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Original Article

Pharmacology Section

Prescription Patterns and Medication Adherence among Heart Failure Patients at a Tertiary Care Hospital in Southern India: A Cross-sectional Study

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ABSTRACT

Introduction: Heart failure bears a significant health burden globally, particularly in India, where its prevalence is on the rise. There are striking regional variations in the prescription pattern for heart failure. Prescription pattern monitoring will help to understand the trends in drug use, compliance with regional, state or national guidelines and provide feedback information to prescribers. Being a chronic disease, medication adherence also plays a major role in improving clinical outcomes.

Aim: To analyse the prescription patterns of heart failure drugs as well as the medication adherence among heart failure patients admitted to a tertiary care hospital.

Materials and Methods: A hospitalbased, cross-sectional, observational study was conducted in the inpatient department (IPD) of Medicine in a tertiary care teaching hospital, over a period of six months from August 2024 to January 2025. A total of 204 prescriptions of heart failure patients were analysed using a prestructured proforma. The patients were asked about cardiac rehabilitation practices, and their responses were recorded by using 5-point Likert scale ranging from never to always. Medication adherence was assessed by using a pre-validated questionnaire containing nine questions, and patients were categorised to have low, moderate or high adherence based on their scores. The collected data were analysed by descriptive statistics.

Results: Males (61.3%) outnumbered females (38.7%). Most patients were aged 51-60 years, with a mean age of 63.2±12.14 years. Hypertension (60.8%), ischaemic heart disease (60.3%) and diabetes (58.3%) were the most common co-morbidities. Combination therapy was preferred with diuretics (92.7%), beta blockers (57.4%) and vasodilators (44.6%) being the most commonly prescribed drugs. Mineralocorticoid Receptor Antagonist (MRA), sodium-glucose cotransporter-2 (SGLT-2) inhibitors and angiotensin receptor neprilysin inhibitors (ARNI) were also prescribed. Cardiac rehabilitation uptake was poor, only 29% adhered to dietary modifications and 7.3% engaged in regular physical activity. Medication adherence assessment showed that 47.6% of patients had high adherence, while 25.5% had moderate and 27% had low adherence levels.

Conclusion: Most of the recommended drugs, including the newer drugs like SGLT-2 inhibitors and ARNI, were observed in the prescriptions. Cardiac rehabilitation and medication adherence were inadequate, highlighting the need for structured and targeted adherence improvement strategies and cardiac rehabilitation programmes.

Keywords: Cardiac rehabilitation, Co-morbidities, Congestive cardiac failure, Drug utilisation

INTRODUCTION

Heart failure (HF) describes the clinical syndrome that develops when the heart cannot maintain adequate output, or can do so only at the expense of elevated ventricular filling pressure. The burden of HF affects approximately 26 million people globally and has a prevalence of around 1% in India, with an estimated 0.1-0.16 million deaths per year. It also imposes a substantial economic burden, costing approximately 108 billion dollars per annum in India [1-3]. The lifetime risk of HF continues to be high, ranging from 20% to 45% in adults aged 45 to 95 years of age, and is dependent on various risk factors [4]. Those with hypertension, coronary artery disease, valvular heart disease, diabetes, metabolic syndrome, obesity, exposure to cardiotoxic agents or genetic variants for cardiomyopathy are persons at risk of developing HF. Furthermore, many individuals have more than one of these modifiable HF risk factors, which further increase the risk [5].

Pharmacological interventions play a crucial role in the management of heart failure, aiming to alleviate symptoms, improve quality of life, and reduce morbidity and mortality. Prescription Pattern Monitoring Studies (PPMS) are drug utilisation studies with the main focus on prescribing, dispensing, and administration of drugs, which explain the extent and profile of drug use, trends in drug use, compliance with regional, state or national guidelines and provide feedback information to prescribers. PPMS have become increasingly important because of the introduction of new drugs, variations in the pattern of prescribing and consumption of drugs, concerns about delayed adverse effects, rising cost of drugs and volume of prescriptions [6]. The study of prescribing patterns helps to monitor, evaluate, and if necessary, suggest modifications in prescribing patterns so as to make medical care rational and cost-effective. At present, few data are available [7-11] for prescription trends in patients with heart failure in our population and even fewer data are available regarding their medication adherence level.

