ORIGINAL ARTICLE

# Differences in clinical characteristics and 1-year outcomes of hospitalized patients with heart failure in ESC-HF Pilot and ESC-HF-LT registries

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**KEY WORDS**

heart failure, hospitalization, prognosis, registry

**ABSTRACT**

**INTRODUCTION** The management of heart failure (HF) has changed significantly in recent decades.

**OBJECTIVES** We analyzed the clinical profile, 1-year outcomes, predictors of mortality, and hospital readmissions in hospitalized patients enrolled in the European Society of Cardiology Heart Failure Pilot Survey (ESC-HF Pilot) and Heart Failure Long-Term Registry (ESC-HF-LT).

**PATIENTS AND METHODS** The analysis included hospitalized Polish patients from both registries. The primary endpoint was all-cause death at 1 year, while the secondary endpoint was all-cause death or hospitalization for worsening HF at 1 year.

**RESULTS** The study included a total of 1415 hospitalized patients (650 from ESC-HF Pilot; 765 from ESC-HF-LT). The primary endpoint occurred in 89 of the 650 patients (13.7%) and in 120 of the 711 patients (16.9%) from ESC-HF Pilot and ESC-HF-LT, respectively ($P = 0.11$). The secondary endpoint was more frequent in ESC-HF Pilot than in ESC-HF-LT (201 of 509 [39.5%] vs 222 of 663 [33.5%]; $P = 0.04$). Compared with ESC-HF Pilot, patients from the ESC-HF-LT registry were older and more often had hypertension, atrial fibrillation, peripheral artery disease, and chronic kidney disease, while the incidence of chronic obstructive pulmonary disease was lower. The percentage of patients receiving drugs for HF (diuretics, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, β-blockers, mineralocorticoid receptor antagonists), anticoagulants, cardiac resynchronization therapy, and implantable cardioverter-defibrillator were higher in the ESC-HF-LT group in comparison with the ESC-HF Pilot group.

**CONCLUSIONS** Patients from the ESC-HF-LT registry had a lower risk of death or hospitalization for worsening HF despite the fact that they were older and had more comorbidities. The results might suggest an improvement in physicians' adherence to the guidelines on the management of HF in the ESC-HF-LT registry.

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Received: November 14, 2018.
Revision accepted: January 10, 2019.
Published online: January 16, 2019.
Conflict of interest: none declared.
Pol Arch Intern Med. 2019;
129 (2): 902-912
doi:10.20452/pamw.4418


**INTRODUCTION** Despite significant progress in the diagnosis and treatment of cardiovascular disease (CVD) in recent decades, the incidence and prevalence of heart failure (HF) continues to rise.[1] The prevalence of HF is approximately 1% to 2% of the adult population in developed countries, increasing to 10% and higher among people older than 70 years of age.[2] Moreover, HF has become the main cause of hospitalization in patients older than 65 years.[2,3] It is suggested that the rising prevalence of HF results from population aging and improved treatment

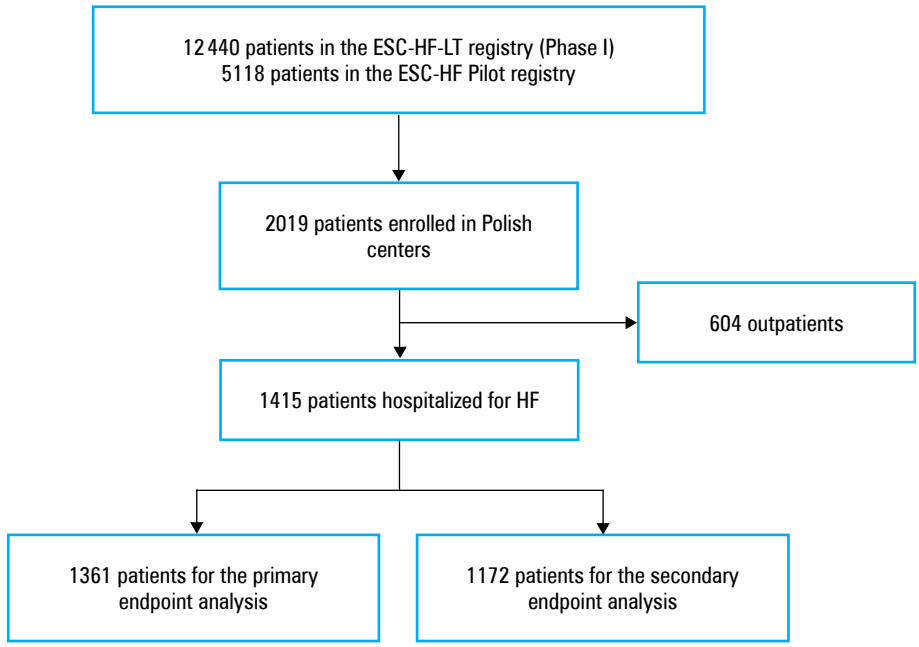


**FIGURE 1** Flow chart of patient enrollment in the study
Abbreviations: HF, heart failure

of CVD. Moreover, there has been an increase in the number of patients with left ventricular dysfunction, which is a consequence of successfully treated acute coronary syndromes.[1,3] HF still has a poor prognosis associated with high rates of hospital readmissions and increasing treatment costs.[1,3]

It has been suggested that the care of HF patients may be improved by participation in registries and clinical trials.[4] The Heart Failure Association of the European Society of Cardiology (ESC)[5] has initiated the Heart Failure Pilot Survey (ESC-HF Pilot) and subsequently the Heart Failure Long-Term Registry (ESC-HF-LT). These are prospective multicenter observational registries aiming to evaluate the clinical profile, pharmacotherapy, and 1-year outcomes of HF patients in European countries.[1,3] In recent years, the management of HF has changed markedly. Therefore, the current study aimed to analyze and compare the characteristics and 1-year outcomes as well as predictors of mortality and hospital readmissions in hospitalized patients enrolled in the ESC-HF Pilot and ESC-HF-LT registries.

## PATIENTS AND METHODS

The ESC-HF Pilot and ESC-HF-LT registries were multicenter prospective observational surveys of HF patients. The registries included outpatients and inpatients with chronic, worsening, or new-onset HF. Patients who were over 18 years of age and met the diagnostic criteria for HF (both outpatients and patients hospitalized for acute or chronic HF) were enrolled. HF was diagnosed according to the typical clinical signs and symptoms as well as biochemical findings (increased levels of N-terminal fragment of the prohormone brain natriuretic peptide ≥125 pg/ml or brain natriuretic peptide ≥35 pg/ml) and, optionally, echocardiographic features of left ventricular dysfunction. There were no specific exclusion criteria. All patients provided written informed consent. The surveys were approved by a local ethical review board.

