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Effect of Precipitating Factors on Acute Decompensated Heart Failure

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Abstract

Background: Acute decompensated heart failure (ADHF) is a life-threatening clinical event requiring urgent medical care and hospitalisation; identifying modifiable precipitating factors and evaluating short-term clinical outcomes after admission are crucial to improve risk stratification, optimise inpatient management and prevent early hospital readmissions.

Objective: To systematically evaluate the main precipitating factors for acute decompensation of heart failure patients and to analyse short term outcomes including length of hospital stay, discharge status, 30-day readmissions, intensive care unit (ICU) admissions, emergency department (ED) revisits and inpatient complications.

Methodology: A prospective observational study was conducted for a period of six months, including 98 patients, as per the inclusion criteria. Demographic data and relevant clinical data were collected using a validated patient profile form. Medication Adherence using MMAS-4, binomial logistic regression modelling and Chi-Square tests were done using SPSS version 22.0.

Results: Heart failure with reduced ejection fraction (HFrEF, EF≤40%) was the predominant phenotype, with Hypertension (76.53%) and type 2 diabetes mellitus (60.20%) as the most prevalent comorbidities. Dyspnea was present in all patients. Anaemia was observed as the major precipitating factor. The majority of the patients were non-adherent (70.40%) to medications. At discharge, 68.36% were clinically stabilised, while a few patients were referred due to clinical worsening. Inpatient complications developed in 86.73% of patients, dominated by persistent anaemia (71.42%) and worsening renal function (42.85%). The study found active smoking (OR=0.080) and acute myocardial infarction (OR=0.167) were significant predictors of extended hospital stay; infection was a strong predictor of readmission (OR=0.120), and acute myocardial infarction independently predicted a worsened discharge status (OR=8.161). Chi-square testing confirmed a significant association between myocardial infarction and worsened discharge condition ($p<0.05$).

Conclusion: Anaemia, medication non-adherence, cardiac arrhythmias, and systemic infections are the primary modifiable triggers driving ADHF hospitalisations. Early clinical recognition of these precipitants, aggressive

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treatment of underlying ischemia, and targeted multidisciplinary pharmacist-led adherence interventions are crucial strategies to optimise short-term outcomes, prevent clinical deterioration, and minimise readmissions.

Keywords: Acute Decompensated Heart Failure; Heart Failure with Reduced Ejection Fraction; Precipitating Factors; Medication Adherence; Short-Term Outcomes; Cardiorenal Syndrome.

Introduction

Acute Decompensated Heart Failure (ADHF) is a leading cause of emergency hospitalisations and short-term mortality among patients with both chronic and new-onset heart failure. It presents with acute symptoms such as pulmonary edema, hypotension, or shock, requiring urgent management. The clinical spectrum is heterogeneous, making early recognition and intervention challenging. The burden is particularly high in low- and middle-income countries, including India, where resource limitations and late presentation further worsen outcomes. ^{[1][2]} The identification of precipitating factors is crucial for effective ADHF management. Commonly implicated triggers include arrhythmias (especially atrial fibrillation), ischemic events (e.g., myocardial infarction), infections, uncontrolled hypertension, and nonadherence to medications. Many of these are modifiable and, if addressed early, can prevent progression to full decompensation. Studies have consistently shown that early detection and intervention targeting these triggers can reduce rehospitalisation and improve survival. ^{[3][4]} Assessment of short-term outcomes - such as ICU admission, emergency revisits, complications, readmission within 30 days, and hospital length of stay—is vital to evaluate the effectiveness of treatment in ADHF. These metrics also aid in risk stratification and resource allocation. Risk prediction models using variables like age, renal function, NT-proBNP, and lactate levels have shown utility in forecasting patient prognosis during acute episodes. ^[5] There is a lack of comprehensive studies from Indian tertiary care centres focusing on both precipitating factors and early clinical outcomes of ADHF. Most existing data come from Western or multinational registries, which may not reflect the demographic, clinical, and socioeconomic context of Indian patients. Locally generated data are necessary to develop population-specific strategies for early detection, prevention, and personalised management. ^[6]

