Original Article

Evaluation of Pharmacological Management and Pharmacist-Led Interventions in Patients with Congestive Heart Failure: A Prospective Observational Study

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A B S T R A C T

Congestive Heart Failure (CHF) is a complex and progressive cardiovascular syndrome characterized by the heart's inability to pump blood efficiently, leading to insufficient perfusion of tissues and organs. This project critically examines the clinical, therapeutic, and pharmaceutical dimensions of CHF, emphasizing its growing impact on global and Indian healthcare systems. The pathophysiology involves neurohormonal activation, structural remodelling, and hemodynamic alterations, which contribute to hallmark symptoms such as dyspnoea, fatigue, and fluid retention.

This study was conducted as a prospective observational analysis at a tertiary care hospital, evaluating 120 patients diagnosed with CHF. It incorporates data on demographic profiles, comorbidities, ejection fraction, drug utilization patterns, and adverse reactions. Pharmacological management included the use of ACE inhibitors, beta-blockers, diuretics, ARBs, MRAs, and emerging agents like ARNI and SGLT2 inhibitors. The findings revealed that pharmacist-led interventions significantly improved medication adherence (as measured by MMAS-8), reduced hospital readmission rates, and enhanced patients' quality of life.

The integration of pharmaceutical care into CHF management demonstrated a clear reduction in symptom burden and healthcare utilization. This report reinforces the necessity of a multidisciplinary approach—combining clinical precision with sustained patient education and counselling—to optimize outcomes. The results advocate for stronger policy support and wider implementation of pharmacist- driven models in chronic disease management, particularly in resource-limited settings.

Keywords: *Congestive Heart Failure; ACE inhibitors; ARNI; SGLT2 inhibitors; Medication adherence; Pharmacist intervention; Cardiac remodelling; Quality of life; MMAS-8; NYHA classification.*

Introduction

Congestive heart failure (CHF) represents a major global public health challenge, characterized by the heart's inability to pump sufficient blood to meet the metabolic demands of the body. It is a complex clinical syndrome resulting from structural or functional impairment of ventricular filling or ejection of blood, often accompanied by symptoms such as dyspnea, fatigue, and fluid retention. The growing prevalence of CHF is attributed to an aging population, increased survival following myocardial infarction, and the rising incidence of comorbid conditions such as hypertension, diabetes mellitus, and coronary artery disease. Despite

advances in therapeutic strategies, CHF continues to be associated with high morbidity, mortality, frequent hospitalizations, and a substantial economic burden on healthcare systems worldwide [1].