The ESC-HF Pilot registry enrolled patients on a single day of the week (chosen by the participating center) from October 2009 to May 2010 in 136 European cardiology centers, including 29 centers from Poland. Patients recruited in ESC-HF Pilot were not subsequently included in the ESC-HF-LT registry. ESC-HF-LT is a 3-phase registry conducted in 211 centers from 21 European countries. During phase I of the registry, covering the period from May 2011 to April 2013, patients were enrolled on the first day of the week for 12 consecutive months. In phases II and III of the registry, patients were enrolled during 5 consecutive days every quarter. Phase III is currently ongoing.[4]

The current analysis included hospitalized Polish patients enrolled in ESC-HF Pilot and in phase I of ESC-HF-LT (FIGURE 1). Ambulatory patients were excluded. In both registries, the primary endpoint was all-cause death at 1 year, whereas the secondary endpoint was all-cause death or hospitalization for worsening HF at 1 year. We compared the characteristics and 1-year outcomes between patients enrolled in both registries and determined the predictors of the primary and secondary endpoints in these populations. Data gathered in both registries included demographic characteristics, diagnostic test results, medical history, clinical presentation at admission and at discharge, management during index hospitalization, previous and current treatment, and 1-year follow-up. Case report forms enabled investigators to choose between "never," "former," "sometimes," or "daily" for alcohol consumption.

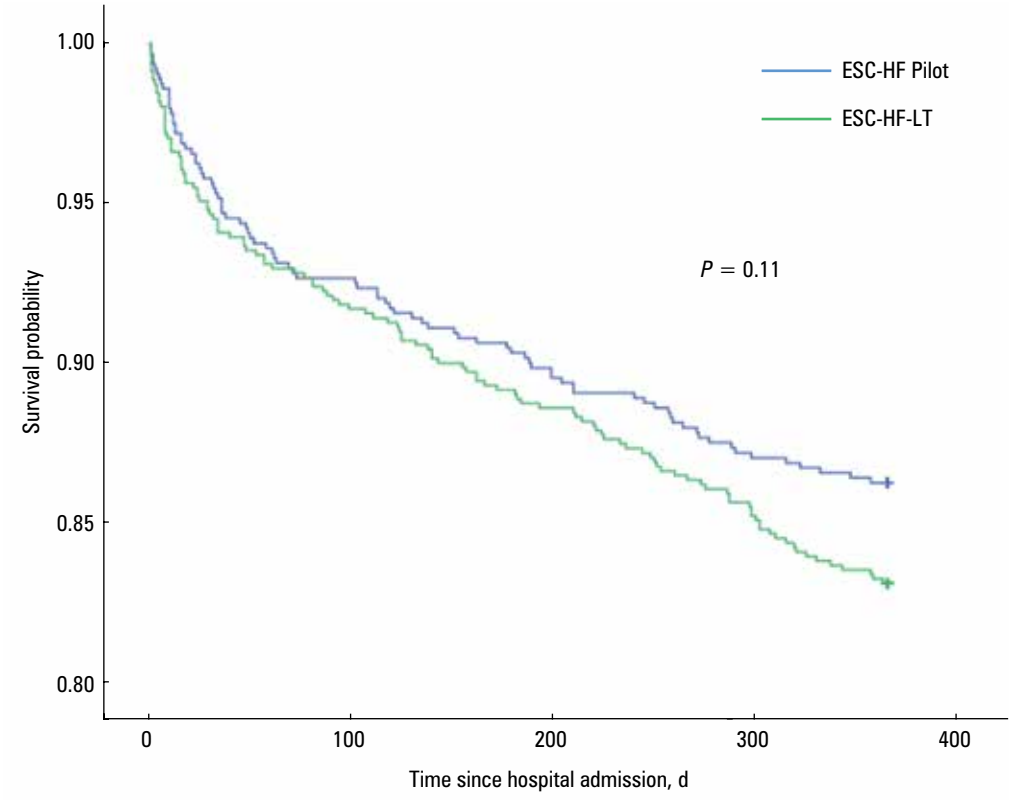


**FIGURE 2** Kaplan–Meier curves for all-cause 1-year mortality in Polish patients enrolled in the ESC-HF Pilot and ESC-HF-LT registries

**Statistical analysis** For the comparison of group characteristics, the Fisher exact test and the Mann–Whitney test were used for categorical and continuous variables, respectively. To identify predictors of the primary and secondary endpoints, the Cox proportional hazards regression model was used. Variables found to be significant in univariate analyses were included in multivariate analyses. To maintain an adequate value of the events per predictor variable (EPV), variables with an incompleteness of data greater than 5% were not included in the Cox model due to the relatively small size of the analyzed groups. A *P* value of less than 0.05 was considered significant for all tests. The tests were 2-tailed. The Kaplan–Meier curves were developed for the primary and secondary endpoints of the ESC-HF Pilot and ESC-HF-LT registries separately (FIGURES 2 and 3). Statistical analyses were performed using the SPSS software (IBM SPSS Statistics 22, Armonk, New York, United States).

## RESULTS

The ESC-HF Pilot and ESC-HF-LT (phase I) registries enrolled 5118 and 12 440 patients across Europe, respectively. The total Polish cohort was 2019 patients. The final analysis included 1415 inpatients: 650 from ESC-HF Pilot and 765 from ESC-HF-LT. Data on 1-year survival were available for 1361 of the 1415 patients (96.2%). Data on 1-year survival or readmission for decompensated HF were available for 1172 of the 1415 patients (82.8%).

The baseline characteristics, clinical course, pharmacotherapy, in-hospital management, and long-term outcomes of the total population are presented in TABLES 1, 2, and 3. The mean doses of recommended HF drugs at admission and at discharge are presented in TABLE 4.

Patients from the ESC-HF-LT registry were admitted with a significantly higher New York Heart Association (NYHA) class than those from ESC-HF Pilot (median [IQR], 3 [3–4] and 3 [2–4], respectively; *P* = 0.01). During index hospitalization, death occurred in 42 of the 1415 patients (2.97%), including 20 of the 650 patients from the ESC-HF Pilot registry (3.1%) and 22 of the 765 patients from the ESC-HF-LT registry (2.9%; *P* = 0.88). The primary endpoint was reached by 209 of the 1361 patients (15.4%). In the ESC-HF Pilot registry, the primary endpoint occurred in 89 of the 650 patients (13.7%), whereas in the ESC-HF-LT registry the all-cause death at 1 year was observed in 120 of the 711 patients (16.9%; *P* = 0.11). The secondary endpoint occurred in 423 of the 1172 patients (36.1%), including 201 of the 509 patients from ESC-HF Pilot (39.5%) and 222 of the 663 patients from ESC-HF-LT (33.5%; *P* = 0.04) (TABLE 3). The Kaplan–Meier curves for the primary and secondary endpoints in the ESC-HF Pilot and ESC-HF-LT registries are presented in FIGURES 2 and 3.

