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

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Abstract

Heart failure is a global public health challenge frequently presenting to the emergency department. After initial stabilization and management, one of the most important decisions is to determine which patients can be safely discharged and which require hospitalization. This is a complex decision that depends on numerous subjective factors, including both the severity of the patient's underlying condition and an estimate of the acuity of the presentation. An emergency department observation period may help select the correct option. Ideally, during an observation period, risk stratification should be carried out using parameters specifically designed for use in the emergency department. Unfortunately, there is little objective literature to guide this disposition decision. An objective and reliable definition of low-risk characteristics to identify early discharge candidates is needed. Benchmarking outcomes in patients discharged from the emergency department without hospitalization could aid this process. Biomarker determinations, although undoubtedly useful in establishing diagnosis and predicting longer-term prognosis, require prospective validation for emergency department disposition guidance. The challenge of identifying

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emergency department acute heart failure discharge candidates will only be overcome by future multidisciplinary research defining the current knowledge gaps and identifying potential solutions.

Keywords
Acute heart failure, emergency department, discharge, risk stratification, prognosis

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Introduction

Heart failure is a global public health challenge, with as many as 15 million Europeans and 5.7 million US citizens living with this diagnosis.[1–3] It is characterized by frequent hospitalizations, estimated to exceed one million annual admissions in each of Europe and the USA, and accounts for the majority of the yearly costs of heart failure-related care.[4,5] A recent Spanish study estimated costs of €10,771 per patient during a two-year follow-up period,[6] and total system costs in the USA are estimated to increase from US$31bn in 2012 to US$70bn in 2030.[5] Ultimately, successful strategies to safely avoid hospitalization could have a major impact, not only on the quality of life for heart failure patients, but also on societal costs.

The role of emergency departments in heart failure

Shortness of breath, one of the most frequent complaints in patients presenting with acute heart failure (AHF), has a wide differential diagnosis and is one of the most common of emergency department (ED) presentations. Since as many as 80% of AHF patients are hospitalized through the ED, emergency physicians play a central role in the determination of AHF treatment and disposition.

The classical combination of clinical history, physical examination, electrocardiogram, chest X-ray and laboratory analysis (including a natriuretic peptide) allow emergency physicians to reliably diagnose the majority of AHF patients.[7,8] Recently available tools to evaluate patients complaining of dyspnoea, such as computed tomography scanning, bedside echocardiography, and lung ultrasound, can add useful information. Early diagnosis is necessary to initiate treatment as soon as possible, since rapid therapeutic intervention favourably impacts both patient outcome and hospital length of stay.[9]

Identification of the precipitant of decompensation is important as this may contribute in the disposition decision. For example, while dietary indiscretion may be easily treated by a temporary increase in diuretics and ED discharge, a concomitant acute coronary syndrome, pulmonary infection or arrhythmia will need hospital admission. In fact, it has been reported that in more than 50% of AHF episodes, at least one of these precipitants is present.[10,11] All these conditions must be investigated and treated early during the ED evaluation, and in parallel with specific AHF treatment.

Once an AHF diagnosis is made and treatment started, several disposition options regarding the ultimate placement of the patient should be considered. These include into the intensive care unit, a general hospital ward, or discharge home, with or without a short period of supervision of treatment response in an ED-dependent observation unit. In this sense, disposition decision-making is unique to the ED and crucial. After initial stabilization and management, one of the most important ED considerations is to determine which patients need to be hospitalized for further treatment and/or studies and which can be safely discharged to the community. Unnecessary hospital admissions are linked to unacceptable costs increases, while inappropriate ED discharges put the patient at increased risk of adverse outcomes. In this scenario, and especially as no clear consensus guiding such a decision-making exists, emergency physicians tend to act conservatively. This is because, after a discharge decision, there is no second opinion, no ability to evaluate treatment response and no capability to intervene in a less than optimal social situation. In this setting, a wrong 'discharge-home' decision may actually harm the patient and discharges without due consideration are also a potential litigation risk. It is because of this environment that the overwhelming majority of heart failure patients presenting to the ED are hospitalized.