Thus, this study aims to fill this critical knowledge gap by evaluating the clinical presentation, triggers, and short-term outcomes in ADHF patients in a tertiary hospital setting. It will enable clinicians to better stratify patient risk, adopt preventive strategies, optimise therapeutic regimens, and ultimately improve both clinical and economic outcomes. Additionally, tools like the Morisky Medication Adherence Scale (MMAS-4) used in this study will help identify non-adherence, a major reversible trigger of decompensation ^{[7][8]}. Multiple studies have shown that precipitating factors such as infections, arrhythmias, myocardial infarction, and medication non-adherence are not only common but are also predictive of short-term outcomes like hospital readmission, emergency department (ED) revisits, 7-day mortality, and complications during hospital stay. However, the exact nature and strength of these associations vary across populations and settings, particularly in resource-limited or diverse clinical environments like those in many Indian tertiary care hospitals. By assessing the association between specific precipitating factors and short-term clinical outcomes, this study helps identify which triggers are most predictive of poor prognosis in the local patient population. This enables better triage and resource allocation in emergency settings, and prioritisation of high-risk patients for aggressive monitoring or interventions ^[6]. Some triggers, like infections or myocardial infarction, are associated with higher in-hospital mortality and complication rates, due to systemic inflammation or extensive cardiac damage. Others, such as uncontrolled hypertension, may be associated with a better prognosis, as they are often easier to manage and reverse quickly with appropriate therapy. ^[1] In India, factors like medication non-adherence, lack of early health-seeking behaviour, and prevalence of undiagnosed comorbidities make it crucial to understand how these context-specific precipitating factors influence outcomes. This study can fill the knowledge gap and guide resource allocation in overcrowded Emergency Departments, and assist in building local treatment protocols and discharge planning systems. ^[1]

Materials and Methods

Study design and clinical setting

A prospective observational study was conducted over a total duration of six months in the Department of General Medicine and Emergency Department of ESIC MC-PGIMS & Model Hospital, Rajajinagar, Bengaluru, Karnataka, India.

Sample size determination

The target sample size (N) was computed using the single proportion sample size formula at a 95% confidence level and a margin of error of 0.05, and was calculated to be 98 patients.

Eligibility criteria

Patients presenting to the emergency or medical wards were screened against predefined inclusion and exclusion criteria. Inclusion criteria were patients above age 18 of either gender, admitted to general medicine or the emergency department with a confirmed primary diagnosis of ADHF, Patient or legally authorised representative who provided informed consent. Exclusion criteria were patients with primary non-cardiac causes of heart failure, chronic stable heart failure without acute decompensation, patients with congenital heart disease, acute pulmonary embolism, severe psychiatric illness, known cases of HIV positivity, Pregnant or lactating women, seriously ill patients unable to undergo clinical assessment, or incomplete medical records

Study procedures and data tools

Data were collected using a validated data collection form. Information was acquired through bedside clinical interviews with patients or bystanders, direct physical examinations, and systematic reviews of medical records.

1. **Demographic and Clinical Form:** Using validated data collection form, demographic data including age, gender, body mass index (BMI), chief presenting complaints (dyspnea, orthopnea, chest pain, edema, fatigue), comorbid conditions, lifestyle habits (smoking, alcohol, physical activity, diet), pre-hospital medication history, diagnostic test parameters (electrocardiogram, chest X-ray, arterial blood gas, echocardiography), baseline laboratory values (serum creatinine, eGFR, AST, ALT, total bilirubin, sodium, potassium, troponin, NT-proBNP), vital signs, and inpatient treatment regimens. Short-term outcomes, viz length of hospital stay (LOS), discharge status (stable, worsened, referred, expired, discharge against medical advice [DAMA]), development of inpatient complications, ICU admission requirements, 30-day readmission, and emergency department revisits.
2. **Morisky Medication Adherence Scale-4 (MMAS-4):** Applied to measure pre-admission adherence to prescribed cardiovascular medications. Scoring categorised patients into High Adherence (score = 8), Medium Adherence (score = 6–7), and Low Adherence (score = 4–5). Specific barriers to adherence were recorded.

Statistical analysis

Continuous variables were summarised as mean and standard deviation (SD), while categorical variables were summarised as absolute frequencies (n) and percentages (%). Binomial logistic regression analysis was conducted to identify independent clinical predictors of short-term outcomes, specifically evaluating factors influencing length of hospital stay, discharge status, and 30-day readmissions. The association between individual precipitating factors and clinical outcomes was evaluated using the Chi-Square (χ^2) test. A p-value <0.05 was considered statistically significant. Statistical procedures were carried out using SPSS Version 22.0 (IBM Corp., Armonk, NY).

