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Clinical Characteristics, Risk Factors and Treatment Outcome of Acute Heart Failure Patients Admitted to a Tertiary Hospital in Addis Ababa, Ethiopia

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Abstract

Background: Acute Heart failure is associated with high mortality and re-hospitalization rates. Clinical severity and in-hospital trajectory are determined by the complex interplay between precipitants, the underlying cardiac substrate, and the patient's comorbidities.

Objective: To determine predictors of outcome of acute heart failure and to characterize clinical profile, risk factors and identify predictors of poor outcome.

Methods: A facility based cross sectional study. All medical records of Heart failure patients age of 14 years and above who visited the adult emergency department of study hospital between 1st of March, 2023 and end of December, 2023. Data from 161 eligible medical records were collected on a structured questionnaire adopted from standard Heart failure registries.

Results: Females were (N=84, 52.2 %) of the study population, the mean age was 41.4. Those with age of 40 and below were the majority of the population (N=84, 52.2%). The most common primary etiology of Heart failure was Rheumatic Heart disease (N=77, 47.8%), followed by ischemic heart disease (N=37, 22.9%) and dilated cardiomyopathy (N=15, 9.3%). In hospital mortality was 14.3%. Reduced left ventricular ejection fraction, worsening renal function and hyponatremia were predictors of mortality.

Conclusion: In hospital mortality was strongly associated with worsening renal function and hyponatremia and left ventricular ejection fraction less than 50%.

Keywords: Acute Heart Failure, Risk Factors, Heart Failure Hospitalization, Mortality

List of Abbreviations

ACE-I - Angiotensin converting enzyme inhibitor

ACS - Acute coronary syndrome

ADHERE - Acute Decompensated Heart Failure National Registry

AHF - Acute heart failure

ALARM-HF - Acute Heart Failure Global Survey of Standard Treatment
CHF - Chronic Heart failure
DCMP - Dilated cardiomyopathy
EF - Ejection fraction
ER - Emergency room
GDMT - Guideline direct medical therapy
HF - Heart failure
HFimpEF - HF with improved EF
HFmrEF - HF with mildly reduced EF
HFpEF - HF with preserved EF
HFrEF - HF with reduced ejection fraction
ICU - Intensive care unit
IHD - Ischemic heart disease
LVEF - Left ventricular ejection fraction
MRA - Mineralocorticoid receptor antagonist
NYHA - New York Heart association
OPTIMIZE-HF - organized program to initiate lifesaving treatment in hospitalized patients with Heart failure
RAAS - Renin angiotensin aldosterone system
RHD - Rheumatic heart disease
SD - standard deviation
SGLT-2i - Sodium glucose co-transporter 2 inhibitor
TASH - Tikur anbesa specialized hospital
THESUS-HF - The Sub-Saharan Africa Survey of Heart Failure
US - United states
WRF - Worsening renal function

Background

Heart failure (HF) is not a single pathological diagnosis, but a clinical syndrome consisting of cardinal symptoms (breathlessness, ankle swelling, and fatigue) that may be accompanied by signs (elevated jugular venous pressure, pulmonary crackles, and peripheral edema) [1].

HF is due to a structural and/or functional abnormality of the heart that results in elevated intra-cardiac pressures and/or inadequate cardiac output at rest and/or during exercise. Most commonly, HF is due to myocardial dysfunction: either systolic, diastolic, or both. However, pathology of the valves, pericardium, and endocardium, and abnormalities of heart rhythm and conduction can also cause or contribute to HF [1].

HF has been defined as a global pandemic, with 64.3 million people estimated to suffer from HF worldwide in 2017. Its prevalence is expected to rise due to the improved survival following a HF diagnosis associated with the availability of life-saving evidence-based treatments and the overall longer life-expectancy of the general population [2]. There is almost a complete lack of data regarding middle to low-income countries, despite the fact they represent over 80% of the world's population [3].

LV EF (left ventricular ejection fraction) is considered important in the classification of patients with HF because of differing prognosis and response to treatments and because most clinical trials select patients based on ejection fraction (EF) [4].

HF with reduced ejection fraction (HFrEF) is defined as LVEF less than or equal to 40%, HF with preserved EF (HFpEF) is when an LVEF above or equal to 50%, those with HF and an LVEF between the HFrEF and HFpEF range have been termed as HF with mildly reduced EF (HFmrEF) with EF of 41% to 49%, HF with improved EF (HFimpEF) as a subgroup of HFrEF to characterize changes in LVEF by more than or equal to 10% from the baseline [4].