Pharmacological management remains the cornerstone of CHF treatment, aiming to alleviate symptoms, improve quality of life, reduce hospital admissions, and prolong survival. Evidence-based drug therapies include angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), beta-blockers, mineralocorticoid receptor antagonists, diuretics, neprilysin inhibitors, and more recently, sodium-glucose co-transporter 2 (SGLT2) inhibitors. These medications target various pathophysiological mechanisms such as neurohormonal activation, fluid overload, and cardiac remodelling. However, optimal therapeutic outcomes depend not only on appropriate drug selection but also on correct dosing, adherence, monitoring for adverse drug reactions, and timely adjustments based on patient response [2].
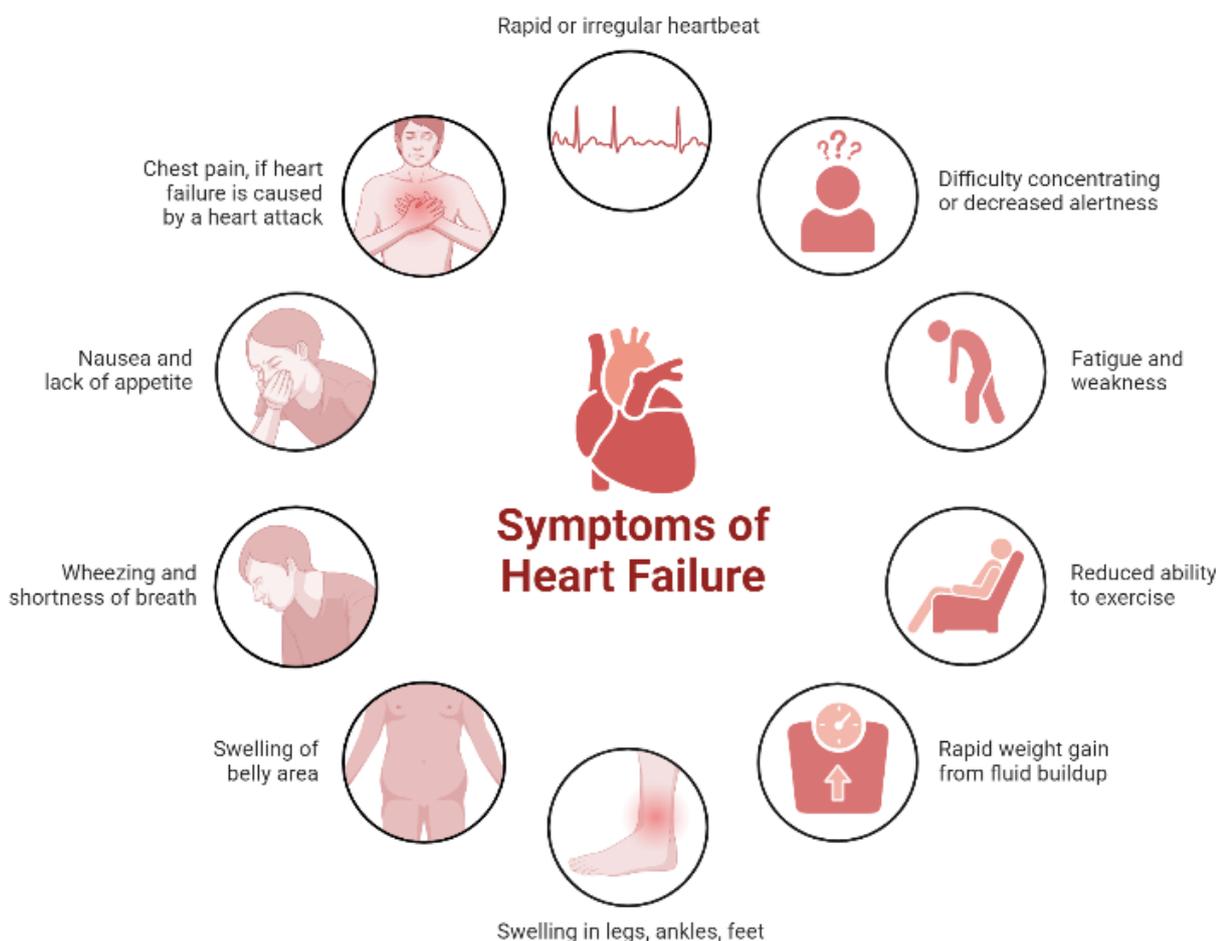

Figure 1: Symptoms of Heart Failure.

Despite well-established clinical guidelines, the real-world management of CHF often deviates from recommended practices due to multiple factors. These include polypharmacy, complex dosing regimens, patient non-adherence, lack of awareness, and inadequate follow-up. Moreover, the presence of multiple comorbidities in CHF patients increases the risk of drug-drug interactions, medication errors, and adverse drug events. These challenges highlight the need for a multidisciplinary approach to CHF management, where healthcare professionals collaborate to optimize therapy and improve patient outcomes [3].

In this context, the role of clinical pharmacists has gained increasing recognition in recent years. Pharmacists are uniquely positioned to contribute to the management of CHF through medication review, patient counseling, identification and resolution of drug-related problems (DRPs), and promotion of adherence to therapy. Pharmacist-led interventions may include medication reconciliation, therapeutic

optimization, patient education regarding disease management, lifestyle modifications, and monitoring for drug efficacy and safety. Several studies have demonstrated that such interventions can significantly reduce hospital readmissions, improve medication adherence, and enhance overall clinical outcomes in CHF patients [4].

Prospective observational studies provide valuable insights into real-world clinical practices and patient outcomes. Unlike randomized controlled trials, which are conducted under controlled conditions, observational studies reflect routine clinical settings and help identify gaps in current management strategies. They are particularly useful in evaluating the effectiveness of pharmacist-led interventions, as they allow for the assessment of interventions in a naturalistic environment without altering standard care practices. By systematically observing and documenting patient outcomes, medication use patterns, and the impact of clinical pharmacy services, such studies contribute to evidence-based improvements in healthcare delivery [5].

