ORIGINAL ARTICLE

# Factors associated with short stays for patients admitted with acute heart failure

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**Objective.** To identify factors associated with short hospital stays for patients admitted with acute heart failure (AHF) admitted to hospitals with short-stay units (SSU).

**Methods.** Multicenter nonintervention study in a multipurpose cohort of patients with AHF to 10 Spanish hospitals with short-stay units; patients were followed prospectively. We recorded demographic data, medical histories, baseline cardiorespiratory and function variables on arrival in the emergency department, on admission, and at 30 days. The outcome variable was a short hospital stay (≤ 4 days). We built receiver operating characteristic curves of simple and mixed predictive models for short stays and calculated the area under the curves.

**Results.** A total of 1359 patients with a mean (SD) age of 78.7 (9.9) years (53.9% women) were included; 568 (41.8%) had short stays. Five hundred ninety patients (43.4%) were admitted to SSU and 769 (56.6%) were admitted to conventional wards. The variables associated with a short-stay according to the mixed regression model were hypertensive crisis (odds ratio [OR], 1.79; 95% CI, 1.17–2.73; *P*=.007) and admission to a SSU (OR, 16.6; 95% CI, 10.0–33.3; *P*<.001). Hypotensive AHF (OR, 0.49; 95% CI, 0.26–0.91; *P*=.025), hypoxemia (OR, 0.68; 95% CI, 0.53–0.88; *P*=.004); and admission on a Wednesday, Thursday, or Friday (OR, 0.62; 95% CI, 0.49–0.77; *P*<.001) were associated with a long stay. The area under the receiver operating characteristic curve was 0.827 (95% CI, 0.80–0.85; *P*<.001). Thirty-day mortality and readmission rates did not differ between patients with short vs long stays (mortality, 0.5% in both cases, *P*=.959; and readmission, 22.9% vs 27.7%, respectively; *P*=.059).

**Conclusion.** Both clinical and administrative factors are independently related to whether patients with AHF have short stays in the hospitals studied, and among therapy, it is remaslcasle the existence of a SSU.

**Keywords:** Acute heart failure. Length of stay. Emergency health services.

## *Factores asociados a estancias cortas en los pacientes ingresados por insuficiencia cardiaca aguda*

**Objetivo.** Identificar factores asociados a un tiempo de estancia hospitalaria (TDEH) corto en pacientes ingresados por insuficiencia cardiaca aguda (ICA) en hospitales con unidad de corta estancia (UCE).

**Método.** Estudio de cohorte multipropósito y multicéntrico no intervencionista, con seguimiento prospectivo de pacientes con ICA ingresados en 10 hospitales españoles con UCE. Se recogieron variables demográficas, antecedentes personales, situación basal cardiorrespiratoria y funcional, de urgencias, del ingreso y de seguimiento a 30 días. La variable resultado fue un TDEH corto (≤ 4 días). Se realizaron curvas de rendimiento diagnóstico (ROC) de modelos simples y mixtos predictivos de TDEH corto y se calculó el área bajo la curva (ABC) de la característica operativa del receptor (COR).

**Resultados.** Se incluyeron 1.359 pacientes con una edad 78,7 (DE: 9,9) años, el 53,9% mujeres, 568 (41,8%) tuvieron un TDE de 4 o menos días. Ingresaron 590 pacientes (43,4%) en UCE y 769 (56,6%) en salas de hospitalización convencional. En el modelo de regresión mixto ajustado al centro, la crisis hipertensiva (OR 1,79, IC 95%: 1,17-2,73; p = 0,007) y el ingresar en UCE (OR 16,6, IC95%: 10,0-33,3; p < 0,001) se asociaron a TDEH corto, y la ICA hipotensiva (OR 0,49, IC 95%: 0,26-0,91; p = 0,025), la hipoxemia, (OR 0,68, IC 95%: 0,53-0,88; p = 0,004) e ingresar en miércoles, jueves o viernes (OR 0,62, IC 95%: 0,49-0,77; p < 0,001) a TDEH largo. El ABC COR del modelo mixto ajustada al centro fue 0,827 (IC 95%: 0,80-0,85; p < 0,001). La mortalidad a 30 días y el reingreso a 30 días no difirieron entre ambos grupos (0,5% frente a 0,5%, p = 0,959; y 22,9% frente a 27,7%, p = 0,059, respectivamente).