Acute heart failure (AHF) is the rapid development or change of signs and symptoms of heart failure that requires medical attention and usually leads to patient hospitalization [5]. Despite advances in medical and device therapy, it still has unacceptably high morbidity and mortality rates. AHF represents a major public health issue, an enormous financial burden, and a challenge for current cardiovascular research [6].

AHF is a leading cause of hospitalizations in subjects aged > 65 years and is associated with high mortality and re-hospitalization rates. In-hospital mortality ranges from 4% to 10%. Post-discharge 1-year mortality can be 30% with up to more than 45% deaths or readmission rates [1]. AHF may be the first manifestation of HF (new onset) or, more frequently, be due to an acute decompensation of chronic HF (CHF) [7]. Compared to patients with acutely decompensated CHF, those with new onset HF may have a higher in-hospital mortality, but have lower post-discharge mortality and re-hospitalization rates [1]. Specific extrinsic factors may precipitate, but not cause, AHF in patients with pre-existing cardiac dysfunction. Clinical severity and in-hospital trajectory are determined by the complex interplay between precipitants, the underlying cardiac substrate, and the patient's comorbidities [8].

A number of large-scale registries performed mainly in the US (United states) and Europe over the last decade have depicted the epidemiology of AHF providing a picture much closer to the real life situation [9]. The ADHERE (Acute Decompensated Heart Failure National Registry) is performed in the US and constitutes the hitherto largest AHF registry in 2005 [10]. The Euro Heart Failure Survey I was organized by the ESC and recruited 11 327 in 115 hospitals from 24 European countries. The ALARM-HF (Acute Heart Failure Global Survey of Standard Treatment) was an international retrospective registry that recruited 4953 patients in 666 hospitals from nine countries and The Sub-Saharan Africa Survey of Heart Failure (THESUS-HF) was a prospective survey that enrolled 1006 AHF patients admitted in 12 university hospitals in nine African countries [11].

This study will answer the question what determinant factors are affecting outcome of acute heart failure and risk of heart failure hospitalization by setting a hypothesis; determinant factors affecting outcome of acute heart failure and risk of heart failure hospitalization are similar across all people with heart failure.

Objective of the Study

To determine predictors of outcome, to know risk factors and characterize clinical profile of acute Heart failure

Methods and Materials

- **Study Area:** A public hospital, Addis Ababa, Ethiopia
- **Study Design:** Facility based retrospective study was conducted.
- **Source Population:** All medical records of HF patients age of 14 years and above who visited the adult emergency department of study hospital between 1st of March, 2023 and end of December, 2023.
- **Study Subjects:** The study population was sample medical records of patients presented to emergency department fulfilling the inclusion criteria during the study period.
- **Inclusion Criteria:** Participant's medical record with age registration of 14 years and above.
 - Received or is eligible to receive a principal hospital admission diagnosis of acute Heart failure.
- **Exclusion Criteria:** Heart failure is present as a comorbid condition, but is not a principal focus of diagnosis or treatment during the index hospitalization.

Incomplete Documentation of Patient's Medical Records

Ethical clearance was obtained from the institutional review board of, Addis Ababa University, college of health sciences, school of medicine, department of Internal medicine. In this study, the risk of unintended health outcome is negligible since it is only review of patient's medical record from both electronic and paper based chart. Patients name, photos or images are not used in this study. Confidentiality of each patient's medical record was maintained throughout the duration of data collection, analysis and manuscript preparation for publication.

Sample size was determined based on the in hospital mortality rate of 17% from local study [12]. Sample size was calculated as prevalence (P) rate 17%, giving any particular out come to be with 5% marginal error and 95% confidence interval of certainty ($\alpha = 0.05$), and 10% allowance for incomplete medical records was considered. Based on this assumption, the actual sample size for the study is computed using one-sample population proportion formula and sample size was 239.

Data collection: Structured questionnaire adopted for the purpose of this study from the OPTIMIZE-HF (organized program to initiate lifesaving treatment in hospitalized patients with Heart failure) registry which includes variables predicting in hospital mortality, post discharge mortality and use of GDMT (guideline directed medical therapy) when applicable based on disease phenotypes [13,14].

The outcome variable is: In hospital mortality.

Data analysis: SPSS version 16, were used for data entry and analysis.