The univariate analyses of predictors of the primary and secondary endpoints for both registries were performed. Variables that were predictive of the endpoint (and maintained an adequate EPV value) were consequently included in the multivariate Cox proportional hazards regression models (TABLE 5).

## DISCUSSION

This observational study revealed less frequent readmission rates during follow-up in patients enrolled in the ESC-HF-LT than

**TABLE 1** Baseline characteristics of patients with heart failure included in the ESC-HF Pilot and ESC-HF-LT registries

| Characteristics | Total (n = 1415) | ESC-HF Pilot (n = 650) | ESC-HF-LT (n = 765) | *P* value |
|---|---|---|---|---|
| **Demographic data** | | | | |
| Male sex | 66.0%; 934/1415 | 64.3%; 418/650 | 67.5%; 516/765 | 0.22 |
| BMI, kg/m$^2$ | 28 (25–31); n = 1335 | 28 (25–31); n = 573 | 28 (25–31); n = 762 | 0.66 |
| Age, y | 69 (59–78); n = 1415 | 69 (58–78); n = 650 | 70 (61–78); n = 765 | 0.03 |
| **Heart failure** | | | | |
| LVEF, % | 36 (25–50); n = 1229 | 37 (26–50); n = 568 | 35 (25–50); n = 738 | 0.20 |
| HFpEF | 26%; 340/1306 | 25.0%; 142/568 | 26.8%; 198/738 | 0.48 |
| HFrEF | 56.4%; 736/1306 | 55.6%; 316/568 | 56.9%; 420/738 | 0.65 |
| HFmrEF | 17.6%; 230/1306 | 19.4%; 110/568 | 16.3%; 120/738 | 0.16 |
| Previous HF hospitalization | 54.6%; 771/1412 | 57.6%; 374/649 | 52.0%; 397/763 | 0.04 |
| Ischemic etiology | 57.7%; 816/1414 | 60.6%; 393/649 | 55.3%; 423/765 | 0.05 |
| Dilated cardiomyopathy | 12.7%; 179/1415 | 9.7%; 63/650 | 15.2%; 116/765 | 0.002 |
| **Medical history** | | | | |
| Hypertension | 68.9%; 973/1413 | 66.0%; 429/650 | 71.3%; 544/763 | 0.03 |
| AF | 43.6%; 616/1412 | 38.9%; 252/647 | 47.6%; 364/765 | 0.001 |
| CAD | 56.2%; 795/1414 | 59.0%; 383/649 | 53.9%; 412/765 | 0.05 |
| Prior PCI or CABG | 34.0%; 481/1414 | 32.8%; 213/649 | 35.0%; 268/765 | 0.40 |
| PAD | 12.7%; 180/1413 | 8.9%; 58/650 | 16.0%; 122/763 | <0.001 |
| Diabetes | 35.1%; 497/1415 | 35.1%; 228/650 | 35.2%; 269/765 | 1.00 |
| CKD | 20.9%; 296/1413 | 12.3%; 80/648 | 28.2%; 216/765 | <0.001 |
| COPD | 18.8%; 265/1413 | 23.3%; 151/649 | 14.9%; 114/764 | <0.001 |
| Stroke | 10.6%; 150/1413 | 10.2%; 66/648 | 11.0%; 84/765 | 0.67 |
| Current smoking | 56.5%; 786/1390 | 57.1%; 357/625 | 56.1%; 429/765 | 0.70 |
| Alcohol (former or sometimes) | 55.8%; 763/1367 | 48.6%; 301/619 | 61.8%; 462/748 | <0.001 |
| Anemia | 32.9%; 466/1415 | 33.1%; 215/650 | 32.8%; 251/765 | 0.96 |
| **Previous pharmacotherapy** | | | | |
| Diuretics | 67.1%; 926/1380 | 62.3%; 383/615 | 71.0%; 543/765 | 0.001 |
| MRA | 44.9%; 618/1376 | 41.7%; 255/611 | 47.5%; 363/765 | 0.04 |
| ACEI | 62.9%; 865/1376 | 61.9%; 378/611 | 63.7%; 487/765 | 0.50 |
| ARB | 8.4%; 116/1373 | 7.9%; 48/608 | 8.9%; 68/765 | 0.56 |
| β-Adrenolytic | 74.5%; 1025/1376 | 71.8%; 439/611 | 76.6%; 586/765 | 0.047 |
| CCB | 13.2%; 181/1375 | 11.1%; 68/610 | 14.8%; 113/765 | 0.05 |
| Statins | 54.9%; 756/1376 | 52.9%; 323/611 | 56.6%; 433/765 | 0.17 |
| Anticoagulants | 31.35; 431/1377 | 27.1%; 166/612 | 34.6%; 265/765 | 0.003 |
| Antiplatelets | 53.6%; 737/1376 | 53.0%; 324/611 | 54.0%; 413/765 | 0.74 |
| Digoxin | 18.6%; 255/1372 | 19.3%; 117/607 | 18.0%; 138/765 | 0.58 |

Categorical variables are presented as number and percentage. Continuous variables are presented as median and interquartile range.

*P* values of less than 0.05 are considered significant.

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; AF, atrial fibrillation; ARB, angiotensin receptor blocker; BMI, body mass index; CABG, coronary artery bypass grafting; CAD, coronary artery disease; CCB, calcium channel blocker; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; HF, heart failure; HFmrEF, heart failure with mid-range ejection fraction; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; LVEF, left ventricular ejection fraction; MRA, mineralocorticoid receptor antagonist; PAD, peripheral artery disease; PCI, percutaneous coronary intervention

in the ESC-HF Pilot registry, which might suggest an improvement in symptomatic treatment of HF in recent years. Although patients included in ESC-HF-LT were older and had more comorbidities, there were no significant differences in 1-year mortality between the registries.

