Heart failure hospitalization in Romania – A national multiannual study based on administrative dataset collection

Ovidiu Chioncel[1,2]*, Dragos Vinereanu[1,3], Dan Dobreanu[4,5], Nona Chiriac[6], Antoniu Octavian Petris[7,8], Andi Dinita[6], Daniel Lighezan[9,10], Bogdan A. Popescu[1,2]

Abstract

Background: Heart failure (HF) is a leading cause of hospitalization and mortality worldwide, with a substantial burden in Central and Eastern Europe. Romania lacks long-term national HF registries, making real-world administrative data an important source of epidemiological evidence.

Methods: We conducted a retrospective national study, using aggregated DRG reimbursement data reported by all public and private hospitals in Romania, between 2017 and 2022. HF hospitalizations were identified using ICD-10 codes (I50.x, I11.0). Key indicators included annual "HF hospital cases" and "HF patients". Age distribution, length of stay, in-hospital mortality, and readmission frequency were collected for annual HF cohorts, with comparisons between pre-pandemic and COVID-19 pandemic periods.

Results: HF accounted for up to 14% of all "hospital cases", with 550,000–590,000 annual HF episodes before the pandemic, declining by ~45% during COVID-19 pandemic. Approximately 1.4 hospitalization episodes per heart failure patient were recorded annually. Mean age was 70.1 (+/- 10) years and most hospitalized patients were ≥65 years old, although nearly 30% were <65 years. Mean length of stay was 6.7 days. In-hospital mortality for heart failure was consistently double that of all hospitalizations (4% vs. 2% pre-pandemic, increasing to 8-9% during the pandemic). One-year readmissions were very frequent, with >20% HF-related readmissions.

Conclusions: HF represents a major and persistent burden on the Romanian medical system, characterized by high mortality and readmission rates. These findings underscore the need for improved post-discharge management and national strategies to optimize HF care.

Keywords
heart failure, hospitalization, mortality, retrospective study, COVID-19

Introduction

Heart failure (HF) is a progressive syndrome associated with a high risk of death, frequent hospitalizations, and substantial consumption of healthcare resources. Despite advances in pharmacological and device-based therapies, HF remains one of the leading causes of hospitalization among adults and is associated with poor short- and long-term prognosis [1]. One-year mortality after an HF hospitalization ranges between 15% and 20%, while recurrent admissions are common, exceeding 30%, and often signal disease progression and suboptimal continuity of care [2]. Population aging, improved survival after acute cardiovascular events, and particularly the growing prevalence of the noncardiac comorbidities [3] are expected to further increase the burden of HF hospitalizations worldwide.

*Corresponding author: Ovidiu Chioncel; E-mail address: ochioncel@yahoo.co.uk.

[1]University of Medicine and Pharmacy "Carol Davila", Bucharest, Romania
[2]Emergency Institute for Cardiovascular Diseases "Prof. Dr. C.C. Iliescu", Bucharest, Romania
[3]University and Emergency Hospital, Bucharest, Romania
[4]"George Emil Palade" University of Medicine, Pharmacy, Science, and Technology, Târgu Mureş, Romania
[5]Emergency Institute for Cardiovascular Diseases and Transplant, Targu Mures, Romania
[6]Novartis Pharma Services Romania SRL
[7]"Grigore T. Popa" University of Medicine and Pharmacy, Iaşi, Romania
[8]"Sf. Spiridon" Emergency County Hospital, Iaşi, Romania
[9]University of Medicine and Pharmacy "Victor Babeş", Timişoara, Romania
[10]Municipal Emergency Hospital, Timişoara, Romania

Contemporary HF epidemiological reviews reported a prevalence of 1–3% in general adult population, and one-year mortality of ~6–10% [4]. The Global Burden of Disease study reported recently a HF age-standardized prevalence rate of 683 cases per 100,000 people, translating into tens of millions of affected individuals globally [5]. Importantly, HF accounts for a disproportionate share of cardiovascular mortality and disability-adjusted life years, largely driven by repeated hospitalizations and high fatality rates following acute decompensation [6].

In terms of prevalence, incidence, survival, and hospitalization rates of HF, there is considerable heterogeneity between regions, reflecting differences in population structure, risk factor profiles, healthcare organization, and study methodologies [7]. In Europe, the European Society of Cardiology (ESC)/Heart Failure Association (HFA) Atlas provides comprehensive comparative data on HF epidemiology and healthcare utilization [8]. ESC/HFA Atlas reported a median value of HF prevalence of 17.20 (IQR 14.30–21) cases per 1000 people, and a hospitalization rate for HF (primary diagnosis) of 6107 per million. The median number of HF hospitalizations was 2671 (IQR 1771–4317) per million people annually, ranging from <1000 in Latvia and North Macedonia to >6000 in Romania, Germany and Norway [9].

Romania faces a substantial burden of HF. Previous population-based studies estimated that approximately 4.7% of adults over 35

years present this condition [10]. In a secondary analysis including national data from ESC-HF-Long-Term Registry, approximately one-third of Romanian patients hospitalized for HF either die or are readmitted for HF within one year of follow-up; the one-year HF readmission rate is 15.2%, the one-year all-cause mortality rate is 24.4%, and the combined outcome rate is 35.8% [11]. In the Romanian Acute Heart Failure Syndromes (RO-AHFS) registry, in-hospital all-cause mortality was 7.4%, and the mean length of stay was 7.3 +/-3 days [12].

However, Romania, like many other European countries, lacks a national HF registry with continuous enrollment, and available evidence is largely derived from time-limited registries, which may not fully capture the real-world national burden of the disease. In this context, routinely collected administrative hospital data represent a valuable and underutilized source of epidemiological information. Retrospective analyses of diagnosis-related group (DRG) databases allow comprehensive national coverage over extended periods, enabling the assessment of hospitalization volumes, patient demographics, outcomes, and temporal trends, including the impact of major system-level crises such as the COVID-19 pandemic.

This study was designed as a national, multiannual, retrospective analysis of HF hospitalizations in Romania, using aggregated DRG reimbursement data reported by all public and private hospitals between 2017 and 2022. By examining hospitalization rates, age distribution, length of stay, in-hospital mortality, and readmission frequency before and during the COVID-19 pandemic, this research aims to provide a comprehensive overview of the hospital burden and outcomes associated with HF at the national level. The principal advantages of this study include large sample size, population-level representativeness, and feasibility in settings where prospective registries are unavailable. Quantifying the magnitude of HF-related hospitalizations, mortality, and recurrent admissions can support the development of national HF prevention and management strategies, including early detection, optimization of guideline-directed medical therapy, structured discharge pathways, and integrated post-discharge follow-up. In a healthcare system facing demographic aging and constrained resources, such evidence is essential to prioritize interventions that may improve survival, reduce avoidable hospitalizations, and mitigate the long-term clinical and economic impact of HF in Romania.

Methods

This retrospective real-world study used national-wide aggregated data from all hospitals, public and private, reporting the minimum patient level dataset for DRG based reimbursement to the National Institute for Health Services Management (INMSS) **(Table 1)**. Romanian national health care services and Hospital DRG-based financing were previously described in another paper [13]. RO DRG V1, the diagnosis coding system for hospital cases, was established in 2010, primarily for DRG classification and reimbursement purposes [14].

INMSS oversees the collection of anonymized patient data including age, sex, length of hospital stay, primary or secondary diagnoses, surgery or other procedures and vital status at discharge [14].

In the current analysis, we included the aggregated data covering hospital episodes (length of hospital stay) and hospitalized patients, as reported to INMSS by all public and private hospitals in contract with the National Health Insurance House (NHIH). Eligible HF patients were of any age, and had a primary and/or secondary HF diagnosis coded according to ICD-10 AM: I50.0 (Congestive heart failure), I50.1 (Left ventricular failure), I50.9 (Heart failure, unspecified), or I11.0 (Hypertensive heart disease with (congestive) heart failure). Annual data were obtained for the 2017–2022 period. Hospitalizations with less than 24 h in-hospital stay were excluded.

Endpoints: for inpatients, “cases” were defined as hospital episodes (including multiple hospitalizations from the same patient), whereas “patients” represent unique individuals. Age distribution was assessed for the overall HF population across the entire analyzed period and categorized into nine age groups. In-hospital mortality was calculated as the percentage of in-hospital deaths relative to the total number of hospitalizations. Length of hospital stay was defined as the difference between the date of discharge and the date of admission. All-cause and HF-related rehospitalizations were defined as readmission episodes for any reason, and for HF respectively. Frequency of readmissions were calculated as the percentage of rehospitalization, any diagnosis, and HF diagnosis, for each annual cohort of patients admitted with a primary diagnosis of HF (number of hospitalization episodes in the following years divided by the number of HF patients in each annual cohort). Readmission frequencies were calculated for 2017, 2018, 2019, 2020, and 2021 cohorts.