Results

Out of 239 medical records only 161 were eligible for analysis and the remaining 78 records were rejected due to lost chart and incomplete electronic medical records.

From the total 161 patients, females were (N=84, 52.2 %) of the study population, the mean age was 41.4 and standard deviation (SD) (18.7).

Hospitalization for heart failure before the index hospitalization was reported in (N=33, 20.5%) with mean and SD of 0.8 [1]. Participants who had their HF diagnosis for the first time were 21.7%. Any history of report for current smoking and alcohol use was reported in 8.1% and 3.7% respectively. Women in HF and pregnancy were 23.8 % and 52% of them had RHD (Rheumatic heart disease) (Table 1).

The cardiovascular related comorbidities were commonly reported as atrial fibrillation and hypertension (N=64, 39.8%) and (N=30, 18.6%) respectively, whereas the non-cardiovascular comorbidity report were anemia (N=66, 41%),

diabetes mellitus (N=27, 16.8%) and others 1.9%.

The most common primary etiology of HF was RHD (N=77, 47.8%), followed by ischemic heart disease (IHD) (N=37, 22.9%) and dilated cardiomyopathy (DCMP) (N=15, 9.3%) (Tables 2 and 3).

The reported NYHA (New York Heart association) functional class was significant for class III and IV with combined proportion of 92%. The mean heart rate and systolic blood pressure (mmHg) were 111.6 and 105.4 respectively, moreover the mean values for baseline hemoglobin (g/dl), serum creatinine (mg/dl) and serum sodium (mmol/l) were (12.4, 1.24 and 130.6) respectively (Table 4).

The most common precipitating cause of acute heart failure was atrial fibrillation (25.5%), community acquired pneumonia (22.4%) and medication discontinuation (8.7%). Despite a high prevalence of anemia on the study population (41%) its attribution as precipitating factor was only documented in (3.7%) of medical records (Table 5).

The use of furosemide was reported as (65.8%), spironolactone (36.1%), beta blockers (27.3%), digoxin (24.8%), ACE-I (Angiotensin converting enzyme inhibitor) (21.1%) and only one patient was on sacubitril-valsartan and SGLT-2i (sodium glucose co-transporter 2 inhibitor). The proportion of warfarin and anti-platelet use was similar at (13.7%) (Table 6).

The majority of patients (N=108, 67.1%) had tachycardia, the proportion of patients presenting with hypotension were (N=47, 29.2%) and patients with anemia, hyponatremia and WRF (worsening renal function) were (41%, 57.1% and 24.2%) respectively (Table 7).

The trajectory of patients with AHF has several outcomes after triage, in our study the majority were admitted to cardiac ward (N= 61, 37.9%), followed by discharge from ER (emergency) after less than 3 days of stay (N=52, 32.3%) and the remaining (N=47, 29.2%) were admitted to cardiac intensive care unit (ICU). Moreover outcome of patients after admission to either cardiac ward or cardiac ICU were discharged in about (N=135, 83.9%) of the study participants and (N=23, 14.3%) died, except 1 patient all deaths occurred at cardiac ICU (Table 8).

Among the deaths (N=14, 61%) were females, age less than 50 years were (N=18, 78.3%). Being female was highly associated with RHD (N=52, 67.5%) and being male was highly associated with both DCMP and IHD with prevalence of (N=11, 73.3%) and (N=22, 71%) respectively. Out of the 39.8% prevalence of atrial fibrillation, females in atrial fibrillation were (N= 44, 62.8%). The majority of atrial fibrillation (N= 51, 80%) occurred in those with RHD. Reduced EF was observed in (N=30, 52.6%) of participants below the age of 50 years. The in-hospital death had occurred in 56.5% of patients with reduced EF. The majority of anemia were seen in females (N=42, 63.6%). WRF were commonly seen in those with age below 50 years (N=23, 59%).

When the duration of HF diagnosis was more than 2 years it was associated with increased risk of death (N=16, 69.6%) and one third of discharge from the emergency was seen for those with newly referred to study hospital and who only had one previous HF hospitalization (N=52, 32.3%).

Those with hyponatremia had a 12.3 higher odds of all cause death than those with normal serum sodium (AOR = 12.3, 95% CI (1.59, 94.45), P = 0.016), the presence of increased serum creatinine had a 7.7 higher odds of in hospital mortality than those with normal serum creatinine at visit (AOR= 7.7, 95% CI (2.91, 20.14), P = 0.0001). LVEF less than 50% was associated with a 2.5 higher odds of dying in hospital than those with preserved EF (AOR=2.5, 95% CI (0.16, 0.94), P =0.035), however association between anemia and in hospital mortality was marginally missed for statistical significance despite higher prevalence of anemia in this study (41%) (Table 9).