Interestingly, the population of patients enrolled in ESC-HF-LT was significantly older compared with the population in ESC-HF Pilot, which is likely due to the aging of the general population. The results of both registries confirm that the ischemic etiology is the most frequent primary cause of HF in the Polish population, which is consistent with previous observations.[3] In both registries, the ischemic etiology of HF was recorded in 57.7% of patients. There was a slight decrease in the percentage of ischemic-related HF observed for the Polish cohort of ESC-HF-LT compared with ESC-HF

**TABLE 2** Clinical course of index hospitalization of patients with heart failure included in the ESC-HF Pilot and ESC-HF-LT registries

| Characteristics | Total (n = 1415) | ESC-HF Pilot (n = 650) | ESC-HF-LT (n = 765) | *P* value |
|---|---|---|---|---|
| **Clinical status at admission** | | | | |
| NYHA class | 3 (3–4); n = 1408 | 3 (2–4); n = 646 | 3 (3–4); n = 762 | 0.01 |
| SBP, mm Hg | 130 (110–145); n = 1412 | 130 (115–150); n = 647 | 130 (110–140); n = 765 | 0.001 |
| DBP, mm Hg | 80 (70–90); n = 1411 | 80 (70–90); n = 647 | 80 (70–85); n = 764 | 0.003 |
| Heart rate, bpm | 80 (70–100); n = 1412 | 80 (70–100); n = 647 | 80 (70–100); n = 765 | 0.80 |
| AF as a cause of admission | 25.2%; 356/1414 | 17.3%; 112/649 | 31.9%; 244/765 | <0.001 |
| ACS as a cause of admission | 19.3%; 273/1412 | 29.7%; 192/647 | 10.6%; 81/765 | <0.001 |
| Cardiogenic shock | 2.5%; 34/1354 | 2.7%; 16/589 | 2.4%; 18/765 | 0.73 |
| Inotropes | 12.1%; 170/1410 | 10.5%; 68/647 | 13.4%; 102/763 | 0.10 |
| Diuretics IV | 67.4%; 950/1410 | 78.3%; 508/649 | 58.1%; 442/761 | <0.001 |
| Nitrates IV | 13.9%; 196/1409 | 15.7%; 102/648 | 12.4%; 94/761 | 0.08 |
| **Clinical signs at admission** | | | | |
| Pulmonary rales | 58.8%; 832/1415 | 55%; 357/650 | 62.1%; 475/765 | 0.01 |
| Peripheral edema | 49.4%; 699/1415 | 48.2%; 313/650 | 50.5%; 386/765 | 0.39 |
| Jugular venous distension (>6 cm) | 13.4%; 190/1415 | 12.5%; 81/650 | 14.2%; 109/765 | 0.35 |
| S3 gallop | 15.6%; 221/1415 | 12.6%; 82/650 | 18.2%; 139/765 | 0.54 |
| Pleural effusion | 14.4%; 204/1415 | 10%; 65/650 | 18.2%; 139/765 | <0.001 |
| Peripheral hypoperfusion | 12.4%; 176/1415 | 9.8%; 64/650 | 14.6%; 112/765 | 0.006 |
| **Laboratory findings at admission** | | | | |
| Serum sodium, mmol/l | 139 (136–141); n = 1401 | 138 (136–141); n = 642 | 139 (136–141); n = 759 | 0.001 |
| Serum potassium, mmol/l | 4.4 (4.1–4.8); n = 1401 | 4.4 (4.0–4.7); n = 641 | 4.5 (4.1–4.8); n = 760 | 0.02 |
| Serum creatinine, mg/dl | 1.1 (0.9–1.4); n = 1381 | 1.1 (0.9–1.4); n = 620 | 1.1 (0.9–1.4); n = 761 | 0.83 |
| Hemoglobin, g/dl | 13.4 (12.0–14.5); n = 1394 | 13.3 (12.0–14.5); n = 636 | 13.4 (12.1–14.5); n = 758 | 0.49 |

Continuous variables are presented as median and interquartile range. Categorical variables are presented as number and percentage.

*P* values of less than 0.05 are considered significant.

Abbreviations: ACS, acute coronary syndrome; DBP, diastolic blood pressure; IV, intravenous; NYHA, New York Heart Association; SBP, systolic blood pressure; others, see **TABLE 1**

Pilot (55.3% vs 60.6%; *P* = 0.05). This trend is reflected in the results from other registries (ATTEND [Acute Decompensated Heart], 33%; ADHERE [Acute Decompensated Heart Failure National Registry], 57%; EHFS-II [EuroHeart Failure Survey II], 30%; OPTIMIZE-HF [Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure], 46%).[6-9] Moreover, the results obtained from the pan-European ESC-HF Pilot registry revealed that in the group of all outpatients and patients admitted with acute HF (AHF), the ischemic etiology was more prevalent in chronic HF than in AHF (84.9% vs 64%). The analysis of the ESC-HF-LT registry suggested that the ischemic etiology was more prevalent in hospitalized patients with AHF (53.8% vs 43.1% of outpatients with chronic HF), especially in the Middle East (Israel, 59.1%), followed by northern Europe (48%), eastern Europe (47.4%), North Africa (44.7%), southern Europe (41.4%), and western Europe (32.7%).[4,5] The lower percentage of the ischemic etiology of HF in Polish patients from ESC-HF-LT compared with ESC-HF Pilot may reflect a recent trend in Poland towards more optimal prevention and treatment of ischemic heart disease.

According to the latest ESC guidelines, angiotensin-converting enzyme inhibitors (ACEIs) (or angiotensin receptor blockers [ARBs] if ACEI is not tolerated or contraindicated) in addition to a β-blocker are recommended for symptomatic patients with HF with reduced ejection fraction (HFrEF) to reduce the risk of HF-related hospitalization and death.[2] The treatment strategy for patients with HF with preserved (HFpEF) or mid-range ejection fraction (HFmrEF) mainly depends on coexisting cardiovascular and non-cardiovascular comorbidities. However, numerous clinical trials have shown that only marginally fewer patients with HFpEF or HFmrEF receive β-blockers, ACEIs, or ARBs in comparison with the HFrEF group.[2] In both ESC-HF registries, the percentages of patients receiving ACEIs, ARBs, or β-blockers prior to hospitalization were 62.9%, 8.4%, and 74.5%, respectively. The analysis of the ESC-HF-LT registry revealed a slightly higher percentage of patients receiving recommended HF drugs in comparison with the ESC-HF Pilot registry; however, significance was only reached in the case of β-blockers (ACEIs, 63.7% vs 61.9%, *P* = 0.50; ARBs, 8.9% vs 7.9%, *P* = 0.56; and β-blockers, 76.6% vs 71.8%, *P* = 0.047). Interestingly, the recently published results for the population of ESC-HF-LT reported that 90.0% of outpatients with chronic HF