**Conclusiones.** En pacientes con ICA existen factores clínicos y organizativos en cada centro que se relacionan de forma independiente con un TDEH corto, entre los que destaca el tener una UCE.

**Palabras clave:** Insuficiencia cardiaca aguda. Tiempo de estancia hospitalaria. Servicio de urgencias.

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## Introduction

Acute heart failure (AHF) is a major public health problem in developed countries. In Spain today, its prevalence is 6.8% in people over 45 years and up to 16% in those over 75 years[1,2]. Given the advanced age and high morbidity and mortality of patients with AHF[3], it is not surprising that AHF is one of the commonest reasons for hospital emergency department (ED) consultation, and the leading cause of hospital admission in patients over 65 years in developed countries[4]. Considering that up to 70% of the cost of care of patients with AHF is due to the need for hospitalization during exacerbations and this economic cost is closely related to the duration of hospitalization[5,6]. Thus a key point in the management of AHF patients is to adapt and minimize hospital length of stay (LOS) while maintaining quality standards.

During recent decades various hospitals have implemented alternatives to conventional hospitalization, such as observation units (OU), home hospitalization units (HHU) or short stay units (SSU). The latter units are for the hospitalization of patients with acute or exacerbated chronic disease, with short stays averaging less than 72 hours. After careful selection of patients eligible for SSU admission, these units have shown reduced LOS, a good safety profile and patient satisfaction without worsening their prognosis, thus achieving more efficient use of hospital beds[7-10]. According to SSU registry data recently published in Spain[8,9], AHF patients are among those most frequently admitted to such units, accounting for nearly 9% of all SSU admissions, and these units have proven to be effective and safe for the management of patients with a particular profile referred from the ED for AHF[10].

Considering that eight out of ten AHF hospital admissions are ED referrals[11], emergency physicians need tools to help them in deciding not only on admission, but also in selecting the most appropriate unit for efficient management of these patients. To achieve these objectives, it is important to know what factors are related with LOS and which could favor a short stay, and thus identify a subgroup of patients who could benefit from SSU admission. This would reduce LOS, and consequently, hospitalization costs, and avoid inadequate stays. To date, despite having identified a set of predictors of prolonged stay, the overall capacity of existing models to predict LOS in AHF patients is modest and the evidence on possible AHF patient placement options requiring hospital admission is limited[12-14]. Therefore, the objective of this study was to identify factors associated with short LOS in AHF patients admitted for AHF in a representative sample of Spanish hospitals with a SSU.

## Method

We performed a multipurpose, multicenter, analytical, non-interventional cohort study, with prospective monitoring of all patients hospitalized for AHF.

The study cohort came from the EAHFE register[3,11] and included all consecutive patients attended for an episode of AHF in 10 Spanish EDs with SSUs (Figure 1 and Table 1). For this study we included cases in the first EAHFE registry (1 month 2007)[3] and EAHFE III (2 months 2011)[11], since only these registries contained data on comorbidity, functional and cognitive status, and baseline conditions that could affect LOS. We excluded patients discharged directly from the ED, those admitted to the intensive care unit (ICU) or to units other than internal medicine, geriatrics, cardiology or SSU, and those who died during admission. The study was approved by the Clinical Research Ethics Committees of all participating hospitals.

Variables collected included demographics (age and sex), medical history (cardiovascular risk factors, previous renal or cardiovascular disease, pulmonary, debilitating diseases, previous heart failure and those fitted with a pacemaker), clinical conditions (hypertensive, normotensive and hypotensive AHF), comorbidity (Charlson index[15], considering ≥ 3 as severe), baseline functional status (Barthel index[16], considering ≤ 60 points as serious), social situation (eg. the patient lives alone), baseline cardiorespiratory status [New York Heart Association scale[17] (NYHA)], clinical data such as blood pressure (systolic arterial pressure <90 mmHg), hypoxemia ($O_2$ saturation <90%) and NYHA episode data, laboratory data such as markers of renal failure [glomerular filtration rate (GFR) <60 ml / min], hyponatremia [natremia <135 mEq / l] and anemia [hemoglobin <13 g / l in men and <12 g / l in non-pregnant women], emergency care data [the episode precipitating factor (PF)] and organizational aspects (day of the week of admission and place). The main outcome variable was short LOS, defined as that within the lowest 25$^{th}$ percentile of LOS for the whole sample (≤ 4 days). In order to evaluate the quality of care, we documented all-cause mortality within 30 days of ED attention and revisits for any reason at 30 days after discharge by review of computerized medical records or previously authorized telephone contact with the patient or their legal guardians.

