ORIGINAL ARTICLE

Quality of Care among Post–discharge Patients with Heart Failure with Reduced Ejection Fraction (HFrEF) at the Outpatient Department (OPD) of a Tertiary Center

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ABSTRACT

Background and Objective. Physician adherence to the recommended management of patients with heart failure with reduced ejection fraction (HFrEF) at the outpatient setting is crucial to reduce the burden of subsequent rehospitalization, morbidity, and mortality. Recently updated guidelines recommend early and rapid titration to optimal doses of medications in the first 2 to 6 weeks of discharge. In the absence of local data, our study evaluates physician adherence to guideline-recommended treatment in this setting.

Methods. This is a retrospective cross-sectional study among post-discharge HFrEF patients at the outpatient department from December 2022 to May 2023 with a follow-up within three months. Clinical profile and treatment were extracted from medical records. Adherence to the 2021 ESC Guidelines Class I recommendations, among eligible patients, is measured as quality indicators. Data are presented using descriptive statistics.

Results. A total of 99 patients were included in the study. Overall, adherence to prescription of beta-blockers (94.8%), ACEI/ARNI/ARBs (88.5%), and diuretics (100%) were high. Prescription of mineralocorticoid receptor antagonists (MRA) and sodium-glucose cotransporter-2 inhibitors (SGLT2i) were 67% and 57.3%, respectively. Over three months of follow-up, improvement in the quality of care was demonstrated with ACEI/ARNI/ARBs (81.8% to 90.9%), MRA (68.7 to 81.2%), and SGLT2i (58% to 67.7%). Beta-blocker use is consistently high at 97%. In the 3rd month post-discharge, titration to optimal doses was achieved in only 26.4%, 15%, and 6.25% for those on beta-blockers, ACEI/ARNI/ARB, and MRA, respectively. For non-pharmacologic management, referral to HF specialty was made in 30% and cardiac rehabilitation in 22.2%.

Conclusion. Among patients with HFrEF seen at the outpatient, there is good physician adherence to beta-blockers, ACEI/ARNI/ARBs, and diuretics. MRA and SGLT2i prescription, referral to HF specialty and cardiac rehabilitation, and up-titration to optimal doses of oral medications for HF need improvement. Hospital pathway development and regular performance evaluation will improve initiation, maintenance, and up-titration of appropriate treatment.

Keywords: outpatient, HFrEF, physician adherence, management

Paper presentations – European Society of Cardiology, Heart Failure Congress 2024, May 11-14, 2024, Lisbon, Portugal; 54th Philippine Heart Association Annual Convention and Scientific Meeting, May 28-31, 2024, Mandaluyong City, Philippines.

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INTRODUCTION

The prevalence of heart failure (HF) among adults in developed countries is approximately 1% to 2%.[1] In Southeast Asia, the reported prevalence is variable, ranging from 0.5% to 12%.[2] While associated with an increased morbidity, mortality, and deterioration in the quality of life of patients, HF also imposes a substantial economic burden.[1,2] Importantly, the spectrum of HF is categorized into heart failure with preserved (HFpEF; LVEF ≥50%), mid-range (HFmrEF; LVEF 41–49%), and reduced ejection fraction (HFrEF; LVEF ≤40%).[1,3] HFrEF comprises approximately half of HF patients; this subset has an approximately 5-year estimated readmission rate of 75.3% and a mortality rate of 82.2%.[4,5] Combination pharmacotherapy with the four pillar drugs [beta-blockers, renin-angiotensin system inhibitors, mineralocorticoid-receptor antagonists (MRAs), and sodium-glucose cotransporter 2 (SGLT2) inhibitors] represents the current standard of care for HFrEF, as they have been shown to remarkably improve survival, reduce hospitalizations, and improve quality of life. Indeed, the suboptimal prescription of guideline-directed medical therapy (GDMT) has been shown to contribute to poor outcomes in chronic heart failure patients.[6] Despite this, analysis of real-world registries has shown that these drugs remain underused among patients with HFrEF worldwide.[7]

Clinical guidelines recommend an attempt to maximal tolerated doses of medications in heart failure.[1] The so-called vulnerable period (30 to 90 days post-discharge) is a period where there is elevated left ventricular filling pressures, a tendency to hemodynamic congestion, and a risk of long-term multiorgan injury. This period is vital in that proper management during this phase reduces rehospitalization and mortality in HFrEF significantly.[8] Until more recently, while several studies recommend a strategy of rapid up-titration, there was limited recommendation with regard to titration of guideline-directed medical therapy in the transitional period.[9–11] Results from the Safety, Tolerability and Efficacy of Up-titration of Guideline-directed Medical Therapies for Acute Heart Failure (STRONG – HF trial, 2022) showed that an intensive strategy of up-titration led to a clear long-term benefit in terms of symptoms, quality of life, and readmission.[12] Indeed, physician adherence to guideline-recommended therapies, with an emphasis on dose escalation, is associated with improvement in both short and long-term outcomes in patients with HFrEF.[13–15]

