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Management of chronic heart failure in the older population

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Abstract

Chronic heart failure (CHF) is the leading cause of hospitalization for those over the age of 65 and represents a significant clinical and economic burden. About half of hospital re-admissions are related to co-morbidities, polypharmacy and disabilities associated with CHF. Moreover, CHF also has an enormous cost in terms of poor prognosis with an average one year mortality of 33%–35%. While more than half of patients with CHF are over 75 years, most clinical trials have included younger patients with a mean age of 61 years. Inadequate data makes treatment decisions challenging for the providers. Older CHF patients are more often female, have less cardiovascular diseases and associated risk factors, but higher rates of non-cardiovascular conditions and diastolic dysfunction. The prevalence of CHF with reduced ejection fraction, ischemic heart disease, and its risk factors declines with age, whereas the prevalence of non-cardiac co-morbidities, such as chronic renal failure, dementia, anemia and malignancy increases with age. Diabetes and hypertension are among the strongest risk factors as predictors of CHF particularly among women with coronary heart disease. This review paper will focus on the specific consideration for CHF assessment in the older population. Management strategies will be reviewed, including non-pharmacologic, pharmacologic, quality care indicators, quality improvement in care transition and lastly, end-of-life issues. Palliative care should be an integral part of an interdisciplinary team approach for a comprehensive care plan over the whole disease trajectory. In addition, frailty contributes valuable prognostic insight incremental to existing risk models and assists clinicians in defining optimal care pathways for their patients.

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1 Introduction

Chronic heart failure (CHF) incidence and prevalence increases with age. It is a major cardiovascular syndrome expected to increase over the next 25 years as its incidence will more than double and its prevalence will increase 10 fold from age 60 to age 80.[1,2] While 50% of patients with HF are over 75 years of age, most clinical trials have included younger patients with a mean age of 61 years. Inadequate data makes treatment decisions challenging for health care providers as they need to extrapolate how best to treat this special population.

CHF is the leading cause of hospitalization for those over the age of 65 and represents a significant clinical and economic burden.[3–5] In Canada, the cost of a heart failure (HF) hospital admission ranges between $6000 and $15000.[4] Rates of readmission are high in the elderly within 3–6 months after discharge, ranging between 27%–47%. About half of re-admissions are related to co-morbidities, polypharmacy and disabilities associated with CHF.[6] Inpatient and outpatient costs associated with CHF management make it one of the most costly health care problems. Leaving aside the monetary cost, HF also has an enormous cost in terms of poor prognosis with an average one year mortality of 33%–35%.[4]

This review paper will focus on the importance of CHF management in the older population. We will review, the epidemiology with a focus on gender differences, the aetiology specific to this population, and the clinical presentation and diagnostic processes. Management strategies will be reviewed, including non-pharmacologic, pharmacologic, quality care indicators, quality improvement, care coordination, transition and lastly, and end-of-life issues.

2 Epidemiology

The prevalence and incidence of CHF are increasing in the Western countries, particularly in individuals older than 80 years of age.[5] Based on Framingham data, the lifetime risk of developing CHF is one in five, and its incidence in-

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creases with age with a steep rise from 1.4%–1.9% among middle-aged patients to 12.8%–14.7% among octogenarians.[7] Older CHF patients were more often female (50% *vs.* 35%; $P < 0.0001$), had less cardiovascular diseases and associated risk factors, but had higher rates of non-cardiovascular co-morbidities.[8] The prevalence of CHF with reduced ejection fraction, ischemic heart disease, and its risk factors declined with age, whereas the prevalence of non-cardiac co-morbidities, including chronic renal failure, anemia, and malignancy, increased with age.[8] Diabetes has been found to be one of the strongest risk factor as a predictor of CHF particularly among women with coronary heart disease.[9]

Based on the 44-year follow-up of the Framingham Heart Study and the 20-year follow-up of the offspring cohort, 80% of men and 70% of women under the age of 65 who have HF will die within eight years.[10] Following the diagnosis of HF, survival is poorer in men than in women, however, less than 15% of women survive more than 8–12 years. The one-year mortality rate is high, with one in five dying. In patients diagnosed with HF, sudden cardiac death occurs at six to nine times the rate of the general population.[10]