Results

A total of 98 patients fulfilling the inclusion criteria were enrolled in the study. Males comprised 63.26% of the cohort, whereas females accounted for 36.73%. The predominant age group was 55–64 years (32.65%), followed closely by patients ≥ 65 years (30.61%). Categorisation by ejection fraction demonstrated that HF_rEF was the most common phenotype (51.03%), HF_pEF was present in 33.67%, and HF_mrEF accounted for 15.31% as shown in table-1. Length of hospital stay varied among patients, with 36 days being the highest and 2 days being the lowest; the average length of stay was 6 days.

Table 1: Demographic profile and heart failure phenotypes

Clinical Parameter	Stratification	Patient Count (n)	Percentage (%)
Ejection Fraction	HFrEF (LVEF $\leq$ 40%)	50	51.03
	HFmrEF (LVEF 41-49%)	15	15.31
	HFpEF (LVEF $\geq$ 50%)	33	33.67

Clinical presentation and comorbid conditions

Dyspnea was found in all patients; fatigue and weakness were predominant in 88.78%. Other frequent signs and symptoms included orthopnea, edema, pulmonary crackles, jugular venous distension, and chest pain, as shown in Table-2.

Table 2: Clinical presentation

Clinical Symptoms and Signs	Patient Count (n)	Percentage (%)
Dyspnea	98	100.00
Fatigue / Weakness	87	88.78
Orthopnea	83	84.69
Swelling / Edema	83	84.69
Pulmonary Crackles	82	83.67
Jugular Venous Distension	61	62.24
Chest Pain	50	51.02
Palpitations	46	46.94
Dizziness / Syncope	18	18.36
Cyanosis (Peripheral or Central)	18	18.36
Dry Cough	12	12.24
Wet Cough	12	12.24
Fever	12	12.24
Reduced Urine Output	7	7.14

Hypertension was the most prevalent comorbidity (76.53%), followed by type 2 diabetes mellitus, coronary artery disease, chronic kidney disease, sleep apnea and COPD/asthma, as shown in Table-3.

Table 3: Comorbidities

Comorbidity Category	Specific Disease	Patient Count (n)	Percentage (%)
Cardiovascular	Hypertension	75	76.53
	Coronary Artery Disease	45	45.91
	Stroke	10	10.20
	Dilated Cardiomyopathy	4	4.08
	LV Apical Clot	1	1.02
	Triple Vessel Disease	1	1.02
	RHD	1	1.02
Respiratory System	Sleep Apnea	23	23.46
	COPD	15	15.30
	Asthma	15	15.30
	Lower Respiratory Tract Infection	4	4.08
Endocrine / Metabolic	Type 2 Diabetes Mellitus	59	60.20
	Thyroid Disorders	9	9.18
	Osteoporosis	1	1.02
Renal / Other Systems	Chronic Kidney Disease	32	32.65
	Hepatitis	3	3.06

	Psoriasis	2	2.04
	Alcohol Dependence Syndrome	2	2.04
	Syphilis	1	1.02
	Seizure Disorder	1	1.02
	Cholelithiasis	1	1.02

Social habits, lifestyle, and medical adherence

Evaluation of social risk factors indicated that 52.09% (n=51) of patients were active or former smokers, and 54.08% (n=53) reported alcohol consumption. A sedentary lifestyle was noted in 44.89% of participants, while 24.48% (n=24) consumed a diet high in both salt and fat.

Precipitating factors for acute decomposition

Anemia was the most frequently identified precipitating trigger (72.44%), followed closely by medication non-adherence (70.40%), cardiac arrhythmias (53.06%), dietary non-compliance (45.91%), renal dysfunction (45.91%), infections (46.93%), uncontrolled hypertension (33.67%), myocardial infarction (29.59%), and recent surgery (29.59%). Table 6: Precipitating factors as shown in Table-4.

Table 4: Precipitating factors

Precipitating Factor	Patient Count (n)	Percentage (%)
Anemia	71	72.44
Cardiac Arrhythmia	52	53.06
Infection (Pneumonia, UTI etc.)	46	46.93
Renal Dysfunction	45	45.91
Dietary non-compliance	45	45.91
Uncontrolled Hypertension	33	33.67
Myocardial Infarction	29	29.59
Recent Surgery	29	29.59

Sub-analysis of arrhythmia types showed atrial arrhythmias in 21.42% of patients, sinus arrhythmias in 20.40%, junctional /nodal arrhythmias in 2.04%, and ventricular arrhythmias in 9.18%. Sub-analysis of renal impairment subtypes demonstrated acute kidney injury in 9.18%, CKD Stage 4 in 9.18%, CKD Stage 5 in 8.16%, and Acute-on-chronic kidney disease in 5.10% of patients.