Cardiac rehabilitation (CR) is defined as a multidisciplinary programme that includes exercise training, cardiac risk factor modification, education on co-morbidities, psychosocial assessment, and outcomes assessment [12]. CR aims to reduce the psychological and physiological stress of cardiovascular disease, lower mortality risk, and enhance cardiovascular function to improve quality of life. A Cochrane review found that CR lowered hospital admissions and contributed to a long-term reduction in all-cause mortality in patients with heart failure and preserved ejection fraction, though no short-term (<12 months) mortality benefit was observed [13].

CR is recommended by many recent HF treatment guidelines, but remains underused globally [14,15].

The chronic nature of HF warrants long-term consumption of various medications. Medication adherence is the extent to which an individual's behaviour corresponds to a healthcare provider's recommendations, and it has its own benefits, like managing symptoms, reducing hospitalisations, improving clinical outcomes and improving quality of life. Similarly, nonadherence in patients leads to substantial worsening of disease, death, and increased unnecessary healthcare expenses [16-18]. The World Health Organisation (WHO) classifies the determinants of poor medication adherence into five categories: socioeconomic factors, factors associated with the health system, disease-related factors, therapy-related factors, and patient-related factors. Understanding root causes of medication nonadherence and cost-effective approaches that are applicable to patient populations is essential to increasing adherence and improving long-term health impact [19,20].

Prescription trends may vary among different parts of the country as well as among different hospital settings and the current study aims to determine the prescription pattern of HF medications in tertiary teaching hospital located in South India. Implementation of CR programmes is poorly studied and assessment of medication adherence, specifically among HF patients, is also a less explored area. Medication adherence largely depends upon population demographics. The findings of the study help healthcare providers to understand the current scenario and may assist in developing and implementing strategies to improve medication adherence among heart failure patients.

MATERIALS AND METHODS

A hospital-based, cross-sectional observational study was conducted in the IPD of Medicine in Government Medical College, Thrissur Kerala, India, over a period of six months from August 2024 to January 2025. The study was initiated after getting permission from the Institutional Ethics Committee (IEC/GMCTSR/2024/062).

Inclusion Criteria: Patients of both genders who were admitted with a clinical diagnosis of heart failure, irrespective of aetiology, were included in the study.

Exclusion Criteria: Heart failure patients without data on the left ventricular ejection fraction (LVEF), as well as patients aged below 18 years, were excluded from the study.

Sample size calculation: Sample size was calculated based on the formula

$$n=\frac{4pq}{d^{2,}}$$

where n is the sample size, p is the expected proportion in the population, q=100-p and d is the relative precision. Based on the previous study by Rao A et al., [7], the proportion of patients receiving beta blockers was 37% (p=37, q=63). With a relative precision of 20% of p (d=7.4), the minimum sample size was 170. A total of 204 patients were included.

Study Procedure

Written patient informed consent was obtained before data collection. A total of 204 prescriptions were screened and the relevant data on patient's demographics such as age and gender; New York Heart Association (NYHA) functional class of HF at the time of admission [21]; type of HF based on LVEF like Heart Failure with reduced Ejection Fraction (HFrEF), Heart Failure with mildly reduced Ejection Fraction (HFmrEF), and Heart Failure with preserved Ejection Fraction (HFpEF) on echocardiogram [14]; co-morbid conditions; pharmacological treatment like details of HF drugs and non-HF drugs prescribed, combination therapy etc were recorded in a pre-structured proforma.

Patients were asked about the frequency of following cardiac rehabilitation practices, such as regular physical activity or exercise training, dietary modifications like salt restriction, reduction in alcohol consumption or cessation of smoking and psychosocial counselling. The responses were recorded by using 5-point Likert scale (Never, rarely, sometimes, often, always).

Patients were interviewed to assess their adherence to medications by using a pre-validated questionnaire. A questionnaire with 9 dichotomous yes/no questions was prepared, referring to previously published tools [22]. Content validity was ensured through expert review. Each item was rated for relevance on a 1-4 scale, and items with a content validity index >0.8 were included. Face validity was also assessed by reviewing the questions by HF patients. The total score was 9, with each 'yes' and 'no' responses scored 0 and 1, respectively. According to the patient's responses, scores were calculated and patients were categorised to have high, moderate, or low (>8, 6-8, and <6, respectively) medication adherence.

