ORIGINAL ARTICLE

Safety and efficiency of discharge to home hospitalization directly after emergency department care of patients with acute heart failure

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Objectives. To analyze whether discharge to home hospitalization (HHosp) directly from emergency departments (EDs) after care for acute heart failure (AHF) is efficient and if there are short-term differences in outcomes between patients in HHosp vs those admitted to a conventional hospital ward (CHosp).

Methods. Secondary analysis of cases from the EAHFE registry (Epidemiology of Acute Heart Failure in Emergency Departments). The EAHFE is a multicenter, multipurpose, analytical, noninterventionist registry of consecutive AHF patients after treatment in EDs. Cases were included retrospectively and registered to facilitate prospective follow-up. Included were all patients diagnosed with AHF and discharged to HHosp from 2 EDs between March 2016 and February 2019 (3 years). Cases from 6 months were analyzed in 3 periods: March-April 2016 (corresponding to EAHFE-5), January-February 2018 (EAHFE-6), and January-February 2019 (EAHFE-7). The findings were adjusted for characteristics at baseline and during the AHF decompensation episode.

Results. A total of 370 patients were discharged to HHosp and 646 to CHosp. Patients in the HHosp group were older and had more comorbidities and worse baseline functional status. However, the decompensation episode was less severe, triggered more often by anemia and less often by a hypertensive crisis or acute coronary syndrome. The HHosp patients were in care longer (median [interquartile range], 9 [7-14] days vs 7 [5-11] days for CHosp patients, $P < .001$), but there were no differences in mortality during hospital care (7.0% vs. 8.0%, $P = .56$), 30-day adverse events after discharge from the ED (30.9% vs. 32.9%, $P = .31$), or 1-year mortality (41.6% vs. 41.4%, $P = .84$). Risks associated with HHosp care did not differ from those of CHosp. The odds ratios (ORs) for HHosp care were as follows for mortality while in care, OR 0.90 (95% CI, 0.41-1.97); adverse events within 30 days of ED discharge, OR 0.88 (95% CI, 0.62-1.26); and 1-year mortality, OR 1.03 (95% CI, 0.76-1.39). Direct costs of HHosp and CHosp averaged €1309 and €5433, respectively.

Conclusion. After ED treatment of AHF, discharge to HHosp requires longer care than CHosp, but short- and long-term outcomes are the same and at a lower cost.

Keywords: Acute heart failure. Mortality. Emergency health services. Home hospitalization.

Análisis de seguridad y eficiencia de la hospitalización a domicilio directamente desde urgencias en pacientes con insuficiencia cardiaca aguda

Objetivos. Analizar si la hospitalización domiciliaria (HDom) directamente desde los servicios de urgencias (SU) de pacientes con insuficiencia cardiaca aguda (ICA) resulta eficiente y si se asocia con diferencias en evolución a corto y largo plazo comparada con hospitalización convencional (HCon).

Método. Análisis secundario del registro Epidemiology Acute Heart Failure in Emergency departments (EAHFE), que es un registro multicéntrico, multiporpósito, analítico no intervencionista, con seguimiento prospectivo que incluye de forma consecutiva a los pacientes que acuden por episodio de ICA al SU. Se incluyeron, retrospectivamente, todos los pacientes diagnosticados de ICA en dos SU ingresados directamente en HDom entre marzo de 2016 y febrero de 2019 (3 años) y se compararon sus resultados con los pacientes diagnosticados de ICA incluidos en el registro EAHFE por esos 2 SU e ingresados en HCon durante los periodos marzo-abril 2016 (EAHFE-5), enero-febrero 2018 (EAHFE-6), y enero-febrero 2019 (EAHFE-7) (6 meses). Los resultados se ajustaron por las características basales y clínicas del episodio de descompensación.

Resultados. Se incluyeron 370 pacientes en HDom y 646 en HCon. El grupo HDom tenía mayor edad, mayor comorbilidad y peor situación funcional basal, pero menor gravedad del episodio de descompensación, más frecuentemente desencadenado por anemia y menos por crisis hipertensiva y síndrome coronario agudo. La duración del ingreso fue mayor [mediana (RIC) 9 (7-14) días frente a 7 (5-11) días, p < 0,001], pero no hubo diferencias en mortalidad intrahospitalaria (7,0% frente a 8,0%, p = 0,56), eventos adversos a 30 días posalta (30,9%

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frente a 32,9%, p = 0,31) ni mortalidad al año (41,6% frente a 41,4%, p = 0,84). En el modelo ajustado, el riesgo asociado a HDom tampoco difirió significativamente en mortalidad intrahospitalaria (OR = 0,90, IC 95% = 0,41-1,97), eventos adversos posalta a 30 días (HR = 0,88, IC95% = 0,62-1,26) ni mortalidad al año (HR = 1,03, IC 95% = 0,76-1,39). El coste directo promedio del episodio en HDom y HCon fue 1.309 y 5.433 euros, respectivamente.

