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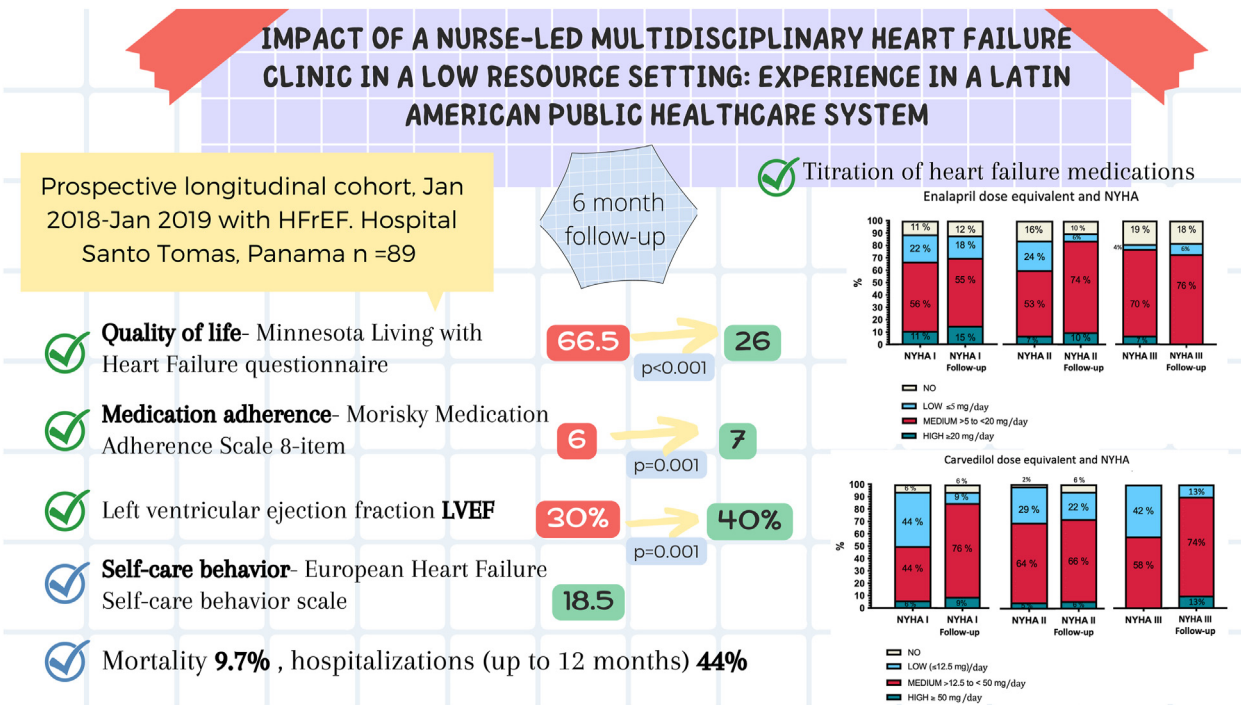
Impact of a Nurse-Led Multidisciplinary Heart Failure Clinic in a Low-Resource Setting: Experience in a Latin American Public Healthcare System

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ABSTRACT

Background: Nurse-led multidisciplinary heart failure clinics (MDHFCs) play an important role in patient care in developed countries, due to their proven benefits relating to mortality, hospitalization, and quality of life. However, evidence is limited regarding the role of MDHFCs in a limited-resource setting.

RÉSUMÉ

Contexte : Les cliniques multidisciplinaires d'insuffisance cardiaque dirigées par du personnel infirmier jouent un rôle important dans les soins aux patients dans les pays développés en raison de leurs bienfaits démontrés en matière de mortalité, d'hospitalisation, et de qualité de vie. Les preuves quant au rôle de ce type de cliniques dans

Methods: Patients with heart failure (HF) with reduced ejection fraction ($n = 89$) were enrolled in a prospective, longitudinal cohort, from January 2018 to January 2019. The following endpoints were collected at baseline and after 6 months of follow-up: (i) quality of life, measured using the Minnesota Living with Heart Failure Questionnaire; (ii) medication adherence using the Morisky Medication Adherence Scale, 8-item; (iii) titration of HF medications; (iv) self-care behavior using the European Heart Failure Self-care Behavior Scale; and (v) mortality and hospitalizations up to 12 months after.