**TABLE 3** In-hospital and long-term outcomes of patients with heart failure included in the ESC-HF Pilot and ESC-HF-LT registries

| Characteristics | Total (n = 1415) | ESC-HF Pilot (n = 650) | ESC-HF-LT (n = 765) | *P* value |
|---|---|---|---|---|
| Major management during index hospitalization; clinical status at discharge | | | | |
| NYHA class | 2 (2–3); n = 1386 | 2 (2–3); n = 643 | 2 (2–3); n = 743 | 0.02 |
| SBP, mm Hg | 120 (110–130); n = 1383 | 120 (110–130); n = 640 | 120 (110–130); n = 743 | 0.28 |
| DBP, mm Hg | 70 (65–80); n = 1380 | 70 (65–80); n = 640 | 70 (65–80); n = 740 | 0.16 |
| Heart rate, bpm | 70 (65–80); n = 1372 | 70 (66–80); n = 629 | 70 (65–80); n = 743 | 0.50 |
| Hemoglobin, g/dl | 13.0 (11.5–14.3); n = 873 | 13.0 (11.4–14.3); n = 416 | 13.0 (11.6–14.3); n = 457 | 0.92 |
| Serum creatinine, mg/dl | 1.1 (0.9–1.4); n = 1010 | 1.1 (0.9–1.4); n = 456 | 1.1 (0.9–1.4); n = 554 | 0.96 |
| Serum sodium, mmol/l | 139 (136–141); n = 1082 | 138 (136–141); n = 491 | 139 (137–142); n = 591 | <0.001 |
| Serum potassium, mmol/l | 4.4 (4.1–4.7); n = 1088 | 4.4 (4.1–4.8); n = 491 | 4.4 (4.1–4.7); n = 597 | 0.21 |
| PCI or CABG | 12.7%; 179/1411 | 13.4%; 87/650 | 12.1%; 92/761 | 0.47 |
| Pharmacotherapy and devices at discharge | | | | |
| Diuretics | 83.4%; 1178/1412 | 81.1%; 525/647 | 85.4%; 653/765 | 0.04 |
| MRA | 64.7%; 913/1411 | 62.8%; 406/646 | 66.3%; 507/765 | 0.18 |
| ACEI | 73.2%; 1034/1413 | 72.8%; 472/648 | 73.5%; 562/765 | 0.81 |
| ARB | 9.4%; 132/1410 | 8.5%; 55/645 | 10.1%; 77/765 | 0.36 |
| β-Adrenolytic | 87.6%; 1238/1413 | 86.7%; 562/648 | 88.4%; 676/765 | 0.37 |
| CCB | 15.4%; 217/1413 | 15.4%; 100/648 | 15.3%; 117/765 | 0.94 |
| Statins | 67.2%; 950/1413 | 68.1%; 441/648 | 66.5%; 509/765 | 0.57 |
| Anticoagulants | 41.9%; 592/1412 | 37.7%; 244/647 | 45.5%; 348/765 | 0.003 |
| Antiplatelets | 63.9%; 903/1413 | 69.1%; 448/648 | 59.5%; 455/765 | <0.001 |
| Digoxin | 24.1%; 341/1413 | 25.8%; 167/648 | 22.7%; 174/765 | 0.19 |
| Amiodarone | 10.7%; 151/1413 | 7.6%; 49/648 | 13.3%; 102/765 | <0.001 |
| Antiarrhythmics | 7.6%; 107/1413 | 9.9%; 64/648 | 5.6%; 43/765 | 0.003 |
| Pacemaker | 7.5%; 106/1415 | 9.2%; 60/650 | 6.0%; 46/765 | 0.03 |
| CRT | 4.0%; 57/1415 | 1.8%; 12/650 | 5.9%; 45/765 | <0.001 |
| ICD | 13.3%; 188/1415 | 5.8%; 38/650 | 19.6%; 150/765 | <0.001 |
| Death during hospitalization, primary and secondary endpoint | | | | |
| Death during hospitalization | 3.0%; 42/1415 | 3.1%; 20/650 | 2.9%; 22/765 | 0.88 |
| 1-year all-cause death | 15.4%; 209/1361 | 13.7%; 89/650 | 16.9%; 120/711 | 0.11 |
| 1-year all-cause death or hospitalization for HF worsening | 36.1%; 423/1172 | 39.5%; 201/509 | 33.5%; 222/663 | 0.04 |

Continuous variables are presented as median and interquartile range. Categorical variables are presented as number and percentage.

*P* values of less than 0.05 are considered significant.

Abbreviations: CRT, cardiac resynchronization therapy; ICD, implantable cardioverter-defibrillator; others, see TABLE 1 and 2

enrolled from eastern Europe receive an ACEI or ARB and 90.8% of them receive a β-blocker, whereas in the AHF group, the respective percentages are 66.7% and 69.4%.[4]

Cardiac resynchronization therapy (CRT) and implantable cardioverter-defibrillator (ICD) implantation rates were significantly higher in ESC-HF-LT compared with ESC-HF Pilot. This indicates increased accessibility to implantable devices and improvement in guideline implementation in Poland in recent years. These data are in line with the recent QUALIFY study by Opolski et al[10] (Quality of Adherence to Guideline Recommendations for Life-saving in Heart Failure Treatment Survey), who revealed that 20.8% and 7.7% of ambulatory HFrEF patients had implanted ICD and CRT, respectively.

In terms of the differences in pharmacotherapy between both registries, a significantly higher percentage of patients received anticoagulant therapy in ESC-HF-LT than in ESC-HF Pilot, which was reported previously.[11] This may result from the observed trend towards a higher prevalence of atrial fibrillation in the ESC-HF-LT registry as well as an improvement in physicians' adherence to the guidelines.

Our analysis revealed that the overall 1-year rate of all-cause death among hospitalized HF patients in Poland was 15.4%, and there was no difference between the registries. However, patients from the ESC-HF-LT registry were admitted with significantly more advanced HF according to the NYHA class. Importantly, there were no significant differences in the prescription of