Despite these striking numbers, HF research has been predominantly in men and in those with systolic dysfunction. It has been shown that only 21% of major HF trial participants are women. Although data shows that 40%–60% of patients hospitalized for HF have preserved left ventricular (LV) systolic function and the majority are women. There has been a clear association between HF with preserved LV and the female gender.[11] Fifty percent of elderly with CHF over the age of 75 suffer from diastolic dysfunction and its long term prognosis appear similar to systolic HF.[12]

3 Etiological factors

The commonest causes of HF are coronary artery disease (CAD), hypertension and diabetes, however, hypertension and diabetes have been found to be stronger risk factors in elderly women and CAD and smoking are stronger risk factors in elderly men.[11] The concomitant diseases such as atrial fibrillation, valvular heart disease, diabetes, chronic kidney disease, anemia, chronic obstructive pulmonary disease (COPD), depression, arthritis, sensory impairment, and cognitive dysfunction substantially add to the complexity of HF care. It has been shown that 2/3 of elderly patients with HF have more than two non-cardiac co-morbidities and over 25% of them have more than six comorbidities.[13,14] Despite advances in the care of individuals with HF, uncertainty remains about how best to manage CHF in elderly patients with complex co-morbidities.[13]

4 Clinical presentation

HF with preserved ejection fraction and contractility is the most common phenotype of HF in the elderly. Age-associated myocardial and vascular wall stiffness with the consequent increase in aortic impedance may lead to increased end-diastolic pressure in a stiff ventricle resulting in pulmonary edema.[8,15]

Conditions which further impair ventricular filling such as atrial fibrillation (very common in this population), has the potential to trigger a HF decompensation more easily in the aged heart with limited cardiac reserve. With time progression and further cardiovascular insults, the left ventricular dilatation worsens and dysfunction may occur as a final stage.[15] It has been demonstrated that elderly patients presenting to hospital with acute HF are more likely to present with acute pulmonary edema and hypertension and only 2% present with hypotension.[16] Factors that have been found to contribute to acute de-compensation are: active ischemia/infarction, uncontrolled hypertension, atrial fibrillation, renal failure, viral infections, pneumonias, COPD, anemia, and drugs [either non-adherence or use of nonsteroidal anti-inflammatory drugs (NSAIDs)].[17]

In the outpatient setting, elderly are more likely to present with a gradual onset of symptoms and atypical findings such as loss of appetite, fatigue, falls and functional decline.[17] Dyspnoea and orthopnea have been found to be good predictive symptoms with a sensitivity of 95%. However, they have a lower specificity of 65%, likely due to other co-morbid conditions such as pulmonary disease, anemia, pulmonary hypertension, sleep disordered breathing, and poor mobility.[18] It is important to note that preclinical HF is four times more common than symptomatic HF and we need to do a better job in recognizing it at the earlier state.[19]

5 Cognitive function

Despite the fact that 80% of patients with heart failure are older than 65 years, recognition of cognitive impairment by physicians in this population has received relatively little attention. In a recent study of older adults hospitalized with HF, cognitive impairment was common (present in 47% of patients) but was only documented in half of the cases (22.7%).[20] The patients with cognitive impairment were significantly more likely to experience mortality or hospital readmission at 6 months compared with patients without cognitive impairment.[21]

Cognitive function is of prime importance for multiple reasons. First, the self-care requirements for optimal disease

management in CHF are extensive; typical discharge instructions include daily weighing, fluid restriction, symptom monitoring, and compliance with a low-sodium diet and multidrug regimens.[22] Cognitive impairment may interfere with any one of these necessary tasks, for example, doses of diuretics may be missed or changes in symptoms (dyspnoea, weight gain) may not be recognized until they are severe. This may explain why patients hospitalized with HF have the highest rates of early readmission following discharge.[23] While causes of early readmission are complex, unrecognized cognitive impairment may contribute to this problem because patients may not be equipped to manage their HF following transition to the home setting. Recognizing cognitive impairment may allow physicians to simplify medication regimens and individualize discharge education and adequate support system.[20,24]

6 Investigations and management

The basic investigations for HF do not significantly differ in comparison to a younger patient. Routine measurements of CBC, electrolytes, renal and liver function, TSH, CXR, and ECG are recommended (Table 1). The objective assessment of Left Ventricular (LV) function with echocardiogram is also advised. Specific assessment for infection, ischemia, and arrhythmia as precipitating factors may need to be considered. Some may require individualized invasive investigations.