We used Microsoft Excel for descriptive statistical analysis. Continuous variables were expressed as mean ± standard deviation or median and interquartile range (IQR), and categorical variables as absolute numbers and corresponding percentages. Categorical variables, in-hospital mortality and annual proportions of hospitalization of total number of cases, were compared by the chi-square test. Annual hospitalization counts from 2017–2019 were pooled and compared with pooled counts from 2020–2022 using a binary time-period indicator (pre-pandemic vs. pandemic). For each outcome, total hospitalizations, any HF hospitalizations, and HF hospitalizations with HF as the primary diagnosis, the odds of hospitalization during 2020–2022 were divided by the odds during 2017–2019 to obtain the OR. Odds ratios and corresponding 95% confidence intervals (CIs) were estimated using logistic regression models with time period as the independent variable.

Comparisons in statistical analysis were produced using SAS release 9.1 (SAS Institute, Inc., Cary, NC, USA), R (R Core Team, 2020). A threshold for significance was set at a p-value of .05

Patients’ informed consent and additional review by the Ethics Committee were not required, because all data were de-identified, and no medical product was in scope. The present study complies with the Declaration of Helsinki.

Table 1 - Number of hospitals included in the analysis, number of hospitals reporting DRG data, and number of hospitals reporting one-year readmission frequencies.

Year	2017	2018	2019	2020	2021	2022
Total number of hospitals in Romania*	535	524	532	541	543	544
Number of hospitals reporting DRG data	505	508	517	514	526	528
Number of hospitals reporting HF readmission frequencies	356	352	357	345	348	363

*Reference 15

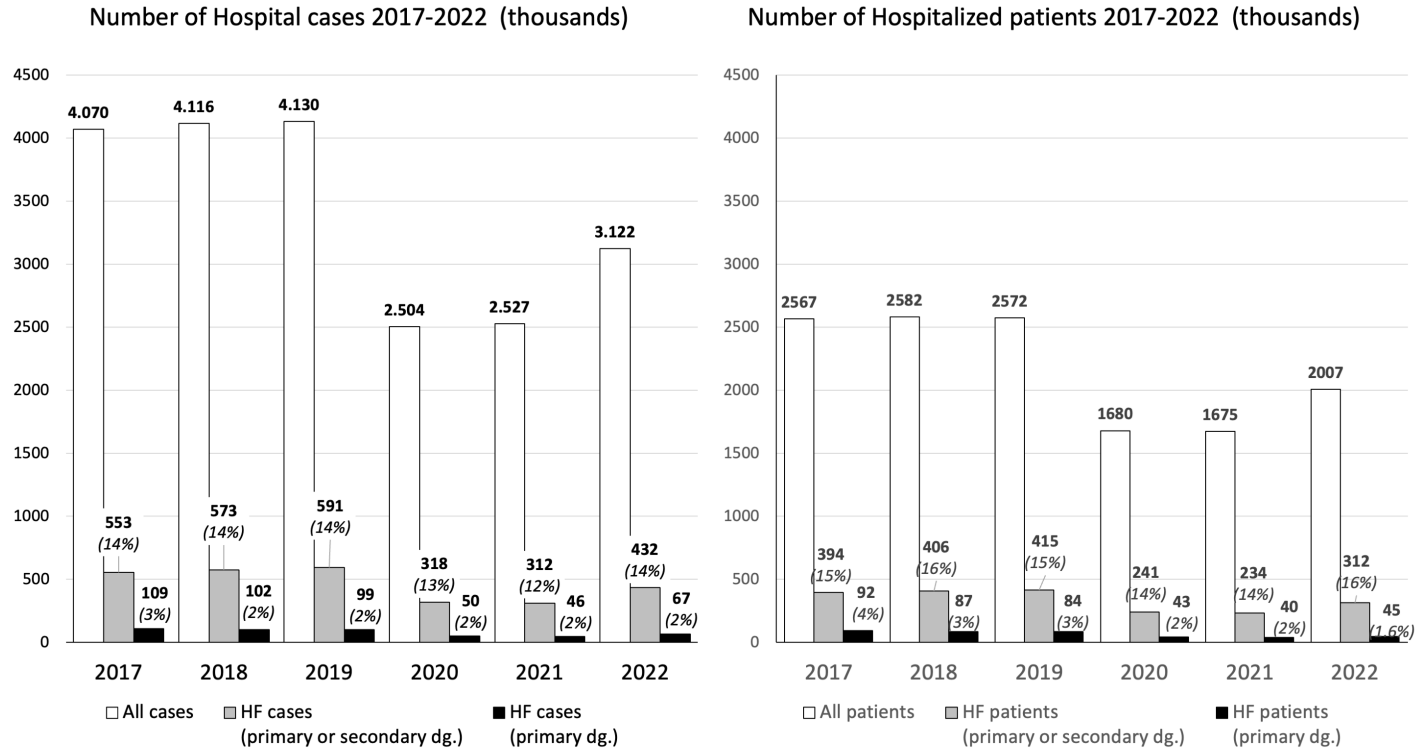


Figure 1 - A. Hospital cases, all cases, and HF* cases, time period 2017–2022 (thousands); B. Unique patients, all patients, and HF* patients, time period 2017–2022 (thousands).
*ICD-10 code for Heart Failure diagnosis I50.0, I50.1, I50.9, I11.0.
Proportions represent percentages out of all cases or all patients.

Results

1. Hospitals

Between 2017 and 2022, over 500 public and private hospitals (ranging from 505 to 528 hospitals) annually reported DRG cases for any diagnosis, while a number of 345–363 hospitals reported hospitalizations with a HF primary and/or secondary diagnosis, indicating broad national coverage and consistent participation across years (**Table 1**).

2. Annual hospitalization, cases, and patients

During the pre-pandemic period (2017–2019), more than 4 million hospitalizations (cases) for all diagnoses were reported each year **(Figure 1)**. Total hospital cases decreased to approximately 2.5 million in 2020–2021, with partial recovery in 2022. The overall volume of hospital activity showed a 39% decline during the COVID-19 pandemic **(Figure 2)**. A similar but more pronounced pattern was observed for HF hospitalizations. HF cases declined from 553,084–591,479 annually before the pandemic to 311,900–318,274 during 2020–2021 (–45%), increasing again to 432,473 in 2022 **(Figure 2)**. HF, as primary and secondary diagnosis, represented a substantial proportion of hospital activity, accounting for 12.3–14.3% of all hospital cases across six-year of follow-up. During 2017-2019 approximately 100,000 hospital admissions were reported with a primary diagnosis ICD-10 code for Heart Failure (I50.0, I50.1, I50.9, I11.0) and decreased by a half during 2020-2022. Hospitalizations for HF as primary diagnosis, represented 1.8-2.7% (2.3% on average) of total hospital cases and 16-20% of total HF hospitalizations (primary and secondary diagnosis).