Conclusión. En la ICA, la HDom directamente desde el SU es más prolongada que la HCon, pero consigue los mismos resultados a corto y largo plazo, y su coste es inferior.

Palabras clave: Insuficiencia cardiaca aguda. Mortalidad. Servicios de urgencias. Hospitalización a domicilio.

Introduction

Acute heart failure (AHF) is one of the main reasons for consultation of hospital emergency departments (ED) and one of the leading causes of hospitalization in Spain.[1,2] In fact, more than 90% of hospitalizations of patients with AHF occur after initial consultation and treatment in the ED.[3,4] These decompensations are associated with high short-term mortality, as well as a high rate of post-discharge readmission.[5,6] It is known that, after ED consultation for a first episode of AHF, the median survival is 3.9 years, and 77% of patients require further hospitalizations, 51% of which are for new episodes of AHF. However, the hospital services to which the patient is admitted often change[3] and the most frequently involved are internal medicine and cardiology.[5]

Regarding the hospitalization process, many Spanish hospitals have developed home hospitalization units (HaH) as an alternative to the traditional conventional hospital care (CHC) to admit patients with acute processes or with decompensation of chronic processes, which do not require a diagnostic approach to new processes.[7] This HaH requires, among others, three fundamental premises: that the patient has a permanent caregiver at home, that the home is within the radius of action of the HaH of the hospital in question, and that the patient is hospitalized in a phase of clinical stability of the current process that generates the admission. Concerning the latter, HaH was initially performed after a period of hospitalization of variable duration in CHC so that, once clinical stability was achieved, the need for hospitalization in the HaH regime could be completed.

AHF is one of the main syndromes leading to admission to HaH and several studies have presented satisfactory experiences in these patients.[8-12] With the consolidation in recent years, admission to HaH directly from the ED, without previous CHC, has become increasingly frequent. A previous study showed that this possibility could be efficient and effective in the case of AHF, although the limited number of cases included did not allow firm conclusions.[13] Therefore, the present study was designed to comparatively analyze patients diagnosed with AHF in the ED and admitted directly to HaH with patients admitted to CHC. The hypothesis is that admission of AHF patients to HaH is safe and efficient compared to CHC.

Methods

Study design

This is a secondary analysis of the Epidemiology Acute Heart Failure in Emergency departments (EAHFE) registry, a multicenter, multipurpose, noninterventional analytical registry with a prospective follow-up that consecutively includes patients presenting with AHF episodes to the ED. Two EDs participated in this study, corresponding to the Hospital General Dr. Balmís in Alicante and the Hospital Clínic in Barcelona. On the one hand, these centers retrospectively identified all patients diagnosed with AHF who were directly admitted to HaH between March 2016 and February 2019 (3 years in total). Patients in this group in whom follow-up data were available constituted the HaH group. On the other hand, all patients diagnosed with AHF included in the EAHFE registry by those 2 EDs and who were admitted to conventional hospitalization (CHC) during the periods March-April 2016 (EAHFE-5), January-February 2018 (EAHFE-6), and January-February 2019 (EAHFE-7) (6 months in total) were included. Patient inclusion characteristics were based on clinical diagnosis of AHF according to Framingham criteria[14] and subsequently confirmed by natriuretic peptides or echocardiography in those patients in whom these data were available, following the criteria of the European Society of Cardiology.[15] Details of the EAHFE registry have been presented in previous studies.[16-18] These patients constituted the CHC group, from which only those patients in whom admission from the emergency department had been to an intensive care unit (ICU) and those in whom follow-up data were not available were excluded. Repeat episodes captured through both inclusion strategies at the same time were eliminated. On the other hand, patients were classified by their destination after emergency care and subsequent transfers between different services were not recorded or considered.