In general, the goals and recommendations described for CHF management are appropriate for older-aged individuals as well.[25] The treatment goals are to alleviate symptoms first and to prevent progression of disease and hospitalization. Maintenance of functional capacity and optimization of co-morbid conditions, home environment, addressing caregivers issues, and emergency response system are crucial. Use of specialized services for complex CHF patients is necessary in most cases.

How do we achieve stability in chronic CHF? Stability can be defined as having no limitation in basic daily activities and being able to walk at least one block without symptoms. This can be achieved by having stable fluid balance, systolic blood pressure (BP) not less than 100 mmHg, and heart rate range of 60-85 beats/min. Optimal management of co-morbid conditions (angina, diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), anemia, renal function), ensuring compliance to medical therapy; and absence of depression all play important roles in CHF management.[26]

Diet and lifestyle changes such as restriction of sodium intake to < 2 g/d and fluid to 1.5–2 L/d should be undertaken in systolic HF. Education regarding weight mainte-

Table 1. If heart failure is suspected, consider the following diagnostic tests (adapted from http://www.chfn.ca/is-it-heart-failure).

Diagnostic methods		
ECG	Echocardiogram (include ejection fraction)	
Chest X-ray	BNP if available	
CBC, Creatinine, Electrolytes		
It is unlikely to be HF if all of the following criteria are met	**It is probably HF if any of the following criteria are met**	**Diagnosis of HF needs further clarification if**
Normal echocardiogram	Any history of cardiomyopathy	Progressive, unexplained symptoms
Normal JVP	Orthnopea, PND	Patient has risk factors for HF (see above) but does
No fluid retention, no peripheral edema,	Increased JVP	not meet other diagnostic criteria
no abdominal bloating	Positive echo:	Credible alternative diagnoses exist
No crackles	Abnormal EF, OR	Echocardiogram shows:
	Grade II to IV diastolic dysfunction OR	Grade 1 or mild diastolic dysfunction
	Moderate to severe valve abnormality	Wall motion abnormality OR
	Positive chest X-ray	Any mild valve abnormlity
	Evidence of pulmonary edema OR	
	Enlarged heart	
Measurement of left ventricular ejection fraction		
Echocardiogram	CT angiogram	
Radionuclide angiogram (RNA or MUGA)	Cardiac MRI (CMR)	
Contrast left ventricular angiogram		

BNP: B type natriuretic peptide; ECG: echocardiogram; EF: ejection fractions; HF: heart failure; JVP: jugular venous pressure; MUGA: multigated acquisition scan; PND: paroxysmal nocturnal dyspnea; RNA: radionuclide angiogram.

Table 2. Physiotherapy exercise prescription and six weeks protocol (adapted from Azad, *et al.*[28]).

(1) The participant is encouraged to meet the maximum exercise duration for their respective interval.
Interval 1: exercise between one and five minutes, as able. Goal: 5 min of continuous exercise.
Interval 2: exercise for 5 min (one work phase "ON") followed by 1 min of rest ("OFF"). This sequence is repeated to a maximum of five work phases (5 ON, 1 OFF × 5). Goal: 25 min of accumulated exercise.
Interval 3: 10 min ON, followed by one minute OFF to a maximum of three work phases (10 ON, 1 OFF × 3). Goal: 30 min of accumulated exercise.
Interval 4: 30 min of continuous exercise
Interval 5: 30 min of continuous exercise at target heart rate
(2) Following completion of each exercise, the participant needs assessment to determine whether was experiencing any symptoms, such as chest pain or atypical angina, nausea, palpitations, excessive sweating, shortness of breath and/or any other muscle or joint pain.
(3) Progression to the next interval could occur if maximum intensity/duration are completed during which the RPE was less than five, their EXHR was less than the target heart rate, and participant is asymptomatic.
(4) If the exercise duration and/or the requirements are not met, the participant would continue with their respective exercise interval the following session.

nance, self-efficacy by adjustment of diuretics and other medications should be done. Low-intensity exercise should be counseled. Who to contact and what to do if symptoms worsen should be clearly laid out to the patient and family.[25] Nevertheless, we need class A evidence for diet recommendations in CHF as the current evidence is level C.[27] Dietary changes need to be individualized and taking every patients' co-morbidity into account and discouraging unnecessary dietary restriction particularly in the frail elderly who require frequent nutritious small meals.

