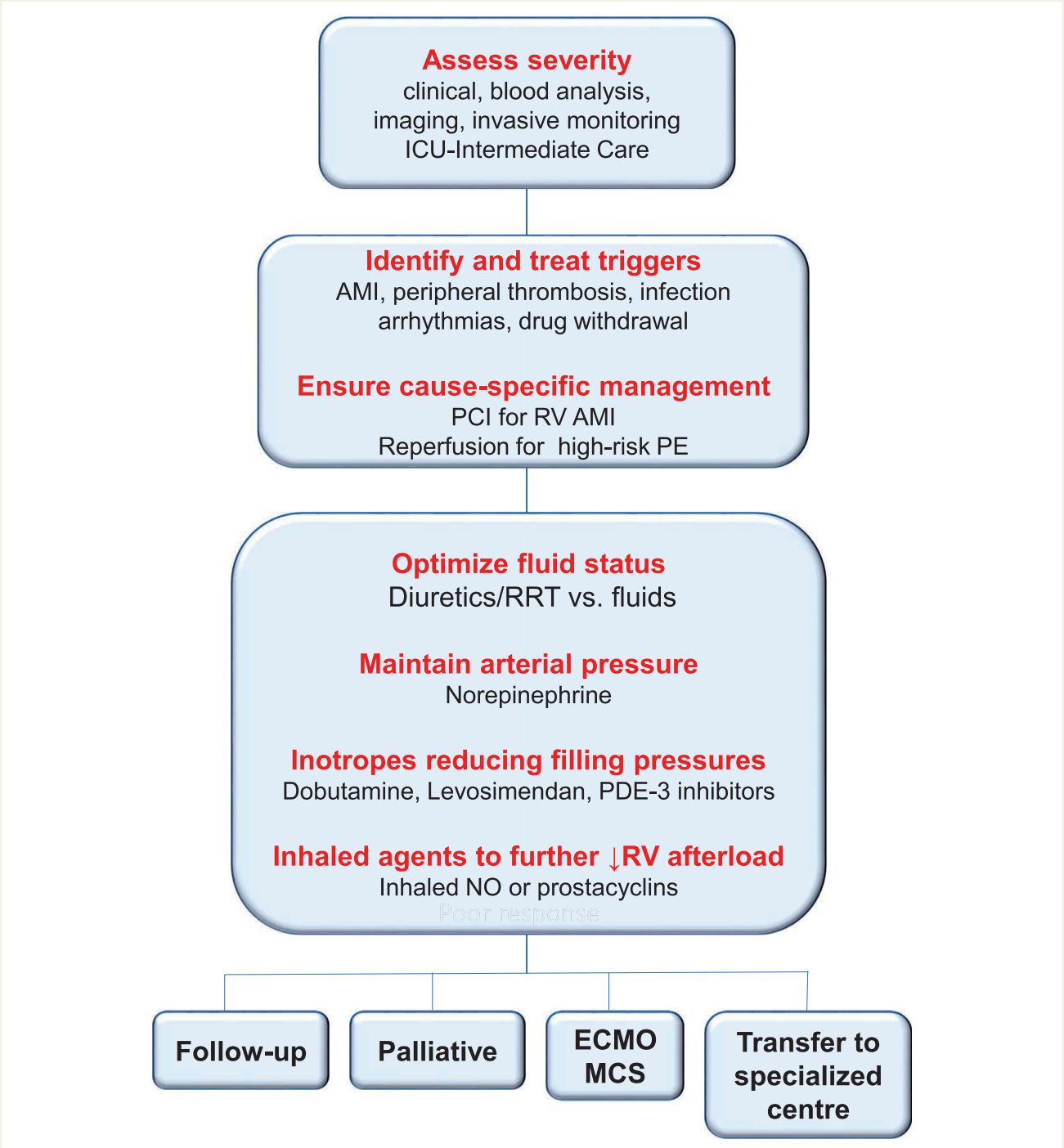

Figure 5 General approach to patients with isolated right ventricular failure based on steps. AMI, acute myocardial infarction; ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit; MCS, mechanical circulatory support; NO, nitric oxide; PCI, percutaneous coronary intervention; PDE, phosphodiesterase; PE, pulmonary embolism; RRT, renal replacement therapy; RV, right ventricle.