**TABLE 4** Doses of the drugs at admission and at discharge in patients with heart failure included in the ESC-HF Pilot and ESC-HF-LT registries

| Drug | | ESC-HF Pilot | | ESC-HF-LT | |
|---|---|---|---|---|---|
| | | Admission | Discharge | Admission | Discharge |
| ACEI, mg/d | Trandolapril | 1.1 (0.82) | 1.25 (1.06) | – | – |
| | Ramipril | 5.1 (3.05) | 5.35 (3.34) | 5.07 (2.97) | 5.06 (3.02) |
| | Quinapril | 16.3 (12.19) | 25.4 (12.66) | – | – |
| | Perindopril | 4.89 (2.19) | 5.07 (2.51) | 4.64 (2.27) | 5.62 (2.72) |
| | Lisinopril | 10.63 (5.45) | 13.6 (6.97) | 15.23 (6.93) | 14.79 (6.44) |
| | Enalapril | 12.63 (7.26) | 17.63 (11.47) | 13.26 (8.20) | 18.25 (11.04) |
| | Cilazapril | 1.22 (1.03) | 1.08 (1.16) | – | – |
| | Captopril | 26.24 (14.26) | 18.5 (0) | 19.98 (5.24) | 14.57 (3.58) |
| ARB, mg/d | Valsartan | 144 (35.78) | 122.66 (41.31) | 116.56 (49.68) | 124.60 (66.19) |
| | Telmisartan | 80 (21.91) | 52 (26.83) | – | – |
| | Losartan | 45.58 (20.63) | 50.2 (19.39) | 44.02 (17.63) | 40.63 (17.73) |
| | Candesartan | 12.71 (6.6) | 9.2 (3.79) | 11.0 (7.77) | 11.0 (8.87) |
| β-Adrenolytic, mg/d | Sotalol | 120 (60.47) | 116.36 (37.76) | – | – |
| | Propranolol | 60 (52.92) | 120 (0) | – | – |
| | Nebivolol | 5 (1.34) | 4.66 (0.88) | 4.08 (1.77) | 4.21 (1.96) |
| | Metoprolol | 57.68 (34.33) | 37.31 (34.33) | 63.32 (39.25) | 70.06 (44.46) |
| | Carvedilol | 19.09 (14.41) | 19.43 (14.32) | 19.33 (14.08) | 19.14 (13.41) |
| | Bisoprolol | 4.87 (2.24) | 4.80 (2.30) | 4.34 (2.59) | 4.61 (2.82) |
| | Betaxolol | 16.66 (5.77) | 13.33 (5.77) | – | – |
| | Atenolol | 50 (43.3) | 100 (0) | – | – |
| MRA, mg/d | Spironolactone | 38.37 (24.29) | 37.63 (23.07) | 34.42 (22.06) | 34.43 (20.75) |
| | Eplerenone | 32.91 (12.16) | 31.49 (11.01) | 30.3 (10.3) | 32.53 (11.53) |

Data are presented as mean (SD).

Abbreviations: see **TABLE 1**

therapy for HF (ACEIs/ARBs, β-blockers, mineralocorticoid receptor antagonists) at hospital discharge between both registries. In the general population of ESC-HF Pilot, the 1-year all-cause mortality rates were 17.4% for hospitalized patients (19.3%, 13.0%, 18.4%, and 24.7% in northern, eastern, western, and southern Europe, respectively) and 7.2% for ambulatory patients (9.0%, 5.0%, 6.2%, and 7.4% in northern, eastern, western, and southern Europe, respectively).[12] In the ESC-HF-LT registry, the 1-year mortality rates were 26% for hospitalized patients with AHF (21.6%, 27.5%, 36.5%, 29.1%, 24.8%, and 29.6% in eastern Europe, Middle East, northern Europe, North Africa, southern Europe, and western Europe, respectively) and 8.3% for outpatients with chronic HF (7.9%, 14.9%, 11.3%, 15.6%, 6.9%, and 7.6% in eastern Europe, Middle East, northern Europe, North Africa, southern Europe, and western Europe, respectively).[4] The insufficient number of outpatient HF clinics in Poland results in a greater number of hospitalizations of patients with less severe HF, which probably explains the lower mortality rate observed in the Polish population.[3] The analysis according to age revealed that in hospitalized Polish participants of the ESC-HF-LT registry, the all-cause death at 1-year occurred in 9.1% of patients younger than 65 years, 18.5% of patients aged 65 years or older, 14.5% of patients aged between 65 and 74 years, and 21.6% of patients aged 75 years or older.[13] Moreover, the analysis of this population revealed that death at 1-year occurred in 17% of patients with HFpEF and in 21% of patients with HFrEF.[14]

In the current analysis, the risk factors associated with 1-year all-cause mortality were only partly comparable to the several other studies conducted in hospitalized HF patients.[15-19] In our analysis, the independent predictors of 1-year all-cause mortality in the total population were older age, chronic obstructive pulmonary disease (COPD), higher NYHA class at admission, lower serum sodium at admission, use of inotropes during index hospitalization, lower systolic blood pressure (SBP) at discharge, higher heart rate at discharge, and amiodarone at discharge. The prescription of β-blockers at discharge was associated with a significant decrease in mortality. In hospitalized Polish patients enrolled in the ESC-HF Pilot registry, the independent predictors of all-cause mortality during 1-year follow-up were a higher NYHA class at admission, inotropic support during hospitalization, and lower estimated glomerular filtration rate at discharge.[3]

In our previous analysis, we assessed the predictors of 1-year all-cause death in a group of hospitalized Polish participants of the ESC-HF-LT