Independent variables

Thirty independent variables were collected. Of these, 23 corresponded to data on the patient's baseline situation: epidemiological (age, gender), comorbidities (arterial hypertension, diabetes mellitus, ischemic heart disease, atrial fibrillation, chronic kidney disease, valvular heart disease, chronic obstructive pulmonary disease, dementia, neoplasia, cerebrovascular disease,

peripheral arterial disease, and previous episodes of AHF), baseline functional status (estimated by NYHA functional class, left ventricular ejection fraction - LVEF - and Barthel index) and chronic treatments (diuretics, beta-blockers, renin-angiotensin axis inhibitors, and mineralcorticoid receptor blockers). The remaining 7 variables corresponded to clinical data from the acute episode: precipitating factors (infection, tachyarrhythmia, anemia, hypertensive crisis, dietary-pharmacological transgression, and acute coronary syndrome (ACS)) and severity of the current AHF episode. The latter was estimated using the MEESSI scale, which is composed of 13 variables: age, whether the episode was triggered by ACS, Barthel index, NYHA class and presence of signs of low cardiac output on arrival at the emergency department, the first determination of systolic blood pressure, respiratory rate and baseline oxygen saturation in the emergency department, the presence of left ventricular hypertrophy in the ECG, and the values of creatinine, potassium, troponin and NT-proBP.[16] Several studies in Spain and Switzerland have shown that this scale adequately stratifies patients according to the predicted probability of death in the 30 days following the AHF episode.[19-21]

Outcome variables

As outcome variables, three variables were included, two corresponding to short-term evolution and one to long-term evolution. As an estimator of short-term effectiveness, we recorded in-hospital all-cause mortality (i.e., during the index episode and before discharge from hospitalization, whatever the modality) and 30-day post-discharge adverse events among patients who survived the index event (adverse event was consultation to the emergency department for AHF, rehospitalization for AHF, or death from any cause). Long-term effectiveness was estimated by all-cause mortality at 1 year. Given the objectivity of the outcome variables, these were adjudicated by the centres' principal investigator, without external review. For adjudication, hospital medical records, primary care medical records, and telephone contact were reviewed at least 30 days after the index event and at one year.

Efficiency analysis

As an efficiency variable, we recorded the total duration of hospitalization, counted from the time of arrival of the patient at the ED until discharge, whether from HaH or CHC, and whether to home or residence. The time elapsed from discharge from the ED to assessment by the HaH health staff was always less than 24 hours. In addition, a calculation was made of the total direct cost of the hospitalization episode per patient for each of the two groups. For the cost calculation, the data provided by the billing services of these hospitals were used for all episodes admitted (with respect to tests performed and hospital stay) in each of the services analyzed, and the cost per day of hospitalization was obtained. From this data, the cost of each episode of AHF was calculated separately in each of the two centers, multiplying the daily cost in the corresponding hospitalization service (HaH or CHC) by the average stay of patients with AHF in these services.

Statistical analysis

Categorical variables were described by frequencies and percentages, and continuous variables by median and interquartile range (IQR). For the comparison between the HaH and CHC groups, the distribution analysis of the categorical variables was performed with the Chi-square test or Fisher's exact test as appropriate, and that of the continuous variables with the Mann-Whitney test. Survival analysis at 30 days and at one year was performed using survival tables and Kaplan-Meier curves, and the comparison between the two groups was performed using the log-rank test. The association between HaH and outcomes was estimated by logistic regression (in-hospital mortality) or Cox regression (30-day and 1-year mortality) and expressed as odds ratio (OR) and hazard ratio (HR), respectively, with their 95% confidence intervals (95% CI). In all comparisons, differences were accepted as statistically significant if the *P* value was less than .05, or if the 95% CI of the OR. Statistical analysis was performed with the SPSS program version 24.0 for Windows (IBM Corp., IBM SPSS Statistics for Windows, Version 24.0, Armonk, New York, USA).

Ethical Aspects

The ethical principles of the Declaration of Helsinki on human research were followed. The EAHFE registry protocol was approved by the Ethics and Clinical Research Committee of the Hospital Universitario Central de Asturias (protocols 49/2010, 69/2011, 166/13, 160/15 and 205/17).

Results

During the 3 years of patient inclusion, the 2 participating centers admitted directly from the ED to HaH 348 patients with AHF, of whom 340 are part of the present study. On the other hand, of the 675 AHF patients admitted to CHC during the 3 EAHFE registry recruitment periods (2016, 2018, 2019, 2019, 6 months in total), 646 are included in the present analysis (Figure 1). The services responsible for the initial hospitalization of patients in the latter group were internal medicine (237 patients, 36.7%), cardiology (142 patients, 22.0%), short-stay unit (108 patients, 16.7%), and other miscellaneous specialties (75 patients, 11.6%). A total of 84 patients were transferred for admission to hospitals other than those providing emergency care (84 patients, 13.0%).

