Review Article

Multidisciplinary Care in Heart Failure Services

GEORGE SOKOS, DO,[1] KAZUHIKO KIDO, PharmD,[2] GURUSHER PANJRATH, MD,[3] EMILY BENTON, PhD, APRN,[4] ROBERT PAGE II, PharmD, MSPH,[5] JIGNESH PATEL, MD, PhD,[6] PATRICK J. SMITH, PhD,[7] SHELLY KOROUS, BSN, RN,[8] AND MAYA GUGLIN, MD, PhD[9]

Morgantown, West Virginia; North Englewood, Maryland; Boulder, and Denver, Colorado; Los Angeles, California; Chapel Hill, North Carolina; and Indianapolis, Indiana

ABSTRACT

The American College of Cardiology/American Heart Association/Heart Failure Society of American 2022 guidelines for heart failure (HF) recommend a multidisciplinary team approach for patients with HF. The multidisciplinary HF team-based approach decreases the hospitalization rate for HF and health care costs and improves adherence to self-care and the use of guideline-directed medical therapy. This article proposes the optimal multidisciplinary team structure and each team member's delineated role to achieve institutional goals and metrics for HF care. The proposed HF-specific multidisciplinary team comprises cardiologists, surgeons, advanced practice providers, clinical pharmacists, specialty nurses, dieticians, physical therapists, psychologists, social workers, immunologists, and palliative care clinicians. A standardized multidisciplinary HF team-based approach should be incorporated to optimize the structure, minimize the redundancy of clinical responsibilities among team members, and improve clinical outcomes and patient satisfaction in their HF care. (*J Cardiac Fail 2023;29:943−958*)

Key Words: Heart failure, multidisciplinary, team-based, interdisciplinary, LVAD, transplant.

The burden of heart failure (HF) continues to increase over time, thereby creating a significant social and economic burden on the health care system.[1] Over the past decade, HF management has become exceedingly complex. With the advent of newer pharmacotherapeutics, devices, and interventions, morbidity and mortality have improved significantly.[2] It is often the case that patients with multiple comorbidities and those who face economic and social challenges can have more difficulty accessing optimal care and may have worse clinical outcomes as a result. These challenges can be caused by a variety of factors, including a lack of access to health care resources, difficulty affording necessary medications and treatments, and inadequate social support. It is important for health care providers to be aware of these challenges and to work with patients to identify and address any barriers to care to improve clinical outcomes. This process may involve coordinating with other health care providers, connecting patients with community resources, or advocating for policy changes to improve

From the [1]Department of Cardiology, West Virginia University School of Medicine, Morgantown, West Virginia; [2]Department of Clinical Pharmacy, West Virginia University School of Pharmacy, Morgantown, West Virginia; [3]School of Medicine and Health Sciences, George Washington University, North Englewood, Maryland; [4]Department of Medicine, University of Colorado, Boulder, Colorado; [5]Department of Clinical Pharmacy, at the University of Colorado Denver Skaggs School of Pharmacy, Denver, Colorado; [6]Department of Medicine, Cedars-Sinai Medical Center, Los Angeles, California; [7]Psychiatry, University of North Carolina School of Medicine, Chapel Hill, North Carolina; [8]Advanced Heart Failure Program, Indiana University Health, Indianapolis, Indiana and [9]Department of Medicine, Indiana University Health, Indianapolis, Indiana.

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Reprint requests: Kazuhiko Kido, PharmD, BCCP, BCPS, Clinical Associate Professor, Department of Clinical Pharmacy, West Virginia University School of Pharmacy, Room 1126 Health Science Center North, Morgantown, WV 26506 E-mail: kazuhiko.kido0322@gmail.com

Dr. Sokos and Dr. Kido contributed equally to this work and shar co-primary authorship.

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access to care.[2] It is often necessary to use the skills and expertise of both cardiovascular team members and primary care providers to provide optimal care to patients with HF, particularly in rural and underserved communities where access to specialists may be limited. Close communication between team members is essential to ensure smooth hand offs and continuity of care, because this practice allows different health care professionals to share information and collaborate in the care of the patient. This work may involve regular meetings to discuss the patient's care plan and progress, as well as the use of electronic medical records and other technologies to facilitate communication and coordination. It is also important for team members to be aware of any barriers to care that the patient may be facing and to work together to identify and address these issues to ensure that the patient receives the best possible care. A multidisciplinary team approach is currently mandated as part of an accreditation process for centers using advanced heart therapies such as a durable left ventricular assist device (LVAD) and transplantation. Accrediting bodies such as The Joint Commission, United Network for Organ Sharing, and the Centers for Medicare and Medicaid Services require certain team members to be available to evaluate patients for candidacy for advanced therapies. This team concept is now entrenched in the daily care of a patient with HF. Studies demonstrate that a multidisciplinary approach decreases the hospitalization rate for HF and health care costs and improves adherence to self-care and the use of guideline-directed medical therapy (GDMT).[3–7] The American College of Cardiology/American Heart Association/Heart Failure Society of America (HFSA) 2022 guidelines for HF currently recommend a multidisciplinary team approach for patients with HF.[2] Multiple expert panels in both the UK and the United States have provided a framework and function for multidisciplinary team-based care for patients with HF or on LVAD.[8–14] However, none explicitly describes the multidisciplinary team care in comprehensive HF programs, including general HF, LVAD, and heart transplant services. The primary goal of this article is to propose a framework for the optimal multidisciplinary team structure and each team member's delineated role in achieving institutional goals and metrics for HF care. The document also provides a framework for new and emerging or established centers in planning their staffing needs, as clinical and quality programs evolve.

Recommended Multidisciplinary Team Structure and HF Spectrum of Care

Patients diagnosed with HF typically begin their care with their primary care physicians, who often manage the care of these complex patients for an extended period of time owing to a lack of access to subspecialized care. Access to higher levels of care can be difficult in rural and underserved areas and results in a referral to a general cardiologist and then to HF specialists and a multidisciplinary team. Based on the complexity of each case, patients may eventually transition back to the original setting or to stay with the multidisciplinary HF team.