STATISTICAL ANALYSIS

Data were entered in Mac numbers and analysed using Statistical Package for the Social Sciences (SPSS version 20.0). The continuous variables were summarised as Mean±standard deviation (SD) and categorical variables were expressed as frequencies and percentages. Macintosh Operating System (Mac OS) pages and numbers (2018 version) were used to enter data and generate graphs, tables, and charts.

RESULTS

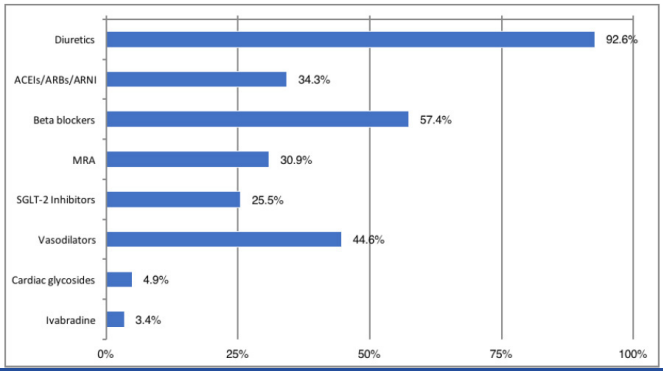
Of the 204 patients, 125 (61.3%) were male and 79 (38.7%) were female, with a mean age of 63.2±12.14 years. The majority of them were in the 51-60-year age group (30.4%). Most of the participants fell under NYHA Grading of class IV (65.2%). The echo findings showed that 39.7% of the patients had HF with an ejection fraction >50% and 35.8% had HF with <40% ejection fraction. All the admitted HF patients had associated co-morbidities, with hypertension (60.8%), ischaemic heart disease (60.3%) and diabetes (58.3%) widely noticed as summarised in [Table/Fig-1]. Among them, 80% of the patients have more than one associated co-morbidity.

Variables	n (%)
Gender	
Male	125 (61.3%)
Female	79 (38.7%)
Age (in years)	
21-30	1 (0.5%)
31-40	5 (2.5%)
41-50	24 (11.8%)
51-60	62 (30.4%)
61-70	52 (25.5%)
71-80	47 (23.0%)
>80	13 (6.4%)
NYHA Grading	
Class I	20 (9.8%)
Class II	23 (11.3%)
Class III	28 (13.7%)
Class IV	133 (65.2%)
Ejection Fraction (EF)	
HFrEF (<40%)	73 (35.8%)
HFmrEF (41-49%)	50 (24.5%)
HFpEF (>50%)	81 (39.7%)
Co-morbidities	

Hypertension	124 (60.8%)
Ischaemic heart disease	123 (60.3%)
Diabetes	119 (58.3%)
Chronic kidney disease	58 (28.4%)
Anaemia	47 (23.0%)
Obesity	35 (17.2%)
Rheumatic heart disease	27 (13.2%)
Dyslipidaemia	17 (8.3%)
Cardiomyopathy	12 (5.9%)
Thyroid disease	12 (5.9%)

[Table/Fig-1]: Baseline characteristics and co-morbidities.

A total of 8 classes of HF drugs were seen among the prescriptions, with diuretics being the most commonly used (92.7%). Diuretics were followed by beta blockers (57.4%) and vasodilators (44.6%) as summarised in [Table/Fig-2]. Angiotensin Aldosterone System (RAAS) inhibitors were prescribed for 70 patients (34.3%), which included Angiotensin Converting Enzyme Inhibitors (ACEIs) 46 patients (65.7%), Angiotensin Receptor Blockers (ARBs) 17 patients (24.3%) and ARNI 7 patients (10%). Prescriptions of MRA (30.9%) and SGLT-2 Inhibitors (25.5%) were also sighted.