For statistical analysis, qualitative variables are presented with their frequency distribution. Quantitative variables are expressed as means and standard deviation (SD) or median and interquartile range (IQR) if not normally distributed. We used Student's t test for comparisons of normally distributed variables and the non-parametric Mann-Whitney U test when they violated the principle of normality according to Kolmogorov Smirnov test. For qualitative variables we used chi-square or Fisher's exact test for small samples, as appropriate.

For the analysis, the sample was divided into groups according to LOS. In order to identify independent factors associated with short LOS, we performed logistic regression analysis that included all variables with a p-value <0.10 in the univariate model. We used simple and mixed stepwise regression models with backward elimination to determine the influence of the hospital.

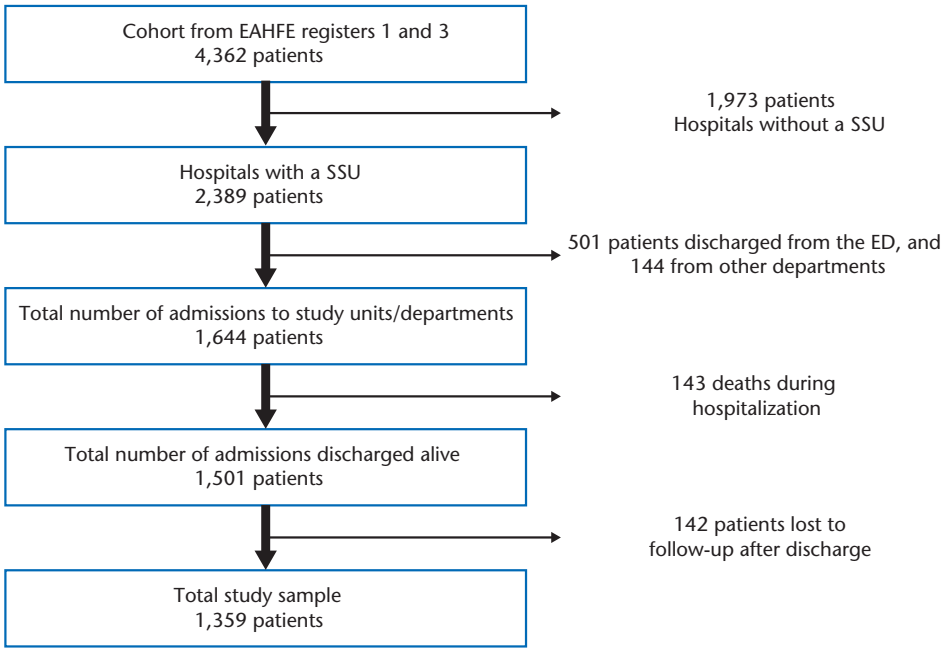


**Figure 1.** Flowchart showing patient inclusion and exclusion from the study. SSU: short stay unit. ED: emergency department.

Continuous variables were dichotomized for convenience using a cut-off with clinical relevance. For these models, the odds ratio (OR) and 95% confidence interval (CI) were calculated. Differences with a p value <0.05 were considered statistically significant or when 95% of the OR excluded the value 1. In multivariate models, we controlled for the hospital of origin. We plotted diagnostic yield curves (DYC) of simple and mixed models to predict short LOS of patients admitted for AHF and the area under the curve (AUC) was calculated.

Data processing and analysis was performed using SPSS 18.0 and STATA 12.0.

## Results

The study included a total of 1,359 patients admitted to hospital from the ED for AHF and meeting the inclusion criteria (Figure 1). They were from 10 Spanish hospitals that had a SSU (Figure 1 and Table 1). Mean age was 78.7 (9.9) years and 732 (53.9%) were women; 675 patients (49.7%) had a severe comorbidity, 243 (18.6%) severe baseline functional dependence, 327 (24.6%) at baseline had NYHA III-IV cardiorespiratory status and 283 (29.8%) lived alone (Table 2); 590 (43.4%) were admitted to the SSU, 769 (56.6%) to other conventional hospital departments [285 (21.0%) were admitted to the cardiology department and 484 (35.6%) to internal medicine or geriatric departments]. Median LOS was 6 days [IQR 3-10]; LOS of 4 or fewer days was observed in 568 patients (41.8%); seven patients (0.5%) died within 30 days and 321 (25.7%) revisited the ED within 30 days of hospital discharge.

