

CLINICAL CHARACTERISTICS, CAUSES, AND OUTCOMES OF 30-DAY READMISSION FOLLOWING HOSPITALIZATION FOR HEART FAILURE: A RETROSPECTIVE COHORT STUDY

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ABSTRACT

Background: Heart failure is associated with frequent hospitalizations and substantial early post-discharge morbidity. Thirty-day readmission remains an important indicator of clinical instability and healthcare utilization, particularly among patients with multiple comorbidities.

Objective: To evaluate the clinical characteristics, causes, outcomes, and predictors of 30-day readmission following hospitalization for heart failure.

Methods: This retrospective cohort study was conducted at Army Cardiac Hospital, Lahore, Pakistan from August 2025 to February 2026, included 300 adult patients hospitalized with acute or acute-on-chronic heart failure. Patients were classified according to whether they experienced an unplanned readmission within 30 days after discharge. Demographic characteristics, comorbidities, laboratory parameters, previous emergency department visits, length of index hospitalization, timing and causes of readmission, and clinical outcomes were recorded.

Results: Of 300 patients, 49 (16.3%) were readmitted within 30 days. Readmitted patients were older than non-readmitted patients (70.4 ± 11.3 vs. 66.1 ± 12.0 years; $p=0.021$) and had higher mean blood urea nitrogen (35.8 ± 16.2 vs. 27.1 ± 13.4 mg/dL; $p<0.001$), serum creatinine (1.65 ± 0.79 vs. 1.31 ± 0.62 mg/dL; $p=0.001$), and index hospital stay (6.8 ± 3.0 vs. 5.1 ± 2.5 days; $p<0.001$). Worsening heart failure was the most common cause of readmission, accounting for 21 (42.9%) cases, followed by renal disorders in 7 (14.3%). Among readmitted patients, 11 (22.4%) required ICU admission, 9 (18.4%) developed acute kidney injury, and 4 (8.2%) died during readmission. **Conclusion:** It is concluded that 30-day readmission after heart failure hospitalization was common and was most frequently related to recurrent heart failure. Chronic kidney disease, previous emergency department utilization, elevated blood urea nitrogen, and prolonged hospitalization were important independent predictors of early readmission.

KEYWORDS: Heart failure; 30-day readmission; rehospitalization; chronic kidney disease; blood urea nitrogen

INTRODUCTION

Heart failure (HF) is a leading cause of hospitalization, morbidity, mortality and utilization of healthcare resources worldwide, especially among elderly and people with multiple cardiovascular and non-cardiovascular co-morbidities [1]. In spite of the progress in guideline-directed medical therapy, hospitalisation for acute or worsening HF remains a marker of a vulnerable period and a significant percentage of patients returns to hospital within a few days of their discharge [2]. The 30-day readmission rate has therefore emerged as a key indicator of post hospitalisation quality of healthcare and outcomes [3]. The reported mortality and 30-day readmission rates vary from around 12% to over 20% after published studies were conducted, depending on the characteristics of the population, the healthcare setting, and definitions used [4,5]. HF hospitalization readmission is complex. While recurrent congestion and progressive worsening of HF are important causes, a substantial portion of readmissions is due to other conditions than HF [6]. Large database studies have shown that both cardiovascular and non-cardiovascular reasons are almost equal in 30-day readmission, with HF itself being the leading cause [7]. The other common alternative causes include pulmonary disease, renal dysfunction, infection, arrhythmias, and ischemic heart disease [8]. In two population-based studies, it was determined that about 60% of the early readmissions were cardiovascular, with 34% due to heart failure and 50.3% due to cardiovascular causes in general [9][10].