[Table/Fig-2]: Distribution pattern of different classes of heart failure drugs n (%)*. *Diuretics – 189 (92.6%), ACEIs/ARBs/ARNI – 70 (34.3%), Beta blockers – 117 (57.4%), MRA – 63 (30.9%), SGLT-2Inhibitors – 52 (25.5%), Vasodilators – 91 (44.6%), Cardiac glycosides – 10 (4.9%), Ivabradine – 7 (3.4%)

Only 18.1% of the patients were receiving monotherapy, and diuretics were the sole drug used. The rest of the patients (81.9%) were having combination therapy, and three drug regimens were the commonly used combination [Table/Fig-3].

Drug therapy regimen	n (%)
Monotherapy	37 (18%)
2-drug regimen	44 (22%)
3-drug regimen	57 (28%)
4-drug regimen	35 (17%)
5-drug regimen	23 (11%)
6-drug regimen	8 (4%)

[Table/Fig-3]: Distribution of number of drugs prescribed in a regimen.

Among the 204 prescriptions reviewed, 34 prescriptions had Fixed-dose Combinations (FDC) of HF drugs. Isosorbide dinitrate-hydralazine (70.6%) was the most frequently encountered FDC, followed by Sacubitral-Valsartan (20.6%). Three diuretic combinations (Furosemide-Amiloride, Furosemide-Spironolactone, Torsemide-Spironolactone) were also found (n=1) each.

Furosemide was the most commonly used diuretic (88.4%). Nitrates (73.6%) were the commonly prescribed vasodilator, and among Beta blockers, Carvedilol (39.3%) and Metoprolol (35.9%) were prescribed the most. Enalapril (51.4%) was the most common ACEI observed in the prescriptions. Spironolactone and Dapagliflozin were the only prescribed MRA and SGLT2 inhibitor respectively [Table/Fig-4].

Drugs	n (%)
Diuretics (total n=189)	
Furosemide	167 (88.4%)
Furosemide + Amiloride	1 (0.5%)
Frusemide + MRA	1 (0.5%)
Torsemide	18 (9.5%)
Torsemide + MRA	1 (0.5%)
Metolazone	1 (0.5%)
ACEIs/ ARBs/ ARNI (total n=70)	
Enalapril	36 (51.4%)
Ramipril	8 (11.4%)
Captopril	2 (2.9%)
Telmisartan	9 (12.9%)
Losartan	5 (7.1%)
Valsartan	3 (4.3%)
Sacubitril-valsartan	7 (10%)
Beta blockers (total n=117)	
Carvedilol	46 (39.3%)
Metoprolol	42 (35.9%)
Nebivolol	16 (13.7%)
Bisoprolol	13 (11.1%)
MRA (total n=63)	
Spironolactone	63 (100%)
SGLT-2 Inhibitors (total n=52)	
Dapagliflozin	52 (100%)
Vasodilators (total n=91)	
Nitrates	67 (73.6%)
Isosorbide dinitrate-hydralazine	24 (26.4%)
Other drugs	
Digoxin	10 (4.9%)
Ivabradine	7 (3.4%)
Antiplatelets	176 (86.3%)
Anticoagulants	76 (37.3%)
Hypolipidaemics	181 (88.7%)
Antihypertensives	122 (59.8%)
Hypoglycaemics	118 (57.8%)
Proton pump inhibitors	177 (86.8%)
Multivitamins	42 (20.6%)
Antibiotics	66 (32.4%)

[Table/Fig-4]: Distribution pattern of individual drugs.

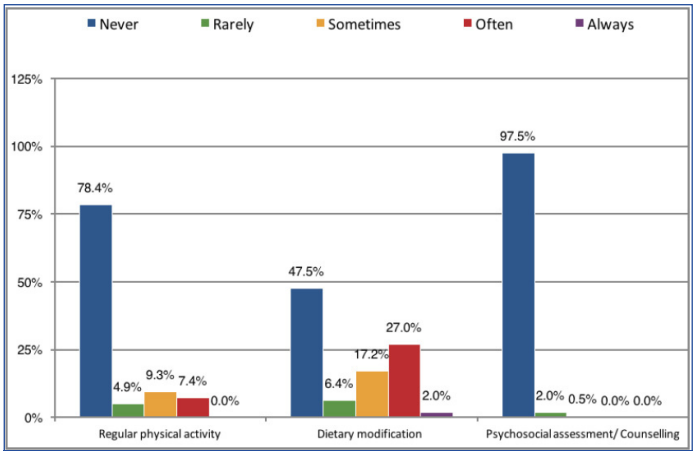
Hypolipidaemics (88.7%), proton pump inhibitors (86.8%), antiplatelets (86.3%), antihypertensives (59.8%) and hypoglycaemics (57.8%) were the other drugs prescribed to the patients [Table/Fig-4].