Results: The questionnaire score was reduced from 66.5 (interquartile range [IQR], 46-86) at baseline to 26 (IQR, 13-45) at 6 months ($P < 0.001$). New York Heart Association (NYHA) functional class improved at 6 months (NYHA I: 41.9%; NYHA II: 39.5%; NYHA III: 17.2%), compared to baseline (NYHA I: 20%; NYHA II: 49%; NYHA III: 31%; $P < 0.001$). Medication adherence using the 8-item Morisky Medication Adherence Scale improved the score from 6 (IQR, 4-7) at baseline to 7 (IQR, 6.25-8; $P = 0.001$) at 6 months. Uptitration of angiotensin-converting enzyme inhibitors/angiotensin receptor blockers (25% vs 18% at target dose) and beta-blockers (25% vs 11% at target dose) was documented. After 6 months of follow-up, the European Heart Failure Self-care Behavior Scale was applied, showing a score of 18.5 (IQR, 15-22). The mortality reported at 12 months of follow-up was 9.7%, and the incidence of hospitalization was 44%.

Conclusion: An MDHFC is a feasible strategy to manage an HF clinic in a low-resource setting.

un contexte de pénurie de ressources sont toutefois limitées.

Méthodologie : Des patients atteints d'insuffisance cardiaque (IC) présentant une fraction d'éjection réduite ($n = 89$) ont été inscrits à une étude de cohortes prospective et longitudinale allant de janvier 2018 à janvier 2019. Les critères d'évaluation suivants ont été mesurés à l'inscription et après six mois de suivi : i) qualité de vie, mesurée par le questionnaire Minnesota Living with Heart Failure Questionnaire; ii) adhésion au traitement médicamenteux, mesuré selon l'échelle en huit points Morisky Medication Adherence Scale; iii) modification de la dose de médicaments contre l'IC; iv) comportements d'autosoins, mesurés selon l'échelle European Heart Failure Self-care Behavior Scale; et v) taux de mortalité et d'hospitalisation jusqu'à 12 mois.

Résultats : Le score au questionnaire a diminué pour passer de 66,5 (écart interquartile [EI] : 46 à 86) au départ à 26 (EI : 13 à 45) à six mois ($p < 0,001$). La catégorie fonctionnelle de la New York Heart Association (NYHA) s'est améliorée à six mois (NYHA I : 41,9 %; NYHA II : 39,5 %; NYHA III : 17,2 %), comparativement au départ (NYHA I : 20 %; NYHA II : 49 %; NYHA III : 31 %; $p < 0,001$). Le score de l'adhésion au traitement médicamenteux mesuré par l'échelle en huit points Morisky Medication Adherence Scale s'est amélioré, passant de 6 (EI : 4 à 7) au départ à 7 (EI : 6,25 à 8; $p = 0,001$) à six mois. On a noté une augmentation de la dose d'inhibiteurs de l'enzyme de conversion de l'angiotensine ou de bloqueurs des récepteurs de l'angiotensine (25 % vs 18 % à la dose cible) et de bêtabloquants (25 % vs 11 % à la dose cible). Après six mois de suivi, l'échelle European Heart Failure Self-care Behavior Scale a été appliquée, ce qui a donné un score de 18,5 (EI : 15 à 22). Le taux de mortalité rapporté à 12 mois de suivi était de 9,7 %, et le taux d'hospitalisation était de 44 %.

Conclusion : Une clinique multidisciplinaire d'insuffisance cardiaque dirigée par du personnel infirmier est une stratégie réaliste pour gérer une clinique d'IC dans un contexte de pénurie de ressources.

Heart failure (HF) is a major public health problem associated with significant levels of morbidity, mortality, and cost.¹⁻³ An estimated 64.3 million people worldwide suffer from HF.⁴ The incidence varies widely among European countries and the US—from 1 to 9 cases per 1000 person-years.¹ In Latin America, the estimated prevalence of HF is approximately 1%, and the anticipated incidence is about 2 cases per 1000 person-years.⁵ Over the years, the increasing prevalence of HF, combined with more costly medical treatments, has increased the economic burden of HF.⁶⁻⁸ In the US, the total cost of HF care in 2020 was estimated to be \$43.6 billion per year, and in Latin America, it was \$10.7 billion in 2015.^{7,9} In comparison to the US, Latin American countries have a lower gross income and lower total expenditure on healthcare per capita. This situation constitutes a paradox, considering that both HF and its risk factors are increasing in prevalence.^{5,10} Therefore, new, and cost-effective strategies are essential for the prevention and management of HF in a low-resource setting.¹⁰