There are several demographical and clinical features that are believed to be associated with early readmissions. Various demographical and clinical factors have been linked to higher chances of early rehospitalization. Sex, chronic

kidney disease, anemia, chronic pulmonary disease, diabetes mellitus, atrial fibrillation, a higher number of comorbidities, a longer index hospital stay and a higher rate of prior ED visits have been identified as risk factors [11] [12]. Patients with elevated natriuretic peptides, increased New York Heart Association functional class, decreased renal function and impaired cardiac function may also be identified as patients at increased risk [13]. Predictive performance is still modest however, demonstrating the complex interplay between disease severity, co-morbidity, socioeconomic factors, discharge planning, medication adherence and access to follow-up care [14]. Clinically, the timing of readmission is also important. It has been shown that over 50% of readmissions can happen within the first two weeks after discharge and that other groups have been observed having events build up over the first 30 days [5][15]. Patients who return to hospital also have significant subsequent morbidity, resource use and mortality rates which highlights the need for potentially preventable causes and high-risk clinical profiles identified.

Objective

To evaluate the clinical characteristics, causes, outcomes, and predictors of 30-day readmission following hospitalization for heart failure.

METHODOLOGY

This retrospective cohort study was conducted at Army Cardiac Hospital, Lahore, Pakistan, from August 2025 to February 2026. A total of 300 adult patients hospitalized with a primary diagnosis of heart failure were included. Patients were identified retrospectively from hospital records and followed for 30 days after discharge to determine readmission status. Patients aged ≥ 18 years who were admitted with acute or acute-on-chronic heart failure and subsequently discharged alive were included. Patients who died during the index hospitalization, were transferred to another acute-care facility, or had incomplete records or unavailable 30-day follow-up information were excluded. The index admission was defined as the initial qualifying hospitalization for heart failure, while 30-day readmission was defined as any unplanned hospital admission occurring within 30 days after discharge.

Data Collection

Demographic and clinical information was extracted from medical records, including age, gender, hypertension, diabetes mellitus, chronic kidney disease, coronary artery disease, atrial fibrillation, chronic pulmonary disease, previous emergency department visits, duration of index hospitalization, blood urea nitrogen, serum creatinine, and other relevant laboratory findings. Patients were divided into two groups according to whether they experienced readmission within 30 days. For readmitted patients, the interval from discharge to readmission was recorded as 0–3, 4–7, 8–15, or 16–30 days. The principal cause of readmission was categorized as worsening heart failure, renal disorders, other cardiovascular conditions, respiratory disorders, infection, or other causes. The primary outcome was all-cause 30-day readmission, while secondary outcomes included timing and cause of readmission, duration of readmission, in-hospital mortality, and factors associated with early rehospitalization.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were presented as mean $\pm$ standard deviation and compared using the independent-samples t-test or Mann–Whitney U test, as appropriate. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test or Fisher’s exact test. Multivariable logistic regression was performed to identify independent predictors of 30-day readmission, with adjusted odds ratios and 95% confidence intervals reported. A p-value <0.05 was considered statistically significant.

RESULTS

Patients readmitted within 30 days were older than those not readmitted, with mean ages of 70.4 $\pm$ 11.3 versus 66.1 $\pm$ 12.0 years ($p=0.021$). Readmitted patients also had higher frequencies of diabetes mellitus, 28 (57.1%) vs. 103 (41.0%) ($p=0.038$), chronic kidney disease, 22 (44.9%) vs. 54 (21.5%) ($p=0.001$), atrial fibrillation, 19 (38.8%) vs. 61 (24.3%) ($p=0.036$), and chronic pulmonary disease, 11 (22.4%) vs. 28 (11.2%) ($p=0.035$). Mean blood urea nitrogen was 35.8 $\pm$ 16.2 vs. 27.1 $\pm$ 13.4 mg/dL, serum creatinine 1.65 $\pm$ 0.79 vs. 1.31 $\pm$ 0.62 mg/dL, and index hospital stay 6.8 $\pm$ 3.0 vs. 5.1 $\pm$ 2.5 days, all significantly higher among readmitted patients.