Despite these findings, a gap exists between the recommended guidelines and the current practice of HF treatment with respect to physician adherence. An observational nationwide study using the Korean National Health Insurance Claims database showed that 28.6% of elderly patients with HF did not receive optimal guideline-directed medical therapy (GDMT).[16] Data from the largest outpatient HFrEF registries (CHAMP, PINNACLE) reveal that a massive therapeutic gap exists with up to one-third of patients not on GDMT. In the CHAMP – HF registry (n = 3158), less than 1% (37) received the target doses of angiotensin-converting enzyme inhibitors/angiotensin receptor blockers/angiotensin receptor neprilysin inhibitor (ACEI/ARB/ARNI), beta-blocker, and MRAs.[7] In a local multi-center study, a heart failure registry showed that the use of ACEI/ARB's, beta-blockers, MRA's and ivabradine in patients hospitalized with HFrEF is suboptimal.[17] Nonpharmacologic forms of management, which include cardiac rehabilitation and timely heart failure specialty referral, also have well-documented evidence of benefit with existing guideline recommendations.[1,3] However, as with pharmacologic management, surveys show a low referral rate for eligible patients.[18,19]

Quality indicators (QI's) are tools to measure the level of implementation of recommendations and clinical practice by hospitals, healthcare providers, and professionals, with the aim of improving quality of care and patient outcomes.[1] In 2020, the American College of Cardiology/American Heart Association recommended these performance measures to evaluate the quality of care provided and to identify opportunities for improvement.[20] In 2022, the Working Group for Heart Failure in collaboration with the Heart Failure Association of the ESC updated its QI's to include sodium-glucose co-transporter 2 inhibitors (SGLT2i).[21] Locally, QI's have been utilized in recent studies. In 2018, a study utilizing QIs based on the ESC HF guidelines evaluated adherence to HFrEF management in hospitalized patients and found that the prescription of class I medications was comparable to existing studies, yet are mostly under-prescribed based on the desired quality of care (80%).[22] The study did not assess adherence to SGLT2I's and other forms of nonpharmacologic management such as cardiac rehabilitation referral and HF specialty care.[22] Notably, previous studies were all based on in-hospital setting.

Recognizing the importance of up-titrating HFrEF medications during the post-discharge period, the authors sought to evaluate the quality of care and describe the management of post-discharge patients with HFrEF seen at the University of the Philippines – Philippine General Hospital (UP-PGH) outpatient department (OPD). In line with the ongoing development of the heart failure pathway of the cardiology service, results from this study provide baseline information and evaluate effectiveness of current care, which will subsequently be used in the implementation of hospital protocols directed at the improvement in the care of HFrEF outpatients.

MATERIALS AND METHODS

Study Population

This was a retrospective cross-sectional study that included all adult patients 19 years of age and above with a diagnosis of HFrEF, defined as a left ventricular ejection fraction (LVEF) of less than or equal to 40%, who were

admitted and discharged from the UP-PGH charity service between December 2022 and May 2023, and referred to the Cardiology Service. The sample size was derived by total enumeration of patients within the duration of the study period (6 months). Patients who were discharged against medical advice were excluded. All outpatient medical records within three months post-discharge, whether the patient was seen by the General Medicine or Adult Cardiology services, were reviewed. Patients without any follow-up within three months after discharge were considered lost-to-follow-up and hence excluded. Data from the most recent follow-up, whether in the 1st, 2nd, or 3rd month, were gathered.

Relevant patient demographic and clinical characteristics from the latest post-discharge follow-up were examined: age, sex, systolic blood pressure, heart rate, New York Heart Association functional class, comorbidities, heart failure etiology, ejection fraction, and whether chest x-ray, serum potassium, and serum creatinine were performed. Ejection fraction was taken from either a full transthoracic echocardiogram, or if not available, the physician's visual estimate on cardiac point-of-care ultrasound (POCUS) transthoracic echocardiogram (full study or cardiac Point-Of-Care-Ultrasound). The latest available ejection fraction result was gathered.

All patients were deidentified, and their medical information was maintained strictly confidential, available only to the investigators. The study was conducted in accordance with the principles of the Declaration of Helsinki and the Philippine National Ethical Guidelines for Health Research, and approved by the University of the Philippines Manila Research Ethics Board (protocol number: 2023-03460-01).