Nurse-led multidisciplinary HF clinics (MDHFCs) have been an essential and innovative strategy for the management of patients with HF, through provision of individualized patient care, with a proven reduction in the number of HF hospitalizations, reduced mortality, and improvement in quality of life (QoL), and self-care behavior.¹¹⁻¹⁴ Little is known about the impact of MDHFCs on HF patients in developing countries, especially in a low-resource setting. Mendez et. al. reported an important benefit of the MDHFC in terms of quality of life, using the Minnesota Living with Heart Failure Questionnaire (MLHFQ).¹⁵ Taken together, these findings point toward the potential utility of this approach.

Panama is a developing country considered to be a high-income nation by the World Bank. According to an analysis of the health financing situation in Panama made by the Pan American Health Organization,¹⁶ the level of public spending on healthcare amounts to 7.6% of the gross domestic product. However, the uneven distribution of wealth, particularly in the public setting, plays a vital role in the development of a low-income public healthcare system.

Panama's healthcare system is composed of the Social Security organization (Caja de Seguro Social), the Ministry of Health (Ministerio de Salud [MINSA]), and private hospitals through private insurance. Every employed worker pays a percentage in taxes to Caja de Seguro Social, which gives them free access to all healthcare provided by the Caja de Seguro Social hospital network. However, healthcare is limited to the

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medications and specialists the network can provide. On the other hand, the MINSA network is mainly designed for the segment of the population that does not work formally, and for foreigners (ie, those with citizenship elsewhere). In the MINSA networks, patients pay a small percentage of the costs, and the rest is subsidized by the government. Hospital Santo Tomas (HST) in Panama City belongs to the MINSA network.

In addition, Panama has a shortage of physicians specialized in the management of patients with HF, thus limiting patient access to appropriate medical care and adequate access to HF medications. Taking these conditions into account, an MDHFC was implemented in HST, to facilitate close follow-up of patients with this condition and improve their medication adherence.

Currently, no studies have evaluated the population of patients with HF in Panama. Considering the context described above, and in the absence of patient access to advanced costly therapies, including heart transplantation, we sought to evaluate the impact of a nurse-led MDHFC in a low-income and low-resource setting, as a potential strategy to manage this clinically complex condition and aid in ensuring patient adherence and follow-up.

Materials and Methods

This longitudinal cohort study is designed to monitor essential clinical endpoints of an MDHFC program in a tertiary-care public hospital such as HST. HST is the second-largest public hospital in Panama, with 652 beds. It opened in its current location in Panama City in 1924, and the MDHFC was opened in 2016. This MDHFC is currently led by one full-time nurse, Monday through Friday, from 7 AM to 3 PM. The nurse is an HF specialist and was trained previously in another MDHFC in Costa Rica.

Participant selection

Patients with HF were enrolled in a registry between January 2018 and January 2019, after the purpose of the study was explained to them. The patients enrolled were selected based on the following inclusion criteria: (i) having evidence of reduced left ventricular ejection fraction (LVEF \leq 40%), as determined by echocardiography performed by the same experienced echocardiography technician (ii) being a clinically stable patient with a new diagnosis of HF (New York Heart Association [NYHA] class I-III); (iii) being aged 18 years; and (iv) not being a patient in another HF clinic and not having previously participated in an education program. We excluded patients who had severe psychiatric disease, dementia, or moderate-to-severe cognitive deficits, and those who were illiterate. To avoid potential selection bias, and due to economic limitations, the registry included only those patients with a new diagnosis of HF as by the cardiologist who were then referred to the MDHFC.