Discussion

Patients admitted with AHF were younger (mean = 41.4) contrary to a local study in Gondar mean age (57.2), the sub-Saharan Africa Survey of Heart Failure cohort (mean = 52.3), registries in ADHERE (mean = 72 .4) and OPTIMIZE-HF (mean = 73) [15,16,10,13]. The observed age difference could be explained by a high prevalence of RHD (47.8%) presenting at young age in our study. In INTER-CHF, patients in Africa, India, and Southeast Asia were approximately 10 years younger than patients in South America and China [2]. More than half of patients were females (52.2%) which is comparable to a study in TASH (Tikur anbessa specialized hospital) (54.4%) (8), sub-Saharan Africa Survey on Heart Failure (50.8 %), ADHERE registry (52.0%) and OPTIMIZE-HF (52.0 %).

Atrial fibrillation was the commonest (39.8%) comorbidity followed by Diabetes (16.8%) and Hypertension (18.6%), the higher prevalence of atrial fibrillation is explained by duration of heart failure, more than one year (80%), and reported more in females. A study from Africa reported that atrial fibrillation prevalence was (18.4%) [11]. The likely reason for higher atrial fibrillation in our study could be due to chronically sick patients with co-morbidities referred to study hospital.

Our study found that RHD (47.8%) is still the leading cause of HF similar to other local studies [12,15,17]. In THESUS-HF registry RHD was reported as low prevalence (14.3%) than several other studies in Africa and the difference could be due to selection bias.

Ischemic heart disease (19.3%), dilated cardiomyopathy (9.3%), hypertensive heart disease (7.5%) were found to be additional causes of heart failure which is lower prevalence than African, Asian and European HF registries [18].

In addition to atrial fibrillation being the commonest comorbidity in our study it is also the leading precipitating factor for AHF (25.5%) followed by pneumonia (22.4%), acute coronary syndrome (14.3%) and drug discontinuation (8.7%).

A study from TASH showed that pneumonia was the commonest risk factor for AHF [12]. The ALARM-HF registry showed that ACS (Acute coronary syndrome) (45.9%), arrhythmia (27.3), infection (16.3%) and poor compliance with medication (19.4%) are the common precipitating factors [19].

Use of diuretics either loop diuretic or combination with thiazide diuretics was the highest reported class of medications (65.8%) which reflects that majority of patients are acutely decompensating chronic HF patients. Use of MRA (mineralocorticoid receptor antagonist) was (36.1%) while the majority of patients are having HFpEF (65%) and RHD. Use of beta blockers and digoxin were seen in (27.3%) and (24.8%). Compared to the ADHERE-HF use of diuretics (76.5%), beta blocker (51.3%), digoxin (49.3%) and ACE-I (66.5%) in our study has the least prescription of diuretics and GDMT [10,220].

The utilization of anti-platelets (13.7%) and lipid lowering agents (11.3%) was very low compared to the prevalence of IHD and other comorbidities such as diabetes in this study. Warfarin use was also reported low (13.7%) despite high prevalence of atrial fibrillation (39.8%) likely due to a combination of factors such as young age, less comorbidities, lack of access and probable non severe Mitral stenosis in RHD.

The association between in hospital mortality and predictor variables were significant for LVEF less than 50% (AOR =2.5, 95% CI (0.16, 0.94), P =0.035), WRF (AOR=7.7, 95% CI (2.91, 20.14), P =0.0001), hyponatremia (AOR=12.3, 95% CI (1.59, 94.45), P = 0.016) and marginal trend for association with anemia (AOR=2.4, 95% CI (0.966, 5.93), P =0.059). The rate of in hospital mortality in our study was 14.3%. A study from TASH reported that the mortality rate was 17.2% which is a little higher than our finding and in hospital death was strongly predicted by smoking, diabetes mellitus, pulmonary hypertension and adverse drug events [12]. But our study showed association of in hospital mortality with LVEF less than 50%, WRF and hyponatremia likely related to differences in study question and inclusion criteria.