Table 1. Clinical characteristics according to 30-day readmission status

Characteristic	Readmitted (n=49)	Not Readmitted (n=251)	p-value
Age (years), mean $\pm$ SD	70.4 $\pm$ 11.3	66.1 $\pm$ 12.0	0.021
Male	29 (59.2%)	137 (54.6%)	0.558
Hypertension	40 (81.6%)	188 (74.9%)	0.313
Diabetes mellitus	28 (57.1%)	103 (41.0%)	0.038
Chronic kidney disease	22 (44.9%)	54 (21.5%)	0.001
Coronary artery disease	25 (51.0%)	104 (41.4%)	0.216
Atrial fibrillation	19 (38.8%)	61 (24.3%)	0.036

Chronic pulmonary disease	11 (22.4%)	28 (11.2%)	0.035
LVEF (%), mean±SD	38.6±12.1	41.9±12.4	0.087
Blood urea nitrogen (mg/dL)	35.8±16.2	27.1±13.4	<0.001
Serum creatinine (mg/dL)	1.65±0.79	1.31±0.62	0.001
Index hospital stay (days)	6.8±3.0	5.1±2.5	<0.001
Previous ED visit within 6 months	24 (49.0%)	67 (26.7%)	0.002

Overall, 49 (16.3%) of the 300 patients were readmitted within 30 days. Readmission occurred in 8 (16.3%) patients within 0–3 days, 10 (20.4%) within 4–7 days, 14 (28.6%) within 8–15 days, and 17 (34.7%) within 16–30 days. Worsening or recurrent heart failure was the most common cause, accounting for 21 (42.9%) readmissions, followed by renal disorders in 7 (14.3%), other cardiovascular causes in 6 (12.2%), respiratory disorders in 5 (10.2%), infection in 4 (8.2%), and other causes in 6 (12.2%).

Table 2. Timing and principal causes of 30-day readmission (n=49)

Characteristic	n (%)
Timing of readmission	
0–3 days	8 (16.3%)
4–7 days	10 (20.4%)
8–15 days	14 (28.6%)
16–30 days	17 (34.7%)
Cause of readmission	
Worsening/recurrent heart failure	21 (42.9%)
Renal disorders	7 (14.3%)
Other cardiovascular causes	6 (12.2%)
Respiratory disorders	5 (10.2%)
Infection	4 (8.2%)
Other causes	6 (12.2%)

ICU admission was required in 11 (22.4%) patients and mechanical ventilation in 4 (8.2%). Acute kidney injury occurred in 9 (18.4%), while 28 (57.1%) developed recurrent decompensated heart failure requiring intravenous diuretics. In-hospital mortality during readmission was 4 (8.2%), while 45 (91.8%) patients were discharged alive.

Table 3. Clinical outcomes among patients readmitted within 30 days

Outcome	Result
Time from discharge to readmission (days), mean±SD	13.2±8.7
Length of readmission (days), mean±SD	5.8±3.1
ICU admission	11 (22.4%)
Mechanical ventilation	4 (8.2%)
Acute kidney injury during readmission	9 (18.4%)
Recurrent decompensated HF requiring IV diuretics	28 (57.1%)
In-hospital mortality during readmission	4 (8.2%)
Discharged alive	45 (91.8%)