Clinical intervention description

Enrolled patients received intensive HF education, titration of medications, and social work evaluation, along with a nutritional assessment in several sessions (at least once every 2 weeks) for the first 3 months. The HF education clinic was led by the HF specialist nurse, using pamphlets designed by the

Panamanian Society of Cardiology and translated into Spanish, for patient use, by the American Heart Association. Appropriate referrals to other specialists, such as those in nutrition, psychiatry, and physical medicine and rehabilitation, were provided as needed. The sessions included a 1:1 conversation with the patient, and time was allotted for questions and answers, with reinforcement in subsequent sessions. The patients were also given pamphlets to take home with them. Titration of medications included an increase in dosages in each session, to try to reach guideline-directed therapy levels recommended by the cardiologist, or a decrease in dosages, due to medication intolerance.

This phase was followed by a maintenance phase of 3 months, in which serial medical evaluations were performed that were focused on strengthening medication adherence, self-care, and proper diet, and promoting healthy habits. These evaluations were performed by the HF specialist nurse and were done every month. Patients also met with the cardiologist for follow-up every 2 to 6 months, depending on the clinical condition of the patient and whether changes in medication were needed due to intolerance or adverse effects. The HF specialist nurse had constant communication with the cardiologists regarding the patients enrolled. After 6 months, patients are seen by the nurse on the date of the follow-up appointment with the cardiologist.

Session time varies greatly, from half an hour for follow-up appointments to up to 1 hour for new patients. Patients were grouped by their primary diagnosis into those with ischemic cardiomyopathy (ICM) and those with nonischemic cardiomyopathy (NICM). ICM included coronary artery disease and dilated cardiomyopathy due to myocardial infarction. NICM included dilated idiopathic, postpartum, familial, myocarditis-related, alcohol, viral, and drug-related cardiomyopathies.

Clinical endpoints measured

The following list of clinical endpoints (i-vi) were evaluated at baseline, before study enrollment, and after 6 months of follow-up: (i) QoL and functional status using the validated Spanish version of the MLHFQ and NYHA functional class assessment. (ii) Medication adherence using the Spanish validated version of the Morisky Medication Adherence Scale, 8-item (MMAS-8).¹⁷ (iii) Titration of angiotensin-converting enzyme inhibitors (ACEis) or an angiotensin receptor blocker (ARB) dose equivalent to the dose of enalapril (see [Supplemental Appendix S1](#) for equivalent dose). Enalapril doses were categorized as low (\leq 5 mg), medium ($>$ 5 to $<$ 20 mg), or high (\geq 20 mg).¹⁸ Titration of beta-blockers (BBs) was to a dose equivalent to that of carvedilol. Carvedilol doses were categorized as low (\leq 12.5 mg), moderate ($>$ 12.5 to $<$ 50 mg), and high ($>$ 50 mg).¹⁹ (iv) Self-care behavior using the Spanish validated version of the European Heart Failure Self-care Behavior Scale (EHFScBS) was evaluated at 6 months of monitoring in the MDHFC. (v) Follow-up echocardiography was performed at 6 months after enrollment in the MDHFC, to estimate the LVEF. Heart failure with recovered LVEF was defined according to the following: documentation of previous LVEF $<$ 40% at baseline; \geq 10% absolute improvement in LVEF; and a second measurement of LVEF $>$ 40%.²⁰ (vi) Mortality and

hospital admission were reported up to 12 months after patients enrolled in the study.

Additionally, we attempted to collect blood pressure measurements and lipid profiles at baseline and 6 months; however, mainly due to economic limitations data were not included in the analysis. A noteworthy point to clarify is that most of the patients enrolled were also on mineralocorticoid receptor antagonists, but these were not included in the final statistical analysis, owing to the lack of data for the 6-month follow-up and the limited number of changes in doses. Also, a small subset of patients was on an angiotensin receptor/neprilysin inhibitor and a sodium/glucose cotransporter-2 inhibitor (SGLT2i). However, due to delays in regulatory approval and its high cost, these medications are not widely available in public hospitals such as HST, and thus, we cannot draw conclusions from the small subset of patients who were on this medication.

MMAS-8 is an 8-item checklist-type validated scale to identify nonadherence. The scores on the scale range from 0 to 8, and higher scores correlate to better adherence to medication. EHFSBS is a 12-item validated scale to evaluate self-care behaviors. Score on the scale range from 12 to 60, and lower values are those that indicate better self-care.

Statistics and ethics

The enrollment characteristics of this study were assessed with descriptive statistics, using proportions for categorical variables, and medians with interquartile range (IQR) for continuous variables, due to an expected skewed distribution. Differences in patient characteristics according to the type of cardiomyopathy were assessed with the Pearson χ^2 test for categorical variables, and the Mann-Whitney U test for continuous variables.