The recommended multidisciplinary team structure of an HF service, including general HF, LVAD, and heart transplant services is outlined in Visual Take Home Graphics. The proposed HF-specific multidisciplinary team is composed of physicians (cardiologists, primary care physicians and cardiothoracic surgeons), nurse practitioners or physician assistants (advanced practice providers [APPs]), clinical pharmacists, specialty nurses (HF specialty nurse in a general HF practice, LVAD nurse coordinator in an LVAD service, and nurse transplant coordinator in a heart transplant service), dieticians, physical therapists, psychologists, social workers, immunologists (only in the heart transplant service), and palliative care clinicians. The delineated roles of each profession are discussed in Table 1 and elsewhere in this article. The standardized multidisciplinary team may streamline the optimal structure of clinical responsibilities among team members. This review only included clinical trials and excluded observational studies, because higher levels of evidence were available. Although trial data are mixed and the degree of benefits of multidisciplinary HF team care varies among trials, majority of clinical trials showed the multidisciplinary team care reduced hospitalization rate, decrease health care costs, and enhance patient satisfaction in the HF care (Table 2). Additionally, multiple studies showed that multidisciplinary HF care is more cost saving than usual care.[6,15,16]

The multidisciplinary HF team coordinates comprehensive disease and comorbidity management with consulting services and primary care providers (Central Illustration and Figure 1). To provide seamless and efficient patient care without overlapping services, it is critical to delineate the role of consulting services for patients with HF. Also, HF providers should carefully assess the necessity of each consulting service and individualize the list of consulting services for each patient with HF based on the severity of symptoms and disease, comorbidities, financial situation, and driving distance to consulting service offices. Details of consulting services for patients with HF are beyond the scope of this article.

The optimal multidisciplinary HF care is delivered in ambulatory and inpatient settings across the spectrum of HF stages. Advanced HF care includes the identification, timely referral, and coordination of hospice or ambulatory parenteral inotropic therapy

Table 1. HF Multidisciplinary Team Members Delineated Roles

Multidisciplinary Team Member	Delineated Roles		
	General HF Service	LVAD Service	Heart Transplant Service
Advanced HF cardiologist	Leader for final decision-making of patient care Establish a patient roadmap	Coleader for final decision-making of multidisciplinary care Shared decision-maker with cardiac surgeon for LVAD replacement LVAD medical management	Coleader for final decision-making of multidisciplinary care Decision-maker for heart transplantation Heart transplant medical management
Cardiac surgeon	Perioperative management during CABG, valve replacements, epicardial LV lead placement for CRT, myectomy or alcohol septal ablation for HCM	Coleader for final decision-making of multidisciplinary care LVAD perioperative management LVAD postoperative management including complication management such as driveline or pocket infections	Coleader for final decision-making of multidisciplinary care Heart transplant perioperative management Heart transplant postoperative management
Nurse practitioners and physician assistants	Makes a diagnosis HF, provide postdischarge clinic visit and frequent follow-ups with medication optimization and up titration of GDMT Responds to and integrates telemonitoring and remote device monitoring information into patient care Gives HF-specific education and coordinates care with the attending physicians to improve overall quality and continuity of care Identify appropriate patients for and make timely referrals to specialty providers such as: LVAD/transplant centers, ICD/CRT upgrade, etc		
Specialty nurses	Coordination of care; provision of comprehensive patient education		
	Postdischarge calls, continuing HF education Protocol-based diuretic management and GDMT titration Remote device monitoring	Protocol-based warfarin management LVAD driveline management Patient presentation for LVAD multidisciplinary committee	Protocol-based CNI dose management Patient presentation for heart transplant multidisciplinary committee
Clinical pharmacists	Evaluates and assists in GDMT selection, dosing, and insurance coverage Assists with deprescribing or discontinuation of inappropriate prescription, over the counter, and/or nutraceutical medications that can potentiate or worsen HF Gives appropriate vaccinations Provides transitions of care and assists in completing admission and discharge medication reconciliations Assists with access to medications	Participates as an active member of the LVAD selection committee Assists with dosing and monitoring of anticoagulation based on device Evaluates and assists in medication optimization pre- and post-device Gives appropriate vaccinations Provides transitions of care and assist in completing admission and discharge medication reconciliations Assists with access to medications	Participates as an active member of the heart transplant selection committee Evaluates and assist in medication optimization pre- and post-transplant including pharmacokinetic monitoring of CNI, adjustment in CNI dose, addition of prophylactic medications for infection and adverse side effects of transplant medications, management of CNI drug−drug interactions, and provision of alternative pharmacotherapies for chronic conditions Provides transplant medication education for recipient and caregivers Gives appropriate vaccinations. Provides transitions of care and assist in completing admission and discharge medication reconciliations Assists with access to medications

(*continued*)

Table 1 (*Continued*)

Multidisciplinary Team Member	Delineated Roles		
	General HF Service	LVAD Service	Heart Transplant Service
Patient navigators	Connects patients with appropriate HF services Coordination of clinic and diagnostic test appointments Acquisition of medical records from other institutions Identifies barriers to HF care and communicates these to multidisciplinary team Assists in overcoming social, transport, and other barriers		
Physical therapists	Coordinates and implements exercise programs in cardiac rehabilitation for outpatients Completes exercise evaluation and prescribes exercise during hospitalization or in clinics Frailty screening and assessment		
Dieticians	Provides dietary education (sodium intake, potassium rich diet) Provides nonpharmacological interventions for comorbidities (eg, hypertension, diabetes, dyslipidemia) Educates patients on weight management (cachexia prevention, obesity management) Provides nutritional interventions for patients with cardiac cachexia, sarcopenia, or low albumin levels Manages enteral and parenteral nutrition during hospitalization Education about vitamin K intake for LVAD patients receiving vitamin K antagonists		
Financial workers	Evaluates insurance/benefits for GDMT, counsels for coverage of other therapies (LVAD, transplant)	Monitors continued coverage for LVAD equipment exchanges and adequate medication coverage Assess suitability for LVAD from the insurance standpoint	Evaluates insurance coverage for immunosuppression and other transplant-related medications Assess suitability for transplant from the insurance standpoint
Immunologists	Monitors for allosensitization Determines need for virtual or prospective crossmatch		Monitors for post-transplant donor specific antibody development
Palliative care clinicians	Provides guidance and emotional support to patients, caregivers, families, and providers throughout the journey of complex decision-making and advanced care planning If engaged early, can ease the transition to hospice as appropriate throughout the HF journey		
Psychologists	Identifies, consults, and manages psychosocial or behavioral health barriers impacting adherence and/or ability to optimally cope with burden of chronic disease	Evaluates psychosocial functioning to assess patient candidacy and optimizes risk factors for poor MCS outcomes Domains evaluated include, but are not limited to, 1) history of medical adherence problems, mental health problems, or substance use problems, 2) patient knowledge and understanding of their current health, current treatment, and future treatment options, as well as their capacity to make treatment decisions, 3) patients' psychosocial resources that could mitigate the impact of psychosocial risk factors (eg, social support, coping skills), and 4) factors related specifically to MCS candidates' knowledge and capacity to operate the device	Evaluates psychosocial functioning to assess patient transplant candidacy and optimizes risk factors for poor outcomes. Domains evaluated include, but are not limited to, 1) history of medical adherence problems, mental health problems, or substance use problems, 2) patient knowledge and understanding of their current health, current treatment, and future treatment options, as well as their capacity to make treatment decisions, and 3) patients' psychosocial resources that could mitigate the impact of psychosocial risk factors (eg, social support, coping skills)
Social workers and case managers	Assesses and plans patient and caregiver's social needs Provides financial needs for transportation issues, GDMT medications (patient assistance program, coupons in collaboration with pharmacists) and medical issues Assist in discharge planning as a case manager		Provides financial needs for transportation issues, transplant medications (in collaboration with pharmacists) and medical issues Assist in discharge planning as a case manager