Outcomes and Quality of Care Evaluation

Aspects of HFrEF management with a class I recommendation were chosen as the specific performance measures and quality indicators in the study.[21] Adapted from the European Society of Cardiology, the following quality indicators were ultimately measured:

1. Proportion of patients with HFrEF who were prescribed the beta-blocker bisoprolol, carvedilol, sustained-release metoprolol succinate, or nebivolol in the absence of any contraindications
2. Proportion of patients with HFrEF who were prescribed an ACE inhibitor, ARB, or ARNI in the absence of any contraindications
3. Proportion of patients with HFrEF who were prescribed an MRA in the absence of any contraindications
4. Proportion of patients with HFrEF who were prescribed an SGLT2 inhibitor in the absence of any contraindications
5. Proportion of patients with HFrEF who were referred to cardiac rehabilitation
6. Proportion of patients with HFrEF who were referred to the HF specialty clinic

To measure quality of care, data on class, type, and doses of HFrEF medications, receipt of cardiac rehabilitation, and HF clinic specialty referral were collected. All patients were assessed for eligibility for both pharmacologic and nonpharmacologic interventions, with eligibility defined as having an indication and no contraindications for the intervention measured.[21]

The authors defined for each quality indicator a numerator (patients who received the intervention measured) and a denominator (all patients eligible for the intervention -- that is, with an indication and no contraindications), as computed below[21]:

$$\text{Adherence rate (\%)} = \frac{\text{(All eligible patients who received the intervention)}}{\text{(All patients eligible for the modality)}}$$

All patients with any indication for the aforementioned pharmacologic and nonpharmacologic interventions were deemed eligible (Appendix Tables 1 and 2). In terms of pharmacotherapy, we monitored the classes, types, and doses of all medications with a class I recommendation for HFrEF among all eligible patients (Appendix Table 3), with the dose of the medication classified as follows: none, versus <½ of the optimal dose, versus ≥½ of the optimal dose, or optimal (Appendix Table 4). Data from the latest follow-up within three months post–discharge was used to compute for the general quality of care (Table 2).

To assess medication utilization at three months post-discharge, a subgroup analysis of all patients with any follow-up consult three months post-discharge was performed. To further examine trends in the quality of their care, another analyses of patients who followed-up at least once every month for the months was done. In patients with multiple follow-up consults in a month, data from the latest follow-up in that month was used.

An adherence rate of 80% was set as optimal quality of care based on previous studies developed locally.[22]

Data Analysis

Descriptive statistics was used to describe the clinical characteristics and outcomes for all patients. Continuous variables were presented as mean and standard deviation, while categorical data were presented as count and percentage. All statistical analyses and data visualization were performed using Microsoft Excel.

A flow diagram of the methodology is shown in Figure 1.

RESULTS

Demographic and Clinical Profile

Out of 197 HFrEF patients discharged from the institution, a total of 99 patients were seen either at the Medicine or Cardiology service OPD within three months and included in the study (50.2% follow-up rate). Baseline characteristics are shown in Table 1.

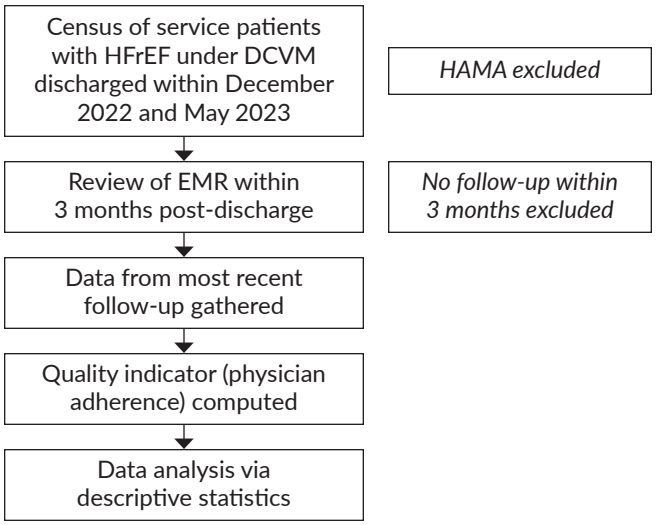

Figure 1. Process flow diagram of methodology.

The cohort had a mean age of 55 ± 11 years old, and majority were male (71.2%) and had a NYHA Functional Class of II (39.6%). Mean systolic blood pressure and heart rate during follow up were 115 ± 15 mmHg and 79 ± 15 bpm, respectively. The most common etiologies of heart failure were IHD/CAD (80.8%) and hypertension (52.5%). Common comorbid conditions include hypertension (68.6%), ischemic heart disease (49.4%), chronic kidney disease (48.4%), and diabetes mellitus (36.3%). 40.4% had a history of smoking. Most patients had a reduced ejection fraction of less than 30% (53.5%). Among the relevant laboratories done at the OPD, a chest radiograph was repeated in 9.09% of patients, creatinine in 32.3%, and serum potassium in 24.2%.