For paired quantitative data, such as the MLHFQ score, LVEF, MMAS-8, and N-terminal pro-B-type natriuretic peptide (NT-ProBNP), Wilcoxon's rank-paired test was performed. For paired categorical data, the McNemar test was carried out. All estimates were reported using a 95% confidence interval, and a *P* value of 0.05 was considered statistically significant. All analyses were performed using Stata version 14.0 (StataCorp, Lakeway Drive, TX). The rate of incomplete data was small overall (< 5%).

The research protocol was approved by the HST Bioethics Committee and followed the principles established in the Declaration of Helsinki. All patients involved in the study provided written informed consent to use of their medical records and monitoring in the HF clinic.

Results

A total of 89 patients were enrolled in the study. Of these 89 patients, 81 completed a follow-up of at least 6 months (5 patients died before the 6-month assessment, and 3 were lost to follow-up). The patient's median age was 54 years (IQR: 45-61). NICM patients were slightly younger than those with ICM (median age, 52 vs 55 years, *P* = 0.003).

Baseline characteristics are represented in Table 1. Hypertension (70.4% [*n* = 62]), obesity (40.4% [*n* = 36]), dyslipidemia (39.3% [*n* = 35]), and diabetes (34.8% [*n* = 31]) were the most prevalent comorbidities.

Clinical endpoints results

1. In the assessment of QoL, a reduction occurred in the MLHFQ score from 66.5 (IQR 46, 86) at baseline to 26 (IQR 13, 45) at 6 months (*P* < 0.001). These reductions were notable in both dimensions measured, physical and emotional (Table 2). Similarly, the NYHA functional class improved at 6 months (NYHA I: 41.9%; NYHA II: 39.5%; NYHA III: 17.2%), compared to baseline (NYHA I: 20%; NYHA II: 49%; NYHA III: 31%; *P* < 0.001; Table 2).
2. Regarding medication adherence using the MMAS-8, an improvement also occurred in the score, from 6 at baseline (IQR 4, 7) to 7 (IQR 6.25-8; *P* = 0.001) at 6 months (Table 2). With this scale, if patients score higher, they are evaluated as being more adherent. We show improved adherence in this group of patients provided by the MDHFC.
3. Uptitration of an ACEi or ARB (equivalent to the enalapril dose) and BBs (equivalent to carvedilol dose) were documented (Table 3); a larger proportion of patients were close to target doses stratified by NYHA functional status at 6 months (25% at target dose), compared with the baseline proportion (18% at target dose; *P* = 0.034). Similarly, BBs were uptitrated closer to target doses at 6 months (25% at target dose), in comparison to baseline proportion (11% at target dose) (*P* = 0.0021).
4. After 6 months of follow-up, EHFSBS was applied to show a score of 18.5 (IQR: 15,22; Table 2).
5. Among the patients who completed the 6-months follow-up, LVEF improved to 40% (IQR: 33%, 45%), compared to a baseline LVEF of 30% (IQR: 25%, 36%; *P* = 0.001). In total, 23.4% (*n* = 19) of patients fulfilled the criteria for recovered LVEF.
6. The mortality reported in the MDHFC at 12 months of follow-up was 9.7% (9 of 89). Of the 9 patients who died, the median time to mortality was 126 days (IQR: 37 -217 days); among these patients, 5 died of complications of acute HF, and 4 were reported as sudden deaths. Regarding hospitalizations, up to 44% of patients enrolled required at least one hospitalization due to HF after 1 year of follow-up.

Discussion

The present study assessed the effect of a nurse-led MDHFC in patients with HF in a low-resource setting—a Latin American public healthcare system. This intervention positively impacted the QoL, medication adherence, appropriate uptitration of HF medication, and improvement in baseline LVEF in this group of patients. These translate into enhanced and effective patient care using the resources available.