**Table 1.** Hospitals participating in the study and patient contribution

| | Patients per hospital |
|---|---|
| Hospital Universitario de Bellvitge (Barcelona) | 253 (18.6) |
| Hospital Clínico San Carlos (Madrid) | 234 (17.2) |
| Hospital General de Alicante (Alicante) | 203 (14.9) |
| Hospital Virgen Macarena (Sevilla) | 157 (11.6) |
| Hospital La Fe (Valencia) | 125 (9.2) |
| Hospital de la Santa Creu i Sant Pau (Barcelona) | 104 (7.7) |
| Hospital Reina Sofía (Córdoba) | 86 (6.3) |
| Hospital Doctor Peset (Valencia) | 81 (6.0) |
| Hospital Marqués de Valdecilla (Santander) | 63 (4.6) |
| Hospital Reina Sofía (Murcia) | 53 (3.9) |

Thirty-day mortality and readmission within 30 days did not differ between groups (0.5% vs. 0.5%, p = 0.959; and 22.9% vs. 27.7%, p = 0.059, respectively).

Table 2 show the characteristics of the patients included in the study and univariate analysis based on short LOS. Specifically, this analysis identified 22 variables (p <0.10) which were then introduced in the multivariate analysis. After stepwise logistic regression, there were nine independent factors associated with a short LOS in the simple regression model: SSU admission, hypertensive crisis and non-adherence as the PF which entered directly, whereas infection and other PF such as type of AHF, hypoxemia and anemia detected in the ED, and admissions on Wednesday, Thursday or Friday did so inversely (Table 3). In the mixed regression model adjusted for center, the factors independently associated with short LOS were SSU admission (OR 16.6, 95% CI 10.0 to 33.3; p <0.001) and hypertensive crisis (OR 1.79, 95% CI 1.17 to 2.73; p = 0.007) as PF acute episodes while hypotensive AHF (OR 0.49, 95% CI 0.26 to 0.91; p = 0.025), hypoxemia in the ED (OR 0.68, 95% CI: 0.53 to 0.88; p = 0.004), and Wednesday, Thursday or Friday admis-