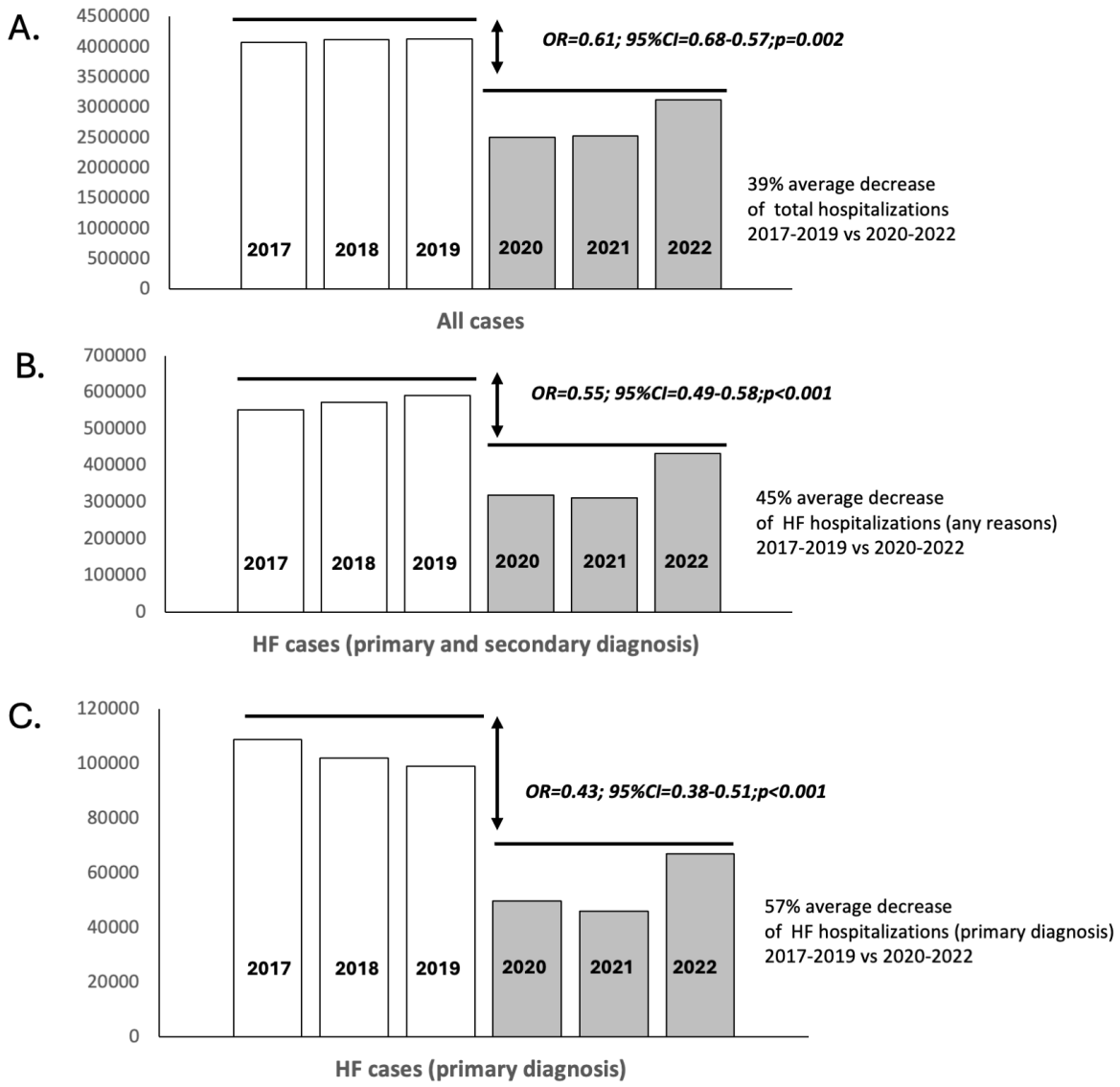


Figure 2 - A. Comparison between 2017–2019 vs. 2020 for total hospitalizations; B. HF hospitalization (any cause); C. HF hospitalizations with HF as primary diagnosis.

"For each panel (A, B, and C) in Figure 2, odds ratios (ORs) were calculated to compare hospitalization volumes during the pre-pandemic period (2017–2019) with those during the pandemic period (2020–2022). ORs <1 indicate a reduction in hospitalizations during 2020–2022 compared with the 2017–2019 reference period."

Abbreviations: OR=odd ratio; CI =confidence interval

Trends in hospitalized patients mirrored those observed for cases **(Figure 1)**. The number of HF patients decreased from approximately 394,000–415,000 annually before the pandemic to 234,529–240,710 during 2020–2021, with an increase to 312,095 in 2022 (Table S3). HF patients consistently represented 14.0–16.1% of all hospitalized patients. Pediatric HF patients accounted for a very small fraction of the total (<0.5% annually). Among adults hospitalized with a primary HF diagnosis, both cases and patients declined sharply during the pandemic, from 108,726 cases and 92,155 patients in 2017 to 49,869 cases and 43,717 patients in 2020, followed by partial recovery in 2022 (**Figure 1**). When accounting for both indicators, "HF cases" and "HF patients", the annual reports show an average rate of 1.4 hospital episodes per HF patient.

Mean age was 70.1 (+/- 10.4) years. Analysis of age distribution for the entire 6-year period (n=1,658,600) demonstrated that hospitalizations for HF predominantly affected older adults (**Figure 3**). Throughout the period 2017–2022, 69.4% of patients with HF were aged ≥65 years, with the largest groups being 65–74 years (32.1%) and 75–84 years (28.5%). Nevertheless, 30% of hospitalized HF patients were younger than 65 years, while pediatric patients accounted for only 0.4%.

3. Outcomes

In-hospital mortality was significantly higher for "HF cases" than for "all hospital cases" for each year (**Figure 4A)**. Before the pandemic, in-hospital mortality for patients hospitalized for HF

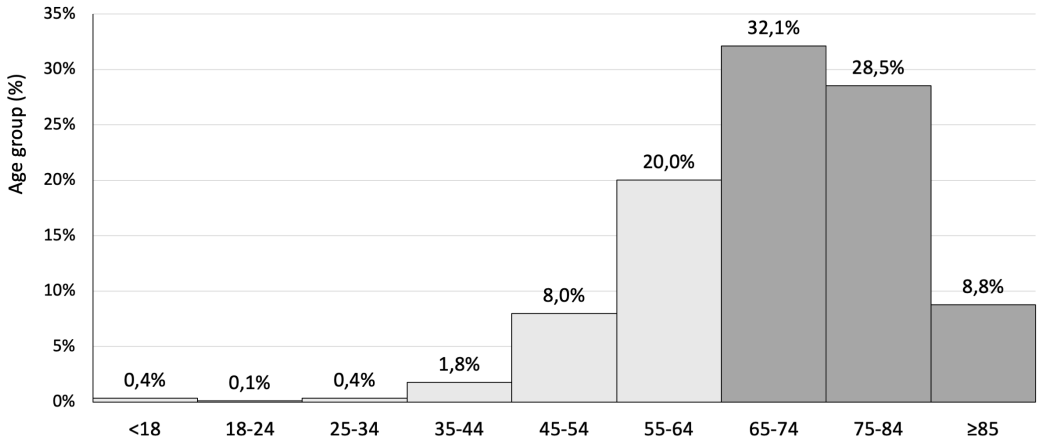


Figure 3 - HF patients by age group, period 2017–2022.

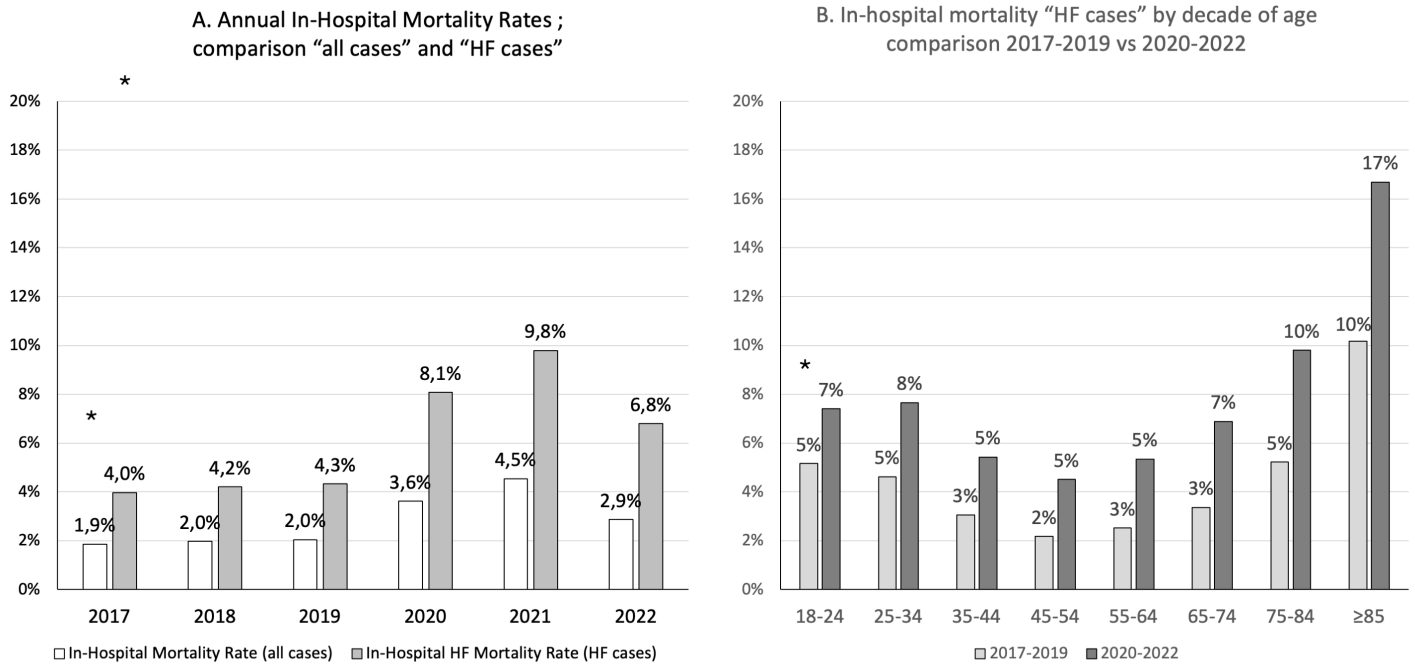


Figure 4 - A. Annual in-hospital mortality rates; comparison of "all cases" vs. "HF cases" ($p<0.001$ for each year); B. In-hospital mortality HF cases by decade of age; comparison of 2017–2019 vs. 2020–2022 ($p<0.001$ for age category >25 years).
**p=0.06*

ranged between 4.0% and 4.3%, about double that of all cases (1.9–2.0%). During the pandemic, HF mortality increased markedly to 8.1% in 2020 and 9.8% in 2021, remaining elevated at 6.8% in 2022. Mortality increased steeply with age, with the highest number of HF-related in-hospital deaths occurring in patients aged ≥75 years (10% in group 75–84 years and 17% in group >85 years) (**Figure 4B**). Except for the 18–24 age group, in-hospital mortality for HF cases was significantly higher during the pandemic than before, for every decade.