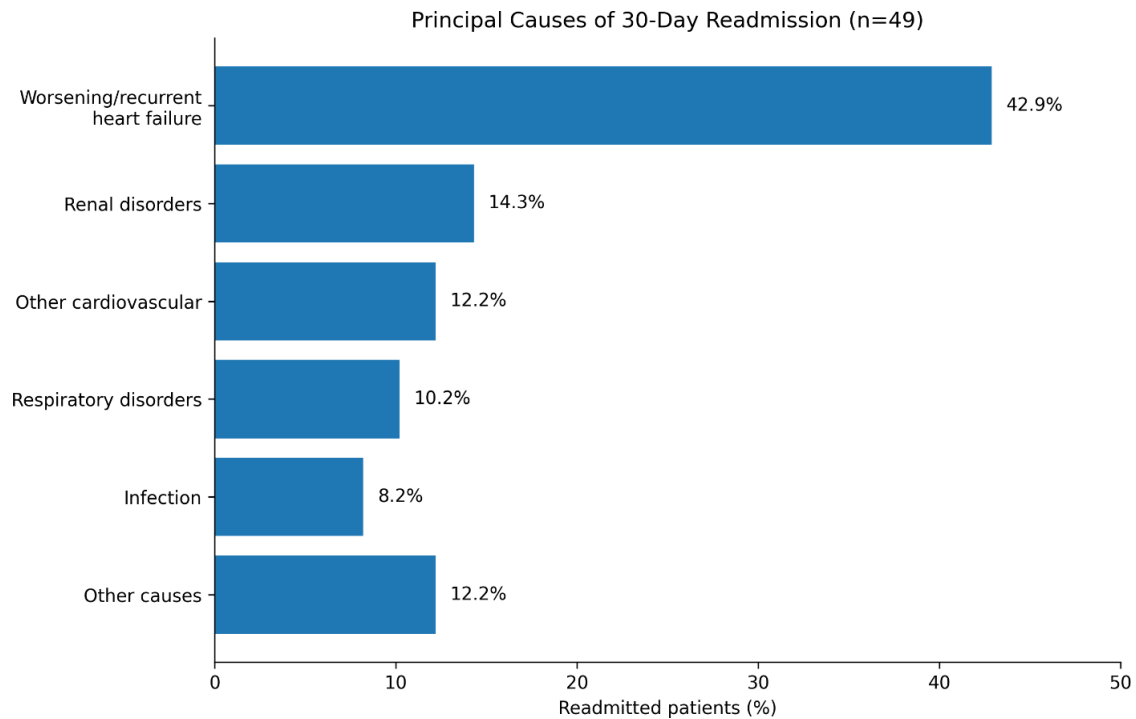


Figure 1: Cause of readmission in hospital

Previous emergency department visits within six months also independently increased readmission risk (aOR 2.28; 95% CI: 1.20–4.33; $p=0.012$), as did blood urea nitrogen >30 mg/dL (aOR 2.05; 95% CI: 1.08–3.90; $p=0.028$) and an index hospital stay ≥ 7 days (aOR 1.94; 95% CI: 1.01–3.72; $p=0.046$). Age ≥ 70 years, diabetes, atrial fibrillation, and chronic pulmonary disease were not independently significant after adjustment.

Table 4. Multivariable predictors of 30-day readmission following heart failure hospitalization

Predictor	Adjusted OR	95% CI	p-value
Age ≥ 70 years	1.68	0.89–3.15	0.108
Diabetes mellitus	1.62	0.87–3.01	0.125
Chronic kidney disease	2.47	1.29–4.73	0.006
Atrial fibrillation	1.71	0.89–3.27	0.107
Chronic pulmonary disease	1.89	0.87–4.08	0.107
Previous ED visit within 6 months	2.28	1.20–4.33	0.012
Blood urea nitrogen >30 mg/dL	2.05	1.08–3.90	0.028
Index hospital stay ≥ 7 days	1.94	1.01–3.72	0.046