The baseline and acute episode characteristics of the patients in each group are shown in Table 1. The patients in both groups were of advanced age, with a high

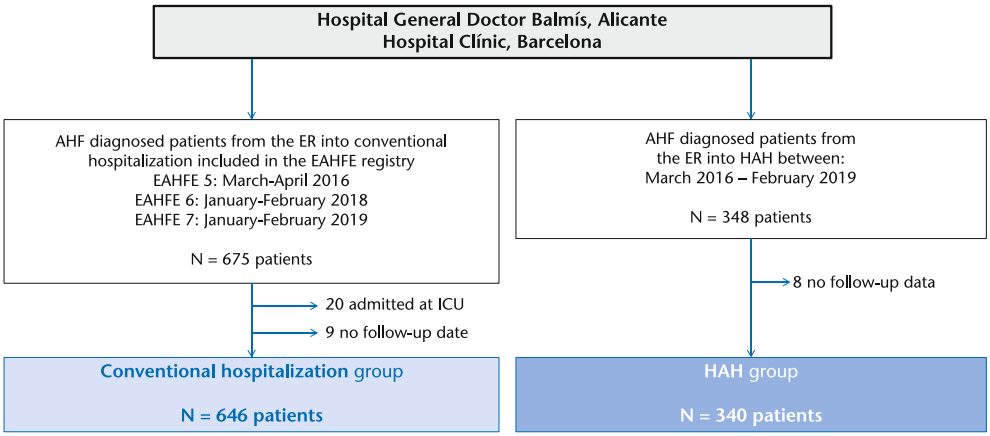

Figure 1. Patient inclusion flowchart.
AHF: acute heart failure; EAHFE: Epidemiology of Acute Heart Failure in Emergency departments.

number of comorbidities, and a deteriorated baseline functional status in more than half of the cases. Most patients in whom echocardiographic studies were available had a preserved LVEF. When comparing both groups, the group of patients admitted to HaH had a worse baseline situation, and their greater age, higher frequency of previous episodes of AHF, atrial fibrillation, ischemic heart disease, heart valve disease, neoplasia and a worse Barthel index were statistically significant (Table 1). There was also a higher percentage of patients on treatment with aldosterone receptor antagonists. On the other hand, the severity of decompensation of the index episode was lower in this group of patients admitted to HaH, and anemia was more frequent as a triggering factor for decompensation and hypertensive crisis and ACS were less frequent (Table 1).

There was no difference between the HaH and CHC groups in in-hospital mortality (7.0% vs. 8.0%, *P* = .56; OR = 0.86, 95% CI = 0.53-1.41). Similarly, the cumulative frequency of adverse events at 30 days post-discharge also did not differ (30.9% vs. 32.9%, *P* = .31; HR = 0.88, 95% CI = 0.68-1.13; Figure 2). Finally, long-term evolution also did not differ between the HaH and CHC groups, with a 1-year mortality of 41.6% and 41.4%, respectively (*P* = .84; HR = 1.02, 95% CI = 0.83-1.26; Figure 2). In the multivariate models, it was observed that, when adjusting for baseline differences, the results in the HaH group tended to improve (given the worse baseline situation of the patients in the HaH group, although without statistical significance), whereas when adjusting for the variables of the acute episode they tended to worsen (given the lesser severity of decompensation, although without statistical significance) (Figure 3). In any case, in the overall model adjusted for baseline and acute episode differences, the risks associated with HaH did not differ practically from those