The mean and median length of hospitalization for patients with HF was 6.7 days and 6 days, respectively.

Among cohorts hospitalized with HF as the primary diagnosis, analyses of subsequent admissions demonstrated a substantial burden of rehospitalizations during follow-up (**Figure 5**;

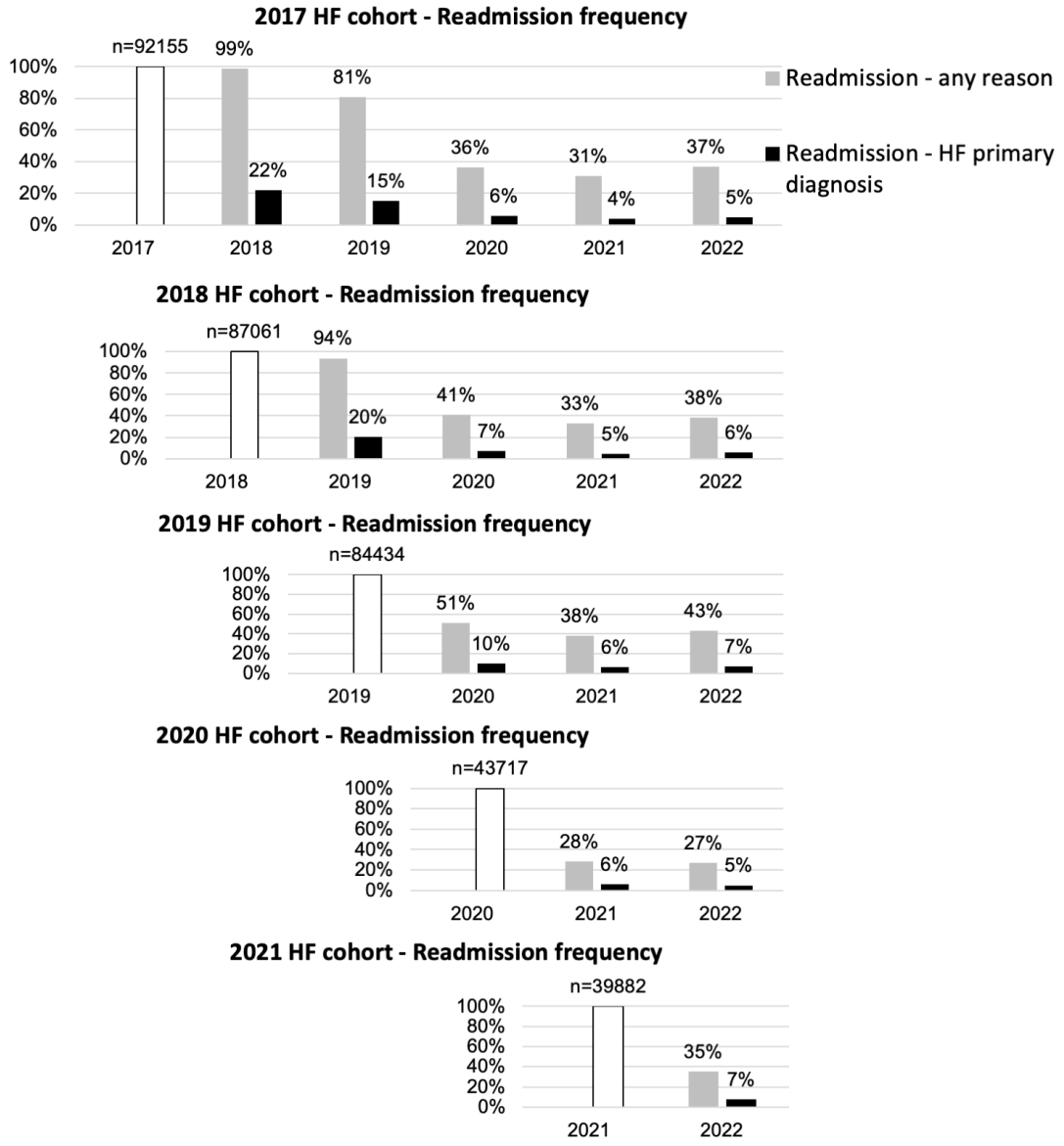


Figure 5 - Frequency of readmissions for each annual cohort of patients admitted with a primary diagnosis of HF for 2017–2021; HF readmission frequency for any reason; and for HF primary diagnosis.

Supplementary Tables). However, the majority of these events were due to causes other than HF. Within the first year after index hospitalization, nearly all patients in the 2017 cohort experienced at least one all-cause readmission, whereas only 22% were hospitalized with HF as the primary diagnosis. A similar pattern was observed in the 2018 cohort, with 94% of patients having at least one all-cause readmission and 20% attributable to HF. In later cohorts, both all-cause and HF-specific readmissions declined markedly: in 2019, 51% of patients were readmitted for any cause and 10% for HF; in 2020, corresponding figures were 28% and 6%; and in 2021, 35% and 7%, respectively. Overall, HF readmissions with HF as the primary diagnosis accounted for approximately 5–22% of one-year all-cause readmissions, underscoring the predominance of non-HF causes in post-discharge hospital utilization among HF patients. Although the frequency of readmissions for any-cause and HF decreased in subsequent years of follow-up and during the pandemic cohorts, it remained substantial, highlighting the chronic and recurrent nature of hospital care associated with HF.

Discussion

This national, multi-year analysis provides a comprehensive, real-world assessment of hospitalization patterns for HF in Romania and confirms that HF is a major and persistent driver of hospital utilization, mortality, and readmissions. By leveraging mandatory DRG-based reporting from >95% of Romanian hospitals over a six-year period, the study provides robust population-level evidence in a healthcare setting.

1. Major findings

Several key findings emerge from this analysis. Firstly, HF represents a substantial proportion of hospital activity in Romania (at a general population of 19 million) [15], accounting for up to 14% of all inpatient cases and affecting on average 400,000 patients annually. Primary HF diagnosis accounted for 15–20% of total HF hospitalized cases (HF primary and secondary diagnosis), and 1.8–2.7% (mean 2.3%) of total hospital cases, with a decreasing trend over the last six years. Secondly, hospital care for HF is characterized by frequent recurrent admissions, with an average of 1.4 hospitalization episodes per patient per year, and very high rates of readmission after discharge. Over 20% of hospital readmissions after one year were related to HF as the primary diagnosis. Thirdly, outcomes remain poor, as in-hospital mortality for HF is consistently double that of the general hospitalized population. Finally, although HF predominantly affects older adults, nearly a third of hospitalized patients were under 65 years of age, highlighting a significant burden on the working-age population.

2. Impact of the COVID-19 pandemic

The COVID-19 pandemic had a profound impact on HF hospital care in Romania. HF hospitalizations declined by approximately 45% during 2020–2021, a more pronounced reduction than that observed for the total number of hospital admissions. This likely reflects a combination of restricted access to care, patients' reluctance to seek medical attention, and reallocation of hospital resources to COVID-19 services [16]. It is important to note that this reduction in hospitalizations was accompanied by a significant increase in in-hospital HF mortality, which doubled during the pandemic years (8–10% during the pandemic compared to 4% in the pre-pandemic years) and remained high thereafter. These findings suggest delayed presentation, higher clinical severity at admission, and possible direct or indirect effects of SARS-CoV-2 infection on cardiovascular outcomes [16]. Similar trends have been reported across Europe, supporting the concept that HF patients were highly vulnerable during the pandemic.