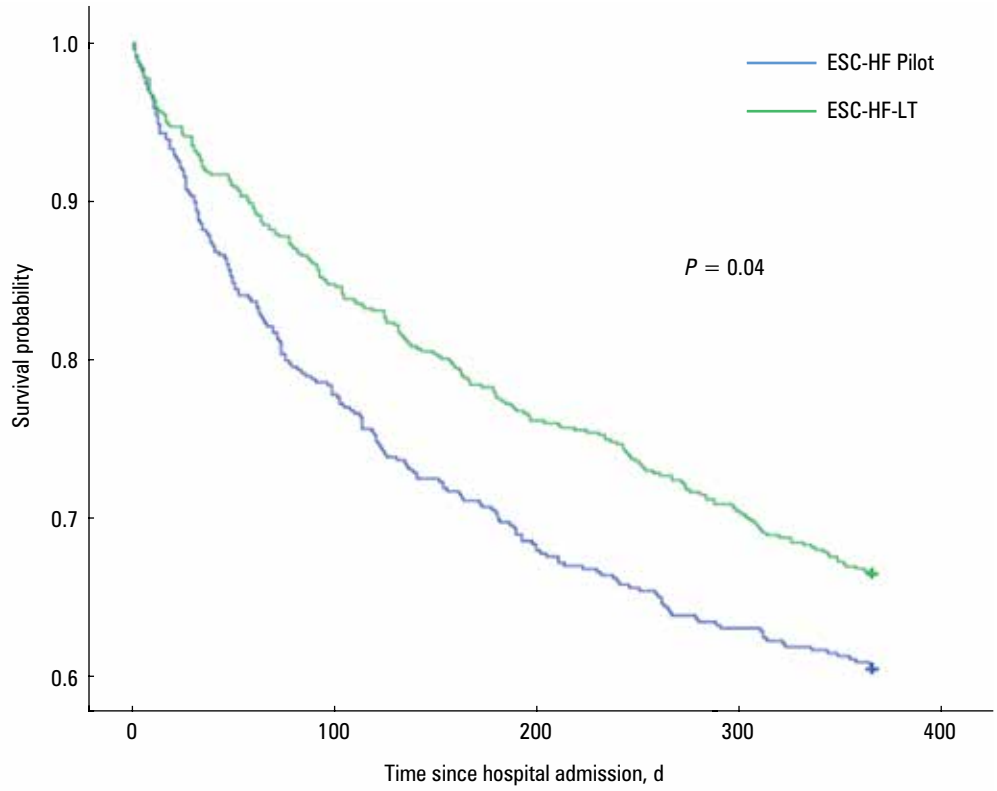


**FIGURE 3** Kaplan–Meier curves for all-cause 1-year mortality or hospitalization in patients enrolled in the Polish part of the ESC-HF Pilot and ESC-HF-LT registries

registry according to age.[13] The independent predictors of death in patients aged 65 years or older were COPD, SBP, NYHA class, and β-blocker use; in patients aged between 65 and 74 years, previous coronary revascularization, NYHA class, serum sodium, and creatinine; and in patients aged 75 years or older, NYHA class and SBP.[13] The independent predictors of 1-year mortality in hospitalized Polish patients with HFpEF in this registry were age, NYHA class at admission, and moderate or severe aortic stenosis. In the HFrEF group, the predictors included age, NYHA class at admission, lower ejection fraction, and lower serum sodium at admission.[14]

In the OPTIMIZE-HF trial, the 60- to 90-day postdischarge mortality was 8.6% and the rate of rehospitalization was 29.6%.[16] The factors predicting early postdischarge mortality were age, serum creatinine, reactive airway disease, liver disease, lower SBP, lower serum sodium, lower weight at admission, and depression. Prescription of statins and β-blockers at discharge was associated with significantly lower mortality.[19] In a Korean HF registry of patients hospitalized for AHF, the 1-year mortality rate was 15% and independent clinical risk factors included age, previous history of HF, anemia, hyponatremia, high serum levels of N-terminal fragment of the prohormone brain natriuretic peptide, and use of β-blockers at discharge.[20] In a study conducted in hospitalized patients with AHF in Switzerland and Finland, the 1-year mortality rate was 29% and its predictors included the presence of cardiogenic shock, left ventricular dysfunction, renal insufficiency, coronary heart disease, and age.[15] Moreover, a recent study has shown that acute kidney injury is significantly associated with a higher risk of mortality in hospitalized patients with HFmrEF, as compared with the HFrEF group.[21]

In the combined Polish cohort of both registries, the secondary endpoint (death or hospitalization) occurred in 36.1% of patients. A comparison between ESC-HF Pilot and ESC-HF-LT revealed a reduced rate of the secondary endpoint in the ESC-HF-LT group (33.5% vs 39.5%, $P = 0.04$). This is an interesting finding, particularly because the Polish population in the ESC-HF-LT registry appeared to be significantly older in comparison with the ESC-HF Pilot group. Moreover, patients in ESC-HF-LT more often had comorbidities, such as atrial fibrillation, hypertension, peripheral artery disease, chronic kidney disease (CKD), and were admitted to the hospital with a significantly worse clinical status (higher NYHA class, lower blood pressure). Finally, these patients showed significantly higher prescription rates of diuretics at discharge.

In hospitalized Polish participants of the ESC-HF-LT registry, the secondary endpoint (death or hospitalization) occurred in 28% of patients aged less than 65 years, 36.1% of patients aged 65 years or older, 29.2% of patients aged between 65 and 74 years, and 41.2% of patients aged 75 years or older.[13] The analysis by ejection fraction revealed that the secondary endpoint was reached by 32% of patients with HFpEF and 40% of those with HFrEF.[14] In the ESC-HF Pilot registry, the secondary endpoint occurred in 35.8% of hospitalized patients with AHF (43.6%, 29.1%, 33.9% and

**TABLE 5** Multivariate analyses of predictors of the primary and secondary endpoint in patients with heart failure included in the ESC-HF Pilot and ESC-HF-LT registries

| Predictor | Primary endpoint | | Secondary endpoint | |
|---|---|---|---|---|
| | HR (95% CI) | *P* value | HR (95% CI) | *P* value |
| Age, y | 1.03 (1.02–1.05) | <0.0001 | 1.01 (1.00–1.02) | 0.24 |
| BMI | 0.99 (0.95–1.02) | 0.36 | – | – |
| CKD | 1.16 (0.81–1.68) | 0.42 | 1.09 (0.85–1.40) | 0.50 |
| AF | 1.07 (0.73–1.58) | 0.72 | 1.07 (0.84–1.35) | 0.61 |
| COPD | 1.59 (1.11–2.28) | 0.01 | 1.22 (0.95–1.57) | 0.13 |
| Anemia | 0.94 (0.57–1.56) | 0.81 | 0.91 (0.66–1.28) | 0.60 |
| Diabetes | – | – | 1.26 (1.02–1.57) | 0.03 |
| Previous HF hospitalization | – | – | 1,23 (0.98–1,54) | 0.08 |
| MI | – | – | 1.28 (1.01–1.62) | 0.04 |
| PAD | 1.29 (0.83–2.01) | 0.26 | – | – |
| Alcohol (former or sometimes) | 0.87 (0.62–1.23) | 0.44 | 0.88 (0.71–1.10) | 0.25 |
| NYHA class at admission, per 1 class | 1.53 (1.14–2.05) | 0.01 | 1.24 (1.03–1.50) | 0.02 |
| NYHA class at discharge, per 1 class | 1.19 (0.90–1.57) | 0.23 | 1.19 (0.99–1.44) | 0.06 |
| SBP at admission, per 10 mm Hg | 1.01 (1.00–1.02) | 0.06 | 1.00 (1.00–1.01) | 0.50 |
| SBP at discharge, per 10 mm Hg | 0.99 (0.97–1.00) | 0.04 | 0.99 (0.98–1.00) | 0.001 |
| DBP at admission, per 10 mm Hg | 0.99 (0.98–1.01) | 0.50 | 1.00 (0.99–1.01) | 0.40 |
| DBP at discharge, per 10 mm Hg | 1.00 (0.98–1.02) | 0.91 | – | – |
| Heart rate at admission | 0.99 (0.99–1.00) | 0.08 | 1.00 (0.99–1.00) | 0.64 |
| Heart rate at discharge | 1.01 (1.00–1.02) | 0.01 | 1.01 (1.00–1.01) | 0.09 |
| Serum sodium at admission, per 1 mmol/l | 0.94 (0.91–0.97) | <0.0001 | 0.98 (0.95–1.00) | 0.04 |
| Hemoglobin at admission, per 1 g/dl | 1.01 (0.89–1.15) | 0.91 | 0.97 (0.89–1.06) | 0.52 |
| Creatinine at admission, per 1 mg/dl | – | – | 1.08 (0.93–1.26) | 0.31 |
| Potassium at admission, per 1 mmol/l | – | – | 0.78 (0.64–0.94) | 0.01 |
| Inotropes[a] | 2.44 (1.61–3.70) | <0.0001 | 1.64 (1.23–2.18) | 0.001 |
| Diuretics IV[a] | 1.15 (0.73–1.80) | 0.55 | 1.48 (1.11–1.96) | 0.01 |
| ACEI at discharge | 0.80 (0.54–1.18) | 0.26 | 0.86 (0.68–1.10) | 0.23 |
| β-Adrenolytic at discharge | 0.58 (0.37–0.91) | 0.02 | 0.78 (0.56–1.08) | 0.13 |
| ARB at discharge | 0.53 (0.25–1.10) | 0.09 | – | – |
| Digitalis at discharge | 1.34 (0.92–1.95) | 0.12 | 1.21 (0.95–1.54) | 0.13 |
| Statin at discharge | 1.11 (0.76–1.61 | 0.60 | 0.99 (0.77–1.26) | 0.92 |
| Antiplatelets at discharge | 1.10 (0.75–1.61) | 0.63 | 1.04 (0.81–1.34) | 0.74 |
| CCB at discharge | 0.77 (0.44–1.34) | 0.36 | 0.92 (0.65–1.30) | 0.63 |
| Amiodarone at discharge | 1.97 (1.26–3.07) | 0.003 | – | – |