The integration of pharmacists into the multidisciplinary care team is especially important in resource-limited settings, where healthcare systems often face challenges such as high patient load, limited physician availability, and inadequate patient education. In such settings, pharmacist-led interventions can play a crucial role in bridging gaps in care, ensuring rational use of medications, and promoting patient-centered approaches to treatment. Furthermore, the involvement of pharmacists in patient care has been associated with improved therapeutic outcomes, reduced healthcare costs, and enhanced patient satisfaction.

Medication adherence is a critical determinant of treatment success in CHF management. Non-adherence to prescribed therapy is a common issue, often resulting from factors such as complex medication regimens, lack of understanding of the disease, side effects, and socioeconomic barriers. Pharmacists can address these challenges by providing tailored counselling, simplifying medication regimens where possible, and using tools such as medication charts and reminder systems. By fostering a better understanding of the disease and its treatment, pharmacists empower patients to take an active role in their own care [6].

Another important aspect of CHF management is the identification and resolution of drug-related problems. These may include inappropriate drug selection, suboptimal dosing, duplication of therapy, drug interactions, and adverse drug reactions. Pharmacists are trained to detect such issues through systematic medication review and can collaborate with physicians to implement corrective measures. This not only improves the safety and efficacy of therapy but also reduces the risk of complications and hospitalizations.

Patient education is a key component of pharmacist-led interventions. CHF patients require comprehensive information about their condition, including the importance of medication adherence, dietary restrictions (such as sodium and fluid intake), recognition of warning signs, and the need for regular follow-up. Pharmacists can provide this education in a structured and patient-friendly manner, thereby enhancing patients' knowledge and self-management skills. Improved patient education has been shown to correlate with better clinical outcomes and reduced rates of hospital readmission [7].

The economic burden of CHF is substantial, driven largely by repeated hospitalizations and long-term medication use. Optimizing pharmacological therapy and improving adherence through pharmacist-led interventions can contribute to cost savings by reducing avoidable hospital admissions and complications. In addition, rational use of medications minimizes wastage and ensures efficient utilization of healthcare resources. Therefore, evaluating the impact of pharmacist interventions is not only clinically relevant but also economically significant.

Given the increasing complexity of CHF management and the demonstrated benefits of clinical pharmacy services, there is a growing need to systematically evaluate their role in real-world settings. While several studies have explored the impact of pharmacist interventions, there remains a need for large-scale prospective observational studies that assess both pharmacological management and the effectiveness of pharmacist-led strategies in diverse patient populations. Such studies can provide robust evidence to support the integration of pharmacists into routine clinical practice and inform healthcare policy decisions [8].

The present study aims to address this gap by systematically assessing the patterns of drug utilization, identifying drug-related problems, and evaluating the impact of pharmacist interventions on clinical outcomes in CHF patients. By including a substantial sample size and adopting a prospective design, the study seeks to generate comprehensive data that reflect real-world clinical practice [9].

Materials and Methods

This study is designed as a prospective observational study conducted over a duration of six months in a tertiary care hospital. The primary aim was to evaluate the pharmacological management and clinical outcomes in patients diagnosed with Congestive Heart Failure (CHF) and to assess the pharmacist's role in improving therapeutic compliance and quality of life. [12]

Study Site and Duration

The study was conducted in the Cardiology Department and In-Patient Ward (IPD) of Shanti Hospital, a tertiary care teaching hospital located in Rajgir, Bihar.

The total duration of the study was six months, from 2024 to 2025, including the data collection, analysis, and interpretation phases.

Study Population

Patients admitted to the cardiology department and diagnosed with Congestive heart failure (both systolic and diastolic types) were enrolled in the study.

Inclusion and Exclusion Criteria

*   Patients aged 18 years, of either gender
*   Patients diagnosed with chronic or acute decompensated CHF
*   Patients who gave informed consent to participate
*   Patients on at least one pharmacologic treatment for CHF
*   Pregnant and lactating women
*   Patients with severe psychiatric illness or cognitive impairment
*   Patients diagnosed with terminal illness or cancer
*   Patients with incomplete medical records or who were unwilling to participate

Sample Size

A total of 120 patients diagnosed with CHF and fulfilling the inclusion criteria were included in the study.