As a part of cardiac rehabilitation, 29% participants reported following dietary modifications and 7.3% reported engaging in regular physical activity. But none were following any sessions for psychosocial assessment or counselling [Table/Fig-5].

Medication adherence was calculated using a prevalidated questionnaire and showed that 97 (47.6%) patients had high adherence, and the rest exhibited moderate 52 (25.5%) to low 55 (27%) adherence levels. Mean scores for the population were 6.93±2.5, and for individual categories of low, moderate and high adherence were 3.33±1.47, 6.87±0.77 and 9, respectively.

DISCUSSION

In this hospital-based, cross-sectional study of 204 HF patients, a predominance of male patients, high prevalence of multiple co-morbidities, frequent use of diuretics, underuse of guideline [14,23]



[Table/Fig-5]: Patients following cardiac rehabilitation as a part of HF management.

recommended agents (MRA, SGLT-2 inhibitors, ARNI), poor uptake of cardiac rehabilitation and suboptimal medication adherence were observed.

The study population observed a male predominance (61.3%) and is similar to previously conducted studies, where male prevalence ranged from 60%-73% [8-10,24]. The majority of the patients in the present study were in the age group 51-60 (30.4%), which correlates with the study conducted by Latha MR et al., [8], where majority (39.1%) of subjects were in the age group 51-65 years. The mean age of the current study population was 63.2±12.14 years, which is comparable to studies conducted by Latha MR et al., (59.05±13.34 years) and Jose J et al., (59.6±9.42 years) [8,9].

In the present study, most of the study participants (65.2%) were admitted with NYHA class IV and found to have HFpEF (39.7%) and this likely reflects the study centre's status as a tertiary care referral hospital. This finding is in concordance with Pallangyo P et al., (56.3%) and Rastogi T et al., (51.9%), where the majority of the patients were NYHA class IV. [18,25]. This is in contrast with Shahri SS et al., (28.3%) and Nalado AM et al., (34%), where most of the patients were classified under class 2 [24,26]. HFpEF (54%) was found as the common HF category by Rastogi T et al., [25], but HFrEF predominates in studies by Pallangyo P et al., and Nalado AM et al., [18,26]. In the present study, hypertension (60.8%), ischaemic heart disease (60.3%) and diabetes (58.3%) were the most common co-morbidities and 80% of them had multiple co-morbidities.Previous studies have reported similar findings [8-10,24,25].

The present study found that combination therapy (81.9%) was the preferred approach for managing HF. These observations are consistent with previous studies [9,10,24,26]. In the present study, the most commonly prescribed drug was found to be diuretics (92.7%), which is in concordance with Latha MR et al., [8] and Rastogi T et al., [25]. Even though diuretics do not retard the disease progression, they play a major role in the improvement of clinical status. Beta blocker prescription was 57.4% in contrast to Shahri SS et al., (76.4%) and Rastogi T et al., (80.3%) [24,25], where these drug groups were prescribed more frequently. Beta blockers improve adverse cardiac remodelling, reduce hospitalisations, and have a high economic value. But vasodilators (44.6%), especially nitrates were found to be high in the present study compared to others. Inhibition of RAAS has been showed to decrease the mortality and morbidity, especially in patients with co-morbidities like diabetes, hypertension, etc., and ARNI showed more advantages over others. But in the current study, RAAS inhibitors were prescribed in 34.31% of patients; this percentage varied widely across previous studies [8,9,24,26]. ARNI was found only in 10% of patients, which is still higher when compared with studies by Shahri SS et al., [24] and Rastogi T et al., [25]. Prescriptions of other guideline-recommended medications like MRA (30.88%) and SGLT-2 Inhibitors (25.49%) were also low in the present study setting compared to Shahri SS et al., [24] and Nalado AM et al., [26]. A study by Uijil A et al., [27] also showed that the use of MRA remained low and did not change throughout the long follow-up period. This underuse in the current study may be related to financial constraints among patients or the non availability of subsidised drugs in a government setting or concerns regarding hyperkalemia. Use of cardiac glycosides (4.9 %) was low, consistent with the declining trend reported in previous studies [9,10,24,25]. and is in line with newer recommendations.