*P* values of less than 0.05 are considered significant.

a During index hospitalization

"–" means that the variable was not predictive in the univariate analysis.

Abbreviations: CI, confidence interval; HF, heart failure; HR, hazard ratio; MI, myocardial infarction; others, see TABLES 1 and 2

46.8% in northern, eastern, western and southern Europe, respectively) and in 17.6% of ambulatory patients with chronic HF (19.4%, 19.0%, 21.1% and 16.4% in northern, eastern, western and southern Europe, respectively).[12] In the ESC-HF-LT registry, the combined endpoint of death or HF hospitalization at 1 year was reached by 36% of patients with AHF and by 14.5% of patients with chronic HF.[4]

In our analysis, the prognostic factors associated with the occurrence of the secondary endpoint were diabetes, myocardial infarction, NYHA class at admission, lower serum sodium at admission, lower serum potassium at admission, use of inotropes during index hospitalization, intravenous use of diuretics during index hospitalization, and lower SBP at discharge. Moreover, the predictors of the secondary endpoint in the Polish cohort of ESC-HF Pilot were a history of previous percutaneous coronary intervention or coronary artery bypass graft and inotropic support during hospitalization.[3] In the Polish participants of ESC-HF-LT, the independent predictors of all-cause death or HF-related rehospitalization in patients

aged 65 years or older were COPD, NYHA class, potassium level, SBP, and physical activity; in patients aged less than 65 years, CKD, NYHA class, and SBP; in patients aged 65 to 74 years, NYHA class and creatinine level; and in patients aged 75 years or older, previous HF hospitalization, coronary artery disease, CKD, COPD, alcohol consumption, smoking, NYHA class, and SBP.[13] Moreover, in the group of patients with HFpEF, the independent predictors of the secondary endpoint were NYHA class at admission, moderate or severe aortic stenosis, and lower serum sodium levels at admission. In the HFrEF group, the predictors were female sex, peripheral artery disease, NYHA class at admission, and lower ejection fraction. Prescription of an ACEI or ARB at hospital discharge was associated with a significantly lower incidence of the secondary endpoint.[14] In the OPTIMIZE-HF study,[19] the most important predictors for the combined endpoint of death or readmission were higher serum creatinine levels, higher SBP, lower hemoglobin levels at admission, less frequent use of an ACEI or ARB at discharge, and presence of pulmonary disease.

Previous research looking at Polish hospitalized patients enrolled in the ESC-HF Pilot registry revealed several independent risk factors of in-hospital mortality, including higher heart rate at admission and lower serum sodium concentration at admission.[22] Moreover, a recent analysis of Polish patients enrolled in both ESC-HF Pilot and ESC-HF-LT registries revealed that the use of β-blockers was associated with a lower incidence of the primary and secondary endpoints.[23] Furthermore, in the multivariate analysis, the lack of β-blocker treatment was an independent predictor only of the primary endpoint.[23] In line with our observations, a recent study by Targher et al[24] of a multinational cohort of hospitalized patients with AHF enrolled in the ESC-HF-LT registry suggested that the presence of diabetes is an independent risk factor of in-hospital mortality, 1-year all-cause mortality, and 1-year rehospitalization.

**Limitations** Although the ESC-HF Pilot and ESC-HF-LT registries enroll real-life patients, some important limitations of the analysis have to be highlighted. Firstly, both registries are observational and the data are incomplete. Moreover, only data included in the case report forms designed by the coordinators of the registries were available for analysis. Furthermore, variables with missing data greater than 5% were not included in the univariate and multivariate analyses to maintain an adequate EPV value due to the relatively small size of the analyzed groups. Another limitation is the relatively low percentage of patients with available data on the secondary endpoint (82.8%), due to the loss of follow-up during the study.

**Conclusions** The results of the present analysis suggest that hospitalized HF patients remain at high risk for adverse outcomes, including death and HF rehospitalization. Recent progress in diagnosis, pharmacotherapy, and interventional treatment of HF continuously changes the patients' clinical profile and risk factors for mortality and HF readmission. It appears that management according to the guidelines, as well as the ability to assess the individual patient's risk factors, plays an essential role in the successful treatment of HF. It is suggested that an assessment of the epidemiological data of real-life patients and their risk factors may contribute to the adjustment of treatment strategies and result in better outcomes.

**ACKNOWLEDGMENTS** Part of the results was previously presented at the 2017 European Society of Cardiology Congress (doi:10.1093/eurheartj/ehx504.P4389).

**CONTRIBUTION STATEMENT** PB, KO, AK-C, SB, AT, MP, MM, MGC-L, APM, JD, GO, and MG were responsible for the study concept and design, data acquisition and analysis, critical revision of the manuscript, and supervision. KO, SB, AT, and MP performed the statistical analysis.



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