**Table 2.** Characteristics of patients included in the study

| | Total (N = 1,359) n (%) | LOS ≤ 4 days (N = 568) n (%) | LOS > 4 days (N = 790) n (%) | p |
|---|---|---|---|---|
| **Demographic data** | | | | |
| Age (years) [mean (SD)] | 78.7 (9.9) | 79.7 (8.7) | 78.0 (10.7) | 0.003 |
| ≥ 75 years | 984 (72.5) | 424 (74.6) | 560 (70.9) | 0.126 |
| ≥ 85 years | 389 (28.6) | 171 (30.1) | 218 (27.6) | 0.313 |
| Female gender | 732 (53.9) | 314 (55.3) | 418 (52.8) | 0.374 |
| **Medical history** | | | | |
| Hypertension | 1,160 (85.4) | 491 (86.4) | 669 (84.6) | 0.337 |
| Ischemic heart disease | 422 (31.1) | 178 (31.3) | 244 (30.8) | 0.847 |
| Diabetes mellitus | 610 (44.9) | 256 (45.1) | 354 (44.8) | 0.908 |
| Dyslipidemia | 601 (44.2) | 259 (45.6) | 342 (43.2) | 0.387 |
| Atrial fibrillation | 679 (50.0) | 300 (52.8) | 370 (47.9) | 0.075 |
| Cerebrovascular disease | 206 (15.2) | 94 (16.5) | 112 (14.2) | 0.226 |
| Peripheral artery disease | 128 (9.4) | 46 (8.1) | 82 (10.4) | 0.156 |
| Valvular disease | 356 (26.2) | 141 (24.8) | 215 (27.2) | 0.330 |
| COPD | 342 (25.2) | 127 (22.4) | 215 (27.2) | 0.043 |
| Chronic renal failure | 315 (23.2) | 125 (22.0) | 190 (24.0) | 0.386 |
| Dementia | 107 (7.9) | 46 (8.1) | 61 (7.7) | 0.794 |
| Severe comorbidity (Charlson ≥ 3) | 675 (49.7) | 266 (46.8) | 409 (51.7) | 0.076 |
| Previous episode of heart failure | 880 (66.3) | 396 (71.0) | 484 (62.9) | 0.002 |
| Cardiac device | 118 (8.7) | 40 (7.0) | 78 (9.9) | 0.069 |
| **Baseline situation** | | | | |
| Cardiorespiratory NYHA III-IV | 327 (24.6) | 140 (25.0) | 187 (24.3) | 0.761 |
| Severe dependence (Barthel <60) | 243/1308 (18.6) | 110/546 (20.1) | 133/762 (17.5) | 0.217 |
| Social (living alone) | 283/815 (29.8) | 89/219 (27.9) | 154/496 (31.0) | 0.195 |
| **Previous cardiologic study** | | | | |
| Reduced LVEF (≤ 45%) | 271/663 (40.9) | 116/276 (42.0) | 155/387 (40.1) | 0.610 |
| **Type of AHF** | | | | |
| Hypertensive (SBP> 140 mmHg) | 644 (48.0) | 303 (53.8) | 341 (43.8) | < 0.001 |
| Normotensive (SAP 100-140 mmHg) | 645 (48.1) | 247 (43.9) | 398 (51.2) | < 0.001 |
| Hypotensive (SBP <100 mmHg) | 52 (3.9) | 13 (2.3) | 39 (5.0) | < 0.001 |
| **Clinical data of the acute episode** | | | | |
| Systolic blood pressure <100 mmHg | 52 (3.9) | 13 (2.3) | 39 (5.0) | 0.011 |
| Hypoxemia ($O_2$ saturation ≤ 90%) | 333 (26.0) | 120 (22.1) | 213 (28.7) | 0.008 |
| NYHA III-IV | 1,246 (93.3) | 520 (93.7) | 726 (93.1) | 0.656 |
| **Laboratory data of the acute episode** | | | | |
| Anemia | 774 (57.3) | 302 (53.5) | 472 (60.0) | 0.018 |
| Renal impairment (eGFR <60 ml / min) | 739 (55.7) | 311 (56.2) | 428 (55.4) | 0.753 |
| Hyponatremia (sodium <135 mEq / L) | 236 (18.8) | 103 (14.3) | 346 (20.8) | < 0.001 |
| Troponin positive | 237/596 (39.8) | 90/216 (41.7) | 147/380 (38.7) | 0.475 |
| **Precipitating factors** | | | | |
| Known | 1,051 (77.3) | 425 (74.8) | 626 (79.1) | 0.061 |
| Infection | 457 (33.6) | 166 (29.2) | 291 (36.8) | 0.004 |
| Rapid atrial fibrillation | 202 (14.9) | 91 (16.0) | 111 (14.0) | 0.310 |
| Anemia | 81 (6.0) | 29 (5.1) | 52 (6.6) | 0.259 |
| Hypertensive crisis | 109 (8.0) | 65 (11.4) | 44 (5.6) | < 0.001 |
| Non-compliance with treatment | 65 (4.8) | 37 (6.5) | 28 (3.5) | 0.011 |
| NSTEACS | 37 (2.7) | 13 (2.3) | 24 (3.0) | 0.405 |
| Other precipitating factors* | 181 (13.3) | 52 (9.2) | 129 (16.3) | < 0.001 |
| **Day of admission** | | | | |
| Wednesday, Thursday or Friday | 633 (46.6) | 234 (41.2) | 399 (50.4) | 0.001 |
| **Place of admission** | | | | |
| SSU | 590 (43.4) | 428 (65.4) | 161 (20.5) | < 0.001 |
| **Results** | | | | |
| Mortality at 30 days | 7 (0.5) | 3 (0.5) | 4 (0.5) | 0.959 |
| Revisit 30 days after discharge | 321 (25.7) | 118 (22.9) | 203 (27.7) | 0.059 |

LOS: hospital length of stay; NYHA: New York Heart Association; eGFR. Estimated glomerular filtration rate; NSTEACS non-ST elevation acute coronary syndrome; SSU: Short Stay Unit. Precipitating factors other than infection, rapid atrial fibrillation, anemia, hypertensive crisis, non-compliance with treatment or NSTEACS.

sions (OR 0.62, 95% CI 0.49 to 0.77; p <0.001) were associated with stays longer than four days (Table 3). Median OR in the mixed model adjusted for center was 1.71. The ABC-DYC of the simple model was 0.79 (95% CI: 0.77 to 0.81; p <0.001) versus 0.83 (95% CI 0.80-0.85; p <0.001) in the mixed model adjusted for center (Figure 2).