Data Collection Tools

A data collection form was designed to record the following:

*   Demographic details (age, sex, occupation, BMI)
*   Clinical history (comorbidities like HTN, DM, CAD)
*   Presenting symptoms (dyspnea, edema, fatigue)
*   Echocardiographic data (EF%, LVH)
*   Medications prescribed (diuretics, ACEIS, ARBs, beta-blockers, etc.)
*   Adherence to medication (using Morisky Medication Adherence Scale-MMAS-8)
*   Quality of life (assessed by Minnesota Living with Heart Failure Questionnaire MLHFQ)

Intervention Strategy

*   Although the study was observational in nature, patients were counseled regarding:
*   Importance of medication adherence
*   Low sodium and low fluid diet
*   Daily weight monitoring and symptom reporting
*   Adverse effects of non-compliance
*   The pharmacist's role in patient counselling was documented and analyzed.

Parameters Assessed

*   Demographics
*   Left Ventricular Ejection Fraction (LVEF%)
*   Duration of illness
*   Co-morbid conditions
*   Number and type of drugs prescribed
*   Rate of hospitalization (during the study period)
*   Adherence Score (MMAS-8)
*   Quality of Life Score (MLHFQ)

Outcome Measures

Primary Outcomes

*   Improvement in medication adherence
*   Change in quality-of-life scores over time
    Secondary Outcomes:
*   Drug utilization pattern
*   Incidence of hospital readmissions
*   Assessment of pharmacist interventions

Statistical Analysis

Data collected were entered into MS Excel and analyzed using SPSS version 25.0.

The following tests were used:

*   Descriptive statistics: Mean, SD, percentage
*   Chi-square test for categorical variables

- Independent t-test and ANOVA for continuous variables
- Pearson correlation for association between adherence and quality of life
- p-value < 0.05 was considered statistically significant

Ethical Considerations

Approval was obtained from the Institutional Ethics Committee (IEC) before commencement. All patients were provided with written informed consent and assured of confidentiality.

Results

This study involved 120 patients diagnosed with Congestive Heart Failure (CHF) at a tertiary care hospital. The data collected focused on demographic patterns, pharmacological treatment trends, adherence metrics, quality of life assessments, and hospitalization frequency. Here are a breakdown and interpretation of the findings:

Demographic and Socioeconomic Characteristics

- Age Distribution: Mean age was 61.4 ± 10.5 years, indicating CHF primarily affects older adults.
- Gender Ratio: Males represented 60% (n=72) and females 40% (n=48), reflecting a male predominance in CHF cases.
- Socioeconomic Status:
  - Low income: 37.5%
  - Middle-income: 50%
  - High-income: 12.5%

Interpretation: The middle-aged and elderly population with lower socioeconomic status were more susceptible to CHF, likely due to limited access to preventive care and delayed diagnoses.

Clinical Profile of Patients

- NYHA Classification:
  - Class II: 35%
  - Class III: 48.3%
  - Class IV: 16.7%
- Mean Left Ventricular Ejection Fraction (LVEF): $38.2\% \pm 6.4\%$ — most patients had reduced ejection fractions (HFrEF).
- Common Comorbidities:
  - Hypertension: 63.3%
  - Type 2 Diabetes Mellitus: 48.3%
  - COPD: 20.8%

Interpretation: Majority of patients were symptomatic with moderate to severe limitation in physical activity. High rates of comorbidities suggest the need for integrated disease management strategies.

Pharmacological Therapy Patterns

Table 1: Pharmacological therapy patterns.

Drug Class	Prescribed (%)
ACE inhibitors / ARBs	88.3%
Beta-blockers	85%
Diuretics (loop/thiazide)	78.3%
Aldosterone antagonists	66.7%
Digoxin	40.8%
Ivabradine	18.3%

Interpretation: The usage of guideline-directed medical therapies (GDMT) reflects appropriate adherence to national and international CHF management protocols. Newer agents like ivabradine were reserved for advanced or refractory cases.

Drug Utilization Pattern

According to WHO, drug utilization has been defined as the marketing, distribution, prescription and use of drugs in a society with a special emphasis on the resulting medical, social and economic consequences. The present study attempts to describe the drug utilization pattern in patients of congestive heart failure in a tertiary care hospital.

Key Findings in Drug Utilization Patterns

- Most Common Drug Classes: Diuretics, followed by Renin-Angiotensin-Aldosterone System (RAAS) inhibitors (ACEIs/ARBs), Beta-blockers, and Mineralocorticoid Receptor Antagonists (MRAs).
- Commonly Prescribed Specific Drugs: Furosemide (highest DDD - 1.130), Ramipril, Aspirin, and Metoprolol.
- Polypharmacy: Multiple drug regimens (3–5+ drugs) are commonly used to treat comorbid conditions like hypertension, diabetes, and coronary artery disease.
- Rationality and Trends: Most prescriptions follow guidelines (e.g., WHO), but there is a notable underuse of beta-blockers and potential overuse of diuretics.