(*continued*)

Table 1 (*Continued*)

Multidisciplinary Team Member	Delineated Roles		
	General HF Service	LVAD Service	Heart Transplant Service
Transitions of care nurses (inpatients)	Provides comprehensive HF education (symptoms, vital monitoring, dietary adherence, and medications) Provides early phone call contact post discharge Coordinates postdischarge clinic visits		

CABG, coronary artery bypass graft; CNI, calcineurin inhibitor; CRT, cardiac resynchronization therapy; GDMT, guideline directed medical therapy; HF, heart failure; LVAD, left ventricular assist device; MCS, mechanical circulatory support.

for patients with advanced HF, LVAD, and heart transplant recipients. During transitions of care (TOC), TOC nurses, HF providers, and pharmacists play pivotal roles in providing discharge counseling and follow-up calls for seamless and uninterrupted care. Details regarding a postdischarge phone call and first postdischarge visit have been discussed previously in the literature.[17] Remote monitoring of implantable cardiac devices and telemedicine follow-ups are also vital for contemporary multidisciplinary HF care.

Multidisciplinary Team Member's Delineated Roles

Physician Leaders

In HF programs with no advanced options available, the cardiologist serves as the leader of the multidisciplinary team and helps to coordinate the plan of care for patients. In the programs with the availability of mechanical circulatory support (MCS), especially durable VADs, and heart transplantation, a HF cardiologist and cardiothoracic surgeon often colead the team. They serve as medical and surgical directors of the VAD or VAD/transplant program. It is not unusual, especially in high-volume and LVAD-oriented programs, for the leadership of the overall team shifts to toward the surgeon, although the balance heavily depends on the history and culture of the program, and on personalities.

Cardiologist

The role of the cardiologist varies by the level of care provided at each facility, as well as by the level of training. In rural and smaller community hospitals, the general cardiologist is the typical team leader and helps to establish a roadmap of care for patients with HF, including working with primary care physicians to determine outpatient care needs, as well as determining the need for referral for advanced therapies. At centers that provide LVAD and/or heart transplantation, the advanced HF cardiologist assumes the responsibility of codirector of the multidisciplinary team, sharing responsibilities with the cardiothoracic surgeon, and guides the evaluation and medical management of the patient while ensuring that all members of the team can provide input on the decision-making process.

Cardiothoracic Surgeon

The role of the cardiothoracic surgeon also varies depending on the level of care provided at each facility, as well as the severity of illness of the patient. Importantly, joint decision-making with the cardiologist includes risk assessment, as well as perioperative management of patients undergoing coronary artery bypass grafting, valve replacement or repair, and septal myomectomy and those being considered for LVAD and cardiac transplantation. The surgeon leads or coleads the team in perioperative management and works closely with the multidisciplinary team to ensure quality care is provided.

Advanced Practice Providers

The use of APPs is critical to the success of any HF program. The APP is a highly trained professional who can provide streamlined care through diagnosis, education, medication optimization, and, most important, continuity of care. APPs, specifically in the outpatient clinic, have been shown to increase the patients' quality of life, medication and dietary adherence, and optimal titration of GDMT with a multidisciplinary approach and HF intensive follow-up.[18] APPs can provide close and detailed follow-up for patients with HF after discharge, providing critical evaluation of volume status and uptitration of GDMT, ultimately preventing hospital readmission.[19] APPs have also been shown to improve the quality of care to patients with HF while decreasing mortality by increasing access to care with HF-specific urgent clinics and proper medication adjustments.[20] In LVAD and transplant centers, APPs are integral to the management of this specialized patient population. From adjustment of therapeutic medications such as warfarin and/or immunosuppression, to coordinating and managing radiology and/or laboratory work, and providing additional clinic evaluations, APPs are necessary for successful advanced therapies programs. Given the ever-increasing medical complexity and treatment

Table 2. Summary of Select Clinical Trials for Multidisciplinary HF Team Care

Author (Study Design)	Patient Population	Intervention Group	Control Group	Primary Outcome	Secondary Outcomes/ Cost of Care	Limitation
Rich 1995; single center, randomized controlled trial[72]	Elderly patients aged >70 years with CHF (no EF cut-off) Follow-up 90 days	Nurse-driven comprehensive patient education, dietician-provided dietary education, social service consultation, outpatient follow-up and a medication review by geriatric cardiologist ($n = 142$)	Conventional care ($n = 140$)	Survival rate at 90 days: 64.1 vs 53.6% ($P = .09$)	Number of readmissions for any cause: 53 vs. 94 ($P = .02$); number of readmission for CHF: 24 vs 54 ($P = .04$). All cost of care: treatment group $4815 (including $216 for intervention) vs $5275 (no intervention cost).	Not on contemporary background GDMT therapy (especially, betablocker use was low around 10%) Shorter follow-up period (90 days)
Gattis 1996; single center, randomized controlled trial[73]	Adult patients with HFrEF (< 45%)	Pharmacist recommendation provision to attending physicians through telephone follow-up visits at 2, 12, and 24 weeks after the initial clinic visit ($n = 90$)	Usual care (no pharmacist recommendations) ($n = 91$)	Composite of all-cause mortality and nonfatal HF events: 4 events vs 16 events, OR 0.22, 95% CI 0.07−0.65, $P = .005$	All-cause mortality: 3 vs 5 events, OR 0.59, 95% CI 0.12-2.49, $P = .48$ Rehospitalization rate: 29 vs 42%. $P = .03$	Cost evaluation was not evaluated No blinding Only applicable for pharmacist interventions No acceptance rate of pharmacist intervention was evaluated Not on contemporary GDMT
Kasper 2002; randomized controlled trial[74]	High-risk patients with HF for hospital readmission*	The team included CHF cardiologist, primary care physician, CHF nurse, telephone nurse coordinator. Telephone call within 72 hours of discharge and weekly for 1 month, twice in the second month, and monthly ($n = 102$)	The team included only a primary care physician ($n = 98$)	Composite of all-cause mortality and number of hospitalization for HF: 50 vs 72 events, $P = .09$	All-cause mortality at 6 months: 7 vs 13 events, $P = .14$ Number of hospitalization for HF: 43 vs 59 events, $P = .09$ No significant difference in outpatient or inpatient resource use between the intervention and nonintervention groups	Applicable only for high risk patients with HF Interventions only by nurse, cardiologist, and primary physician
Ducharme 2005; open-label single center, randomized controlled trial[75]	Outpatients who were recently discharged after the hospitalization for congestive HF with a LVEF of <45%	Multidisciplinary specialized HF outpatient clinic: discharge follow-up visit within 2 weeks of hospital Discharge performed by a HF cardiologist; rapid access to expert health care professionals (cardiologists, clinician nurses, dieticians, and pharmacists) Intravenous diuretics if required Nurse telephone calls within 72 hours from the discharge, then monthly	Standard care by attending cardiologists	All-cause hospital admission, 39 vs 57%, HR 0.59, 95% CI 0.38−0.92, or total number of days in the hospital at 6 months, 514 vs 815 days, HR 0.56, 95% CI 0.35−0.89	Total number of emergency visits: no significant difference.	No cost evaluation was performed No blinding Not receiving contemporary GDMT
Angerman 2012; open-label multicenter randomized controlled trial[76]	Patients aged >18 years with signs and symptoms of decompensated HF and an LVEF of ≤40%	HeartNetCare: in-hospital face-to-face contact between specialty nurse and patients to explain the care; telephone monitoring with 19-item questionnaire Uptitration of GDMT; teaching patients about diuretic adjustment Specialty care coordination Measures for high quality interventions ($n = 352$)	Standard postdischarge planning (treatment plans, discharge plan, postdischarge clinic visit within 7−14 days ($n = 363$)	Composite of time to all-cause death or rehospitalization: 37% vs 38%, HR 1.02; 95% CI 0.81−1.30, $P = .89$	All-cause mortality: 9% vs 14%, HR 0.62, 95% CI 0.40−0.96, $P = .03$ CV mortality: 6% vs 10%, HR 0.66, 95% CI 0.38−1.12; $P = .12$	No-cost evaluation was performed No blinding Not receiving contemporary GDMT