## Discussion

In recent years several national[18-20] and international[21-26] studies have evaluated the factors that influence the LOS of patients admitted for AHF. The main objective in most cases was to define a profile of patients most likely to have a prolonged hospital stay in order to deve-

lop more efficient management strategies of hospital resources involved in the process of treating AHF. Similarly, they have determined the factors that favor short hospital stays, as this knowledge should help ED physicians identify a subgroup of AHF patients who may be candidates for admission to alternative units such as SSU, when available, rather than conventional hospitalization.

The present study, designed to respond to this question, identified five factors independently associated with short LOS which were common to the 10 participating hospitals: SSU admission and hypertensive crisis as the PF of AHF (favorable), the detection of hypoxemia and anemia during initial ED care and admission on a Wednesday, Thursday or Friday (unfavorable). Of these five predictors common to all the centers, the presence of SSU admission from the ED regardless of the other factors reinforces the positive role that such units can play in more efficient AHF patient management since the adjusted OR for a LOS of 4 days or less was 16-fold higher compared to that of conventional hospitalization.

Regarding the episode PF, in eight out of ten patients at least one PF was identified, which is consistent with previously published results[27,31]. Such knowledge is not only necessary to optimize the clinical management of AHF patients[27,30,32] and their prognosis[27,31], but it is also useful in predicting LOS. To date, only scarce data on the relationship between PF and LOS have been published[28,31]. Hypertensive crises and high blood pressure on arrival correlate inversely with length of stay and with prognosis, in both conventional hospital ward and SSU admissions[10,24,27,32,33].

Regarding the severity of the acute episode, we found no factor among those studied which conditioned a short hospital stay. However, as previously described, the presence of hypoxemia[10] and anemia[10,19,20,34] were associated with prolonged hospital stays over 4 days. The role of hypoxemia as an indicator of the severity of an episode is known[35,36], as is its influence on the need for intensified therapeutic and clinical control of the patient[37].

Different studies have analyzed the association between anemia and heart failure, highlighting the former as a risk factor for death and hospital readmission, and that hemoglobin values are related to the degree of hemodynamic deterioration and functional class. This, coupled with the fact that additional studies are often required during admission to establish the etiology of the anemia, explains why this factor is associated with longer stays[38,39].

However, when assessing the likely duration of LOS, clinical and laboratory findings are clearly important, as most published studies report, but there are also various structural and organizational factors in different centers which condition the LOS and must therefore be considered in decision-making on the admission of a patient with AHF. On the one hand, our results add to the evidence about the influence of the day of admission on LOS duration described in previous studies in our setting[10,40] and at the international level[24,41]; patients admitted on a Wednesday, Thursday or Friday had extended stays. This result may be attributable to the low number of weekend discharges from conventional hospital wards and in smaller numbers from SSU due to possibly reduced medical staff in both the ED and other hospital departments. On the other hand, an even more striking finding was the relationship between the place of hospital admission and LOS - patients who were admitted to a SSU were more likely to show a short stay.

This result once again shows the possible influence of a SSU on LOS in certain processes, including AHF, and especially that a SSU is the ideal care unit for AHF patients with an estimated stay of 4 days or less[42-44]. As