A study from Gondar also showed that in hospital mortality rate was 10.6% and reduced EF was one of the predictors of in hospital mortality [15]. OPTIMIZE-HF and ADHERE-HF registries had low in hospital mortality (3.8%) and (4%) respectively, compared to our study [10,13]. The reason for higher mortality rate in our patients' could be due to patients presenting with severe and advanced disease, low rate of intervention for valvular Heart disease and sub-optimal GDMT.

Among the in hospital predictors for death in OPTIMIZE-HF were increased serum creatinine and hyponatremia which is similar to our study. Although we didn't find statistical association between in hospital death and systolic blood pressure and increased heart rate the OPTIMIZE-HF has shown that low systolic blood pressure, tachycardia and old age were strongly associated [13,21].

There is a disparity of predictors of death between our study and THESUS-HF registry from sub-Saharan countries, in the later sodium level was not found to be predictor unlike other European, North American and our study. The differences could be due to less activation of the RAAS (renin angiotensin aldosterone system) system in the later since the common cause of HF was hypertension and newly presenting patients before marked neuro-hormonal activation [13,18,22].

Limitation and Strength of the Study

Our study has several limitations: it is a cross sectional (retrospective) observational study conducted in a single center. The sample size is small and some predictors could have been well elaborated had we been able to include more samples so that more association could be found with NYHA functional class, low systolic blood pressure, tachycardia and anemia. We were unable to quantify dose optimization of GDMT because of inconsistent recordings of medication dose.

The study would have more power if patient follow up continued after discharge to measure post discharge outcomes in the first 30 days, 90 days and 1 year. Inclusion of more variables such as serum iron and natriuretic peptides would have been more predictive.

Our study showed a proof of concept that AHF and poor outcome predictors can be measured in resource limited countries with baseline laboratory and imaging techniques such as serum creatinine, serum sodium, hemoglobin and estimation of LVEF.

This study is the first local experience to use standard variables mostly used in European, Asian and North American HF registries: medication compliance, NYHA functional class, systolic blood pressure, heart rate, LVEF, hemoglobin, serum sodium and serum creatinine to predict AHF outcomes.

Declaration

Ethical Approval and Consent to Participate

Ethical approval was obtained from institutional review board of Addis Ababa University, college of health sciences, school of medicine, department of Internal medicine. Consent to participate is not applicable in this study because the participants are not patients rather their medical records without the use of their names, identification number and photos or images from their medical records.

Availability of Data and Materials

The SPSS raw data that is used for analysis of this research will be shared with your journal, however we are afraid if it is not opening on your side since it is an old version and software used was copy than original since access for original software is not possible in our setup because it is expensive.

Competing Interests: No competing interests

Funding: The research is fully funded by the authors and no funding was available from any organization

Consent for Publication:

Not applicable

Conclusion

In this study we found that AHF patients were young and females are more represented than males. The mean duration of HF was 3.6 years and nearly half of patients had 2 or more previous hospitalization for HF. Atrial fibrillation was found to be both the commonest comorbidity and precipitating factor, it was also observed in three fourth of patients with RHD. RHD was the leading etiology of HF.

The most common medications prescribed were diuretics, beta blockers and digoxin while ACE-I, warfarin, anti-platelets and lipid lowering agents were the least prescribed. Almost three fourth of patients were admitted to either ward or cardiac ICU, of whom 14.3% died in the hospital, half of the deaths were related to RHD and a fifth of them had DCMP. Increased serum creatinine, low serum sodium, reduced EF and anemia were associated with increased risk of in hospital mortality.

Recommendation

We recommend a large sample size, registry based prospective cohort follow up of patients with two or more centers from different regions of the country.

Establishing a dedicated HF clinic involving multidisciplinary team to increase quality of care, optimization of GDMT

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Tables

Characteristics	Description	Number (%)	Mean (SD)
Sex	Male	77 (47.8)	
	Female	84 (52.2)	
Age	=< 40	84 (52.2)	41.4 (18.7)
	41-64	60 (37.3)	
	>= 65	17 (10.5)	
Place of living	Addis Ababa	77 (47.8)	
	Oromia region	51 (31.7)	
	Amhara region	19 (11.8)	
	South region	9 (5.6)	
	Others	5 (3.1)	
Newly referred patients		69 (42.9)	
Previous HF hospitalization	>= 2	33 (20.5)	0.8 (1)
Duration of HF diagnosis (years)	Newly diagnosed	35 (21.7)	3.6 (4)
	1-5	91 (56.5)	
	6-10	25(15.5)	
	>10	10 (6.3)	
Smoking	Not-quantified	13 (8.1)	