QIs for Management for all Eligible Patients

Table 2 shows the use of class I recommended treatment, both pharmacologic and non-pharmacologic, for all eligible patients, taken from the most recent post-discharge follow-up. For class I medications, adherence to beta-blockers (94.8%), ACEI (88.5%), and diuretics (100%) were noted to be desirable (at least 80%). Adherence to prescription of MRA and SGLT2I were at 67.3% and 57.3%, respectively. Cardiac rehabilitation was done in only 22.2% of patients, while HF subspecialty referral was performed in only 30%. Of note, we found that cardiac rehabilitation referrals were only made during the pre-discharge phase.

On analysis within each drug class, the authors found that the most commonly used beta-blocker was carvedilol (72.04%), followed by bisoprolol (17.2%), metoprolol tartrate (7.5%), and metoprolol succinate (2.15%). Among those on ACEI/ARNI/ARB, 45.8% were on sacubitril-valsartan and 31% on enalapril. Losartan (4.7%), valsartan (11.7%), and telmisartan (5.8%) were the most commonly used ARBs. Empagliflozin (70.5%) was more frequently used than dapagliflozin (33.3%).

Table 1. Demographic and Clinical Profile of Adult Patients with HFrEF at the OPD

Characteristic	Total (N=99)[1]
Age (years)	55.5 (11.6)
Sex	
Male	71 (71.2%)
Female	28 (28.7%)
Systolic blood pressure (mmHg)	115 (15.7)
Heart rate (bpm)	79 (15.8)
New York Heart Association functional class	
I	18 (17.8%)
II	40 (39.6%)
III	34 (34.6%)
IV	7 (7.9%)
Co-morbidities[2]	
Hypertension	68 (68.6%)
Diabetes mellitus	36 (36.3%)
Ischemic heart disease (IHD) / Coronary artery disease (CAD)	49 (49.4%)
Valvular heart disease	6 (6.06%)
Cerebrovascular disease	9 (9.09%)
Chronic kidney disease	48 (48.4%)
Asthma	6 (6.6%)
Chronic pulmonary obstructive disease	3 (2.9%)
Pulmonary tuberculosis	18 (17.8%)
Alcohol use	37 (37.3%)
Smoking	40 (40.4%)
Illicit drug use	17 (17.1%)
Etiology of Heart Failure[2]	
Hypertension	52 (52.5%)
IHD / CAD	80 (80.8%)
Valvular	5 (5.05%)
MAP-associated cardiomyopathy	14 (14.1%)
Alcoholic cardiomyopathy	3 (3.03%)
Thyrotoxic heart disease	5 (5.05%)
Cardiorenal syndrome	4 (4.04%)
Peripartum	4 (4.04%)
Dilated cardiomyopathy	4 (4.04%)
Ejection fraction (%)[3]	
30-40	46 (46.5%)
<30	53 (53.5%)
Laboratories done as outpatient	
Chest Radiograph	9 (9.09%)
Creatinine	32 (32.3%)
Potassium	24 (24.2%)

[1] *N (%); mean (SD)*
[2] *Not mutually exclusive – may have combination of etiologies / comorbidities.*
[3] *Patients with a visual ejection fraction of 25-30% were included in the <30% subset.*

Table 2. Quality Indicator for Management for all Eligible Patients

Class I recommended therapy		Eligible with no contraindication	Eligible who are given treatment	Quality Indicator[1]
Pharmacologic	Beta-blocker	98	93	94.8%
	ACEI/ARB/ARNI	96	89	88.5%
	MRA	95	64	67.3%
	SGLT2i	89	51	57.3%
	Diuretic	18	18	100%
Non-pharmacologic	Cardiac rehabilitation	99	22	22.2%
	HF specialty referral	50	15	30%

ACEI – Angiotensin converting enzyme inhibitor, ARNI – angiotensin receptor neprilysin inhibitor, ARB – angiotensin receptor blocker, MRA – mineralocorticoid receptor antagonist, SGLT2i – sodium-glucose cotransporter-2 inhibitor, HF – heart failure