In the current study, drugs other than HF drugs, hypolipidaemics (88.7%), proton pump inhibitors (86.8%) and antiplatelets (86.3%) were encountered more and this is in parallel with findings of previous studies [9,24].

As a part of cardiac rehabilitation, very few were following dietary modifications (29%) or regular physical activity (7.3%). This showed the underutilisation of CR programme even after the establishment of its benefits [28]. Major factors accounting for underuse may be lack of structured CR programmes, limited awareness and education among the providers as well as various physical or economic barriers among patients. A questionnaire-based assessment of medication adherence shown that more than half of the study participants exhibited moderate to low adherence (52.5%). This observation is in par with previous medication adherence studies in HF patients [29-31].

Limitation(s)

The current study has several limitations. As a single-centre cross-sectional study, it could not establish long-term outcomes and the findings may not be generalised to other settings. A larger sample size could also help to assess the different drug utilisation patterns efficiently. Medication adherence was assessed by a self-reported questionnaire, and recall bias could have affected the assessment. Future prospective studies are needed to evaluate the impact of adherence interventions on long-term clinical outcomes.

CONCLUSION(S)

The prescribing pattern shows that diuretics are the most frequently used drug for management of HF, followed by beta blockers, vasodilators, RAAS inhibitors, and MRAs. A declining trend in the use of cardiac glycosides, as well as the presence of newer drugs like ARNI and SGLT-2 inhibitors in the treatment regimen, is also identified. Additionally, the present study shows that implementation of multidisciplinary CR programmes and medication adherence interventions is needed to optimise outcomes in HF patients.

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REFERENCES

[1] Groenewegen A, Rutten FH, Mosterd A, Hoes AW. Epidemiology of heart failure. Eur J Heart Fail. 2020;22(8):1342-56. Doi: 10.1002/ejhf.1858. Epub 2020 Jun 1. PMID: 32483830; PMCID: PMC7540043.

[2] Savarese G, Lund LH. Global public health burden of heart failure. Card Fail Rev. 2017;3(1):7-11. Doi: 10.15420/cfr.2016:25:2. PMID: 28785469; PMCID: PMC5494150.

[3] Singh A, Chauhan S, Devasia T, Karkala YR, Paramasivam G, Shetty PN, et al. Financial burden of heart failure in a developing country: Cost analysis from Manipal Heart Failure Registry, India. J Public Health. 2021;29(3):585-94. Doi: 10.1007/s10389-019-01141-w.

[4] Tsao CW, Lyass A, Enserro D, Larson MG, Ho JE, Kizer JR, et al. Temporal Trends in the Incidence of and Mortality Associated With Heart Failure With Preserved and Reduced Ejection Fraction. JACC Heart Fail. 2018;6(8):678-85. Doi: 10.1016/j.jchf.2018.03.006. Epub 2018 Jul 11. PMID: 30007560; PMCID: PMC6076350.

[5] Hamo CE, Kwak L, Wang D, Florido R, Echouffo-Tcheugui JB, Blumenthal RS, et al. Heart Failure Risk Associated With Severity of Modifiable Heart Failure Risk Factors: The ARIC Study. J Am Heart Assoc. 2022;11(4):e021583. Doi: 10.1161/JAHA.121.021583. Epub 2022 Feb 12. PMID: 35156388; PMCID: PMC9245814.