Assessment of pre-admission adherence using the MMAS-4 tool revealed that only 29.59% of patients maintained high medication adherence. Medium adherence was observed in 38.77%, and low adherence was found in 31.63%. The primary barriers to adherence included forgetting to take medications (58.16%), stopping therapy upon feeling better (46.93%), difficulty remembering dosage schedules (44.89%), and discontinuing drugs when feeling worse (25.51%), as shown in Table-5.

Table 5: Medication adherence and barriers to adherence

Parameter (MMAS-4)	Category or Behaviour	Patient Count (n)	Percentage (%)
Adherence Category	High Adherence	29	29.59
	Medium Adherence	38	38.77
	Low Adherence	31	31.63
Specific Barriers	Forgetting to take medication	57	58.16
	Stopping medication when feeling better	46	46.93
	Difficulty remembering dosage schedule	44	44.89
	Stopping medication when feeling worse	25	25.51

Prescription pattern for ADHF Patients

In-hospital treatment involved diuretic therapy in all patients, with furosemide prescribed in 89.79% and spironolactone in 60.20% f/b Statins, antiplatelet therapy, beta-blockers, CCBs, ARBs, SGLT2 inhibitors

(dapagliflozin), ACE inhibitors, inotropes, and ARNI (sacubitril/valsartan). Other prescribed medications are as shown in Table-6.

Table 6: Distribution based on medications prescribed

Drug Class	Specific Agent Prescribed	Patient Count (n)	Percentage (%)
Diuretics	Furosemide	88	89.79
	Spironolactone	59	60.20
	Torsemide	15	15.30
	Metolazone	1	1.02
Beta-Blockers	Metoprolol	33	33.67
	Bisoprolol	12	12.24
RAAS Blockers / ARNI	Telmisartan (ARB)	30	30.61
	Ramipril (ACEi)	15	15.30
	Perindopril (ACEi)	7	7.14
	Sacubitril + Valsartan (ARNI)	6	6.12
Statins & Antiplatelets	Atorvastatin	61	62.24
	Rosuvastatin	5	5.10
	Aspirin	62	63.26
	Clopidogrel	27	27.55
	Ticagrelor	3	3.06
SGLT2 Inhibitors	Dapagliflozin	25	25.51
Calcium Channel Blockers	Cilnidipine	24	24.48
	Amlodipine	8	8.16
Inotropes & Vasodilators	Digoxin	7	7.14
	Dopamine	6	6.12
	Nitroglycerin	3	3.06
	Hydralazine	1	1.02

Laboratory Findings, Diagnostics and Vital Signs

Laboratory profiling revealed significant baseline cardiorenal stress and myocardial injury. Mean NT-proBNP was 212.1 pg/mL, and mean troponin was 174.1 ng/L. Mean serum creatinine was 1.5 mg/dL, with a corresponding mean eGFR of 27.54 mL/min/1.73m². Mean serum sodium was 137.8 mmol/L, and mean potassium was 4.2 mmol/L.

Diagnostic evaluations revealed ECG abnormalities in 84.69% of patients, led by LV abnormalities (30.61%) and ST-T segment changes (29.59%). Chest X-rays were abnormal in 77.55%, showing pulmonary congestion (31.63%) and pleural effusion (27.55%). ABG analysis showed abnormalities in 64.28%, with isolated hypoxemia present in 30.61%.

Vital sign parameters demonstrated favourable hemodynamic responses post-treatment, as shown in Table-7.

Table 7: Vitals

Vital Sign Parameter	Pre-Treatment Mean $\pm$ SD	Post-Treatment Mean $\pm$ SD
Systolic Blood Pressure (mmHg)	149.06 $\pm$ 26.17	126.19 $\pm$ 18.32
Diastolic Blood Pressure (mmHg)	99.54 $\pm$ 15.05	78.67 $\pm$ 34.68
Pulse Rate (bpm)	96.83 $\pm$ 18.04	90.80 $\pm$ 12.89
Respiratory Rate (cpm)	19.27 $\pm$ 5.34	18.85 $\pm$ 4.43
Oxygen Saturation (SPO ₂ %)	93.51 $\pm$ 6.60	95.76 $\pm$ 2.26