The variability of emergency departments and emergency medicine worldwide

Large ED infrastructure and acute cardiac care/emergency medicine practice variations exist. For example, because the response to AHF treatment is not immediate, an observation period after initial therapy is useful to help define the correct disposition. Unfortunately, this timeframe (usually 12–24 h) is simply not available in all EDs. Further, even when observation options are available, global standardization has been challenging as ED organization and staffing, cardiologist involvement, provider credentials, ED capabilities and patient care pathways are highly variable.[12,13] Good practices should include well-defined local guidelines, treatment protocols, admission criteria and referral pathways. These factors may be missing in some EDs.[14] Finally, cardiologists must play a central role in the provision of care to AHF patients. However, because cardiologist involvement in ED

disposition-decisions is also diverse, opportunities for improvement may exist in some institutions.

Observation units linked to the ED are used in some hospitals and countries, but are highly variable according to their characteristics and the specialists in charge.[15–17] For AHF, the observation unit may represent a good destination for the less sick patient to check clinical improvement, obtain cardiologist advice, receive proper education and instruction and have their post-discharge appointments arranged, thereby allowing direct discharge without hospitalization. Where available, pre-discharge assessment by the heart failure team and patient linkage with the heart failure clinic is desirable. In the absence of an observation option, admission of practically all patients with AHF will be the rule.

It is important to note that an observation unit strategy is consistent with the current trend in health care management, developed during the last decade, of avoiding unnecessary hospital admissions by creating health care structures, resources and pathways to support ambulatory care for patients that otherwise would have been hospitalized. The main goals behind the transition to outpatient management are to reduce costs, prevent hospital-related complications and readmissions and provide health care in the patient's usual environment.[18–20]

Direct ED discharge of AHF patients: realities and uncertainties

Considering global ED variability, and that AHF may manifest from minor decompensation to life-threatening illness, it is easy to understand the worldwide variation in the proportion of AHF patients considered for direct ED discharge. Direct ED discharge will seldom occur in EDs unable to provide a post-treatment observation period, nor will it be common in those EDs without immediate availability of bedside echocardiography, rapid natriuretic peptide measurement or outpatient cardiology/heart failure clinic referral. Conversely, direct discharge may be considered in most AHF patients admitted to an observation unit. The presence of an observation strategy may explain some of the large differences in direct ED discharge of AHF found among countries, but what is the right proportion of patients who can be safely discharged home from the ED has not been established. While in the USA only 16% of patients are directly discharged from the ED,[21] this figure rises to 24% in Spain[22] and 36% in Canada.[23]

Not all practitioners agree with an ED discharge strategy. The usual high level of ED activity and occupancy, with overcrowding during certain hours of the day or periods of the year, together with the lack of inpatient beds in many hospitals worldwide, may put ED physicians under excessive pressure to discharge patients who, in other circumstances, would be admitted.[24,25] It has been shown that across countries and across US hospitals, longer median length of stay of patients admitted for heart failure was independently associated with lower risk of readmission.[26] Additionally, Lee et al. have shown that, in patients with comparable predicted risks of death, subsequent 90-day mortality rates were higher among discharged (11.9%) than admitted (9.5%) patients.[27]

Adverse events must be accounted for within the system in which they occur. In some cases, adverse events are not related to a wrong discharge decision and may be related to failure of proper post-discharge follow-up. Interestingly, when AHF patients directly discharged from ED were asked about their opinion on the ED disposition-decision, more than 90% agreed with going home.[28] Additionally, there is no difference in the ED subjective quality scores given by the patients directly discharged from ED as compared with those hospitalized, nor are these scores influenced by post-discharge adverse events, which seems to indicate that AHF patients directly discharged from ED do not blame emergency physicians for their ED return visits.[28] Nonetheless, 'Is direct discharge safe?' 'How should we measure success or failure?' and 'What are acceptable rates for short-term ED re-visits, hospital admissions, or even death, after direct ED discharge?' are questions that still need to be addressed.[29]