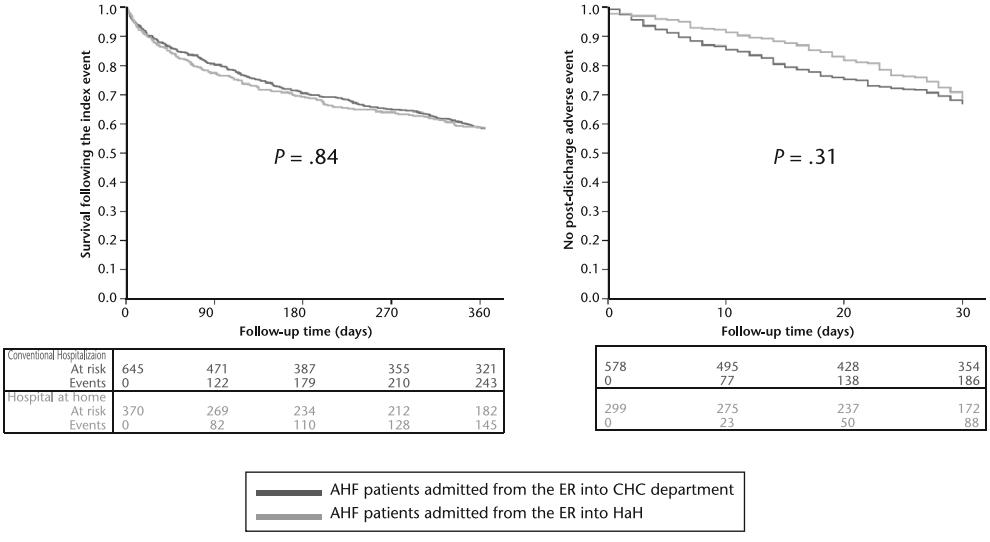

Figure 2. Kaplan-Meier curves of all-cause mortality at 365 days (left) and adverse event during the 30 days after discharge (right) of patients admitted to conventional hospitalization and home hospitalization.
H: hospitalization.

Table 1. Characteristics of patients admitted to hospital at home (HaH) and patients who were admitted to conventional hospitalization

	Valid values patient %	HaH N = 370 n (%)	CHC admission N = 646 n (%)	*P* value
Epidemiological data				
Age [median (IQR)]	100	86 (80-90)	84 (77-89)	**.003**
Gender: Female	98.8	191 (52.9)	351 (54.6)	.61
Comorbidities				
Previous episodes of acute heart failure	92.0	291 (90.9)	425 (69.1)	< **.001**
Arterial hypertension	99.5	318 (86.6)	555 (86.2)	.84
Atrial fibrillation	99.5	221 (60.2)	330 (51.2)	**.006**
Dyslipidemia	99.5	183 (49.9)	328 (50.9)	.74
Diabetes mellitus	99.5	297 (46.1)	149 (40.6)	.09
Chronic renal disease (creatinine > 2 mg/dL)	99.5	133 (36.2)	230 (35.7)	.87
Ischemic heart disease	99.5	128 (34.9)	169 (26.2)	**.004**
Cardiac valvulopathy	99.5	118 (32.2)	152 (23.6)	**.003**
Chronic obstructive pulmonary disease	99.5	150 (23.3)	101 (27.5)	.14
Neoplasia	99.6	79 (21.5)	96 (14.9)	**.007**
Cerebrovascular disease	99.5	62 (16.9)	84 (13.0)	.09
Dementia	99.6	47 (12.8)	74 (11.5)	.53
Peripheral arterial disease	99.5	32 (8.7)	57 (8.9)	.94
Hepatic cirrhosis	99.5	6 (1.6)	9 (1.4)	.76
Chronic home treatment				
Diuretics	99.2	300 (81.7)	502 (78.3)	.19
Renin-angiotensin system inhibitors	99.1	190 (51.8)	326 (50.9)	.80
Beta-blockers	99.0	181 (49.3)	312 (48.8)	.88
Mineralocorticoid receptor antagonists	99.1	80 (21.8)	91 (14.2)	**.002**
Baseline functional status				
NYHA functional class III-IV	94.0	70 (21.1)	124 (19.9)	.67
LVEF (%) [median (IQR)]	57.5	51 (40-60)	55 (40-60)	.13
Barthel index [median (IQR)]	95.8	85 (50-100)	85 (60-100)	**.03**
Precipitating factor of decompensation				
Infection	96.8	145 (41.5)	257 (40.5)	.76
Rapid atrial fibrillation	96.8	37 (10.6)	82 (12.9)	.28
Hypertensive crisis	96.8	15 (4.3)	50 (7.9)	**.03**
Anemia	96.8	33 (9.5)	31 (4.9)	**.005**
Dietary-pharmacologic transgression	96.8	13 (3.7)	27 (4.3)	.69
Acute coronary syndrome	97.4	1 (0.3)	13 (2.0)	**.03**
Severity of decompensation				
Risk category according to the MEESSI* scale	73.8			**.008****
Low risk		101 (42.4)	171 (33.4)	
Intermediate risk		93 (39.1)	220 (43.0)	
High risk		33 (13.9)	74 (14.5)	
Very high risk		11 (4.6)	47 (9.2)	