[6] Jain S, Upadhyaya P, Goyal J, Kumar A, Jain P, Seth V, et al. A systematic review of prescription pattern monitoring studies and their effectiveness in promoting rational use of medicines. Perspect Clin Res. 2015;6(2):86-90. Doi: 10.4103/2229-3485.154005. PMID: 25878953; PMCID: PMC4394586.
[7] Rao A, Kumar S, Rai M. Prescription pattern in patients having heart failure in South India tertiary care hospital - A retrospective study Indian J Pharm Pharmacol. 2017;4(3):114-19. Doi: 10.18231/2393-9087.2017.0026.
[8] Latha MR, Rafeez M, Manoj RA, Mateti UV, Kodangala S, Shetty S, et al. Risk Factors and Prescribing Pattern among Congestive Heart Failure Patients: A Retrospective Study in Tertiary Care Hospital. J Young Pharm. 2022;14(2):231-5. Doi: 10.5530/jyp.2022.14.43.
[9] Jose J, Baby B, Ahammed S, Chand S, Nandakumar UP, Vinay BC, et al. Risk factors and prescription pattern among patients with congestive heart failure. J Pharmacol Pharmacother 2021;12:94-6. Doi: 10.4103/jpp.jpp_25_21.
[10] Hemamalini MB, Rekha MB, Narayanamurthy BV, Tanuja D. Study on pattern of drug utilization in the treatment of congestive cardiac failure in a tertiary care hospital. Natl J Physiol Pharm Pharmacol 2023;13(4):732-35. Doi: 10.5455/njpp.2023.13.06258202218082022.
[11] Aparna SS, Saleema S, Farsana VK, Smitha P, Jereena E. Current Trends In Prescription Pattern And Risk Factor Analysis Of Patients Admitted With Acute Heart Failure In A Tertiary Care Teaching Hospital. Journal of Pharmaceutical Negative Results 2022;13(8):955-64. Doi: 10.47750/pnr.2022.13.S08.119.
[12] Balady GJ, Ades PA, Comoss P, Limacher M, Pina IL, Southard D, et al. Core components of cardiac rehabilitation/secondary prevention programs: A statement for healthcare professionals from the American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation Writing Group. Circulation. 2000;102(9):1069-73. Doi: 10.1161/01.cir.102.9.1069. PMID: 10961975.
[13] Anderson L, Oldridge N, Thompson DR, Zwisler AD, Rees K, Martin N, et al. Exercise-Based Cardiac Rehabilitation for Coronary Heart Disease: Cochrane Systematic Review and Meta-Analysis. J Am Coll Cardiol. 2016;67(1):1-12. Doi: 10.1016/j.jacc.2015.10.044. PMID: 26764059.
[14] Heidenreich PA. Bozkurt B, Aguilar D, Allen LA, Byun JJ, Colvin MM, et al. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: Executive summary: A report of the American College of Cardiology/American Heart AssociationJoint Committee on Clinical Practice Guidelines. Circulation. 2022;145(18):e876-94. Doi: 10.1161/CIR.0000000000001062. Epub 2022 Apr 1. PMID: 35363500.
[15] Taylor RS, Dalal HM, McDonagh ST. The role of cardiac rehabilitation in improving cardiovascular outcomes. Nat Rev Cardiol. 2022;19:180-94. Doi: 10.1038/s41569-021-00611-7. Epub 2021 Sep 16. PMID: 34531576; PMCID: PMC8445013.
[16] Silavanich V, Nathisuwan S, Phrommintikul A, Permsuwan U. Relationship of medication adherence and quality of life among heart failure patients. Heart Lung. 2019;48(2):105-10. Doi: 10.1016/j.hrtlng.2018.09.009. Epub 2018 Oct 30. PMID: 30384984.
[17] Ruppar TM, Cooper PS, Mehr DR, Delgado JM, Dunbar-Jacob JM. Medication Adherence Interventions Improve Heart Failure Mortality and Readmission Rates: Systematic Review and Meta-Analysis of Controlled Trials. J Am Heart Assoc. 2016;5(6):e002606. Doi: 10.1161/JAHA.115.002606. PMID: 27317347; PMCID: PMC4937243.