It is quite reasonable to think that EDs discharging a very small proportion of AHF patients will achieve a lower rate of adverse events than those discharging a higher proportion because the former are selecting the least sick, for whom better outcomes are foreseeable. Figure 1, comparing the rates of ED discharge versus adverse events, seems to support such a direct relationship. However, no understanding of the intensity of care pathways is provided by these data. Additionally, it is difficult to attribute an adverse event to wrong ED discharge decision-making, with any certainty, because AHF is a syndrome with an inherently high morbidity and mortality. For example, patients with advanced heart failure may have a high basal risk of death and readmission, but even early discharge can be considered appropriate in some instances. This speaks to the need of randomized control groups in all discharge studies, so that the impact of early discharge can be evaluated. Even after inpatient hospitalization, the rates of re-hospitalization or death during the following 30 days are markedly higher than for other conditions and are consistently reported to be near 30% and 10%, respectively.[22,23,30–32] Of course, it is anticipated that hospitalized patients represent a cohort with greater severity of illness, but if a subset with one-third of patients with low-risk of adverse events can be identified, would not both patients and health care systems benefit from hospitalization avoidance?

While there are few studies comparing AHF outcomes based on disposition (discharge/hospitalization), or the practitioner who is discharging them (hospitalists/ED physician), there are analyses documenting that standardizing observation care and the implementation of treatment protocols is

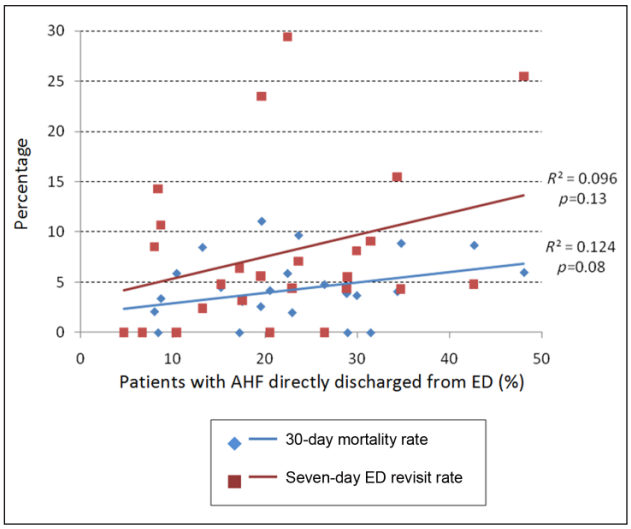

Figure 1. Relationship between percentages of patients directly discharged from 25 Spanish emergency departments participating at the EAHFE Registry[22] and outcomes.
AHF: acute heart failure; ED: emergency department

associated with markedly lower rates of rehospitalization. In fact, in one 'before and after' outcome study of 154 patients following implementation of an AHF observation unit treatment protocol, the overall 90-day heart failure revisit rate decreased by 43%, and the death rate, initially 4%, declined to 1%.[33] These authors suggested that to obtain optimal outcomes it may not be sufficient to simply provide an observation option for emergency physicians and that it may be necessary to provide proper infrastructure to maximize downstream benefits. Furthermore, because results commented on above were obtained by the application of published observation unit inclusion, exclusion and discharge criteria, implementation of such criteria may also be important for the successful management of the early discharge candidate.[34,35] Finally, it is important to emphasize that all these discharge plans have to be developed using a multidisciplinary approach, in conjunction with cardiologists and heart failure clinics and teams, in order to provide the best assessment and options to the patient.

The challenge to define low-risk patients

Despite efforts to identify a risk stratification strategy that selects patients at low risk, an important question remains: how do we define low risk? This has to be answered from the perspective of an ED physician and must describe what is the appropriate threshold defining a particular patient as low risk. In an attempt to cover this gap, a recent expert consensus document proposes standards for adverse outcomes in AHF patients directly discharged from the ED.[36] These authors propose that in EDs with observation units, the discharge rate should be above 40%, and the 30-day ED/hospital readmission, and mortality rates should be below 20% and 2%, respectively. For institutions without observation units available, these rates were recommended to be above 20%, and below 15% and 1%, respectively. The lower rates proposed for the EDs without observation capabilities are justified by the fact that they are discharging fewer patients and thus selecting only those at lowest risk. These figures are arbitrary, with a level of evidence of C, yet they are aimed to challenge EDs to improve outcomes and system resource use. Local audit and benchmarking is essential, with stakeholder involvement in identifying problems, designing solutions and re-auditing the impact of any changes.