3. Comparison with other studies

The Romanian findings are largely consistent with international data, while also revealing distinct national patterns. HF hospitalization rates in Romania are among the highest reported in Europe, comparable to Germany and Norway and higher than those observed in Denmark or France. Country specific rates of hospitalization for HF, as percentage of general population, have been previously reported in Germany (4600–6000 per million) [17, 18], in Denmark (1000 per million) [19], and France (2500 per million) [20].

The proportion of HF cases (as primary diagnosis) among total hospitalizations (2.3% in Romania) aligns with data from Germany (1.4–2.3%) [15], but lower than in Slovenia (6.5%) [21]. When both primary and secondary HF diagnoses were considered, HF accounted for 14% of all hospital cases. A similar research analysis, coming from the Czech Republic in 2000, reported 25% for the ratio between HF cases and total hospital cases [22]. When considering the hospitalization rate per HF patient, the ratio observed in the current analysis (1.4) was comparable to that reported in Germany during 2009–2013 (1.8 hospitalizations/patient over two years) [23].

Romanian HF patients appear younger than those in Western European cohorts, where mean ages often exceed 75–80 years. In Germany in 2017, three-quarters of HF patients were >75 years. The mean age of HF patients was 80.1 years in Spain for 2011–2015 [24]; 78 years in France in 2012 [17]; 76.6 years in Sweden for 2010–2015 [25]; and 77.8 years in Norway for 2000–2014 [26].

Hospital stay was shorter than in several other countries, possibly reflecting differences in care pathways, bed availability, or different thresholds for hospital admission. The length of hospital stay for HF cases in this study (7 days) is similar with the one reported in Spain for 2013–2015 [27], and shorter than in Germany (10.2 days in 2017) [14], France (10 days in 2012) [17], Poland (9.6 days in 2016) [28], and Slovakia (9.4 days in 2015) [24].

In-hospital mortality for HF cases (fatality rate) varies largely among European countries: from 3.9% in Hungary in 2017 [29], 6.2% in Slovakia in 2015 [30], and 9.5% in Germany for 2005–2016 [15], to 11.5% in Poland in 2016 [31], and 12–13% in Spain for 2001–2015 [21].

One-year hospital readmission frequencies were extremely high and comparable to those reported in Spain (>96%) [17], Sweden (65%) [32], and Italy (57%) [33], underscoring the chronic and relapsing nature of HF across healthcare systems.

4. Impact on the health system

The combination of high admission volumes, recurrent hospitalizations, and elevated mortality translates into a major and sustained burden on the Romanian healthcare system. HF consumes substantial hospital capacity and financial resources. The financial burden of chronic HF in Romania was recently explored. In 2019, the weighted average cost per HF inpatient was EUR 1002, with a national budget impact was EUR 376 million, representing 4.4% of the total NHIH budget [34]. In working-active categories, the societal cost associated with duration of hospital stay and medical leave was EUR 122 million.

5. Strategies to reduce hospitalization rates

The extremely high frequency of post-discharge readmissions, including a significant proportion directly attributable to HF, underscores persistent gaps in continuity of care, outpatient management, and HF prevention. Limited access to multidisciplinary outpatient HF programs, lack of the structured post-discharge follow-up, and fragmentation between hospital-based and ambulatory care, likely contribute to recurrent admissions. Health system characteristics, including low thresholds for hospitalization and reliance mainly on inpatient care, may also explain these findings. Close post-discharge follow-up and treatment optimization represent a window of opportunity in HF management [35]. Also, reducing avoidable HF hospitalizations via primary and secondary prevention measures should be a national priority [36]. To note, none of the IV therapies used to treat congestion during HF have been associated with reducing number of hospitalizations [37–39]. Earlier diagnosis, coupled with etiological-based treatment of HF, including medical,

interventional, and surgical therapies, have been shown to reduce HF hospitalizations and CV mortality [40–46]. Broader implementation of guideline-directed medical therapy [47], identification and treatment of non-cardiac comorbidities [3], structured discharge planning, and closer post-discharge follow-up [35] represent evidence-based strategies to decrease hospitalization rates. Although these could be achieved by integration of HF patients in multidisciplinary programs, improved coordination between hospital and primary care may help to prevent recurrent admissions. The development of HF multidisciplinary programs based on the most common comorbidities is ly important, considering higher proportion of non-HF-related hospitalizations reported in this study. Similarly, evidence from both European [48] and US [49] administrative datasets demonstrates that HF is coded as a secondary diagnosis in the majority of hospitalizations involving HF patients, accounting for approximately 58–72% of all HF-related hospital admissions. In these cases, HF most often represents a major comorbidity or precipitating condition rather than the primary reason for admission. The most frequent principal causes of hospitalization when HF is coded as a secondary diagnosis include respiratory diseases, infections, oncology-related admissions, and non-cardiac surgery [48, 49]. Targeting younger HF patients may also yield substantial socioeconomic benefits.

Notably, in July 2025, the Romanian Government adopted "The National Strategy for Management of Cardiovascular and Cerebrovascular Diseases" [50], aiming to combat rising deaths and disabilities from heart diseases by focusing on integrated data systems, improved diagnostics, rehabilitation, workforce development, and research. This strategy involves multiple domains, prevention, early detection, and treatment, with a key goal to reduce avoidable mortality by 5% by 2030.

6. Future research directions

While administrative DRG data provide valuable epidemiological insights, future research should focus on establishing longitudinal national HF registries capturing clinical characteristics, treatments, and long-term outcomes. Such registries would enable evaluation of quality of care, adherence to guidelines, and effectiveness of integrated HF management strategies. In the context of Central and Eastern Europe, combining administrative data with prospective observational studies based on consecutive enrolment [51] represent a critical step toward improving HF outcomes and health system performance.

Limitations

The current analysis is based on a national administrative database which collects discharge reports. Consequently, it lacks granularity of in-hospital clinical data (e.g., HF etiology, phenotype, disease severity, or treatment). Overall, in administrative datasets, the validity for HF diagnosis varies, with high specificity—most recorded cases represent true HF—but low sensitivity, as many true cases are missed or underreported. Also, it has restricted ability to assess long-term outcomes beyond hospital readmissions. However, the general in-hospital admissions and in-hospital death figures are in line with a recent report in the context of COVID-19 pandemic [52].

The accuracy of the reports relies on the data entered by the contributing hospitals, and although all hospitals are using a standard DRG system, coding accuracy has not been centrally validated. The data are limited to in-hospital "HF cases" and "HF patients", and cannot provide information for HF patients with a hospital stay of less than 24 hours or for HF patients who present in ambulatory offices for worsening HF.

The readmission figures for HF patient cohorts were reported as frequency instead of rate, possibly overestimating any-cause readmissions. Also, the current analysis is based on aggregated administrative data, and we were unable to calculate patient-level readmission rates or time-to-event outcomes.

No statistical inferences can be drawn from this study, since methodology involved only data collected at discharge.

Additional meaningful clinical indicators for HF patients could be collected only by longitudinal cohort studies and reliable HF registries.

Conclusions

This national, multiannual analysis demonstrates that HF represents a major and sustained burden on the Romanian hospital system, both before and after the COVID-19 pandemic. HF accounted for a substantial proportion of total hospitalizations, affecting predominantly older adults but also a considerable working-age population, and was associated with prolonged hospital stays, high in-hospital mortality, and very frequent readmissions. Although overall hospital admissions declined markedly during the pandemic, HF-related mortality increased and remained elevated thereafter, highlighting the vulnerability of this population and potential delays or barriers in access to care. In the absence of comprehensive national HF registries, routinely collected DRG data provide valuable real-world insights into disease burden and outcomes at the population level. These findings support the urgent need for coordinated national strategies focused on early diagnosis, guideline-directed therapy, and integrated follow-up programs to reduce preventable hospitalizations and mitigate the long-term clinical and economic impact of HF in Romania.

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Conflict of interest

OC, DV, DD, AP, DL, and BAP declare no conflict of interest regarding this work; NC and AD are Novartis employees.

Author contributions

OC: conception and design of the study, analysis and interpretation of data, drafting and revision of the manuscript. DV, DD, AP, DL, BAP: analysis and interpretation of data, revision of the manuscript. AD: conception and design of the study; drafting and revision of the manuscript. NC: conception and design of the study, data acquisition, revision of the manuscript. All the authors approved the final version of the manuscript and agreed to be responsible for all aspects of the work.

The sponsor had no involvement in the interpretation of the data or in the scientific conclusions of this research.