*The MEESSI scale is composed of 13 variables obtained on arrival at the ED (age; whether the episode was triggered by acute coronary syndrome; Barthel index, NYHA class, and presence of signs of low cardiac output on arrival at the ED; the first determination of systolic blood pressure, respiratory rate, and baseline oxygen saturation in the ED; the presence of left ventricular hypertrophy on ECG; and creatinine, potassium, troponin, and NT-proBNP values) and stratify the risk of death during the 30 days following arrival at the ED. **The P value was calculated using the chi-square test for linear trend.
IQR: interquartile range; LVEF: left ventricular ejection fraction.
Bold P values denote statistical significance ($P < .05$).

found in the crude analysis, with no statistically significant differences in in-hospital mortality (OR = 0.90, 95% CI = 0.41-1.97), adverse events after 30 days (HR = 0.88, 95% CI = 0.62-1.26) or mortality at one year (HR = 1.03, 95% CI = 0.76-1.39) (Figure 3).

The median duration of admission was significantly longer in the HaH group (median = 9 days, IQR = 7-14) than in the CHC group (median = 7 days, IQR = 5-11; $P < .001$); and this difference remained significant after eliminating from the calculation the patients who died during this index event (Figure 4). Analysis of the cost of each of the two AHF management strategies showed that admission to HaH was economically more favorable, with a 76% reduction in the cost per episode, which was €1309 in HaH and €5433 in CHC, resulting in a saving of €4124 per episode of AHF requiring hospitalization if this hospitalization was performed in HaH (Table 2).

Discussion

The main findings of the study are threefold. First, AHF patients admitted to HaH have a baseline profile characterized by high complexity, which is even worse than that of patients admitted to CHC, although the

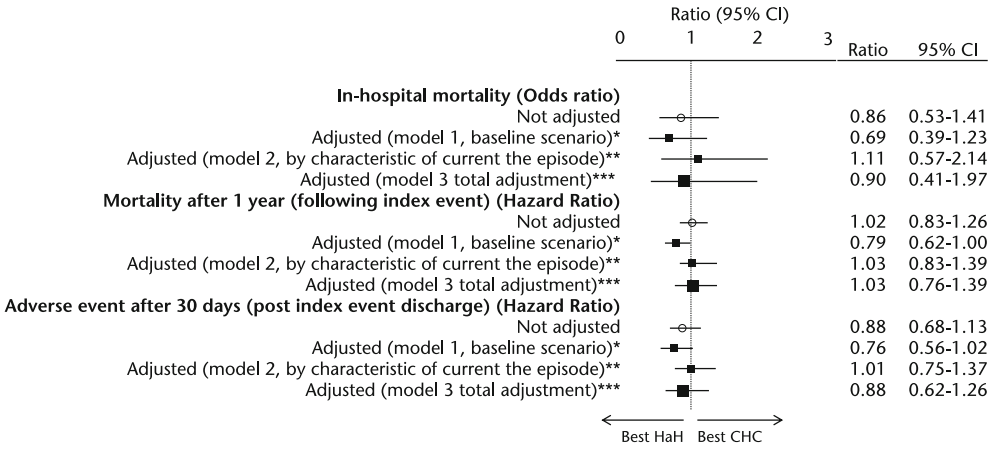

Figure 3. Crude and adjusted risks for patients admitted to home hospitalization with respect to those admitted to conventional hospitalization for the outcome variables included in the present study.
*Adjusted for age, gender, previous episodes of acute heart failure, atrial fibrillation, ischemic heart disease, valvular heart disease, neoplasia, baseline Barthel index and chronic treatment with aldosterone receptor antagonists.
**Adjusted for precipitating factors hypertensive crisis, anemia, and acute coronary syndrome and for the MEESSI scale score.
***Adjusted for age, gender, previous episodes of acute heart failure, atrial fibrillation, ischemic heart disease, valvular heart disease, neoplasia, baseline Barthel index, chronic treatment with aldosterone receptor antagonists, precipitating factors hypertensive crisis, anemia, and acute coronary syndrome, and MEESSI score.
H: hospitalization.

severity of decompensation is lower. Second, despite these differences, the immediate and long-term health outcomes are similar, with no differences in in-hospital mortality, adverse events at 30 days post-discharge, or mortality at 1 year. And third, although HaH is longer, 2 days longer on average in the present study, the economic cost of this management option is markedly lower, 76% lower, resulting in a saving of 4 124 euros per episode of AHF requiring hospitalization.