Finally, ED discharge does not have to lead to an increase in patient risk. However, when ED discharge is performed, ED physicians must assure that even though the patient is at low risk, a minimum number of clinical precautions should be enacted before discharging, including factors that encourage successful patient self-management.[37] These include the presence of partner or care-giver, an appropriate supply of medication, arrangement of follow-up visits (either at home by nurse or primary care physician, or at a clinic, primary care or hospital) and specific advice given about when to seek further help or return to the ED. Patients' follow-up by either heart failure clinic, general cardiologist or internist should be mandatory. In addition to risk stratification to identify low-risk patients, barriers to successful outpatient management should be evaluated. In institutions capable of providing prolonged observation, this may be the ideal environment to identify challenges and initiate strategies to overcome their impact. However, when self-care barriers are perceived which are not possible to overcome during an ED stay, hospitalization is required, even in those otherwise rated as low risk. Finally, for patients experiencing their first episode of heart failure, hospital admission for further investigations is mandatory.

Risk stratification of AHF patients

In our current scenario, it is crucial to perform ED AHF risk stratification. The aim of such stratification is to allow a rational and objective decision regarding a patient's final disposition. In general, criteria for identifying patients who are at increased risk of adverse events and who may benefit from hospitalization are better delineated than those variables characterizing patients safe for ED discharge.[38] In fact, the objective identification of low-risk AHF patients remains a challenge.

One attractive strategy to identify early discharge candidates is to include only those patients without any of the significant risk factors described as influencing outcome (Table 1).[39] Unfortunately, the absence of high risk does not equate to the presence of low risk, and a specific tool identifying low-risk AHF patients could help improve ED decision-making. Some authors have proposed risk stratification scales to separate highest and lowest risk patients,

Table 1. Some criteria that could be used, in conjunction with clinical judgment, to consider a patient with acute heart failure for discharge home directly from the emergency department.[35]

– Substantial subjective clinical improvement
– Respiratory rate <25/min
– Basal oxygen saturation > 90% (no home oxygen)
– Systolic blood pressure > 90 mmHg
– Resting heart rate < 100 beats/min
– Adequate diuresis (defined as >50 ml/h or >0.75 ml/kg per h; ideally, >1500 ml should be recorded during the first 24 h if patient remains in an observation unit)
– Controlled arrhythmia (atrial fibrillation with acceptable ventricular response)
– No chest pain
– Normal renal function (or moderate worsening of renal function, chronic renal disease might be present) and electrolytes
– If patients observed during 12–24 h, no increase in cardiac troponin
– Possibility of proper ambulatory follow-up

so that the former can be hospitalized and the latter considered as discharge candidates. While at least 10 different scales have been published,[40–49] the majority were derived from hospitalized AHF populations, from retrospective review of administrative data, or include data not available in most EDs. Accordingly, these scales have been designed to predict outcomes in AHF patients discharged from hospital wards, rather than directly from EDs. Despite being promising tools for outcome improvement, they ignore the 16–36% of AHF patients already cared for in EDs that are entirely managed and directly discharged without hospital admission.