(*continued*)

Table 2 (*Continued*)

Author (Study Design)	Patient Population	Intervention Group	Control Group	Primary Outcome	Secondary Outcomes/ Cost of Care	Limitation
Smith 2014; a single-center randomized controlled trial[77]	Hospitalized patient with HFs with NYHA functional class III or IV (no EF criteria)	Four multidisciplinary clinic (NP, a mental health specialized clinical nurse, a social worker, and a dietician) appointments within 8 weeks after randomization; pedagogy approach ($n = 92$)	Education from a discharge nurse; post-discharge phone call follow-up by NP; follow-up visit with cardiologist within 1 month of discharge; GDMT titration by providers ($n = 106$)	Time to CV mortality or rehospitalization for HF: 24% vs 28%, HR 0.45, 95% CI 0.21−0.98, $P = .04$	Total number of hospitalizations for HF: 28 vs 45 events, HR 0.68, 95% CI 0.37−1.24	Smaller sample size No pharmacist intervention Not receiving SGLT 2 inhibitors Single-center design No cost evaluation was performed
Mao 2015; a single center randomized controlled trial[78]	Hospitalized patients owing to HF (both HFrEF and HFpEF)	Multidisciplinary disease management program ($n = 174$) (2 HF cardiologists, 1 psychologist, 1 dietician, 1 pharmacist, and 2 case managers) Provided individualized HF education (self-monitoring, medication, and cardiac and laboratory assessments) Computerized clinical pathway to verify the use of all GDMT agents unless intolerances Then, discharge visit in 1 week after discharge and then monthly clinic visit for 6 months	Standard care ($n = 175$) (1 primary cardiologist provided patient evaluation, treatment, and clinic visit)	All-cause mortality, HR 0.49, 95% CI 0.27−0.91, $P = .02$, or rehospitalization for HF, HR 0.44, 95% CI 0.25−0.77, $P = .004$	N/A	The multidisciplinary care was provided under a national health insurance program Both HFrEF and HFpEF were included Not receiving contemporary GDMT therapy Smaller sample size
Chen 2018; a single center randomized controlled trial in China[79]	HF diagnosis with NYHA functional class II to IV and aged >18 years	HF team includes 3 cardiologists, 1 coach nurse, 10 nurses, 1 dietician, and 1 psychiatrist The intervention included discharge education, physical exercise training, and follow-up visits (home visit 2 weeks after discharge, telephone visits every 2 weeks, education at 3 and 6 months) in addition to the standard care) ($n = 31$)	Standard care (a nurse-led telephone call within 2 weeks after discharge and follow-up visits by 2 cardiologists at 3 and 6 months) ($n = 31$)	Minnesota living with HF self-care behavior scale, 57.2 vs 54.4, $P = .40$	Mortality or rehospitalization for HF, 35.5 vs 32.2, $P = .793$	No cost evaluation was performed Small sample size Primary outcome was quality of life scale
Huynh 2019; multicenter randomized controlled trial in Australia[80]	Adult patients aged ≥18 years with primary diagnosis of HF (both HFrEF and HFpEF) Exclusion criteria included admission for HF in the previous 6 months	Optimization of discharge timing based on intravascular volume status (bedside echocardiography or BNP) Leaflet and video instruction Improvement in TOC (2 telephone calls within 3 days and the second weeks after discharge) ($n = 215$).	Usual care included a standard disease management program (guideline-recommended care, self-care education, discharge plan, and preventative care) ($n = 197$) Also, a follow-up telephone visit within 1 month after discharge	All-cause readmission or death within 30 and 90 days since discharge (usual care vs interventional care) 30-Day outcomes: readmission rate 32.5% vs 20.5%, RR 0.66, 95% CI 0.45−0.88 Mortality rate 9.1% vs 5.6%, RR 0.61, 95% CI 0.30−1.24 90-Day outcomes: readmission rate 44.7% vs 27.9%, RR 0.62, 95% CI 0.48−0.81) Mortality rate 15.2% vs 10.7%, RR 0.70, 95% CI 0.42−1.17	N/A	No cost analysis No hospitalization for HF was collected

(*continued*)

Table 2 (*Continued*)

Author (Study Design)	Patient Population	Intervention Group	Control Group	Primary Outcome	Secondary Outcomes/ Cost of Care	Limitation
Schulz 2019; multicenter randomized controlled trial[81]	Elderly patients with CHF diagnosis aged >60 years currently on diuretic and hospitalized within the last 12 months or increased BNP/ NT-proBNP	The pharmacy care: a medication review, regular dose dispending and counseling ($n = 90$)	Usual care (no pharmacist recommendations) ($n = 112$)	Medication adherence to all three HF medication classes (ACE-I/ARB, beta-blocker, and MRA) (using pharmacy claim data during 1 year of follow-up) based on the proportion of days covered: 91.2 ± 11.9 vs 85.5 ± 16.6%, $P = .007$	Proportion of patients classified as adherent (mean proportion of days covered ≥80%): 86% vs 68%, $P = .005$	Only interventions by pharmacists No cost analysis performed Not receiving SGLT 2 inhibitors