[1] *Optimal quality of care = quality indicator of 80%*

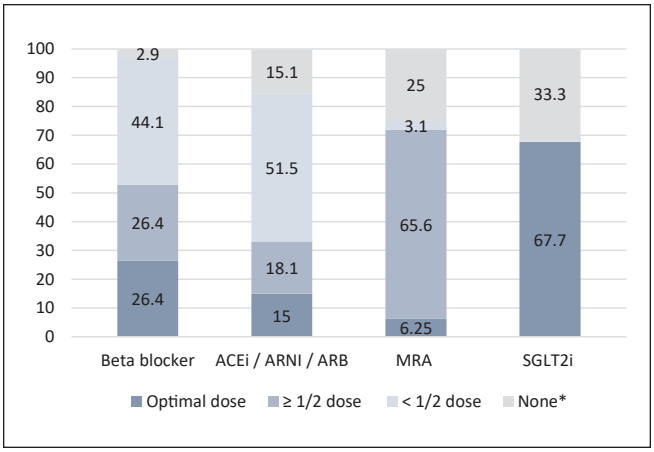

Figure 2. Dose of medications among eligible patients on the 3rd month of follow-up.

Dosing (Optimal, >1/2, <1/2) found in Appendix Table 4

** Patients with contraindications were excluded*

ACEI – Angiotensin converting enzyme inhibitor, ARNI – angiotensin receptor neprilysin inhibitor, ARB – angiotensin receptor blocker, MRA – mineralocorticoid receptor antagonist, SGLT2i – sodium-glucose cotransporter-2 inhibitor

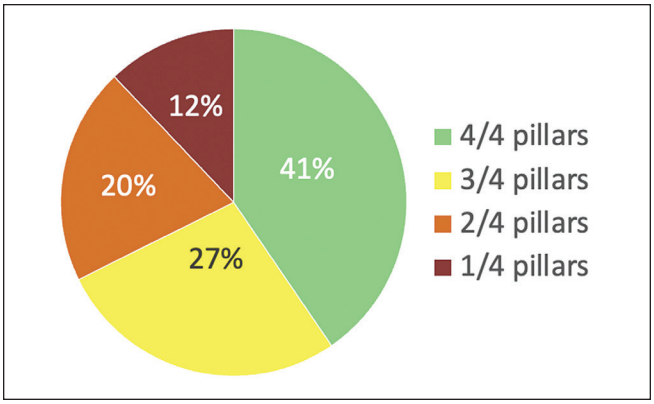

Figure 3. Distribution of patients based on the number of pillar medications on the 3rd month of follow-up.

Dose and Number of Medications among Patients with a Follow-up on the 3rd Month Post- discharge

The authors performed a subgroup analysis of patients with any follow-up consult at the 3rd month post-discharge and examined the dosage of their HFrEF medications (Figure 2). Among patients on a beta-blocker, ACEI/ARNI/ARB, and MRA, optimal dose was achieved in 26.4%, 15%, and 6.25% of eligible patients, respectively. In addition, a substantial proportion of patients on ACEI/ARNI/ARB (51.5%) and beta-blockers (44.1%) was on less than half the optimal dose of these medications.

Furthermore, majority of the patients had the complete (4 of 4) pillars of HFrEF at 41% (Figure 3). 27%, 20%, and 12% were on 3, 2, and 1 of the pillar medications, respectively.

Trends in Physician Adherence among Patients with Three Months of Follow-up

In a subgroup analysis of patients with at least follow-up consult per month for the months (n=34), the levels of physician adherence to prescribing each class I medication were examined (Figure 4). With beta-blockers, quality of care was optimal and consistent from 1st to 3rd month (97%). For the other drug classes, increasing adherence rates over the time period were noted. With ACEI/ARB/ARNI's, there was desirable adherence within the 1st and 2nd month of follow-up (81.8%) with more physicians utilizing the medication approaching the 3rd month (90.9%). There was initially inadequate adherence to MRA's (68.7%) with improvement during the 3rd month (81.2%). For SGLT2i's, there was an improving trend in the use of the medication over time (58%, 61%, and 67.7% during the 1st, 2nd, and 3rd month, respectively). Similarly, the authors observed that over the course of 3 months, the number of patients on 3 or 4 drug classes increased, while those on only 1-2 drug classes decreased (Figure 5).

In another analysis of this set of patients, the authors noted that out of the 34 patients, most patients (17) had a NYHA class of II with some having a NYHA class of I (8), III (8), and IV (1). Among these patients, the percentage of patients on 4 pillars were 62.5% for class I, 58.8% for class

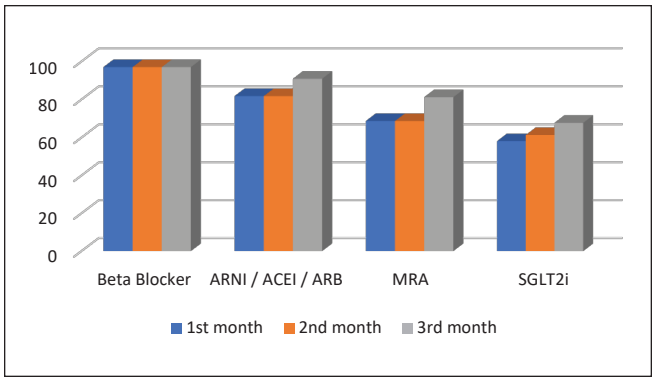

Figure 4. Trends in physician prescription of the HFrEF pillars over 3 months of follow-up.