It is well known that AHF is the most frequent cause of hospitalization in patients over 65 years of age, and has been increasing over the years in accordance with the aging of the population in recent decades.[22,23] The frailty and dependence that frequently coexist in this population adds to the difficulty of management and further increases the risk of poor outcomes of the episode of decompensation.[18,24] The present study confirms this scenario of complexity, while showing that the HaH resource directly from the emergency department is not underutilized for this reason. On the contrary, patients admitted to HaH have an even worse baseline condition. The importance of recognizing

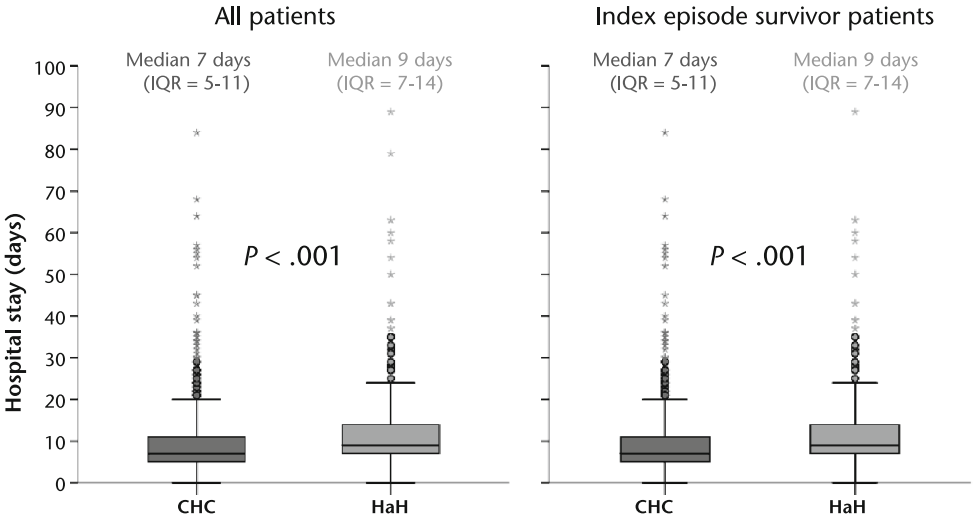

Figure 4. Distribution of hospital stay of patients admitted to conventional hospitalization and home hospitalization.
IQR: interquartile range.

Table 2. Calculation of direct costs of admission due to the acute event in the home hospitalization and conventional hospitalization groups

	HaH group	CHC group	CHC group (detailed per hospitalization unit)				
			Internal medicine	Cardiology	Short stay	Other services	Other hospitals
Hospital General Dr. Blamís, Alicante							
Number of episodes assessed	188	290	67	83	107	23	10
Inpatient days (mean)	16.7	9.0	12.0	7.6	7.1	9.3	21.1
Expenses per day (€)	92	735	575	922	915	557	286
Expenses per episode (€)	1536	6616	6900	7007	6496	5180	6035
All episodes expenses (€)	288843	1918510	462300	581597	695125	119142	60346
Hospital Clínic, Barcelona							
Number of episodes assessed	182	356	170	59	0	53	74
Inpatient days (mean)	13.3	10.6	10.2	14.4	–	8.1	10.3
Expenses per day (€)	81	422	383	534	–	498	339
Expenses per episode (€)	1076	4469	3.910	7693	–	4030	3496
All episodes expenses (€)	195753	1590962	664781	453887	–	213590	258704
TOTAL							
Number of episodes assessed	**370**	**646**					
Expenses per episode (€)	**1309**	**5433**					
All episodes expenses (€)	**484596**	**3509472**					

Expenses in euros.

these factors that are frequently associated with AHF is fundamental, as they imply multidisciplinary and multidimensional care.[25]