Currently, only two risk stratification scales have been created from ED cohorts, both derived in Canada. Stiell et al.[40] developed the Ottawa Heart Failure Risk Scale from clinical data recorded in 559 patients diagnosed at six EDs. In the final model, the scale is based on 10 clinical variables that rendered a moderate discriminative capacity in the derivation study (C-statistic of 0.77) and which remained practically unchanged by excluding results of natriuretic peptides (C-statistic: 0.75). On the other hand, Lee et al.[41] developed the Emergency Heart Failure Mortality Risk Grade (EHMRG) derived from 7433 AHF cases (and validated in 5158) in 86 Canadian EDs. It estimates seven-day mortality risk in non-palliative patients and is easily applicable as it is based on 10 ED relevant variables (and, optionally, the natriuretic peptide level) (Table 2). The EHMRG scale rendered a 0.807 and 0.804 C-statistic for the derivation and validation cohorts, respectively. Validation in European cohorts is ongoing. The EHMRG is able to prospectively predict risk. In the lowest four deciles, seven-day mortality was 0.3%, as compared with 3.5% and 8.2% in deciles 9 and 10, respectively. Since an EHMRG calculator is available online (https://ehmrg.ices.on.ca/#/), risk stratification is now quickly available. Additionally, as natriuretic peptides are not required in the EHMRG scale, it may be applied even in those EDs with laboratory limitations. However, as