**Table 3.** Logistic regression analysis of independent factors associated with a short stay (≤ 4 days)

| | Univariate | | | Simple multivariate model | | | Mixed multivariate model | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR | 95% CI | p | OR | 95% CI | p | OR | IC95% | p |
| MH: atrial fibrillation | 1.21 | 0.98-1.51 | 0.075 | – | – | – | – | – | – |
| MH: COPD | 0.77 | 0.60-0.99 | 0.043 | – | – | – | – | – | – |
| MH: CHF | 1.44 | 1.14-1.83 | 0.002 | – | – | – | – | – | – |
| MH: Cardiac device | 0.69 | 0.47-1.03 | 0.069 | – | – | – | – | – | – |
| Severe comorbidity | 0.82 | 0.66-1.02 | 0.076 | – | – | – | – | – | – |
| AHF type: | | | | | | – | – | – | |
| Hypertensive | — | – | – | – | – | – | – | – | |
| Normotensive | 0.38 | 0.20-0.72 | 0.003 | 0.38 | 0.17-0.88 | 0.023 | – | – | – |
| Hypotensive | 0.70 | 0.56-0.87 | 0.002 | 0.76 | 0.56-1.02 | 0.07 | 0.49 | 0.26-0.91 | 0.025 |
| PF. Infection | 0.71 | 0.56-0.89 | 0.004 | 0.70 | 0.51-0.97 | 0.031 | – | – | – |
| PF. Hypertensive crisis | 2.19 | 1.47-3.27 | < 0.001 | 1.82 | 1.06-3.13 | 0.029 | 1.79 | 1.17-2.73 | 0.007 |
| PF. Non-adherence | 1.90 | 1.15-3.14 | 0.011 | 2.17 | 1.10-4.26 | 0.025 | – | – | – |
| PF. Other | 0.52 | 0.37-0.73 | < 0.001 | 0.56 | 0.35-0.90 | 0.016 | – | – | – |
| Hypoxemia‡ | 0.71 | 0.55-0.91 | 0.008 | 0.59 | 0.43-0.83 | 0.002 | 0.68 | 0.53-0.88 | 0.004 |
| Hyponatremia" | 0.62 | 0.46-0.84 | 0.002 | – | – | – | – | – | – |
| Anemia† | 0.77 | 0.62-0.96 | 0.018 | 0.75 | 0.56-0.99 | 0.046 | – | – | – |
| Admission Wed-Thurs-Fri | 0.69 | 0.55-0.86 | 0.001 | 0.57 | 0.42-0.75 | < 0.001 | 0.62 | 0.49-0.77 | < 0.001 |
| SSU admission | 12.5 | 9.09-14.3 | < 0.001 | 14.3 | 11.1-20.0 | < 0.001 | 16.6 | 10.0-33.3 | < 0.001 |

Multilevel mixed model (hospital level, intraclass correlation: 0.08; Median Odds Ratio: 1.71); CI: confidence interval; MH: medical history; PF: precipitating factor. COPD: chronic obstructive pulmonary disease; CHF: chronic heart failure; cardiac device: pacemaker, defibrillator, resynchronization therapy; AHF: acute heart failure; HBP: high blood pressure; Wed: Wednesday; Thurs: Thursday; Fri: Friday; SSU: Short Stay Unit. Other: Precipitating factors other than infection, rapid atrial fibrillation, anemia, hypertensive crisis, non-compliance with treatment or NSTEACS.

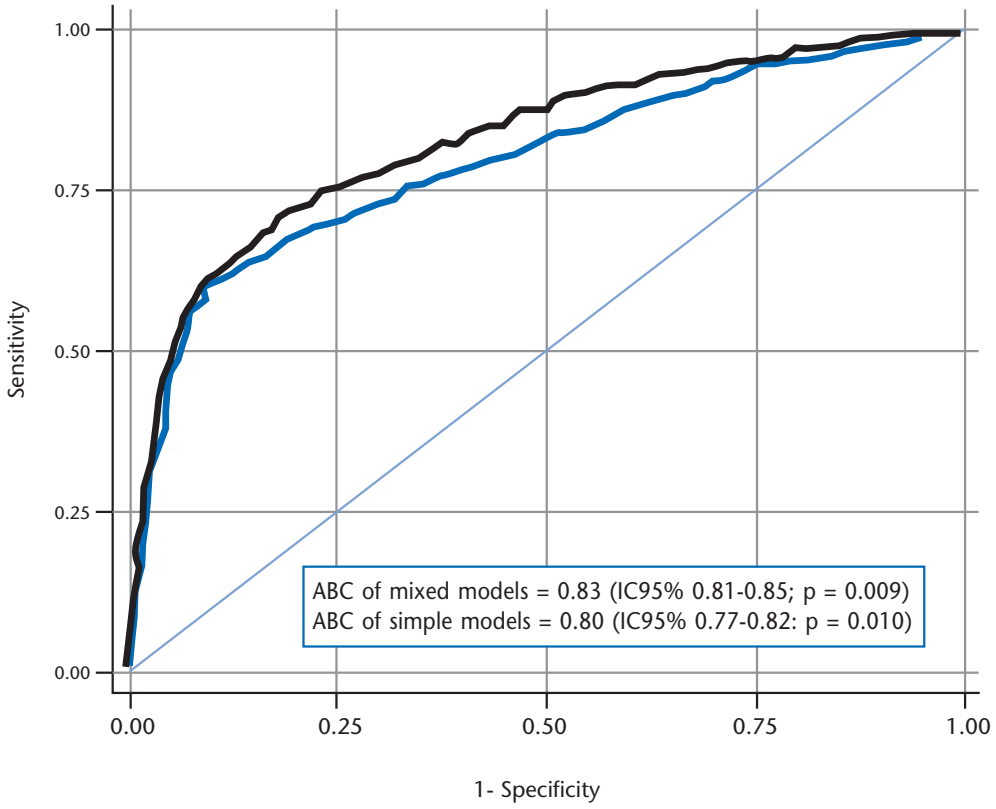


**Figure 2.** ROC curves of simple and mixed models to predict a short stay (≤ 4 days) in patients hospitalized for acute heart failure.