In our study, most patients enrolled were middle-aged adults with NICM, and the prevalence of hypertension, diabetes, and obesity was high. Similar epidemiologic research also describes a high prevalence of HF in middle-aged adults related to a high prevalence of comorbidities such as hypertension and obesity.^{21,22}

In Panama, hypertension, diabetes, and obesity are among the most common comorbidities in national-based registries, with a reported prevalence of 29.6%, 9.5%, and 27.1%, respectively.²³⁻²⁵ In addition, this population has important

Table 1. Baseline characteristics of patients with heart failure enrolled in the nurse-led multidisciplinary heart failure clinic

Variable	General (n = 89)	ICM (n = 38)	NICM (n = 51)	P
Sex				0.267
Female	34 (38)	12 (31.6)	22 (43.1)	
Male	55 (62)	26 (68.4)	29 (56.9)	
Age, y	54 (45–61)	55 (46–60)	52 (42–63)	0.003*
Education time, y	10 (7–12)	12 (8–12)	9 (7–12)	0.248
NYHA functional status:				0.351
I	18 (20.3)	8 (21.1)	10 (19.6)	
II	44 (49.4)	20 (52.6)	24 (47.1)	
III	27 (30.3)	10 (26.3)	17 (33.3)	
Smoking	24 (27.3)	14 (37.8)	10 (19.6)	0.071
Hypertension	62 (70.4)	28 (75.7)	35 (68.6)	0.404
CAD	20 (22.7)	20 (54)	0 (0)	< 0.001*
Diabetes	31 (34.8)	18 (48.7)	13 (25.5)	0.025*
Obesity	36 (40.4)	19 (51.4)	17 (33.3)	0.090
Dyslipidemia	35 (39.3)	20 (52.6)	15 (29.4)	0.034*
Cerebrovascular disease	8 (8.9)	4 (10.8)	4 (7.84)	0.633
Atrial fibrillation	13 (14.6)	5 (13.16)	8 (16)	0.710
NT-proBNP, pg/mL	1067 (216.5–3583)	433.5 (189–3506)	1297 (367–3855)	0.248
LVEF, %	30 (25–36)	21 (20–30)	35 (25–36)	0.475
MMAS-8	6 (4–7)	6 (4–7)	6 (4–7)	0.853
MLHFQ score	66.5 (46–86)	59 (46–82)	67 (39–88)	0.747
Beta-blocker use	84 (97.6)	35 (97.2)	47 (97.9)	0.532
ACEi/ARB use	76 (84)	33 (86)	42 (84)	0.431

Values are n (%), or median (interquartile range), unless otherwise indicated. Education time refers to the number of years spent in an academic institution, including elementary school, junior high, high school, and university.

ACEi, angiotension-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CAD, coronary artery disease; ICM, ischemic cardiomyopathy; LVEF, left ventricular ejection fraction; MLHFQ: Minnesota Living with Heart Failure Questionnaire; MMAS-8, Morisky Medication Adherence Scale, 8-item; NICM, nonIschemic cardiomyopathy; NT-proBNP, N-terminal-pro hormone brain natriuretic peptide; NYHA, New York Heart Association.

* Statistically significant.

disability-adjusted life-years (DALYs), as high as 21.7 years of life in men and 24.5 years of life in women, among those aged 50 to 59 years.^{7,21,26,27} Focused studies are necessary to determine the extent to which these risk factors affect the burden of HF in Panama.

Regarding the quality of life, previous studies have reported the benefit of HF clinics in QoL.^{14,28,29} From the different types of instruments used to assess QoL in patients with HF, we chose MLHFQ. This instrument was applied in a previous study in Latin America, has a simple structure, and is easy to administer to patients.³⁰ Our study demonstrated a reduction of the general score of 40.5 points, a physical score of 20, and an emotional score of 7 from baseline at 6 months follow-up. A study in Mexico reported a reduction of 19 points in the general score.¹⁵ This result could be related to better adherence, appropriate titration of medications, and better self-care achieved in the MDHFC.