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

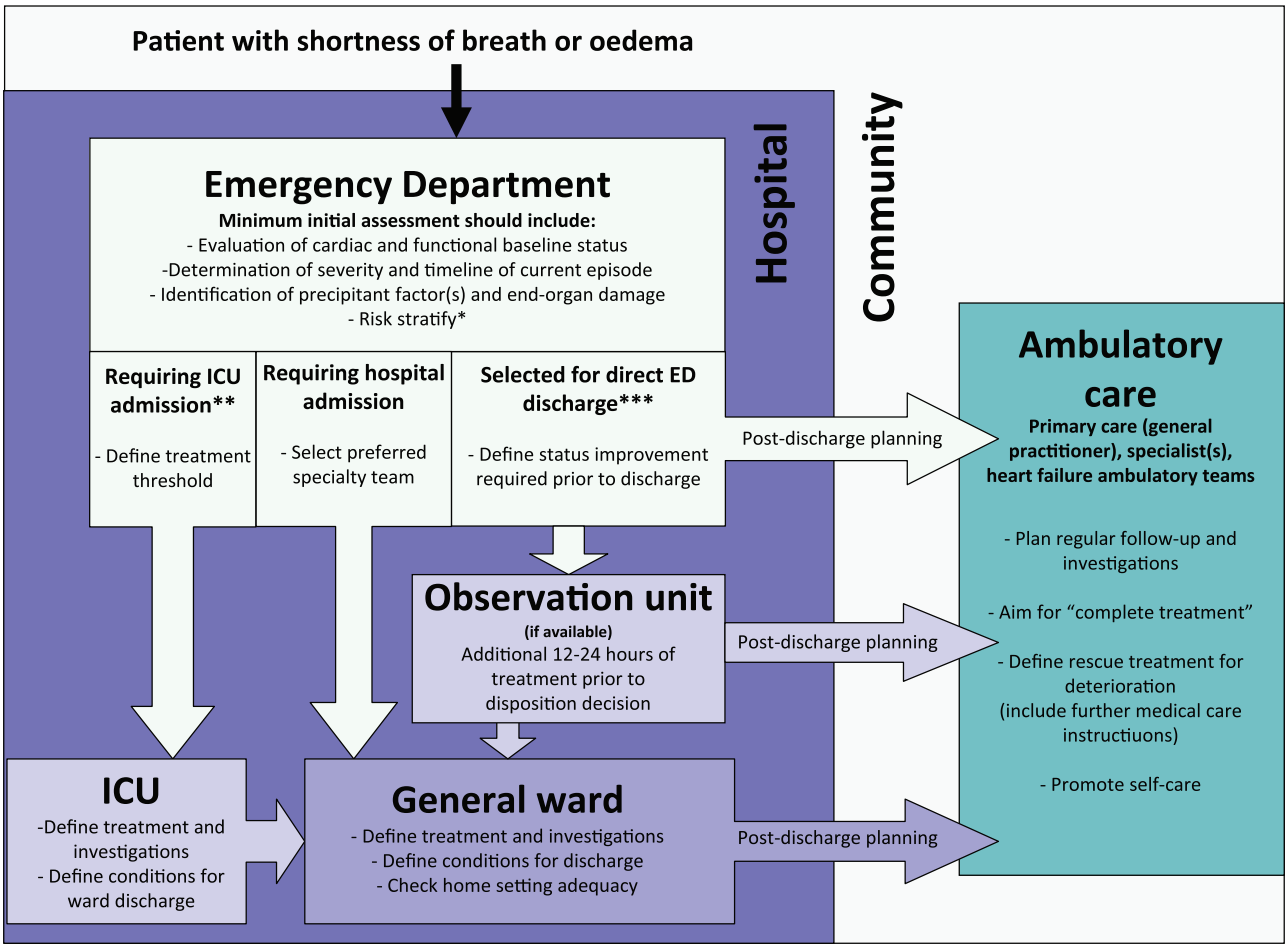

Figure 2. General algorithm for disposition decision-making at emergency department for patients with acute heart failure.
*Risk stratification is highly recommended, and scales derived from patients attended at the emergency department (ED) (like Emergency Heart Failure Mortality Risk Grade or Ottawa Heart Failure Risk Scale) are preferred at this stage.[40,41]
**Intensive care unit (ICU) admission should be considered for patients classified as high risk by risk algorithms, and those with respiratory rate >25 beats/min, peripheral capillary oxygen saturation <90%, use of accessory muscles for breathing, systolic blood pressure<90 mmHg, need of intubation or non-mechanical ventilation (or being already ventilated), need of invasive or continuous monitoring, need of intravenous vasodilators or inotropic support, signs of hypoperfusion: oliguria, cold peripheries, altered mental status, lactate >2 mmol/l, metabolic acidosis, mixed venous oxygen saturation <65% (partially based on the consensus document of Mebazaa et al.[52]).
***Direct ED discharge should be considered for patients with self-reported subjective improvement, resting heart rate <100 beats/min, no hypotension when standing, adequate urine output, oxygen saturation >95% in room air, no or moderate worsening of renal function (chronic renal disease might be present) (partially based on the consensus document of Mebazaa et al.[52]).

natriuretic peptides do have prognostic power,[50,51] it will be important to determine their utility with such a tool in the future. It is important to note that the EHMRG scale is an informational tool designed to assist clinicians in the ED setting, and its use is not intended to replace clinical decision-making by a qualified medical professional. Future prospective studies evaluating its usefulness in a broader range of clinical settings are recommended.

Recent studies have demonstrated that measurement of global functional status (including comorbidities), aside from New York Heart Association class, contribute to better delineation of the risk of adverse outcomes, especially in the elderly.[43,51] AHF in patients with advanced age may represent an important clinical entity potentially driven by different mechanisms (e.g. greater rates of comorbidities and frailty) from in the young.[51] Assessing these parameters at hospital admission, ideally in the ED, may improve management. In this regard, it has been suggested that the addition of Barthel Index measurements to the EFFECT scale (to create the BI-EFFECT scale) significantly improves prediction of 30-day mortality.[43] Thus, appreciation of global functional status may be considered in future refinements of risk scales for AHF patient evaluation.

In the meantime, until a final validated risk stratification tool is available for emergency physicians, disposition decision-making will be guided by personal expertise and consensus documents. In this sense, the recent consensus

attained among the Heart Failure Association of the European Society of Cardiology, the European Society of Emergency Medicine, and the Society of Academic Emergency Medicine about pre-hospital and early hospital management of AHF can assist in this setting.[52] Based on this paper, we propose a general algorithm to be applied during the ED assessment of patients presenting with AHF (Figure 2).

Role of biomarkers in risk stratification

The measurement of natriuretic peptides is extremely helpful in the ED diagnosis of AHF and can contribute to better patient management.[50,51] ED use of natriuretic peptides significantly improves diagnostic accuracy,[53,54] which has therapeutic and operational implications.[55] It is less clear whether natriuretic peptide concentrations should also guide disposition decisions in the ED. In contrast to their determination at 48h, at hospital discharge, or in the stable outpatient setting, natriuretic peptide levels at ED presentation have low prognostic accuracy.[56]

Other biomarkers, like mid-regional pro-adrenomedullin, copeptin or procalcitonin, may also provide advice in diagnosis of undifferentiated ED patients with acute dyspnoea and might therefore be helpful to improve resource utilization and patient care.[57–59] However, their utility in ED decision-making is not as well described as for the natriuretic peptides.