ACEI – Angiotensin converting enzyme inhibitor, ARNI – angiotensin receptor neprilysin inhibitor, ARB – angiotensin receptor blocker, MRA – mineralocorticoid receptor antagonist, SGLT2i – sodium-glucose cotransporter-2 inhibitor

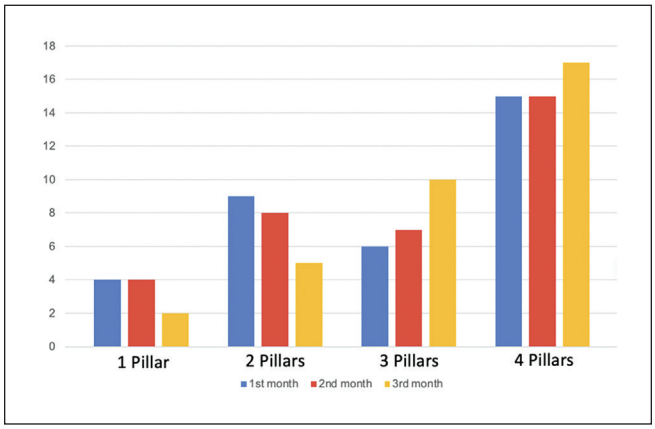

Figure 5. Trends in utilization of HFrEF pillars over 3 months of follow-up.

II, and 25% for class III. The patient with NYHA class IV was on 3 pillars of GDMT.

DISCUSSION

To the best of our knowledge, this is the first study to evaluate quality of care in HFrEF in the post-discharge, outpatient setting.

Pharmacologic Therapies

Physician adherence to class I guideline-recommended therapies has been well-documented to significantly improve short- and long-term outcomes in patients with HFrEF.[13–15] In existing HF registries based in the US, usage rates of the so-called pillars of HFrEF are found to be 72.1% to 78% for ACEI/ARB/ARNI, 66.8 to 74.6% for beta-blockers, and 33.1% for MRA.[7] Internationally, among patients with HFrEF, data appear to be more favorable with a 92.2% usage rate for ACEI/ARB, 92.7% for beta-blockers, and 67% for MRA.[7,12] It is important to note that these data were made from 2013-2018 during which ARNI and SGLT2i were not yet among the foundational therapies. Nevertheless, results from the present study show comparable adherence to international data with the use of beta-blockers (94.8%), ACEI/ARNI/ARB (88.5%), and MRA (67.3%). It is important to take note, however, that some non-class I recommended therapy (such as metoprolol tartrate, telmisartan) were given to patients due to availability and socioeconomic issues and were thus included in the analysis. As with the STRONG – HF trial, these agents though not considered to be disease-modifying, were included in their study.[12]

Literature on SGLT2i prescription, on the other hand, remains varied and lacking. The earlier CHAMP-HF database, which ran from 2015-2017, show that only 2% of HF patients were being treated with the medication.[7] After the publication of the landmark trials DAPA – HF and EMPEROR-REDUCED, published in 2019 and 2020, respectively, and after incorporation to the more recent guidelines as a class I recommendation, rate of SGLT2i use among HFrEF patients were notably increasing (20.2%).[23] Compared to the mentioned data, results from the present study show a significantly more favorable adherence rate with SGLT2i use in HFrEF (67.7%).

The recently published 2023 Focused Update of the 2021 Heart Failure recommends the rapid up-titration of evidence-based treatment in HF patients within 6 weeks post-discharge[24], following the findings of the STRONG – HF trial, which showed significant benefit with an intensive strategy of titration (half of optimal dose of 4 pillars prior to discharge and optimal tolerated dose at day 90) in terms of symptom reduction, improved quality of life, and reduced all cause death or heart failure readmission compared to usual care.[12] In this trial, patients in the high-intensity care group were up-titrated to full doses of prescribed drugs by day 90 [renin-angiotensin system-inhibitors (55%), beta-blockers (49%), and MRA's (84%)]. This is comparable to older landmark trials (CIBIS-II, MERIT-HF, SOLVD, CHARM) which also achieved target doses of ACEI/ARBs in at least 50-60% of patients.[25] Despite this, real-world data from the ESC Heart Failure Long – Term Registry showed that among chronic HFrEF patients, only 29.3%, 17.5%, and 30.5% of patients were on target doses of ACEI/ARBs, beta-blockers, and MRA's, respectively.[7] Similarly, findings from our study reveal that only a small group of patients seen during the 3rd month of follow-up were on optimal (full) doses of ACEI/ARNI/ARB (15%), beta-blockers (26.4%), and MRA's (6.25%).