Beyond QoL, uptitration of BBs and ACEis to a target dose was achieved in a few patients. According to the latest (2022) HF guidelines from the American College of Cardiology/American Heart Association, the 4-pillar medication strategy includes the use of BBs and ACEis uptitrated to an optimal dose upon tolerance. In our study, approximately 33% of patients required an increase in their dose of BBs, and 17% increased their dose of ACEis. The **Change the Management of Patients With Heart Failure (CHAMP-HF)** registry showed, in clinical settings, that few patients were receiving the target dose of ACEi/ARB (17%) and BBs (28%), mainly due to medication intolerance.³¹ Expert opinion suggests that even low doses have some benefits relating to

mortality, although clinical trials were generally not designed to determine whether the benefits were dose-related.³²

In our study, the main limitation of medication uptitration was medication intolerance, as we can evidence in our comparison data regarding BB and ACEi/ARB use during follow-up (Table 1). Despite the fact that we could not achieve the target doses according to guidelines in most patients, an improvement in NYHA functional status, LVEF, and QoL occurred. We hypothesize that, in clinical practice, the multidisciplinary approach of self-care, education, titration, and medication adherence is the real value of an MDHFC. Therefore, applying this approach to manage this complex condition is an effective method.

Regarding hospitalization and mortality, we observed high rates—close to 44% for hospitalization, and close to 10% for mortality at 1 year of follow-up; these rates were higher than those reported by other clinics.^{12,14,28} In Canada, an MDHFC showed a benefit in mortality (hazard ratio, 0.69; number needed to treat, 16) and readmissions (hazard ratio, 0.27; number needed to treat, 4); however, their population tends to be older, compared to our population.¹⁴ Additionally, in our clinic, we have limited access to advanced therapies for patients with HF, including resynchronization therapy, heart transplantation, and left ventricular assist device, limiting the management in advanced stages. The authors hypothesize that the absence of these advanced devices and the absence of medications such as sacubitril-valsartan and SGLT2is (which have proven mortality and hospital readmission rate benefits) may impact the ability to adequately control the symptoms and the progression of the disease.

Table 2. Clinical endpoints of patients with heart failure admitted to the nurse-led multidisciplinary heart failure clinic

Variable	General			ICM			NICM		
	Baseline	6 mo	P	Baseline	6 mo	P	Baseline	6 mo	P
NYHA functional status			< 0.0001*			< 0.0001*			< 0.0001*
I	18 (20)	34 (41.9)		8 (21.1)	17 (48.6)		10 (19.6)	17 (36.4)	
II	44 (49)	32 (39.5)		20 (52.6)	11 (31.4)		24 (47.1)	21 (45.6)	
III	27 (31)	14 (17.2)		10 (26.3)	6 (17.1)		17 (33.3)	8 (17.4)	
IV	0	1 (1.2)		0	1 (2.9)		0	0	
LVEF, %	30 (25–36)	40 (33–45)	< 0.001*	21 (20–30)	40 (32–46)	< 0.001*	35 (25–36)	39 (33–44)	< 0.001*
MLHFQ score	66.5 (46–86)	26 (13–45)	< 0.001*	59 (46–82)	24 (12.5–39.5)	< 0.001*	67 (39–88)	27 (14–47)	< 0.001*
Physical	30 (21–36)	10 (2–16)	< 0.001*	29 (18–35)	9 (2–15)	< 0.003*	31 (22–37)	11 (3–17)	< 0.001*
Emotional	12 (6–18)	5 (2–8)	< 0.001*	11 (5–19)	4 (1–7)	< 0.004*	14 (7–20)	6 (3–9)	< 0.002*
MMAS-8	6 (4–7)	7 (6–8)	< 0.001*	6 (4–7)	7 (6.25–8)	< 0.001*	6 (4–7)	7 (6–8)	< 0.009*
NT-proBNP (pg/mL)	1067 (216.5–3583)	553 (166–2078)	0.712	433.5 (189–3506)	344.5 (118–649)	0.585	1297 (367–3855)	990 (206–2260)	0.340
BBs use	84 (94.3)	75 (90.3)	0.042*	35 (97.2)	32 (94)	0.002*	47 (97.9)	43 (95)	0.067
ACEi/ARB use	76 (84)	68 (82)	0.031*	33 (86)	28 (84)	0.043*	42 (84)	40 (88)	0.074

Values are n (%), or median (interquartile range), unless otherwise indicated.

ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; BB, beta-blocker; ICM, ischemic cardiomyopathy; IQR, interquartile range; LVEF, left ventricular ejection fraction; MLHFQ, Minnesota Living with Heart Failure Questionnaire; MMAS-8, Morisky Medication Adherence Scale, 8-item; NICM, nonischemic cardiomyopathy; NT-proBNP, N-terminal-pro hormone brain natriuretic peptide; NYHA, New York Heart Association.

* Statistically significant ($P < 0.05$).