REFERENCES

1. McDonagh TA, Metra M, Adamo M, Baumbach A, Böhm M, Burri H, Čelutkiene J, Chioncel O, Cleland JGF, Coats AJS, Crespo-Leiro MG, Farmakis D, Gardner RS, Gilard M, Heymans S, Hoes AW, Jaarsma T, Jankowska EA, Lainscak M, Lam CSP, Lyon AR, McMurray JJV, Mebazaa A, Mindham R, Muneretto C, Piepoli MF, Price S, Rosano GMC, Ruschitzka F, Skibelund AK. ESC Scientific Document Group. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. European Heart Journal. 2021 Sep 21;42(36):3599–3726. doi:10.1093/eurheartj/ehab368; PMID: 34447992

2. Chioncel O, Mebazaa A, Harjola VP, Coats AJ, Piepoli MF, Crespo-Leiro MG, Laroche C, Seferovic PM, Anker SD, Ferrari R, Ruschitzka F, Lopez-Fernandez S, Miani D, Filippatos G, Maggioni AP. Clinical phenotypes and outcome of patients hospitalized for acute heart failure: the ESC Heart Failure Long-Term Registry. Eur J Heart Fail. 2017;19(10):1242–1254. doi:10.1002/ejhf.890; PMID: 28463462

3. Chioncel O, Benson L, Crespo-Leiro MG, Anker SD, Coats AJS, Filippatos G, McDonagh T, Margineanu C, Mebazaa A, Metra M, Piepoli MF, Adamo M, Rosano GMC, Ruschitzka F, Savarese G, Seferovic P, Volterrani M, Ferrari R, Maggioni AP, Lund LH. Comprehensive characterization of non-cardiac comorbidities in acute heart failure: an analysis of ESC-HFA EUR Observational Research Programme Heart Failure Long-Term Registry. Eur J Prev Cardiol. 2023 Sep 1;30(13):1346–1358. doi:10.1093/eurjpc/zwad151; PMID: 37172316

4. Savarese G, Becher PM, Lund LH, Seferovic P, Rosano GMC, Coats AJS. Global burden of heart failure: a comprehensive and updated review of epidemiology. Cardiovasc Res. 2023 Jan 18;118(17):3272–3287. doi:10.1093/cvr/cvac013; PMID: 35150240

5. Roth GA, Dorsey H, Decleene N, Razo C, Stark B, Johnson C, Collaborators TGB of DS. The global burden of heart failure: a systematic analysis for the Global Burden of Disease Study 2021. Eur Heart J. 2023 Nov 9;44 (Supplement_2). doi: 10.1093/eurheartj/ehad655.876

6. Rosano GMC, Seferovic P, Savarese G, Spoletini I, Lopatin Y, Gustafsson F, Bayes-Genis A, Jaarsma T, Abdelhamid M, Miqueo AG, Piepoli M, Tocchetti CG, Ristić AD, Jankowska E, Moura B, Hill L, Filippatos G, Metra M, Milicic D, Thum T, Chioncel O, Ben Gal T, Lund LH, Farmakis D, Mullens W, Adamopoulos S, Bohm M, Norhammar A, Bollmann A, Banerjee A, Maggioni AP, Voors A, Solal AC, Coats AJS. Impact analysis of heart failure across European countries: an ESC-HFA position paper. ESC Heart Fail. 2022 Oct 1;9(5):2767–2778. doi:10.1002/ehf2.14076; PMID: 35869679

7. Emmons-Bell S, Johnson C, Roth G. Prevalence, incidence and survival of heart failure: a systematic review. Heart. 2022;108(17):1351–1360. doi: 10.1136/heartjnl-2021-320131; PMID: 35042750

8. Seferović PM, Vardas P, Jankowska EA, Maggioni AP, Timmis A, Milinković I, Polovina M, Gale CP, Lund LH, Lopatin Y, Lainscak M, Savarese G, Huculeci R, Kazakiewicz D, Coats AJS. The Heart Failure Association Atlas: Heart Failure Epidemiology and Management Statistics 2019. Eur J Heart Fail. 2021 Jun 1;23(6):906–914. doi: 10.1002/ejhf.2143; PMID: 33634931

9. Seferović PM, Polovina M, Savarese G, Milinković I, Stanisavljević D, Lund L, Chioncel O, Abdelhamid M, Lopatin Y, Störk S, Anguita Sanchez M, Piepoli M, Maggioni AP, Jankowska E, Bayes-Genis A, Cohen Solal A, Ristić A, Tokmakova M, Birhan Yilmaz M, Skouri H, Miličić D, Amir O, Rakisheva A, Filippatos G, Rosano G, Metra M, Coats AJ. Insights into the European heart failure epidemiology. Eur J Heart Fail. 2025;27:1950–1960. doi: 10.1002/ejhf.3710; PMID: 40444537

10. Macarie C, Chioncel O. Studiul românesc de prevalenţă a insuficienţei cardiace în populaţia arondată medicilor de familie. Progrese in cardiologie. 2007;311:27.

11. Chioncel O, Tatu-Chiţoiu G, Christodorescu R, Coman I, Deleanu D, Vinereanu D, Macarie C, Crespo M, Laroche C, Fereirra T, Maggioni A, Filippatos G. Characteristics of patients with heart failure from Romania enrolled in- ESC-HF Long-Term (ESC-HF-LT) Registry. Romanian Journal of Cardiology; 2015;25(4):413–420.

12. Chioncel O, Vinereanu D, Datcu M, Ionescu DD, Capalneanu R, Brukner I, Dorobantu M, Ambrosy A, MacArie C, Gheorghiade M. The Romanian Acute Heart Failure Syndromes (RO-AHFS) registry. Am Heart J. 2011;162(1). doi: 10.1016/j.ahj.2011.03.033; PMID: 21742101

13. Vladescu C, Scintee SG, Olsavszky V, Hernandez-Quevedo C, Sagan A. Romania: Health System Review. Health Syst Transit. 2016 Aug;18(4):1–170. PMID: 27603897

14. DRG — Centrul de Cercetare si Evaluare a Serviciilor de Sanatate. Bucharest: Institutul National de Management al Serviciilor de Sanatate. Available at https://www.drg.ro/index.php?p=drg&s=romania

15. Institutul National de Statistica. Romania in cifre. Bucharest; 2002. Available at https://insse.ro/cms/sites/default/files/field/publicatii/romania_in_cifre_2022.pdf

16. Palazzuoli A, Metra M, Collins SP, Adamo M, Ambrosy AP, Antohi LE, Ben Gal T, Farmakis D, Gustafsson F, Hill L, Lopatin Y, Tramonte F, Lyon A, Masip J, Miro O, Moura B, Mullens W, Radu RI, Abdelhamid M, Anker S, Chioncel O. Heart failure during the COVID-19 pandemic: clinical, diagnostic, management, and organizational dilemmas. ESC Heart Fail. 2022 Dec 1;9(6):3713–3736. doi: 10.1002/ehf2.14118; PMID: 36111511

17. Dörr M, Riemer U, Christ M, Bauersachs J, Bosch R, Laufs U, Neumann A, Scherer M, Störk S, Wachter R. Hospitalizations for heart failure: still major differences between East and West Germany 30 years after reunification. ESC Heart Fail. 2021 Aug 1;8(4):2546–2555. doi: 10.1002/ehf2.13407; PMID: 33949148

18. Keller K, Hobohm L, Ostad MA, Göbel S, Lankeit M, Konstantinides S, Münzel T, Wenzel P. Temporal trends and predictors of in hospital death in patients hospitalised for heart failure in Germany. Eur J Prev Cardiol. 2021 Sep 1;28(9):990–997. doi: 10.1177/2047487320936020; PMID: 34402877

19. Andersson C, Gerds T, Fosbøl E, Phelps M, Andersen J, Lamberts M, Holt A, Butt JH, Madelaire C, Gislason G, Torp-Pedersen C, Køber L, Schou M. Incidence of new-onset and worsening heart failure before and after the COVID-19 epidemic lockdown in Denmark: a nationwide cohort study. Circ Heart Fail. 2020 Jun 1;13(6):E007274. doi: 10.1161/CIRCHEARTFAILURE.120.007274; PMID: 32482087

20. Gabet A, Juillière Y, Lamarche-Vadel A, Vernay M, Olié V. National trends in rate of patients hospitalized for heart failure and heart failure mortality in France, 2000–2012. Eur J Heart Fail. 2015 Jun 1;17(6):583–590. doi: 10.1002/ejhf.284; PMID: 25950872