Cardiac Rehabilitation and HF Specialty Clinic Referral

Findings from the Get with The Guidelines – Heart Failure (GWTG – HF) registry, among whom 48% of 105,619

patients had HFrEF, revealed that only 12.2% received CR referral at discharge.[26] In a sub-analysis of this registry, among patients who were clinically stable at 6 weeks post-discharge, only a quarter (25.8%) were referred for CR.[26] Prior local studies among admitted patients show an unsatisfactory CR referral rates, ranging from 14% to 21.1%.[27,28] Similarly, in the present study, only 22.2% of eligible HFrEF patients had a cardiac rehabilitation referral prior to discharge and no referrals were made at the outpatient setting. Hence, among eligible patients in the outpatient setting, there exists a need to facilitate rehabilitation referral.

Dedicated heart failure specialty clinics have also been shown to reduce mortality, rehospitalization, and improve patient adherence to medications, yet only approximately 10% of HFrEF patients receive HF specialty care based on a review of several studies.[29] Results from the present study showed a HF subspecialty referral rate of 30%, which is increased compared to international data. These better results were likely based on the fact that the study was conducted in a training institution. Issues related to lack of physician awareness and unclear referral criteria, together with patient-related factors such as socio-economic status and geographic access barriers, may contribute to the low referral rate.[30]

Overall, this study showed good physician adherence to most of the recommended medications in HFrEF such as beta-blockers, ACEI/ARNI/ARBs, and diuretics. Though results were comparable to international studies, some of physician practices, in particular MRA and SGLT2i prescription, and referral to HF clinic and cardiac rehabilitation did not meet the desired adherence rate (80%). Major factors identified in existing literature may be physician-related (clinical inertia, fear of adverse events, inadequate provider knowledge, hospital formulary restriction, etc.) or patient-related (socio-economic disparities, cultural beliefs, comorbidities, etc.)[25,29,31], although further qualitative studies are needed to describe and characterize the factors that influence physician practices locally. In the clinical setting, the authors recommend the continuous development and evaluation of both local and national clinical practice guidelines for HFrEF, together with evidence-based, educational campaigns targeted towards both patients and physicians. In a broader national level, government efforts to improve availability of health care such as minimization of cost of medications and provision of easier access to specialized units should be initiated.

Limitations of the Study

There are several limitations identified in the study. One is that the scope of the study is limited only to charity patients in their first three months post-discharge, hence representation of the total population of HFrEF in the institution may be inadequate. In relation to this, the use of other components in the non-pharmacologic management (CRT, ICD) was not assessed since the window period of this study was only within the first three months post-discharge, which is not within the recommended period of decision-making for these interventions (≥3 months). In addition, due to availability issues and socio-economic limitations, drugs that are not considered disease-modifying agents for HF were analyzed under the same class of medications they belong (ex. metoprolol tartrate, telmisartan). Lastly, this study mainly utilized descriptive research design; further studies are needed to understand the factors that affect initiation and titration of therapy.

CONCLUSIONS

Among patients with HFrEF discharged and followed-up at the OPD, there is good physician adherence to beta-blockers, ACEI/ARNI/ARBs, and diuretics. MRAs and SGLT2is, as well as referral to HF specialty and cardiac rehabilitation, are underutilized and require improvement. There is also a need to augment up-titration to optimal doses. Hospital pathway creation, regular performance evaluation, and physician education all have the potential to improve initiation, maintenance, and up-titration of appropriate treatments in the OPD setting, with the goal of reducing the burden of HFrEF readmission, morbidity, and mortality.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

All authors declared no conflicts of interest.

Funding Source

None.