Role of ultrasonography

Echocardiography should be obtained at least once in every patient diagnosed with heart failure. This is because it helps establish the primary cause of the heart failure (especially for patients with the first episode), provides immediate information on chamber volumes, systolic and diastolic function, wall thickness and valve function, rules out potential complications and serves as a guide for therapeutic pathway determination.[7] On the other hand, immediate complete echocardiography is not usually needed during the initial evaluation of most AHF diagnosed at ED, unless haemodynamic instability is present.[52]

One of the most important revolutions in EDs during the last decade has been the use of ultrasonography by emergency physicians. The integration of chest ultrasound into the emergency physician's armamentarium has considerably changed the clinical diagnosis of pulmonary oedema. This is because the finding of echocardiographic B-lines is easily and reliably detected with just a few hours' training, and enhances the diagnostic performance of the classical workup (based on chest X-ray) for AHF.[60] A recent report has shown that, after a 30-min chest ultrasonography course, emergency medicine residents can identify sonographic B-lines with accuracy similarly to an expert sonographer, which then allows a proper diagnosis of pulmonary oedema.[61] The role of ED ultrasound for risk stratification in suspected AHF needs to be assessed in the near future.

Conclusions and future directions

We must provide the best patient care while balancing proper treatment and resource use. For those EDs having observation units, these settings seem an appropriate place to evaluate treatment response, as well as to arrange and ensure proper short term follow-up. With regard to the latter, disposition decision-making is fundamental. While not all patients with AHF require hospitalization, wrong discharge decisions may be associated with unacceptable risks of adverse outcomes. Participation of cardiologists, as well as heart failure teams where they exist, is highly recommended at this stage.

In selected candidates, when appropriate, direct ED discharge can be done with safety. Selection of appropriate candidates requires accurate risk stratification and becomes a key tool that can lead the decision-making process. However, risk stratification is not currently performed in most EDs, essentially because of the lack of proper and validated tools, and the absence of a clear definition of what a low risk means for AHF patients in terms of mortality, rehospitalization and ED re-consultation. All these issues have to be properly addressed by multidisciplinary research, involving cardiologists, internists, geriatricians and ED physicians, during the next coming years.[13,62,63] In the meanwhile, we propose a consensus algorithm based on previous papers and on our own experience in order to be applied at EDs and to give some advice to emergency physicians treating AHF patients.

Conflict of interest

OM received advisory/consulting fees from Novartis and The Medicine Company; research funding from Bayer Health Care, Thermofisher, Novartis, Orion-Pharma. FWP reports research grants: Abbott, Alere, Cardiorentis, Roche, The Medicine's Company. Consultancies: Alere, Cardiorentis, ZS Pharma; and ownership interests: Emergencies in Medicine, LLC, Comprehensive Research Associates, LLC. HB received research grants from AstraZeneca and advisory/speaker fees from Abbott, AstraZeneca, Bayer, BMS, Daiichi Sankyo, Eli Lilly, Menarini, Novartis, Pfizer, Sanofi and Servier. MC reports a research grant from Roche Diagnostics as well as speaker/consulting honoraria from Roche Diagnostics, Novartis, MSD, Alere, MSD, Boehringer Ingelheim, Pfizer, and Philips. LC has received research grants from the Queensland Emergency Research Foundation, Abbott, ALERE, Radiometer Pacific, Roche, Siemens, and the Royal Brisbane and Women's Foundation, as well as speaker/consulting honoraria or travel support from Abbott, ALERE, Astra Zeneca, Boehringer Ingelheim, Novartis, Radiometer Pacific, Roche, and Siemens. SDS is consultant for Novartis, Cardiorentis, Alere and Thermofisher. FJMS OM received advisory/consulting fees from Novartis. EP has received research grants from the National

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