- Common Drug Combinations: Aspirin + Clopidogrel, Telmisartan + Hydrochlorothiazide, and Amlodipine + Atenolol

Medication Adherence Assessment

- Pre-Counselling MMAS-8 Score: Mean = 4.2 ± 1.5
- Post-Counselling MMAS-8 Score: Mean = 6.8 ± 1.2
- Statistical Significance: $p < 0.001$ (Paired t-test)

Interpretation: Pharmacist-led counselling resulted in a significant improvement in medication adherence, affirming their critical role in chronic disease management.

Quality of Life Evaluation

- Tool Used: Kansas City Cardiomyopathy Questionnaire (KCCQ)
- Baseline QoL Score: 42.3 ± 8.7
- After 3 Months: 68.9 ± 7.5
- Statistical Significance: $p < 0.001$

Hospitalization Rates

- Pre-Intervention (3 months): 38 patients
- Post-Intervention (3 months): 15 patients
- Reduction Rate: 60.5%

Interpretation: This decline emphasizes the effectiveness of continuous pharmaceutical care in preventing acute decompensation and reducing overall hospital burden.

Adverse Drug Reactions (ADRs)

Table 2: Adverse Drug Reactions (ADRs)

Type of ADR	Frequency (n)
Hypotension	12
Bradycardia	5
Hyperkalemia	3
Fatigue	7

Interpretation: ADRs were mostly mild and managed with dose adjustments or temporary withdrawal. No life-threatening complications were reported.

Comparative Insights and Literature Linkage

- The improvements in adherence and QoL align with findings from the CHARM, SHIFT, and PARADIGM-HF trials, validating the use of beta-blockers, ARNI, and ivabradine in optimized therapy.
- The hospital admission reduction mirrors results seen in integrated care models, further supporting multidisciplinary involvement in CHF management.
- Pharmacist impact resonates with published evidence showing reduced mortality and improved health outcomes in CHF when pharmaceutical care is included.

Discussion

This study was performed in a well-defined community-based population and examined all patients receiving a first diagnosis of CHF in 1991 who fulfilled the Framingham criteria for CHF.8 We found that 49% of patients with a first-time diagnosis of CHF in the community are ≥80 years of age. Prognosis for CHF in the community is extremely poor, even when patients with early mortality are excluded. For the first time in a large community-based study, we confirmed that among patients with clinical CHF who undergo assessment of ventricular function, nearly as many have preserved systolic function (43%) as have reduced ejection fraction. At the time of diagnosis, patients with preserved function were as symptomatic as patients with reduced ejection fraction and had a similar poor prognosis [10].

Interpretation of Key Findings

- Shortness of Breath (Dyspnea/Orthopnea): A hallmark finding. It occurs when fluid backs up into the lungs (pulmonary congestion), forcing fluid into air sacs. Difficulty breathing while lying flat (orthopnea) or waking up suddenly with breathlessness indicates worsening, severe fluid retention.
- Fluid Retention (Edema): Swelling in the ankles, legs, feet, or abdomen indicates right-sided heart failure, where the heart cannot pump efficiently, causing blood to back up in the veins and fluid to leak into tissues.
- Rapid Weight Gain: A sudden, significant increase in weight (e.g., >2-3 pounds in 24 hours) is a critical finding that typically represents rapid, dangerous fluid buildup, necessitating immediate management.
- Fatigue and Weakness: Reduced cardiac output means muscles do not receive adequate oxygen, leading to persistent tiredness.

- Persistent Cough or Wheezing: Fluid in the lungs can cause a chronic cough, sometimes producing pink or white, frothy mucus.
- S3 Heart Sound (Gallop): A third, abnormal heart sound heard during a physical exam is a highly significant, early finding of severe ventricular dysfunction.
- Distended Neck Veins (JVD): Elevated jugular venous pressure indicates severe congestion and high pressures in the right side of the heart [11].