ACE-I, angiotensin converting-enzyme inhibitor; ARB, angiotensin receptor blocker; BNP, brain natriuretic peptide; CHF, congestive heart failure; CI, confidence interval; CV, cardiovascular; EF, ejection fraction; GDMT, guideline-directed medical therapy; HF, heart failure; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; HR, hazard ratio; MRA, mineralocorticoid receptor antagonist; NP, nurse practitioner; NYHA, New York Heart Association; OR, odds ratio; PCP, primary care provider; SGLT, Sodium-glucose cotransporter

*High risk was defined if one of the following: age >70 years, EF <35%, ischemic cardiomyopathy, ≥1 additional CHF hospital admission in the previous year, peripheral edema at hospital discharge, <3 kg weight loss during the hospitalization, peripheral vascular disease, or hemodynamic finding (pulmonary capillary wedge pressure >25 mm Hg, cardiac index < 2.0 L/min/m^2, systolic BP >180 mm Hg, or diastolic BP >100 mm Hg.)

options for HF, the role of the APP is continuing to grow in the HF population.

HF Nurses

The role of the nurse, within any HF program, is critical to define and optimize to achieve success. An accomplished HF program is built upon a strong core of nurses functioning as the glue of the program. A nurse's role is multifaceted and evolves as HF programs progress to LVAD and transplant centers. The HF nurse (HFN) is specially trained in the nuances of HF and provides continuity of care, while also serving as additional eyes and ears to the HF treatment team to provide excellent care to a complex patient population. A few of the integral roles of the HFN include but are not limited to transition of care from hospital to home, frequent patient contact, telemonitoring, HF education, coordination of clinic visits, procedures, and laboratory draws; communication of a patient's HF symptoms or worsening clinical status to the treatment team provides successful management of the complicated patient with HF.[21] In the era after coronavirus disease 2019, the increased use of telemonitoring services has been beneficial to the survival of the patient with HF.[22] With the rising implementation of remote monitoring, the HFN must be able to incorporate incoming information and contact the patient with HF and assess symptoms, while communicating changes and concerns to the treatment team. The ability of the HFN to juggle multiple platforms of incoming information is critical to the success of a HF team. The HFN is able to direct patient-specific information to appropriate team members, such as pharmacists for possible drug reactions versus the APP or cardiologists for hypotension or hyperkalemia. The HFN also evaluates the functional status of the patient with HF and can identify declines owing to the close relationships. As the patient with HF declines and progresses to New York Heart Association functional class III or IV disease, the HFN can work alongside the treatment team to coordinate referral to an advanced therapies center for consideration of LVAD or cardiac transplant.

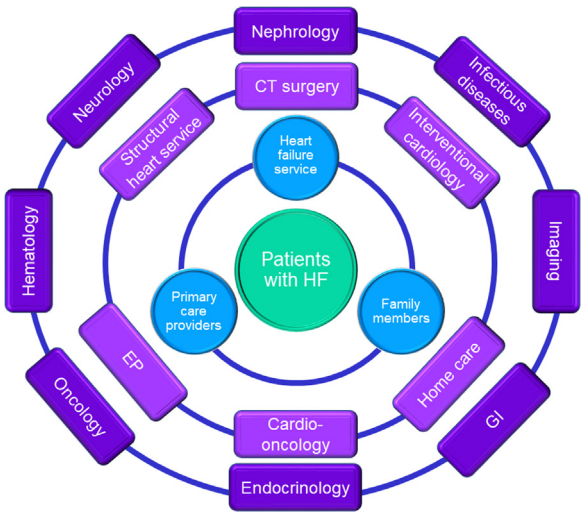

Fig. 1. Patient-centered comprehensive disease and comorbidity management with consulting services and primary care providers. CT, cardiothoracic; GI, gastrointestinal; EP, electrophysiology; HF, heart failure.

Specialty Nurses for LVAD and Transplant

The specialty nurse role is built on a framework of the HFN in knowledge and role execution, although

it requires further training specific to LVAD and cardiac transplantation. The role of the specialty nurse operates at the highest function and scope of practice within a nursing role. The specialty nurse covers patient care from referral to evaluation and determined treatment for each patient with HF. After LVAD implantation or cardiac transplantation, the appropriate specialty nurse provides treatment specific-education, follow-up care, and enhanced patient contact and/or communication to prevent further hospitalizations after treatment. In working alongside the treatment team, the specialty nurse provides an extension of treatment specific care that is fundamental to the success of an advanced therapies program.

Clinical Pharmacists

Within both the outpatient and inpatient settings, pharmacists serve as an excellent resource for drug information, and GDMT suggestion and selection, titration, and monitoring in the management of patients with acute or chronic HF. Under collaborative practice agreements, pharmacists can initiate and titrate GDMT for heart failure with reduced ejection fraction and monitor drug therapy. Additionally, pharmacists can assist with medication coverage and access, medication alternatives when drug shortages exist, patient education, TOC, deprescribing of inappropriate medications, mitigation of drug–drug interactions, chronic condition management, and vaccination management.[23,24]

For patients undergoing advanced therapies evaluation (i.e., transplant or MCS device implantation), the United Network for Organ Sharing amended their bylaws in June 2004 such that a clinical pharmacist should be included as an essential member of the transplant team because they can identify and address a spectrum of solving medication-related problems to monitoring of patient care plans. In 2007, the Centers for Medicare and Medicaid Services published their Medicare Conditions of Participation for organ transplant programs. In its final rule, the Centers for Medicare and Medicaid Services mandated that, for a transplant program to be reimbursed, every transplant program must have a designated qualified expert in transplant pharmacology who should serve as a member of the multidisciplinary transplant team and be involved in every step of the patient's transplant care journey (eg, pretransplant evaluation, as well as perioperative and postoperative inpatient and outpatient care).[25] With their expertise in the pharmacokinetics of current immunosuppressive drugs, the clinical pharmacists can proactively identify potential drug–drug interactions and adverse events, as well as provide patient-specific dosing, monitoring recommendations, and medication education. For those receiving a MCS device, clinical pharmacists can assist with the selection, monitoring, and dosing of anticoagulation in both the preoperative and postoperative management periods.[25]