Short-term outcomes and inpatient complications

1. Length of stay: The mean length of hospital stay was 7 days. The minimum length of stay was 2 days, and the maximum was 36 days. Other status at discharge and short-term clinical outcomes are as mentioned in Table-8

Table 8: Short-term outcomes

Outcome Measure	Category or Status	Patient Count (n)	Percentage (%)
Discharge Status	Stable	67	68.36
	Worsened and referred	20	20.40
	Clinical Worsening	8	8.16
	In-Hospital Mortality (Expired)	2	2.04
	Discharged Against Medical Advice (DAMA)	1	1.02
Clinical Outcomes	Inpatient Complications Observed	85	86.73
	Rehospitalization	16	16.32
	ICU Admission Required	11	11.22
	30-Day Readmission	9	9.18
	Emergency Department Revisit	6	6.12
	No Readmission	60	61.22

2. Inpatient complications were observed in 86.73% of patients. The most frequent complications were persistent anaemia, worsening renal function, secondary cardiac arrhythmias, respiratory distress, acute myocardial infarction, and uncontrolled hypertension, as shown in Table-9.

Table 9: Inpatient complications

Inpatient Complications	Patient Count (n)	Percentage (%)
Anemia	70	71.42
Worsening Renal Function	42	42.85
Cardiac Arrhythmias	35	35.71
Respiratory Distress	31	31.63
Myocardial Infarction	23	23.46
Uncontrolled Hypertension	10	10.20
Dilated Cardiomyopathy	4	4.08
Volume Overload	3	3.06
Shock	3	3.06
Acute Exacerbation of COPD	2	2.04
Cellulitis	1	1.02
DKA	1	1.02
CLD	1	1.02
Flash Pulmonary Edema	1	1.02

Logistic regression and chi-square association models

Binomial logistic regression modelling was used to evaluate independent predictors of short-term outcomes. In the hospital length-of-stay model (χ^2 (10) = 24.0, p = 0.008), active smoking (p = 0.034, OR = 0.080) and acute myocardial infarction (p = 0.002, OR = 0.167) were statistically significant independent predictors of prolonged hospital stay, as shown in Table-10.

Table 10: Binomial logistic regression table for factors influencing length of stay

Predictor Variable	Standard Error	Z-value	p-value	Odds Ratio (OR)	95% Confidence Interval
Intercept	0.787	0.8271	0.408	1.9179	0.4098 – 8.974
Smoking	1.191	-2.1206	0.034	0.0800	0.0077 – 0.826
Alcohol Use	1.188	1.6117	0.107	6.7842	0.6612 – 69.607
Infection	0.531	0.0999	0.920	1.0544	0.3726 – 2.983
Uncontrolled Hypertension	0.566	-0.0659	0.947	0.9634	0.3176 – 2.921
Myocardial Infarction	0.569	-3.1454	0.002	0.1671	0.0547 – 0.509
Cardiac Arrhythmia	0.499	-1.0130	0.311	0.6031	0.2266 – 1.604
Renal Dysfunction	0.526	1.3350	0.182	2.0190	0.7197 – 5.664
Recent Surgery	0.573	1.0543	0.292	1.8304	0.5949 – 5.631
Anemia	0.561	1.6005	0.109	2.4555	0.8173 – 7.377
Medication non-Adherence	0.565	-0.4962	0.620	0.7556	0.2498 – 2.285

In the discharge status model (Deviance=95.7, AIC=118, R2McF=0, χ^2 (10) =26.6, p =0.003), acute myocardial infarction independently increased the odds of a worsened discharge status by over eight-fold (p <0.001, OR=8.161). Active smoking showed a statistical trend (p =0.064, OR=5.772), as shown in Table-11.