21. Omersa D, Erzen I, Lainscak M, Farkas J. Regional differences in heart failure hospitalizations, mortality, and readmissions in Slovenia 2004–2012. ESC Heart Fail. 2019 Oct 1;6(5):965–974. doi: 10.1002/ehf2.12488; PMID: 31264804

22. Rosolova H, Cech J, Simon J, Spinar J, Jandova R, Widimský Sen J, Holubec L, Topolcan O. Short to long term mortality of patients hospitalised with heart failure in the Czech Republic—a report from the EuroHeart Failure Survey. Eur J Heart Fail. 2005 Aug;7(5):780–783. doi: 10.1016/j.ejheart.2005.03.009; PMID: 16051521

23. Störk S, Handrock R, Jacob J, Walker J, Calado F, Lahoz R, Hupfer S, Klebs S. Epidemiology of heart failure in Germany: a retrospective database study. Clin Res Cardiol. 2017 Nov 1;106(11):913–922. doi: 10.1007/s00392-017-1137-7; PMID: 28748265

24. Aizpuru F, Millán E, Garmendia I, Mateos M, Librero J. Hospitalizations for heart failure: epidemiology and health system burden based on data

gathered in routine practice. Medicina Clínica Práctica. 2020 Jul 1;3(4–5). doi.org/10.1016/j.mcpsp.2020.100140

25. Lindmark K, Boman K, Olofsson M, Törnblom M, Levine A, Castelo-Branco A, Schlienger R, Wirta SB, Stålhammar J, Wikström G. Epidemiology of heart failure and trends in diagnostic work-up: a retrospective, population-based cohort study in Sweden. Clin Epidemiol. 2019;11:231–244. doi: 10.2147/CLEP.S170873; PMID: 30962724

26. Sulo G, Igland J, Øverland S, Egeland GM, Roth GA, Vollset SE, Tell GS. Heart failure in Norway, 2000–2014: analysing incident, total and readmission rates using data from the Cardiovascular Disease in Norway (CVDNOR) Project. Eur J Heart Fail. 2020 Feb 1 [cited 2025 Dec 25];22(2):241–248. doi: 10.1002/ejhf.1609; PMID: 31646725

27. Méndez-Bailón M, Jiménez-García R, Hernández-Barrera V, Comín-Colet J, Esteban-Hernández J, de Miguel-Díez J, de Miguel-Yanes JM, Muñoz-Rivas N, Lorenzo-Villalba N, López-de-Andrés A. Significant and constant increase in hospitalization due to heart failure in Spain over 15 year period. Eur J Intern Med/ 2019 Jun 1;64:48–56. doi: 10.1016/j.ejim.2019.02.019; PMID: 30827807

28. Niedziela JT, Parma Z, Pawlowski T, Rozentryt P, Gasior M, Wojakowski W. Secular trends in first-time hospitalization for heart failure with following one-year readmission and mortality rates in the 3.8 million adult population of Silesia, Poland between 2010 and 2016. The SILCARD database. Int J Cardiol. 2018 Nov 15;271:146–151. doi: 10.1016/j.ijcard.2018.05.015; PMID: 30223348

29. Tomcsányi J. Mortality among heart failure patient population in Hungary in 2017. Orv Hetil. 2020 Jun 1;161(24):1012–1014. doi: 10.1556/650.2020.31748; PMID: 32469842

30. Goncalvesová E, Danková M. What we know about epidemiology of heart failure in Slovakia and globally. Vnitr Lek. 2018;64(9):839–846. PMID: 30441996

31. Sierpiński R, Sokolska JM, Suchocki T, Koń B, Urbański F, Kruk M, Sokolski M, Ponikowski P, Jankowska EA. 10 year trends in hospitalization rates due to heart failure and related in-hospital mortality in Poland (2010–2019). ESC Heart Fail. 2020 Dec 1; 7(6):3365–3373. doi: 10.1002/ehf2.13060; PMID: 33089965

32. Cui X, Zhou J, Pivodic A, Dahlström U, Ge J, Fu M. Temporal trends in cause-specific readmissions and their risk factors in heart failure patients in Sweden. Int J Cardiol. 2020 May 1;306:116–122. doi: 10.1016/j.ijcard.2020.02.048; PMID: 32145935

33. Corrao G, Ghirardi A, Ibrahim B, Merlino L, Maggioni A Pietro. Short- and long-term mortality and hospital readmissions among patients with new hospitalization for heart failure: a population-based investigation from Italy. Int J Cardiol. 2015 Feb 15;181:81–87. doi: 10.1016/j.ijcard.2014.12.004; PMID: 25497525

34. Lorenzovici L, Bârzan-Székely A, Farkas-Ráduly S, Pană BC, Csanádi M, Chiriac ND, Kaló Z. Burden of Chronic Heart Failure in Romania. Healthcare (Basel). 2022 Jan 1;10(1). doi: 10.3390/healthcare10010107; PMID: 35052271

35. Metra M, Adamo M, Tomasoni D, Mebazaa A, Bayes-Genis A, Abdelhamid M, Adamopoulos S, Anker SD, Bauersachs J, Belenkov Y, Böhm M, Gal T Ben, Butler J, Cohen-Solal A, Filippatos G, Gustafsson F, Hill L, Jaarsma T, Jankowska EA, Lainscak M, Lopatin Y, Lund LH, McDonagh T, Milicic D, Moura B, Mullens W, Piepoli M, Polovina M, Ponikowski P, Rakisheva A, Ristic A, Savarese G, Seferovic P, Sharma R, Thum T, Tocchetti CG, Van Linthout S, Vitale C, Von Haehling S, Volterrani M, Coats AJS, Chioncel O, Rosano G. Pre-discharge and early post-discharge management of patients hospitalized for acute heart failure: a scientific statement by the Heart Failure Association of the ESC. Eur J Heart Fail. 2023 Jul 1;25(7):1115–1131. doi: 10.1002/ejhf.2888; PMID: 37448210

36. Piepoli MF, Adamo M, Barison A, Bestetti RB, Biegus J, Böhm M, Butler J, Carapetis J, Ceconi C, Chioncel O, Coats A, Crespo-Leiro MG, De Simone G, Drexel H, Emdin M, Farmakis D, Halle M, Heymans S, Jaarsma T, Jankowska E, Lainscak M, Lam CSP, Løchen ML, Lopatin Y, Maggioni A, Matrone B, Metra M, Noonan K, Pina I, Prescott E, Rosano G, Seferovic PM, Sliwa K, Stewart S, Uijl A, Vaartjes I, Vermeulen R, Verschuren WM, Volterrani M, Von Haehling S, Hoes A. Preventing heart failure: a position paper of the Heart Failure Association in collaboration with the European Association of Preventive Cardiology. Eur J Prev Cardiol. 2022 Jan 1;29(1):275–300. doi: 10.1093/eurjpc/zwab147; PMID: 35083485

37. Mullens W, Damman K, Harjola VP, Mebazaa A, Brunner-La Rocca HP, Martens P, Testani JM, Tang WHW, Orso F, Rossignol P, Metra M, Filippatos G, Seferovic PM, Ruschitzka F, Coats AJ. The use of diuretics in heart failure with congestion — a position statement from the Heart Failure Association of the European Society of Cardiology. Eur J Heart Fail. 2019 Feb 1;21(2):137–155. doi: 10.1002/ejhf.1369; PMID: 30600580

38. Chioncel O, Mebazaa A, Farmakis D, Abdelhamid M, Lund LH, Harjola VP, Anker S, Filippatos G, Ben-Gal T, Damman K, Skouri H, Antohi L, Collins SP, Adamo M, Miro O, Hill L, Parissis J, Moura B, Mueller C, Jankowska E, Lopatin Y, Dunlap M, Volterrani M, Fudim M, Flammer AJ, Mullens W, Pang PS, Tica O, Ponikowski P, Ristic A, Butler J, Savarese G, Cicoira M, Thum T, Bayes Genis A, Polyzogopoulou E, Seferovic P, Yilmaz MB, Rosano G, Coats AJS, Metra M. Pathophysiology and clinical use of agents with vasodilator properties in acute heart failure. A scientific statement of the Heart Failure Association (HFA) of the European Society of Cardiology (ESC). Eur J Heart Fail. 2025 Jun 1;27(6):1067–1088. doi: 10.1002/ejhf.3673; PMID: 40320261

39. Riccardi M, Pagnesi M, Chioncel O, Mebazaa A, Cotter G, Gustafsson F, Tomasoni D, Latronico N, Adamo M, Metra M. Medical therapy of cardiogenic shock: Contemporary use of inotropes and vasopressors. Eur J Heart Fail. 2024 Feb 1;26(2):411–431. doi: 10.1002/ejhf.3162; PMID: 38391010