There are several descriptions of CS in the guidelines, mentioning that hypotension (SBP < 90 mmHg despite adequate filling status or already on vasopressors) and hypoperfusion are common criteria. In a recent position paper about myocardial infarction-related CS from ESC-ACVC, CS was described as the conjunction of hypotension >30 min, evidence of tissue hypo-perfusion and elevated left ventricular filling pressures, and cardiogenic cause of shock.[56] Indeed, this position paper highlighted the importance of the initial risk assessment, recommending the externally validated IABP-SHOCK II score.[59]

The recent five stages CS classification regarding the evolution and the severity, proposed by the Society for Cardiovascular

Angiography and Intervention,[60] is presented in the Supplementary material online, *Figure S2* of the guidelines. This classification has been assessed in Intensive Cardiovascular Care Units,[61] providing a realistic view of the heterogeneous nature of CS, which require different approaches at every stage. The guidelines provide practical recommendations for the general management of patients with CS but are not directly related to these stages. Recently, an international group of experts proposed a refined classification of the severity of CS secondary to acute myocardial infarction including organ dysfunction and response to treatment.[62] Finally, the role of the CS teams for patients admitted in the ICU to discuss the best management should be further highlighted, as well as the importance of hospital networks with referral centres for CS patients.[63]

Specific treatments for acute heart failure

Diuretic treatment is well covered, showing an algorithm with specific recommendations. The combination of a loop diuretic with thiazide-type diuretics in patients with persistent congestion who do not respond to increasing loop diuretic doses (low doses are suggested as a way to start, followed by higher doses in repeated bolus or infusion) has been upgraded from IIb to IIa Class B. The use of urine excretion of sodium for diuretic titration is of interest for the evaluation of diuretic response in ED and has to be considered an extra tool, not mentioned in previous guidelines.

Although no randomized trials have been conducted to assess the efficacy and safety of morphine in comparison to alternative treatments of severe anxiety associated with APO, some systematic reviews and meta-analyses have concluded that the use of morphine is associated with increased risk of death, even after adjustment for potential confounders.[64,65] Therefore, opiates have a class III recommendation in these guidelines (not to use), except for patients with severe/intractable pain or anxiety who cannot be managed otherwise. However, it should be mentioned that opiates, in small doses, have been widely used in anxious patients with poor adaptation to NIV, which may protect them from hypoventilation, a side effect of opiates.[49,66]

Regarding vasodilators, the downgrade in the recommendation of the use of intravenous vasodilators is relevant. They were widely used previously despite the lack of evidence, being Class IIa as initial therapy to improve symptoms and reduce congestion in patients with hypertensive AHF. Now they are only considered (Class IIb) in patients with AHF and SBP >110 mmHg. This change has been motivated by the results of the GALACTIC[67] and the ELISABETH trials.[68] However, these trials analysed the use of nitrates in patients with AHF with SBP > 100 mmHg (26% had SBP < 120 mmHg in the GALACTIC trial) and a substantial subgroup of patients was probably not the most appropriate cohort for the use of vasodilators, which have been shown to improve outcomes in APO patients with SBP >160 mmHg.[52,53]

The updated section of inotropes and vasopressors includes recent data regarding the preferred use of norepinephrine vs. dopamine or epinephrine, and its combination with inotropes including levosimendan, phosphodiesterase-3 inhibitors, and dobutamine.

The section addressing short-term MCS is extensive and is complemented with the section of advanced HF and the Supplementary

Table 4 Strengths and weaknesses

Strengths	Weaknesses
• Uniform and clear algorithms throughout the guidelines	• Reduced role of AHF with respect to the role given to CHF
• CHAMPIT alert (inclusion of infection)	• Some figures are presented away from the reference text, which may confuse readers
• Four clinical presentations with minimal overlapping	• A significant proportion of the content is presented in the Supplementary material online (usually less accessed)
• Differentiated algorithms for each one of the clinical forms	• Chest X-ray has been downgraded two steps, and together with LUS, are considered Class IIb, which would deserve further discussion
• Extensive guidance for monitoring	• Relatively short paragraph addressing EMS and the pre-hospital phase
• Algorithm for diuretic therapy	• Lack of specific paragraph for ED management. More extensive guidance for directly discharge from ED would be appreciated
• Paragraph dedicated to disposition with criteria for ICU admission and endotracheal intubation	• There is some mismatch between the incidence of respiratory failure in ADHF and APE phenotypes
• Out of the AHF section, cardiac and non-cardiac comorbidities are deeply addressed, covering many AHF scenarios	• No clear recommendations for hypertensive AHF patients. Vasodilators have been downgraded to Class IIb but still may have a bigger role in these patients
• More extensive data regarding MCS	• Diuretic combination with MRA is not mentioned in the current version
• Advanced HF (that shares some clinical scenarios with AHF) is extensively covered	• The possible overlap between CS and hypoperfusion in other clinical forms requires further clarification

Natriuretic peptides were downgraded to Class IIa but in the final version are Class I.
ADHF, acute decompensated heart failure; AHF, acute heart failure; APE, acute pulmonary oedema; CHF, chronic heart failure; CS, cardiogenic shock; ED, emergency department; EMS, emergency medical services; IRVF, isolated right ventricular failure; LUS, lung ultrasound; MRA, mineralocorticoid receptor antagonists.

material online, being one of the major contributions of the present version.

As a summary of this review, *Table 4* highlights some of the strengths and weaknesses of the 2021 HF guidelines regarding AHF.

In conclusion, these ESC HF Guidelines cover AHF syndromes more comprehensively than previous and provide extensive guidance for managing these patients, although there are still some areas that would benefit from further extension, mainly the pre-hospital and the ED approach.

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