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APPENDICES

Table 1. Class I therapeutic indications will be used as the performance measures in the study*

Recommendations	Class of recommendation	Level of evidence
Beta-blockers	I	A
ACEi	I	A
ARB	I	B
MRA	I	A
SGLT2i	I	A
ARNI	I	B
Diuretic as needed	I	C
Referral to cardiac rehabilitation program	I	A
Referral to HF specialty	I	C

** Taken from the 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure.*

Table 2. Non-pharmacologic Management*

Management	Indications
Cardiac rehabilitation	Exercise is recommended for all patients who are able in order to improve exercise capacity, QOL, and reduce HF hospitalization.
Advanced heart failure specialty	Any of the following: 1. Very limited life expectancy and/or poor QOL conditions that may impair follow-up and/or worsened prognosis after advanced HF therapies[a] 2. NYHA Class II w/ any of the ff: • Admission or unplanned visit to HF clinic within last 12 months • Prior inotropic use • Intolerant to beta-blocker or RASi/ARNI • LVEF <20% • Worsening RV function • Worsening renal function • Worsening liver function • Ventricular arrhythmias/ICD shocks • Need for escalating diuretic doses for persistent congestion • SBP <90 mmHg and/or signs of peripheral hypoperfusion 3. NYHA III–IV despite optimal medical therapy (including ICD/CRT when indicated)

[a] Limited life expectancy may be due by major comorbidities such as cancer, dementia, end-stage organ dysfunction; other conditions that may impair follow-up or worsen post-treatment prognosis include frailty, irreversible cognitive dysfunction, psychiatric disorder, or psychosocial issues.

** Taken from the 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: supplementary data. Developed by the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC).*

Table 3. Practical guidance on the use of Class I medications in patients with HFrEF*

Drug Class	Contraindications
Beta-blockers	1. Second- or third-degree AV block (in the absence of a permanent pacemaker) 2. Critical limb ischemia 3. Asthma (relative contraindication): if cardio-selective beta-blockers are indicated, asthma is not necessarily an absolute contraindication, but these medications should only be used under close medical supervision by a specialist, with consideration of the risks for and against their use; COPD is not a contraindication. 4. Known allergic reaction/other adverse reaction (drug-specific)
ACE-I	1. History of angioedema 2. Known bilateral renal artery stenosis 3. Pregnancy/risk of pregnancy 4. Known allergic reaction/other adverse reaction (drug-specific).
MRA	1. Known allergic reaction/other adverse reaction (drug-specific)
SGLT2i	1. Known allergic reaction/other adverse reaction (drug-specific) 2. Pregnancy/risk of pregnancy and breastfeeding period 3. eGFR <20 mL/min/1.73 m^2 4. Symptoms of hypotension or a SBP <95 mmHg ** DAPA-CKD (dapagliflozin) enrolled patients with an eGFR >25 mL/min/1.73 m^2*
ARNI	1. History of angioedema 2. Known bilateral renal artery stenosis 3. Pregnancy/risk of pregnancy and breastfeeding period. 4. Known allergic reaction/other adverse reaction (drug-specific). 5. eGFR <30 mL/min/1.73 m^2 6. Symptoms of hypotension or a SBP <90 mmHg (PARADIGM-HF enrolled patients with SBP >95 mmHg at randomization)
Diuretic as needed	1. Not indicated if the patient has never had symptoms or signs of congestion 2. Known allergic reaction/other adverse reaction (drug-specific)

** Taken from the 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: supplementary data. Developed by the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC)*

Table 4. Reference for optimal doses of oral guideline–directed medical therapy for heart failure adapted from the STRONG-HF Trial[14]

Medication generic name	Dose (half)	Optimal (full) dose
MRA		
Eplerenone	25 mg OD	50 mg OD
Spironolactone	25 mg OD	50 mg OD
Beta-blocker		
Bisoprolol	5 mg OD	10 mg OD
Carvedilol	25 mg BID	50 mg BID
Metoprolol succinate extended-release tablet	100 mg OD	200 mg OD
Nebivolol	5 mg OD	10 mg OD
Atenolol	50 mg OD	100 mg OD
Betaxolol	10 mg OD	20 mg OD
Metoprolol tartrate	50 mg BID	100 mg BID
ACEi		
Captopril	25 mg TID	50 mg TID
Enalapril	10 mg BID	20 mg OD
Lisinopril	17·5 mg OD	35 mg OD
Ramipril	2.5 mg BID or 5 mg OD	5 mg BID or 10 mg OD
Trandolapril	2 mg OD	4 mg OD
Perindopril	4 mg OD	8 mg OD
Fosinopril	20 mg OD	40 mg OD
Zofenopril	15 mg BID	30 mg BID
ARB		
Candesartan	16 mg OD	32 mg OD
Valsartan	80 mg BID	160 mg BID
Losartan	75 mg OD	150 mg OD
Irbesartan	150 mg OD	300 mg OD
Telmisartan	40 mg OD	80 mg OD
Olmesartan	20 mg OD	40 mg OD
Azilsartan Medoxomil	40 mg OD	80 mg OD
ARNI		
Sacubitril/valsartan	49/51 mg BID	97/103 BID