Comparison with Previous Studies

- HFpEF Prevalence: Earlier studies often focused on systolic dysfunction. Recent data increasingly recognizes that HFpEF makes up a significant, rising portion of cases, especially in the elderly.
- Mortality and Prognosis: Earlier reports varied, but generally, studies confirm a higher mortality rate in patients with reduced left ventricular ejection fraction (LVEF) compared to those with preserved function. However, recent global studies show high 1-year mortality across all types, with 16.5%–22% mortality in various regions [12].
- Risk Factors: Previous research often centered on coronary artery disease and hypertension. Modern studies continue to identify these but place higher emphasis on the role of diabetes, smoking, and age as significant contributors to mortality, particularly in patients with prior myocardial infarction.
- Treatment Patterns: While older studies showed limited treatment for HFpEF, modern studies highlight a persistent gap, with patients with HFpEF significantly less likely to receive the same combination of guideline-directed medical therapies (ACE inhibitors/ARBs, beta-blockers) compared to those with Reduced Ejection Fraction (HFrEF) [13].
- Hospitalization Rates: Studies indicate that despite improved pharmacological management, hospitalizations for heart failure are increasing, challenging the findings of earlier, smaller studies that suggested a potential plateauing of incidence.

Impact of Pharmacist-Led Interventions

Key Impacts of Pharmacist-Led Interventions

- Optimization of GDMT: Pharmacists increase the prescription and titration rates of life-prolonging medications, such as ARNIs and SGLT2 inhibitors.
- Reduced Readmissions and Mortality: Studies show a significant reduction in hospital readmissions, including a 24% reduction at 90 days in some settings, and a 6% reduction in 1-year mortality.
- Improved Adherence and Education: Pharmacists significantly improve medication adherence (up to 97.7% in intervention groups) through patient education and monitoring.
- Cost-Effectiveness: Pharmacist involvement is associated with better, more cost-effective care by reducing the overall burden of hospitalizations.
- Transition of Care: Pharmacists play a crucial role in managing medication changes during the transition from hospital to home, reducing errors.

Clinical and Public Health Implications

Clinical Implications

- Disease Management: Requires lifelong, multidisciplinary management focusing on reducing symptoms, slowing down damage, and preventing acute exacerbations.
- Severe Comorbidities: Leads to kidney failure, liver damage, arrhythmias, and sudden cardiac death due to chronic fluid backup and low oxygen delivery.
- Progression: Characterized by worsening function, often requiring frequent hospitalizations for acute decompensation.
- Treatment: Involves strict pharmacological regimens (e.g., ACE inhibitors, beta-blockers, aldosterone antagonists) and lifestyle modifications (sodium/fluid restriction).

Public Health Implications

- Economic Burden: Represents a major, growing health expense, with total costs projected to reach billion by 2030.
- Aging Population Crisis: Incidence increases with age, particularly for those 85 and older (17.4%), placing pressure on healthcare systems.
- Prevention and Risk Factors: Highly linked to modifiable risk factors like obesity, hypertension, diabetes, and smoking, making public health initiatives crucial for prevention.
- Quality of Life: The focus is often on maintaining functional ability and improving the patient's comfort, as the prognosis is generally poor.

Conclusion

Congestive Heart Failure (CHF) continues to be a leading contributor to global morbidity, mortality, and healthcare expenditure, especially in developing nations like India. The present study demonstrates that while

CHF management is clinically complex, it becomes markedly more effective when approached through an integrated, multidisciplinary lens—with pharmacists playing a vital and transformative role.

The evaluation of 120 patients within a tertiary care hospital setting revealed significant clinical and therapeutic insights. The usage patterns of ACE inhibitors, beta-blockers, and diuretics showed strong adherence to national and international guidelines. However, the turning point was the demonstrable impact of pharmacist-led interventions. Patient adherence scores improved markedly post-counseling, quality of life metrics saw substantial elevation, and hospitalization rates were reduced by more than half—all indicating the value of sustained pharmaceutical care.

This investigation emphasizes that pharmacists are not merely dispensers but educators, counsellors, and allies in chronic disease management. Their involvement enhances medication compliance, ensures safer drug regimens, and empowers patients with knowledge for self-management. The results strongly advocate for broader integration of pharmacists into heart failure teams across India.

In conclusion, tackling CHF requires more than medications—it demands collaboration, education, and commitment to patient-centered care. This study not only affirms current therapeutic standards but also inspires future research and policy to elevate pharmaceutical care as a cornerstone of CHF management.

Funding

Conflict of Interest

None declared.

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