Dieticians

Dieticians are vital multidisciplinary team members who optimize dietary interventions for patients with HF throughout the whole spectrum of care. Dieticians provide assessment of nutritional status and recommend interventions for patients with a variety of conditions, including obesity, cardiac cachexia, and sarcopenia, as well as low albumin levels, which can be associated with a worse prognosis in more advanced HF.[26–29] The Academy of Nutrition and Dietetics evidence-based practice guideline for the management of HF recommends that a registered dietician provide medical nutrition therapy to patients with HF.[30] In addition to sodium intake education, the HFSA consensus statement proposed structure and criteria for dietician-led nutritional evaluation and counseling.[26] The benefits of dietary interventions also apply to advanced HF services, such as dietary counseling and weight management for LVAD recipients, which have been shown to prevent increases in body mass index and obesity effectively compared with the nondietician intervention group.[31]

Physical Therapists

Frailty is an important predictor of all-cause mortality and hospitalization in patients with HF, and comprehensive strategies for the assessment and screening of frailty are critical.[32] Frailty before LVAD implantation or heart transplantation is also associated with a significantly increased mortality risk.[33,34] Thus, frailty should be considered as a factor for a LVAD or heart transplant patient selection. Among diverse strategies for the management of frailty, exercise is the most effective intervention to improve frailty status, and physical therapists play a pivotal role in assessing and managing the exercise recipe for frailty.[35]

The American College of Cardiology/American Heart Association/HFSA guidelines for HF recommend exercise training or regular physical activity for all patients with HF who participate in exercise or physical training.[2] The American Physical Therapy Association clinical practice guideline for HF states that physical therapists provide exercise training interventions in a multidisciplinary team environment.[32] Given the substantial benefits documented by cardiac rehabilitation, it is suggested across the continuum of the HF journey, from the patient newly diagnosed with HF to the post-LVAD patient and cardiac transplant recipient. The details for

cardiac rehabilitation for patients with HF are discussed elsewhere.[36] Physical therapists play vital roles in implementing evidence-based exercise training programs throughout the whole spectrum of HF care.

Immunologist

According to the Registry of the International Society for Heart and Lung Transplantation, one-third of patients undergoing heart transplantation are sensitized at transplantation.[37] The increased rates of sensitization are attributable to the larger number of patients on mechanical support before transplantation, blood transfusions, increased numbers of patients with congenital heart disease with previous surgery using homografts, and more repeat transplants. Allosensitization is a risk factor for an increased wait time to transplant and poor post-transplant outcomes.[38] The interpretation of various tests developed to assess alloimmunity requires some expertise. The transplant immunologist, therefore, plays a critical role in assessing the alloimmune risk for the patient awaiting heart transplantation and helps to provide a collaborative decision with the clinical team regarding the need for a virtual or prospective cross-match at transplant. Given that this risk may vary with time, patients on the transplant waitlist require periodic monitoring as recommended by consensus guidelines.[39] Ongoing monitoring is required after transplantation for all transplant recipients because up to 30% may develop de novo donor-specific antibodies.[40]

Palliative Care Services

Integrating palliative care services (PCS) into care for the HF population is necessary, given the symptom burden (emotional and physical), caregiver burden, and overall poor prognosis associated with the HF disease process. PCS offer guidance and emotional support to patients, caregivers, families, and providers throughout the journey of complex decision-making and advanced care planning that is encountered with the varying treatment modalities offered in HF.[41] Although the timing to integrate PCS is not well-defined, it is recommended to engage PCS early and often throughout the disease trajectory given the unpredictable survival.

PCS can aid in discussions that provide a better understanding of the patients' treatment desires, while also bridging the transition to hospice care as appropriate.[41,42] For example, the use of palliative inotropes in patients with HF who are not eligible for advanced therapies, such as LVAD or cardiac transplantation. Inotropes in patients with HF can temporarily decrease symptom burden and provide a bridge for the patient to get home for a period of time; however, survival remains poor and the transition to hospice must be discussed at the time of discharge.[43] It is essential to understand that PCS is not hospice, although engaging PCS early in the HF trajectory develops a stable patient–provider–team relationship that promotes a seamless transition to hospice and a dignified dying process when appropriate.

Psychologists

The integration of psychologists into the multidisciplinary care of patients with advanced HF has been variable, with psychologists playing a critical role in the evaluation of candidates for a heart transplant and LVAD, and an inconsistent, peripheral role in the general management of patients with HF.[44–47] As detailed elsewhere, patients with HF being evaluated for MCS therapies often undergo psychosocial evaluations encompassing an array of psychosocial domains, including mental health history and current functioning, neurobehavioral functioning, behavioral compliance history, substance use history, and social support system integrity.[44–47] In the context of MCS therapies, these considerations are critical because the likelihood of experiencing untoward clinical outcomes secondary to nonadherence with pharmacological or device-specific compliance (eg, anticoagulation and LVAD battery maintenance) is increased significantly.[48] Psychosocial assessments are particularly pertinent given the high degree of depressive symptoms observed among patients with HF and numerous observational studies demonstrating that elevated depressive symptoms predict subsequent mortality.[46,49] In addition, MCS candidates exhibit a high degree of cognitive impairment,[50] even among middle-aged candidates free from clinical dementia,[51] and cognitive changes are highly variable following transplantation[52] and LVAD placement[51,53,54] owing to microembolic events,[55,56] hemodynamic instability,[57] and comorbid frailty.[58] Moreover, affective or cognitive disorders can impair self-management capacity among MCS candidates, underscoring the importance of multidisciplinary approaches to bolster social support, cultivate compensatory techniques to mitigate the impact of comorbid cognitive weaknesses, and optimize treatment for mood-related symptomatology.[54,59–61]

As we now report, psychologists play an important role in the evaluation of transplant candidacy and are increasingly incorporated into post-transplant care. Although a systematic approach to psychological care after transplantation is still developing, numerous studies have demonstrated that worse post-transplant psychological functioning (eg, elevated depressive symptoms) is predictive of long-term clinical outcomes.[46,47,62]

Psychologists may also play an important role among patients with HF requiring palliative and end-of-life care. The majority of available evidence suggests that patients prefer to have a high degree of autonomy over their health care decisions, including the transition period from targeted, disease-modifying treatments to symptom management among individuals with advanced disease.[63,64] Nevertheless, such treatment transitions are difficult to navigate for both patients and providers, are often met with difficulty accepting or even denial of disease progression, and the need to thoughtfully align treatment approaches with the patient's underlying values and psychological needs. In this setting, psychologists can play a potentially important role guiding patients and personalizing multidisciplinary treatment approaches for advanced patients with HF.