One of the main concerns of having patients with AHF hospitalized at home is the recognition of the worsening of the patient by the primary caregiver. In this regard, Morcillo et al.[26] performed an educational intervention in patients with systolic HF once a week after hospital discharge aimed at improving hygienic-dietary compliance and the patient's ability to identify signs and symptoms of decompensation. They showed that this resulted in a reduction in new emergency room visits and hospital admissions, as well as reducing costs and improving patients' quality of life. Like what was observed in this study, caregiver empowerment during the period that the patient remains admitted to HaH also pursues this improved self-management in the patient's usual environment. We believe that the similar percentage of post-discharge events observed in our cohorts of patients admitted to HaH and CHC reaffirms these capabilities in caregivers when there is prior health training appropriate to the patient's personal and disease circumstances. Thus, several meta-analyses of populations with a profile similar to that of the present study have shown that even the time to readmission of patients treated in HaH is lengthened, while reducing reconsultations to the emergency department, improving the quality of life of patients and family members, and reducing costs.[27,28] However, it should be noted that in many of these studies the use of HaH was performed after a few days of admission of the patient to CHC and not directly from the emergency department, as in the present study. The possibility that many Spanish HEDs have of observing their patients for a period (usually less than 24 hours) prior to deciding regarding the patient's destination may favor the use of HaH directly from the ED, after an initial correct response to treatment has been observed.[29]

Admission to HaH also proved to be cost-effective. For the same health outcomes, the saving for each episode of AHF requiring admission was 4124€, even considering that the hospitalization time was 2 days longer in HaH. In addition, there was probably an improvement in the patient's quality of life since, although this was not measured in the present study, it is known that hospital admissions lead to a deterioration in quality of life and survival at 5 years.[28] HaH has already been shown to be effective and safe and markedly cheaper than CHC in the therapy of infectious diseases requiring intravenous treatment, although in many of these studies HaH was used as a bridge between CHC and discharge (and not as a primary resource as in the present study).[30] A clinical trial recently conducted in Boston (USA) demonstrated that the use of HaH directly from the ED reduced the adjusted mean cost of the acute care episode by 38% compared to CHC.[31] In addition, patients managed in the HaH group underwent fewer laboratory tests and spent a smaller proportion of the day sitting or lying down during admission. Finally, although patients assigned to the HaH group were hospitalized one day longer than those assigned to the CHC group, there was a 56% reduction in ED visits and a 70% reduction in hospitalizations during the 30 days following discharge. Remarkably, 16% of the patients included in that trial were patients with the principal diagnosis of AHF. All this suggests that, although our results come from an observational study carried out in a country with a public health system and require a clinical trial to confirm them throughout Spain and in other countries, they are possibly real and not biased by prior patient selection. In fact, adjustment of the results for the baseline characteristics of the patient and for the severity of the decompensation hardly modified the findings, and the savings achieved (76%) were double those observed in the North American trial (38%).[31]

This study has several limitations. First, as in any observational study, causal relationships cannot be inferred, and the results should be considered hypothesis-generating. In addition, possible indication bias must be considered, i.e., some reasons for using HaH instead of CHC were not collected as independent variables and therefore could not be included in the statistical adjustment. Second, the sample size was not calculated, and the lack of statistical significance in some comparisons may have occurred due to beta error. However, given that most of the estimates (OR or HR) were close to 1 (no difference), we believe that the chances of this beta error are low. Thirdly, the study was performed in 2 Spanish EDs, and it is well known that AHF care in Spain is heterogeneous,[32,33] so our results will need to be confirmed in other centers before they can be generalized. On the other hand, the Spanish health care system is public, and the findings of this study may not be directly exportable to other settings with other health care systems. Fourth, this study included a high percentage of elderly patients with AHF, most with preserved left ventricular ejection fraction, and in whom frailty and dependence are frequent, so these findings should be considered if they are applied to different populations. Fifth, this is a cohort from real life, without any planned intervention, and there could be differences in physicians' strategies in the treatment and disposition of patients. Sixth, the diagnosis of AHF was based on clinical criteria, and the final diagnosis of AHF was not supported in all cases by natriuretic peptide or echocardiogram results. Although these last two limitations may impose caution in the interpretation of some of our conclusions, this focus on routine clinical practice makes the findings reported here more generalizable to the real-world emergency medical system and ED practice.

As conclusions, it can be stated that the population admitted to HaH has a highly complex profile, as it is of advanced age, highly comorbid and with notable functional limitations. However, the results achieved with this management strategy are superimposable to those achieved with CHC. Furthermore, HaH is more economical, even though the hospitalization time is somewhat longer than in CHC. Therefore, we believe that HaH can be a good option for admission directly from the emergency department in patients with AHF, since it is a cost-effective option that achieves the same results in mortality and post-discharge readmission as CHC.

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