Another plausible explanation for the higher mortality and readmission rate shown in this clinic could be associated with the high prevalence of other comorbidities, such as diabetes, atrial fibrillation, cerebrovascular disease, and hypertension predisposing patients to different cardiovascular outcomes or HF decompensation.

This study represents the first cohort registry assessing the quality of life and the impact of a nurse-led MDHFC in Panama. The study also highlights the utmost relevance of the role of nurses in achieving high-quality care for complex patients such as HF patients, especially in developing countries, such as Panama.

Conclusions

Use of a nurse-led MDHFC is a feasible strategy to manage HF clinics in a low-resource setting. Such a comprehensive and structured approach seems to be associated with significant improvement in QoL, medication adherence, uptitration of medication to target dose, and possible improvement in LVEF from baseline. These documented benefits might have an impact on the clinical management of a patient with HF and reduced ejection fraction in a limited-resource setting.

Limitations

Among the limitations, we can highlight that as a descriptive type of research, the lack of a control group allows us to hypothesize only a correlation with the positive clinical endpoints shown. Also, the relatively small number of patients enrolled, and the short follow-up (6 months only), limit the amount of sustained benefit regarding the QoL, medication adherence, and uptitration we can attribute to the MDHFC and not just medication. More studies with higher statistical power, such as randomized clinical trials, are necessary to establish a real benefit in mortality and hospitalization, particularly in the younger population.

Another limitation applies to the type of patients, as this study included only newly diagnosed HF patients, per economic and human-resource shortages. Plans are in place to expand the benefit population to chronic HF patients (both those with HF with reduced ejection fraction and those with HF with preserved ejection fraction).

The authors also recognize that, due to the cost and low availability of mineralocorticoid receptor antagonists, angiotensin receptor/neprilysin inhibitors, and SGLT2 in Panama's public healthcare system, the data regarding the use of and experience with these medications were not included in the statistical analysis.

Data Availability Statement

Raw data were generated at HST Heart Failure Clinic. Derived data supporting the findings of this study are available from the corresponding author HB on request.

Ethics Statement

The research protocol was approved by the Santo Tomas Hospital Bioethics Committee and followed the principles established in the Declaration of Helsinki. All patients

Table 3. Uptitration of ACEis or ARBs (equivalent to enalapril dose) and BBs (equivalent to carvedilol dose), according to NYHA functional status

NYHA functional status	ACEi/ARB dose, baseline (n = 89)	ACEi/ARB dose, at 6 mo (n = 81)	BB dose, baseline (n = 89)	BB dose, at 6 mo (n = 81)
I	N = 18	N = 34	N = 18	N = 34
Low dose	4 (22)	6 (18)	8 (44)	3 (9)
Medium dose	10 (56)	19 (55)	8 (44)	26 (76)
High dose	2 (11)	5 (15)	1 (6)	3 (9)
II	N = 44	N = 32	N = 44	N = 32
Low dose	11(24)	2 (6)	13 (29)	7 (22)
Medium dose	23 (53)	24 (74)	28 (64)	21 (66)
High dose	3 (7)	3 (10)	2 (5)	2 (6)
III	N = 27	N = 15	N = 27	N = 15
Low dose	1 (4)	1 (6)	11 (42)	2 (13)
Medium dose	19 (70)	11 (76)	16 (58)	11 (74)
High dose	2 (7)	0 (0)	0 (0)	2 (13)

Values are n (%), unless otherwise indicated. Note that ACEi/ARB dose is equivalent to enalapril dose; BBs dose is equivalent to carvedilol dose. For enalapril, low dose is ≤ 5 mg/d; medium dose is > 5 to < 20 mg/d; high dose is ≥ 20 mg/d. For carvedilol low dose is ≤ 12.5 mg/d; medium dose is > 12.5 to < 50 mg/d; high dose is ≥ 50 mg/d.

ACEi, angiotensin converting enzyme inhibitor; ARB, angiotensin receptor blocker; BB, beta-blocker; NYHA, New York Heart Association.

involved in the study were provided written informed consent to allow the use of their medical records and monitoring in the heart failure clinic.

Patient Consent

The authors confirm that a patient consent form(s) has been obtained for this article.

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Disclosures

The authors have no conflicts of interest to disclose.

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Supplementary Material

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