40. Harjola VP, Parissis J, Bauersachs J, Brunner-La Rocca HP, Bueno H, Čelutkienė J, Chioncel O, Coats AJS, Collins SP, de Boer RA, Filippatos G, Gayat E, Hill L, Laine M, Lassus J, Lommi J, Masip J, Mebazaa A, Metra M, Miró Ò, Mortara A, Mueller C, Mullens W, Peacock WF, Pentikäinen M, Piepoli MF, Polyzogopoulou E, Rudiger A, Ruschitzka F, Seferovic P, Sionis A, Teerlink JR, Thum T, Varpula M, Weinstein JM, Yilmaz MB. Acute coronary syndromes and acute heart failure: a diagnostic dilemma and high-risk combination. A statement from the Acute Heart Failure Committee of the Heart Failure Association of the European Society of Cardiology. Eur J Heart Fail. 2020 Aug 1;22(8):1298–1314. doi: 10.1002/ejhf.1831; PMID: 32347648

41. Omerovic E, Citro R, Bossone E, Redfors B, Backs J, Bruns B, Ciccarelli M, Couch LS, Dawson D, Grassi G, Iacoviello M, Parodi G, Schneider B, Templin C, Ghadri JR, Thum T, Chioncel O, Tocchetti CG, van der Velden J, Heymans S, Lyon AR. Pathophysiology of Takotsubo syndrome — a joint scientific statement from the Heart Failure Association Takotsubo Syndrome Study Group and Myocardial Function Working Group of the European Society of Cardiology — Part 2: vascular pathophysiology, gender, and sex hormones, genetics, chronic cardiovascular problems and clinical implications . Eur J Heart Fail. 2022 Feb 1;24(2):274–286. doi: 10.1002/ejhf.2368; PMID: 34655287

42. Chioncel O, Adamo M, Nikolaou M, Parissis J, Mebazaa A, Yilmaz MB, Hassager C, Moura B, Bauersachs J, Harjola VP, Antohi EL, Ben-Gal T, Collins SP, Iliescu VA, Abdelhamid M, Čelutkienė J, Adamopoulos S, Lund LH, Cicoira M, Masip J, Skouri H, Gustafsson F, Rakisheva A, Ahrens I, Mortara A, Janowska EA, Almaghraby A, Damman K, Miro O, Huber K, Ristic A, Hill L, Mullens W, Chieffo A, Bartunek J, Paolisso P, Bayes-Genis A, Anker SD, Price S, Filippatos G, Ruschitzka F, Seferovic P, Vidal-Perez R, Vahanian A, Metra M, McDonagh TA, Barbato E, Coats AJS, Rosano GMC. Acute heart failure and valvular heart disease: a scientific statement of the Heart Failure Association, the Association for Acute CardioVascular Care and the European Association of Percutaneous Cardiovascular Interventions of the European Society of Cardiology. Eur J Heart Fail. 2023 Jul 1;25(7):1025–1048. doi: 10.1002/ejhf.2918; PMID: 37312239

43. Gorenek B, Wijnmaalen AP, Goette A, Mert GO, Porter B, Gustafsson F, Dan GA, Ector J, Stuehlinger M, Spartalis M, Gosau N, Amir O, Chioncel O. Ventricular arrhythmias in acute heart failure: a clinical consensus statement of the Association for Acute CardioVascular Care, the European Heart Rhythm Association, and the Heart Failure Association of the European Society of Cardiology. Europace. 2024 Oct 1;26(10). doi: 10.1093/europace/euae235; PMID: 39270731

44. Sliwa K, van der Meer P, Petrie MC, Frogoudaki A, Johnson MR, Hilfiker-Kleiner D, Hamdan R, Jackson AM, Ibrahim B, Mbakwem A, Tschöpe C, Regitz-Zagrosek V, Omerovic E, Roos-Hesselink J, Gatzoulis M, Tutarel O, Price S, Heymans S, Coats AJS, Müller C, Chioncel O, Thum T, de Boer RA, Jankowska E, Ponikowski P, Lyon AR, Rosano G, Seferovic PM, Bauersachs J. Risk stratification and management of women with cardiomyopathy/heart failure planning pregnancy or presenting during/after pregnancy: a position statement from the Heart Failure Association of the European Society of

Cardiology Study Group on Peripartum Cardiomyopathy. Eur J Heart Fail. 2021 Apr 1;23(4):527–540.; PMID: 33609068

45. Seferović PM, Polovina M, Rosano G, Bozkurt B, Metra M, Heymans S, Mullens W, Bauersachs J, Sliwa K, de Boer RA, Farmakis D, Thum T, Olivotto I, Rapezzi C, Linhart A, Corrado D, Tschöpe C, Milinković I, Bayes Genis A, Filippatos G, Keren A, Ašanin M, Krljanac G, Maksimović R, Skouri H, Ben Gal T, Moura B, Volterrani M, Abdelhamid M, Lopatin Y, Chioncel O, Coats AJS. State-of-the-art document on optimal contemporary management of cardiomyopathies. Eur J Heart Fail. 2023 Nov 1;25(11):1899–1922. doi: 10.1002/ejhf.2133; PMID: 37470300

46. Gualandro DM, Masip J, Halvorsen S, Price S, Rosselló X, Chioncel O, Peacock WF, Miró Ò, Oliveira MT, Mebazaa A, Platz E, Amir O, Schaubroeck H, Grand J, Sionis A, Tavazzi G, Pöss J, Verbrugge FH, Gambaro A, Tica O, Arrigo M, Mueller C. Acute heart failure in non-cardiac surgery. Eur Heart J. 2025 Oct 21;46(40):4042–4059. doi: 10.1093/eurheartj/ehaf559; PMID: 40838822

47. Cotter G, Deniau B, Davison B, Edwards C, Adamo M, Arrigo M, Barros M, Biegus J, Celutkiene J, Čerlinskaitė-Bajorė K, Chioncel O, Cohen-Solal A, Damasceno A, Diaz R, Filippatos G, Gayat E, Kimmoun A, Lam CSP, Metra M, Novosadova M, Pang PS, Pagnesi M, Ponikowski P, Saidu H, Sliwa K, Takagi K, Ter Maaten JM, Tomasoni D, Voors A, Mebazaa A. Optimization of evidence-based heart failure medications after an acute heart failure admission: a secondary analysis of the STRONG-HF randomized clinical trial. JAMA Cardiol. 2024 Feb 14;9(2):114–124. doi: 10.1001/jamacardio.2023.4553; PMID: 38150260

48. Bueno H, Go?i C, Salguero-Bodes R, Palacios B, Vicent L, Moreno G, Rosillo N, Varela L, Capel M, Delgado J, Arribas F, Del Oro M, Ortega C, Bernal JL. Primary vs. Secondary Heart Failure Diagnosis: Differences in Clinical Outcomes, Healthcare Resource Utilization and Cost. Front Cardiovasc Med. 2022 Mar 17;9:818525. doi: 10.3389/fcvm.2022.818525

49. Kwok CS, Seferovic PM, Van Spall HG, Helliwell T, Clarson L, Lawson C, Kontopantelis E, Patwala A, Duckett S, Fung E, Mallen CD, Mamas MA. Early Unplanned Readmissions After Admission to Hospital With Heart Failure. Am J Cardiol. 2019 Sep 1;124(5):736-745. doi: 10.1016/j.amjcard.2019.05.053

50. Strategia Nationala de Combatere a Bolilor Cardiovasculare si Cerebrovasculare 2025–2030. Ministerul Sanatatii. 14 July 2025 [Accessed Jan 7 2026]. Available at https://legislatie.just.ro/Public/DetaliiDocumentAfis/299945

51. Chioncel O, Savarese G, Laroche C, Amir O, Tokmakova M, Cannata A, Do Doan L, Kafafy TANA, Krejci J, Moura B, Lund L, Adamo M, Guillouche W, Volterani M, Iung B, Metra M. Global Registries and Surveys Programme-Heart Failure (GRASP-HF): rationale, study design and research implications. Eur J Heart Fail. 2025 Nov;27(11):2061-2073. doi: 10.1002/ejhf.70065 ;PMID: 41126578

52. Vladescu C, Ciutan M, Rafila A. In-hospital admissions and deaths in the context of the COVID-19 pandemic, in Romania. Germs [Internet]. European Academy of HIV/AIDS and Infectious Diseases. 2022;12(2):169. doi: 10.18683/germs.2022.1320; PMID: 36504608