Table 11: Binomial logistic regression table for factors influencing Discharge status

Predictor Variable	Standard Error	Z-value	p-value	Odds Ratio (OR)	95% Confidence Interval
Intercept	0.899	-2.4955	0.013	0.106	0.0182 – 0.618
Smoking	0.948	1.8499	0.064	5.772	0.9009 – 36.977
Alcohol Use	0.944	-1.7685	0.077	0.188	0.0296 – 1.198
Infection	0.570	1.6191	0.105	2.519	0.8233 – 7.704
Uncontrolled Hypertension	0.604	1.2714	0.204	2.154	0.6599 – 7.033
Myocardial Infarction	0.584	3.5926	<0.001	8.161	2.5962 – 25.653
Cardiac Arrhythmia	0.534	0.2002	0.841	1.113	0.3909 – 3.168
Renal Dysfunction	0.594	1.5708	0.116	2.542	0.7937 – 8.141
Recent Surgery	0.584	-0.0498	0.960	0.971	0.3091 – 3.052
Anemia	0.623	0.2569	0.797	1.173	0.3463 – 3.976
Medication non-Adherence	0.638	-1.6079	0.108	0.358	0.1027 – 1.252

In the readmission prediction model (Deviance=55.7, AIC=77.7, R2McF=0.244, χ^2 (10) =17.9, p =0.056), acute infection was identified as a statistically significant predictor of 30-day readmissions (p =0.017, OR=0.120), as shown in Table-12.

Table 12: Binomial logistic regression table for factors influencing readmission

Predictor Variable	Standard Error	Z-value	p-value	Odds Ratio (OR)	95% Confidence Interval
Intercept	1.084	0.0793	0.937	1.090	0.1301 – 9.126
Smoking	1.282	0.3181	0.750	1.504	0.1218 – 18.563
Alcohol Use	1.207	-1.1773	0.239	0.241	0.0227 – 2.572
Infection	0.889	-2.3818	0.017	0.120	0.0211 – 0.687
Uncontrolled	0.845	1.0562	0.291	2.441	0.4660 – 12.784
Myocardial	0.768	1.2329	0.218	2.578	0.5721 – 11.617
Cardiac Arrhythmia	0.771	0.7403	0.459	1.770	0.3905 – 8.020
Renal Dysfunction	0.831	0.8912	0.373	2.096	0.4115 – 10.680
Recent Surgery	0.955	-1.7919	0.073	0.181	0.0278 – 1.174
Anemia	0.835	-1.1275	0.260	0.390	0.0759 – 2.004
Medication adherence non-	0.846	-0.2068	0.836	0.839	0.1599 – 4.408

Chi-Square testing demonstrated that acute myocardial infarction had a statistically significant association with hospital length of stay ($\chi^2=10.023$, $p=0.00666$) and discharge status ($\chi^2=13.8718$, $p=0.0002$). Anaemia also showed a notable association with length of hospital stay ($\chi^2=4.916$, $p=0.0856$), as shown in Table-13, 14.

Table 13: Association of length of stay with precipitating factors by chi-square test

Precipitating factors	Chi-Square value (χ^2)	p-value	degree of freedom
Smoking	4.092995	0.129187	2
Alcohol consumption	0.696573	0.705897	2
Infection	0.760504	0.683689	2
Uncontrolled HTN	2.187246	0.335001	2
MI	10.02333	0.00666	2
Arrhythmia	1.688189	0.429947	2
Renal dysfunction	2.751934	0.252595	2
Recent surgery	5.470075	0.64892	2
Anemia	4.915848	0.085613	2
Medication non-adherence	1.258058	0.533109	2

Table 14: Association of length of stay with precipitating factors by chi-square test

Precipitating factors	Chi-Square value (χ^2)	p-value	degree of freedom
Smoking	0.03819	0.84506	1
Alcohol consumption	0.5921	0.44161	1
Infection	2.25352	0.13331	1
Uncontrolled HTN	1.38583	0.23911	1
MI	13.8718	0.0002	1
Arrhythmia	1.02205	0.31203	1
Renal dysfunction	3.74974	0.5282	1
Recent surgery	0.75552	0.38473	1
Anemia	0.5612	0.45378	1
Medication non-adherence	0.75552	0.38473	1

Discussion

This prospective observational study provides clinical insights into the precipitating factors, baseline characteristics, and short-term outcomes of patients hospitalised for acute decompensated heart failure at an urban South Indian tertiary care centre. The observed demographic pattern—demonstrating a clear male predominance (63.26%) and a peak presentation among middle-aged and elderly individuals (55–64 years)—aligns with Indian national registry findings, such as the Indian College of Cardiology National Heart Failure Registry (ICCNHFR), as well as regional studies by Shinde et al. Compared to Western registries like ADHERE, where the median age of ADHF presentation typically exceeds 70 years, Indian heart failure cohorts present roughly a decade earlier.

This earlier onset is largely attributable to the accelerated prevalence of premature coronary artery disease, poorly controlled hypertension, and metabolic syndrome in South Asian populations.