[18] Pallangyo P, Millinga J, Bhalia S, Mkojera Z, Misidai N, Swai HJ, et al. Medication adherence and survival among hospitalized heart failure patients in a tertiary hospital in Tanzania: A prospective cohort study. BMC Res. Notes 2020;13:89. Doi: 10.1186/s13104-020-04959-w. PMID: 32085803; PMCID: PMC7035643.
[19] de Tantillo L, Pordeli L, McCabe BE, Zdanowicz MM, Ortega J, Gonzalez, JM. A Systematic Review of Medication Adherence Interventions for Patients with Heart Failure. Heart and Mind 2025;9(4):311-20. Doi: 10.4103/hm.HM-D-24-00098.
[20] Pawar B, Dua P, Seth S, Maulik SK, Reeta KH. A Randomized Controlled Trial Studying the Effect of Medication Adherence Tools in Patients With Heart Failure. Cureus. 2025;17(9):e93238. Doi: 10.7759/cureus.93238. PMID: 41146764; PMCID: PMC12553968.
[21] Dolgin M, Association NYH, Fox AC, Gorlin R, Levin RI, New York Heart Association. Criteria Committee. Nomenclature and criteria for diagnosis of diseases of the heart and great vessels. 9th ed. Boston MA: Lippincott Williams and Wilkins;1994.
[22] Lam WY, Fresco P. Medication Adherence Measures: An Overview. Biomed Res Int. 2015;2015:217047. Doi: 10.1155/2015/217047. Epub 2015 Oct 11. PMID: 26539470; PMCID: PMC4619779.
[23] McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Bohm M, et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J. 2021;42:3599-726. Doi: 10.1093/eurheartj/ehab368.
[24] Shahri SS, Pirayesh Z, Noughabi AZ, Heshmati M, Bizhaem SK, Jafari S, et al. Assessing the application of American Heart Association (AHA) guidelines in the management of heart failure with reduced ejection fraction. Egypt Heart J. 2025;77(1):28. Doi: 10.1186/s43044-025-00629-z. PMID: 40063170; PMCID: PMC11893950.
[25] Rastogi T, Duarte K, Huttin O, Roubille F, Girerd N. The Prescription Pattern of Heart Failure Medications in Reduced, Mildly Reduced, and Preserved Ejection Fractions. J Clin Med. 2022;12(1):99. Doi: 10.3390/jcm12010099. PMID: 36614899; PMCID: PMC9821188.
[26] Nalado AM, Saidu H. Prescription patterns of evidence-based heart failure medications in a tertiary hospital in North-Western Nigeria - A retrospective study. Niger J Basic Clin Sci 2022;19(2):151-6. Doi: 10.4103/njbcs.njbcs_34_22.
[27] Uijl A, Vaartjes I, Denaxas S, Hemingway H,Shah A,Cleland J, et al. Temporal trends in heart failure medication prescription n a population-based cohort study. BMJ Open 2021;11:e043290. Doi: 10.1136/bmjopen-2020-043290. PMID: 33653753; PMCID: PMC7929882.
[28] Bozkurt B, Fonarow GC, Goldberg LR, Guglin M, Josephson RA, Forman DE, et al. Cardiac Rehabilitation for Patients With Heart Failure: JACC Expert Panel. J Am Coll Cardiol. 2021;77(11):1454-69. Doi: 10.1016/j.jacc.2021.01.030. PMID: 33736829.
[29] Raffaa HSM, Alasmari BA, Abadi SA, Al Metrek MA, Raffaa HS, Al Qarni HZM, et al. Adherence of heart failure patients to heart failure medications and its determinants in the Aseer region, Southern Saudi Arabia. J Family Med Prim Care. 2020;9(9):5041-45. Doi: 10.4103/jfmpc.jfmpc_904_20. PMID: 33209841; PMCID: PMC7652160.
[30] Jarab AS, Al-Qerem WA, Hamam HW, Alzoubi KH, Abu Heshmeh SR, Mukattash TL, et al. Medication Adherence and Its Associated Factors Among Outpatients with Heart Failure. Patient Prefer Adherence. 2023;17:1209-20. Doi: 10.2147/PPA.S410371. PMID: 37187575; PMCID: PMC10178996.
[31] Jarrah M, Khader Y, Alkouri O, Al-Bashaireh A, Alhalaiqa F, Al Marzouqi A, et al. Medication Adherence and Its Influencing Factors among Patients with Heart Failure: A Cross Sectional Study. Medicina 2023;59(5):960. Doi: 10.3390/medicina59050960. PMID: 37241192; PMCID: PMC10224223.

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