Psychologists are also uniquely positioned to inform treatment modifications based on a patient's current cognitive or psychosocial limitations. For example, cognitive impairment is common among individuals with advanced HF and associated with worse self-management capacity. In addition, individual differences in cognitive profile are not only informative for current self-management capacity (eg, executive functions), but in some cases are highly predictive of future cognitive stability (eg, amnestic memory impairment). Characterizing such deficits may help the team to modify treatment strategies to align with the patient's individual self-management capacity and social support needs, such as by streamlining medication regimens to decrease their complexity, incorporating reminder systems to decrease reliance on patient memory functioning, and using eliciting support from allied health members.[65]

Among individuals with advanced HF symptoms, such as those being considered for cardiac transplantation or MCS, consensus recommendations suggest that optimizing psychosocial risk factors may be appropriate if patients are sufficiently stable from a medical standpoint.[47] Psychologists may be uniquely positioned to provide insight into the strategies to improve modifiable psychosocial risk domains (eg, substance use), as well as the likelihood that psychosocial functioning will be responsive to intervention.[46] Although such considerations have not been explored thoroughly in the general HF population, it is likely that ultimate treatment success is more likely among some individuals when treatment plans are modified to prioritize psychosocial barriers.

Transitions of Care

TOC are individual interventions and programs designed to transition from one setting to another, most commonly from hospital to home.[21] Although the role is typically designated to a HFN, the role encompasses a community of individuals, such as APPs, physicians, home health providers, pharmacists, family caregivers, and even telemonitoring companies, who come together to provide care for patients with HF. The HFN TOC role is most impactful upon hospital discharge to home. The highest risk for a HF readmission and death is within the first 3 months after admission for decompensated HF.[19] The proper use of the TOC role can significantly reduce hospital admissions.[19,21] However, it is important to acknowledge that the TOC role varies among institutions and is not isolated to a HFN. For example, evidence showed that telephone interventions by pharmacists were associated with a decrease in hospitalization within 30 days of discharge.[66] Thus, to provide successful care for the complex patient with HF, it is critical that HF programs understand and use the entire community to provide cohesive care. A primary benefit of TOC is focusing on early follow-up, within 1 week of discharge. This practice provides specific education about symptoms, weight monitoring, dietary adherence, and medication adjustments as appropriate.[19] The TOC role can coordinate patient care through various modalities, such as clinic visits, phone calls, and remote patient management strategies, such as telehealth and remote monitoring, as appropriate for each patient. A collaborative, multidisciplinary approach with HFN is beneficial in providing comprehensive care to patients with HF.[19]

Evaluation of HF Services

The key to implementing and adopting a multidisciplinary HF team model is buy-in from all stakeholders. Of paramount importance is setting the vision and a clear understanding of the goals of such a program. Although the size and scope may vary for each program, financial sustainability and alignment with each health system or practice model's goals and vision will ensure appropriate resource allocation and downstream stability. The models of the multidisciplinary team may vary from all teams under one roof to providers in different location, but tied coherently with excellent communication and hand offs. This factor is even more critical in rural settings, where access to specialists may not be feasible owing to transportation, economic and staffing barriers. Although hub-and-spoke models have been used in the delivery of advanced HF care, a similar structure can be created for multidisciplinary care as well. Telemedicine can also play an important role in providing these services to patients in underserved areas, both urban and rural. Several multidisciplinary models exist that are often

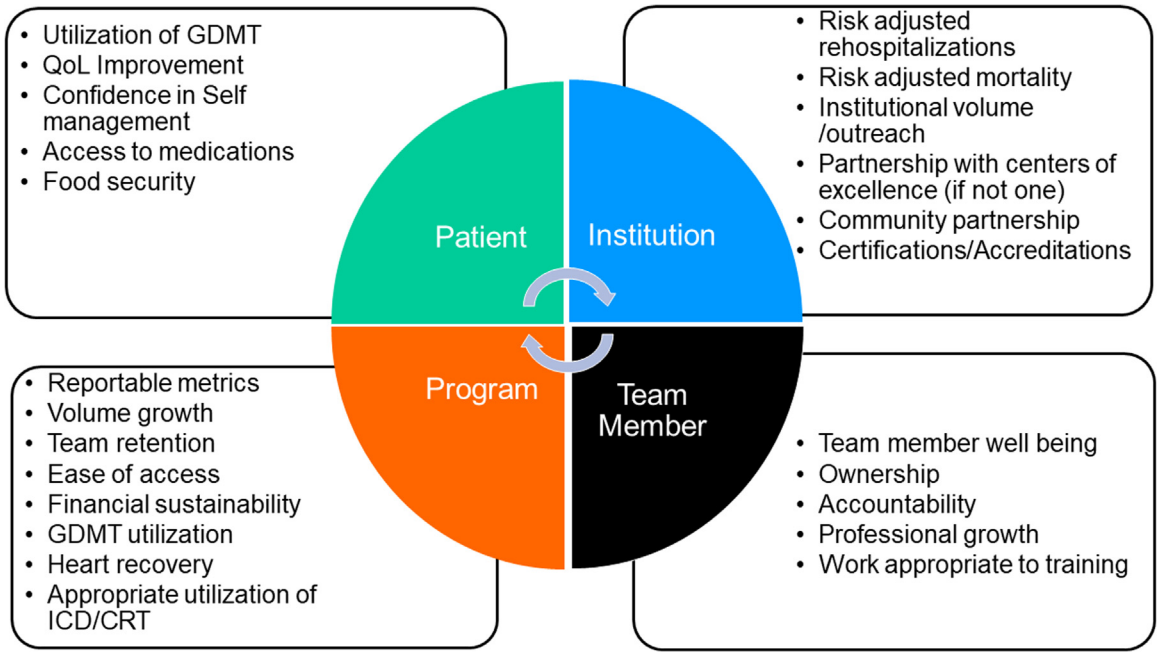

Fig. 2. Framework of metrics and goals at the patient, institution, program and multidisciplinary heart failure team level. CRT, cardiac resynchronization therapy; GDMT, guideline directed medical therapy; ICD, implantable cardioverter defibrillator.

designed to serve specific populations based on need as well as organizational philosophy and finances. The design of the multidisciplinary HF team model should be tailored to the specific needs of the community being served, the scope of services being provided, resources available, and unique barriers in the care delivery both in the facility and the community. The complex nature and needs of patients with HF can vary and the duration of multidisciplinary care should be determined by the situation of individual patient.