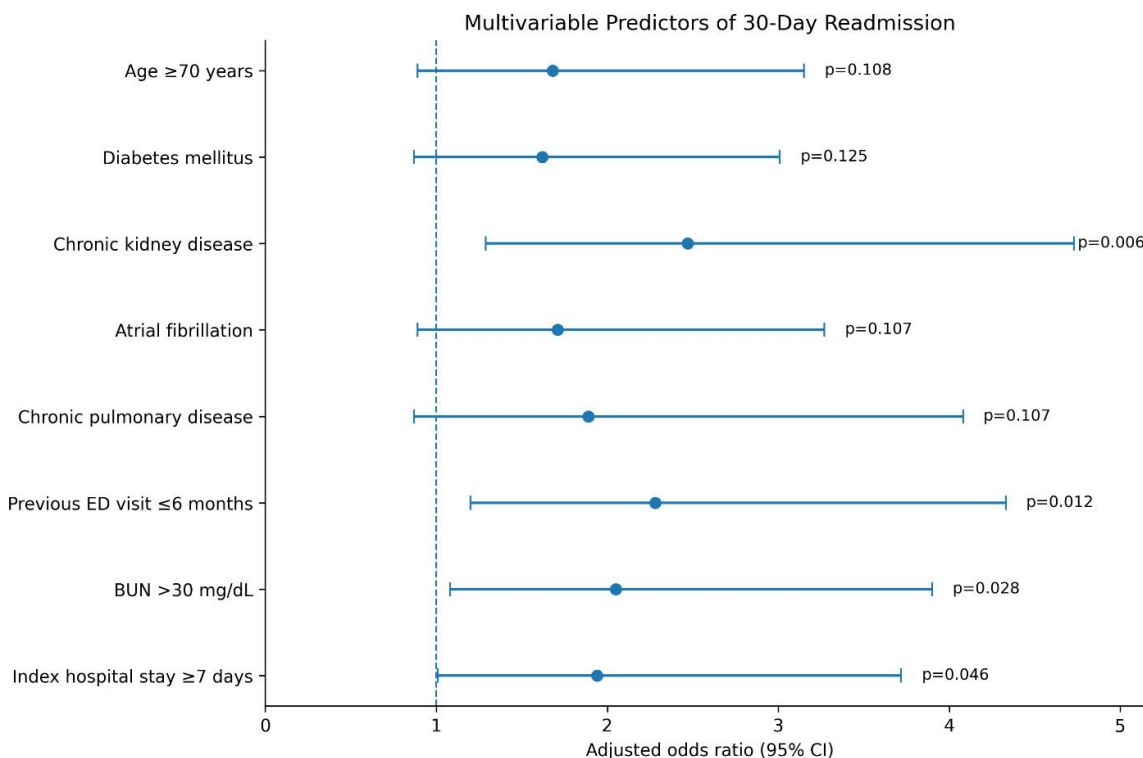


Figure 2: Multivariable predictors of 30-day readmission following heart failure hospitalization

DISCUSSION

The present study evaluated 300 patients hospitalized with heart failure and found a 30-day readmission rate of 16.3%. Patients re-admitted were older with a mean age of 70.4 ± 11.3 years vs. 66.1 ± 12.0 years for those who were not re-admitted ($p=0.021$). A similar rate of early rehospitalization after heart failure discharge was found in previous studies that included 2420 heart failure hospitalizations (16.3%) [16] and in a large national analysis (21.2%) [17]. Patients who were readmitted had higher levels of comorbidity burden. Diabetes mellitus was present in 57.1% compared with 41.0% of non-readmitted patients ($p=0.038$), chronic kidney disease in 44.9% versus 21.5% ($p=0.001$), atrial fibrillation in 38.8% versus 24.3% ($p=0.036$), and chronic pulmonary disease in 22.4% versus 11.2% ($p=0.035$). Higher prevalence of diabetes, atrial fibrillation, chronic pulmonary disease and chronic kidney disease was also found among readmitted patients in previous studies, and chronic kidney disease and chronic pulmonary disease were independently associated with 30-day rehospitalization [17,18]. An earlier study found that diabetes (OR 1.06) and chronic lung disease (OR 1.13) and renal failure or electrolyte disorders (OR 1.12) were associated with higher readmission rates [19]. In particular, renal function was significant in the current study. Readmitted patients had a higher mean blood urea nitrogen level of 35.8 ± 16.2 mg/dL compared with 27.1 ± 13.4 mg/dL and a higher mean serum creatinine level of 1.65 ± 0.79 versus 1.31 ± 0.62 mg/dL. Multivariable analysis revealed that chronic kidney disease independently raised the risk of readmission by 2.47-fold and blood urea nitrogen greater than 30 mg/dL conferred an increased risk of readmission of around two-fold. Elevated BUN has also been found in previous studies to be an important predictor of early readmission, and BUN > 45 mg/dL was incorporated into a multivariable prediction model for 30-day rehospitalization [16]. A previous study also found that higher baseline BUN was an independent risk factor for readmission or mortality after hospitalisation for acute heart failure [20]. The mean length of the index hospitalization was significantly higher for readmitted patients (6.8 ± 3.0 vs 5.1 ± 2.5 days, $p<0.001$). An index hospital stay ≥ 7 days independently increased the odds of 30-day readmission (aOR 1.94; 95% CI 1.01–3.72; $p=0.046$). A previous study also found readmitted patients were longer in stay on the index admission (6.2 versus 5.4 days) [17]. A longer length of hospital stay, as evidenced by an index stay > 5 days, was also shown to be a significant predictor of readmission within 30 days of discharge in another previous study [16]. The rate of previous presentation to an ED within 6 months was higher for readmitted patients (49.0%) than non-readmitted patients (26.7%) ($p=0.002$), and remained an independent predictor of ED readmission (aOR 2.28, 95% CI 1.20–4.33, $p=0.012$). However, previous studies have also identified that a single ED visit in the three months prior to hospitalisation was associated with a higher risk of hospitalisation in the next 30 days [16]. This indicates that patients who have been frequent users of the health system prior to the index hospitalization may be those with unstable disease, multiple comorbidities or poor outpatient disease management.