The primary insight derived from this study concerns the major role played by preventable and modifiable precipitating factors. Anaemia (72.44%) and medication non-adherence (70.40%) were identified as the two most common triggers initiating acute decompensation.

Pathophysiologically, anaemia reduces tissue oxygen delivery, forcing a compromised myocardium to increase cardiac output through compensatory tachycardia and increased stroke volume. This neurohormonal and hemodynamic stress increases left ventricular filling pressures, accelerates myocardial oxygen demand, and worsens volume overload.

Simultaneously, medication non-adherence functions as a major trigger for decompensation. Evaluation using the MMAS-4 scale revealed that over 70% of patients had medium or low pre-admission adherence, with nearly half (46.93%) acknowledging that they stopped taking their medications once their symptoms improved. This finding points to a substantial health literacy gap regarding chronic heart failure management. Patients frequently treat heart failure medications as temporary symptomatic interventions rather than lifelong disease-modifying therapies. Premature cessation of loop diuretics or GDMT leads to rapid sodium and water retention, secondary neurohormonal activation, acute pulmonary congestion, and avoidable emergency department admissions.

Ischemic heart disease remains a central determinant of adverse short-term clinical outcomes. In our regression models, acute myocardial infarction independently increased the odds of a worsened discharge status by over eight-fold ($p < 0.001$, $OR = 8.161$) and significantly extended hospital length of stay ($p = 0.002$, $OR = 0.167$).

Superimposing acute ischemia onto a chronically failing ventricle causes abrupt loss of functional myocardium, severe diastolic stiffness, acute mitral regurgitation, and hemodynamic instability. This severe pathophysiology explains why 20.40% of patients required emergency referral to higher care centers for mechanical circulatory support or advanced invasive care.

Systemic infections (46.93%), primarily lower respiratory tract infections and urinary tract infections, were identified as the primary independent predictor of 30-day readmissions ($p = 0.017$, $OR = 0.120$). Acute infections induce systemic inflammatory cytokine release, high fever, tachycardia, and peripheral vasodilation, which collectively overwhelm cardiac reserve. Infection-induced inflammatory cascades also impair endothelial function and worsen cardiorenal hemodynamics, leaving patients with residual congestion at discharge that predisposes them to early post-discharge relapse.

Baseline laboratory findings underscore the frequent coexistence of cardiorenal syndrome. The high prevalence of baseline renal impairment (mean eGFR 27.54 mL/min/1.73m²) and in-hospital worsening renal function (42.85%) highlights the complex cardiorenal interaction in ADHF. Aggressive diuretic therapy, while essential for pulmonary decongestion, often reduces renal perfusion, creating a difficult balancing act between achieving euvolemia and preserving renal function.

In-hospital prescription practices showed high compliance with acute decongestive strategies (100% diuretic prescription). However, gaps remain in the rapid inpatient initiation and titration of foundational GDMT prior to discharge. While beta-blocker (45.91%) and SGLT2 inhibitor (25.51%) use was moderate, advanced

therapies like ARNI (6.12%) were underutilised. This underutilization is often driven by financial barriers, transient inpatient hypotension, or concerns regarding worsening renal function.

Study Limitations

Major limitations include: The study was a single centred study with sample size of 98 which limits the generalizability of the findings to broader regional or national populations. Secondly, the data include recall bias and social desirability bias. The study did not incorporate long-term post-discharge follow-up beyond short-term windows, precluding assessments of 1-year mortality or recurrent rehospitalisation rates. Finally, financial status and individual familial predispositions were not formally controlled for in the multivariable models.

Conclusion

Hospitalisations in tertiary care settings for Acute decompensated heart failure are heavily driven by preventable and modifiable precipitating factors, predominantly anaemia, medication non-adherence, cardiac arrhythmias, systemic infections, and cardiorenal dysfunction. Acute ischemic events such as myocardial infarction represent high-risk triggers that directly drive prolonged hospital stays, elevated complication rates, and clinical deterioration requiring specialised tertiary referral.

Improving outcomes in ADHF requires a shift from reactive inpatient decongestion to proactive management of precipitating factors. Establishing clinical pharmacist-led medication therapy management programs focused on patient education, post-discharge follow-up, routine screening for anaemia and renal dysfunction, and systematic pre-discharge GDMT optimisation represents an essential strategy to improve clinical trajectories, reduce length of stay, and minimise avoidable hospital readmissions.

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