Identifying and integrating key clinical and administrative leaders will ensure accountability and appropriate resource allocation. Setting goals and standard operating procedures will set the framework and a roadmap for all team members. Metrics should be modeled around national standards, including publicly reportable performance measures and data standards guided by professional organizations and governmental agencies.[67–69] For instance, a multidisciplinary HF team is a requirement for organ procurement and a transplant network to succeed in heart transplant programs.[70] The American Heart Association Get With The Guidelines HF program also guides hospitals to adhere to the latest evidence and guidelines for improving quality of HF care.[71] In addition, each program should have additional metrics unique to its needs and barriers. Accountability for both clinical and administrative leaders is crucial, and setting up metrics and timeline-based review by quality assurance and performance improvement teams will enhance effectiveness and sustainability. Each team member should be assessed individually and collectively, as a group, to evaluate their ability to deliver quality care in alignment with the goals set forth. Figure 2 depicts a potential framework of metrics that could serve as meaningful end points at the patient, institution, program, and multidisciplinary HF team levels.

Similarly, Figure 3, although having some overlapping goals with Figure 2, provides a broad range of aspirational as well as structural goals to be adopted by the multidisciplinary HF team in an integrated system with a specific focus on meaningful patient journey. Although each component and metric may not apply to every setting, this figure serves as a general roadmap for internal deliberations to structure programs. One of the critical features of any multidisciplinary HF team should be a patient-centered focus and team member engagement, and professional fulfillment. Because multidisciplinary HF teams require substantial resource allocation, each system or institution should take a holistic approach to long-term patient well-being and success as they balance financial revenue to costs associated with such a program.

Gaps in Knowledge

Although multidisciplinary care is vital and well-recognized in the management of the patients with HF, institutional resources to hire all essential professionals in each HF care model could be a limiting factor. Future studies are needed to evaluate the

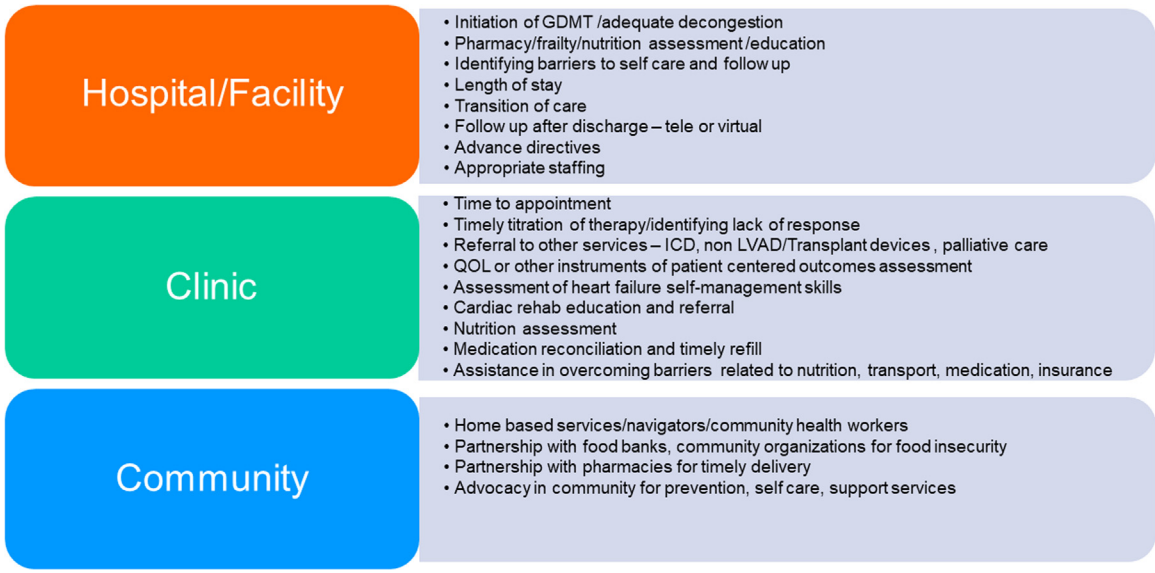

Fig. 3. Proposed outcomes for measuring success of the multidisciplinary heart failure team in an integrated system. LVAD, left ventricular assist device; QOL, quality of life. Other abbreviations as in Figure 2.

minimum number of essential professionals needed based on the HF services provided. For example, general HF practice may focus on GDMT optimization, which can be done by HF APP, pharmacists, or HFN under protocols. Second, having redundancy in team roles may be important in some situations when one team member is absent from the team for an extended time. During one professional's absence, another professional may be able to cross-cover the role such as assessing financial affordability of HF medications (social workers, financial counselors, and pharmacists), GDMT titration (APPs, pharmacists, and HFNs), patient education (APPs, pharmacists, and HFNs), and TOC (providers, TOC nurses, HFNs, and pharmacists). Third, cost-effectiveness or cost–benefit analyses of multidisciplinary care in HF services are essential to justify the multidisciplinary HF team approach financially. Our expert group has proposed the structure and function of core team members, but evidence to select the essential members in multidisciplinary teams remains limited. Fourth, the optimal structure of a multidisciplinary HF team may change longitudinally based on patient's clinical condition and goals of care. Further investigation is needed if patients could complete multidisciplinary HF team care or less frequently follow up with the multidisciplinary HF team care once they are in remission. Fifth, the structure of a multidisciplinary HF team may also change in the context of an unprecedented event such as the coronavirus disease 2019 pandemic, and the implementation of telemedicine in contemporary HF care needs to be investigated. Sixth, the clinical trials included in Table 2 had conflicting results in clinical outcomes, mainly because multidisciplinary HF interventions were different among trials and professions on the multidisciplinary team were not the same. Also, multiple different interventions were involved in the same trial and we could not identify which intervention was most crucial to affect clinical outcomes. The standardized interventions and structure of multidisciplinary HF team may help clinicians compare the results among multiple trials and apply the models to real-world settings. Last, the collaborative relationships with consulting services for patients with HF were briefly discussed, but a separate article or expert panel is needed to delineate each consulting service in a HF multidisciplinary team care.

Conclusion

A multidisciplinary HF team-based approach is now recommended for patients with HF in the American College of Cardiology/American Heart Association/HFSA guidelines. This approach is beneficial to reducing the hospitalization rate for HF, improving adherence to self-care and GDMT, and potentially reducing health care costs. This expert guidance should help implement the structured multidisciplinary HF team-based approach in the real-world HF practice.

Lay Summary

The guidelines for HF recommend a multidisciplinary team approach for patients with HF. The HF team-based approach reduces the hospitalization rate for HF and health care costs and improves adherence to self-care and use of appropriate medications. This article proposes the optimal HF team structure and each team member's delineated role

to achieve institutional goals and metrics for HF care. A structured HF team-based approach should be incorporated to optimize the structure, minimize redundancy of clinical responsibilities among team members, and improve clinical outcomes and patient satisfaction in their HF care.

A proposed tweet

A structured multidisciplinary HF approach should be implemented to improve clinical and patient-centered outcomes.

Disclosure

The authors have no relationships with the industry and nothing to disclose.

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