The timing of readmission showed that 8 (16.3%) patients returned within 0–3 days, 10 (20.4%) within 4–7 days, 14 (28.6%) within 8–15 days, and 17 (34.7%) during days 16–30. A similar trend was previously shown, whereby 11.9% of readmissions happened on days 0–3, 15.2% on days 4–7, 31.5% on days 8–15, and the greatest number (41.4%) on days 16–30 [16]. A recent study found that the median time to readmission was around 12 days, which is similar to the median interval of 13.1 days in the present study (mean interval: 13.2±8.7 days) [21]. The most common reason for readmission was worsening or recurrent heart failure, accounting for 21 (42.9%) cases; other cardiovascular conditions accounted for 6 (12.2%) cases, renal disorders accounted for 7 (14.3%) cases, respiratory disorders accounted for 5 (10.2%) cases and infections accounted for 4 (8.2%) cases. Heart failure was also previously reported as the most common reason for readmission (36.0%) and the second most common reason for readmission was renal disorders (8.4%), while other cardiac diseases accounted for 6.9%. A large national study also identified that 39.0% of the readmissions were attributable to a heart failure, 12.4% for pulmonary disorders, 9.3% for infection, and 4.1% for renal disorders. These findings further highlight the significance of the early postdischarge period and emphasize the importance of meticulous follow-up of high-risk patients. There were a number of limitations in this study. It was a retrospective design relying on completeness and accuracy of hospital records and could have suffered from documentation or selection bias. The study was carried out at one centre, and the number of participants in the study was relatively small, which might restrict the generalizability. Readmissions at other hospitals may not have been included, which may underestimate the actual 30-day readmission rate. Not all the relevant information including medication compliance, socioeconomic status, counselling after discharge, outpatient follow-up, natriuretic peptide level, and detailed echocardiographic parameters were available at all times. Moreover, a few predictors might be affected by residual confounding after multivariable adjustment.

CONCLUSION

It is concluded that 30-day readmission after hospitalization for heart failure remained common, affecting 16.3% of patients. Recurrent or worsening heart failure was the leading cause of readmission, followed by renal and other cardiovascular conditions. Chronic kidney disease, previous emergency department visits, elevated blood urea nitrogen, and prolonged index hospitalization were identified as independent predictors of early readmission. Readmitted patients also experienced substantial morbidity, including ICU admission, acute kidney injury, recurrent decompensated heart failure, and in-hospital mortality. These findings highlight the importance of identifying high-risk patients before discharge and providing closer post-discharge monitoring and follow-up.

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