documented in the EPAHF-ECU[10] study, the only one so far on patients with AHF admitted to a SSU, these units have proven to be effective and safe for the treatment of a patients with a particular profile admitted from the ED for an episode of AHF. In addition, that study reported a median LOS of 3 days and it considered factors such as the presence of hypertensive crises, respiratory failure, anemia, history of chronic obstructive pulmonary disease (COPD) and a Thursday admission were associated with prolonged hospitalization in a SSU.

In the present study, the median LOS for patients with AHF was 6 days, similar to that reported in the USA (4-6 days)[45,46] and lower than that of European registers (9-13 days)[47,48], which both included AHF patients admitted to conventional hospital wards

This could be because nearly half of our patients were admitted to a SSU, as well as the non-inclusion of ICU patients and those hospitalized in other departments apart from cardiology, internal medicine and geriatrics. In any case, these results underline the need for rethinking hospital management strategies and policies to improve stay time and reduce the high costs associated with this disease.

Regarding short-term results, patients with short LOS did not show worse outcome than those with longer LOS. Global data are consistent with those of previous registers[46,48,49]. On analysis of short-term mortality according to LOS, this did not differ significantly, and for all-cause revisits within 30 days we observed a trend towards increased revisits after discharge in the group with LOS longer than 4 days. This is very important, since it shows that brief hospitalization in the group with short LOS, albeit with lower risk, was not associated with worse results in terms of revisits.

This finding supports the need to implement programs of comprehensive care for AHF patients to improve management during hospitalization to ensure that LOS conforms to the needs of each patient[37].

Importantly, the study identified five factors associated with short LOS which were common to all the participating centers, despite important heterogeneity between them. Thus, the peculiarities of each center which determine the criteria for referral of these patients according to factors such as the availability of beds, existence of alternative inpatient units or local protocols, did not influence the results obtained.

The present study has certain limitations. First, the data come from a cohort of patients admitted to certain Spanish hospitals who volunteered to participate. Second, the diagnosis of AHF in the ED was performed on the basis of Framingham AHF clinical criteria. The sensitivity of these criteria is known to be limited, and current guidelines recommend performing a B-type natriuretic peptide (BNP) blood test to improve diagnostic accuracy[1,2], but our data collection began at a time when the possibility of ur-

gent BNP determination in Spanish EDs was very low. Third, the decision on admission and location of the patient was taken by the physician responsible for patient care. Although there were criteria predefined by our group, we assume some intra- and inter-center variability in their application. Fourth, we did not analyzed the adequacy of hospital admission, so some patients could possibly have been discharged directly from the ED. Fifth, we excluded AHF patients admitted to the ICU or other departments apart from those described and this could have eliminated patients with extremely prolonged stays. Sixth, since the study design eliminated deceased patients, we should consider the possibility of selection bias, since patients who die during hospitalization tend to have a higher degree of comorbidity, dependence and acute episodes that are most frequently associated with early death50. Seventh, we did not consider the need for admission in order to perform diagnostic or therapeutic procedures, which may have influenced the LOS. Eighth, we did not record treatment at discharge or coordination with other care units or departments, which could have influenced the short-term results. Finally, the study only included hospitals that had a SSU, so these findings can only be extrapolated to hospitals of similar characteristics. Therefore, the clinical applicability of the results should be evaluated by prospective studies that include all these variables.

Despite these limitations, this work could have significance in clinical, organizational and patient management since it provides a number of useful tools to predict LOS and identify AHF patients most likely to have a LOS of 4 days or less who would benefit from admission to a SSU. Future studies are required to demonstrate whether SSU, compared to conventional hospitalization, achieve more efficient management of AHF patients and reduce costs associated with hospitalization, which supports the creation of new resources in those centers that do not have them.

## Conflict of interest

The authors declare no conflict of interest reated to this article.

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## Ethical Responsibilities

All authors have confirmed the maintenance of confidentiality and respect for patient rights in the author's responsibilities document, publication agreement and transfer of rights to EMERGENCIAS.

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## Annex

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