Alcohol	Not-quantified	6 (3.7)	
Pregnancy		15 (23.8)	

Table 1: Demographic and Baseline Characteristics of the Study Patients

Characteristics	Description	Number (%)
Comorbidity	Anemia	66 (41)
	Atrial fibrillation	66 (39.8)
	Diabetes mellitus	27 (16.8)
	Hypertension	30 (18.6)
	Others	3 (1.9)
Etiology	Rheumatic heart disease	77 (47.8)
	Ischemic heart disease	37 (22.9)
	Dilated cardiomyopathy	15 (9.3)
	Hypertensive heart disease	12 (7.5)
	Others	20 (12.4)

Table 2: Comorbidities, Etiologies and Cardiovascular Interventions

Characteristics	Number (%)
Revascularization	7 (4.3)
Valve replacement	3 (1.9)
PMBV*	3 (1.9)
Pacemaker implantation	4 (2.5)

*percutaneous mitral balloon valvuloplasty

Table 3: Cardiovascular Interventions

Characteristics	Description	Number (%)	Mean (SD)
Functional class	NYHA class II	13 (8.1)	
	NYHA class III	64 (39.8)	
	NYHA class IV	84 (52.2)	
Heart rate			111.6 (2.8)
Systolic blood pressure			105.4 (24.8)
Hemoglobin			12.4 (1.9)
Creatinine	Serum		1.24 (0.94)
Potassium	Serum		3.85 (0.61)
Sodium	Serum		130.6 (11.8)
Chest X-ray	Evidence for HF	83 (51.6)	
LVEF	2D echocardiography		47.7 (1.4)

Table 4: Clinical and Diagnostic Characteristics

Characteristics	Number (%)
Atrial fibrillation	41 (25.5)
Community acquired pneumonia	36 (22.4)
Acute coronary syndrome	23 (14.3)
Drug discontinuation	14 (8.7)
Pregnancy	13 (8.1)
Sub-acute bacterial endocarditis	6 (3.7)
Anemia	5 (3.1)
Others	12 (7.4)

Table 5: Precipitating Factors of Acute Heart Failure

Characteristics	Number (%)
Diuretics	106 (65.8)
MRA	58 (36.1)
Beta blockers	44 (27.3)
Digoxin	40 (24.8)
ACE-I	34 (21.1)
Warfarin	22 (13.7)
Antiplatelet	22 (13.7)
Lipid lowering agents	19 (11.8)
Monthly benzanthine penicillin	Out of 77 eligible, 35 (45.5)
Others	50 (31.1)

Table 6: Medication Use

Predictor variable	Category	Number (%)
NYHA functional class	>= III	148 (92)
Tachycardia	Rate > 100	108 (67.1)
Hypotension	Systolic BP < 90	47 (29.2)
Reduced LVEF	EF < 50%	57 (35.4)
Anemia	Hemoglobin (Hgb =< 12)	66 (41)
WRF	Cr >= 1.3	39 (24.2)
Hyponatremia	Sodium (Na < 135)	92 (57.1)
Hypokalemia	Potassium (K < 3.5)	33 (20.5)

Table 7: Categorical Description of Predictor and Secondary Outcome Variables

Trajectory after admission to emergency	
Description	Number (%)
Admitted to cardiac ward	61 (37.9)
Discharged from the emergency	52 (32.3)
Admitted to cardiac ICU	47 (29.2)
Went out against advise to stay	1 (0.6)
Trajectory after admission to either cardiac ward or ICU	
Discharged	135 (83.9)
Died	23 (14.3)
Went out against advise to stay	3 (1.9)

Table 8: In-Hospital Trajectory of Patients After Triage at Emergency

Variables	Adjusted odds ratio (AOR)	95% CI	P- value
Hypotension	1.35	(0.53, 3.45)	0.525
Higher NYHA class (III and IV)	29.7	(0.01, 9.32)	0.987
Tachycardia	1.88	(0.66, 5.38)	0.239
LVEF less than 50%	2.5	(0.16, 0.94)	0.035
Anemia	2.4	(0.966, 5.93)	0.059
WRF	7.7	(2.91, 20.14)	0.0001
Hypokalemia	1.8	(0.68, 4.71)	0.237
Hyponatremia	12.3	(1.59, 94.45)	0.016

Table 9: Multivariate Logistic Regression Between Primary Outcome in Hospital Mortality and Predictor Variables