From the exercise perspective, patients should be encouraged to be as active as possible starting with low intensity exercise such as 5 min continuous exercise with gradual weekly increments (Table 2).[28] There are theoretical benefits in reduced neurohormonal activation, improved endothelial function, skeletal muscle physiology and perceived quality of life.[29,30]

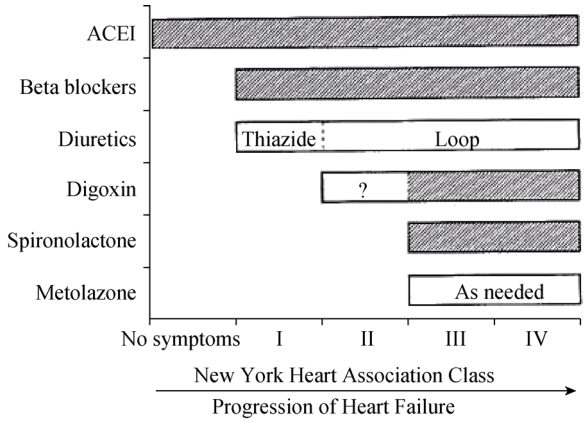

Figure 1. Approach to treatment of systolic heart failure. Shaded areas represent treatments demonstrated to be beneficial in prospective randomized clinical trials. ACEI: angiotensin-converting enzyme inhibitors.

7 Pharmacotherapy in systolic heart failure

Unfortunately, older CHF patients are under-represented in randomized controlled clinical trials. As a result, therapies recommended in the current guidelines are based largely on studies in a younger population with a different clinical profile which have not been adequately tested in elderly patients (Figure 1).[15]

Pharmacology needs to be carefully selected for a multitude of reasons. First, there are physiological age-related changes that influence drug pharmacokinetics and pharmacodynamics. Ageing is also associated with a change in body composition, which results in a lower volume of distribution and higher plasma concentrations of hydrophilic drugs, while the plasma concentrations of lipophilic drugs tend to decrease.[26,31] Second, these patients often have multiple other co-morbidities which increases the risk of drug side effects (renal, liver dysfunction, orthostatic hypotension) and conflicts with HF treatment guidelines e.g., angiotensin-converting enzyme inhibitors (ACEI) with orthostatic hypotension. The presence of cognitive impairment makes treatment compliance more challenging and is a marker of poorer outcome. Polypharmacy also increases the risk of drug-drug interactions. Patients with CHF, on average take 10 medications with significant risk for adverse drug reactions.[32] Third, the presence of social and economic issues, frailty and caregiver burden needs all to be taken into account when choosing a management plan.[33,34]

7.1 Diuretics

Diuretics have been found to be of major importance for symptomatic treatment and maintenance of euvolemia. The ADHERE registry in USA reported that 30% of HF inpatient's weights did not change during hospital stay, actually 15% of weights were higher at the time of discharge from hospital, suggesting that patient were not decongested adequately.[35] Diuretics should be prescribed in all patients

with symptoms/signs of pulmonary or systemic congestion. Monitoring renal function and electrolyte balance are important during diuretic use while observing for hypoperfusion or worsening renal insufficiency.[26] During chronic management, the dose of diuretic may have to be reduced several times to allow for up titration of other drugs to achieve the lowest dose compatible with stable weight and symptoms. Rise in serum creatinine implies that rate of diuresis has exceeded the rate that volume can be reabsorbed from the interstitium. It does not necessarily mean you have reached normal volumic state and clinical assessment is necessary.

7.2 Digoxin

Digoxin is indicated as an adjunct for rate control in atrial fibrillation and for HF with advanced systolic dysfunction as an inotropic agent in New York Heart Association (NYHA) class III or IV. While it may improve function and quality of life, it does not impact survival.[36] With age-related changes in renal function and body water, an equivalent dose is likely to cause toxicity (especially in older women). Symptoms of mild toxicity are often under recognized such as anorexia, confusion, visual disturbance.[37] Close monitoring of electrolyte abnormalities (i.e., hypokalemia, hypomagnesemia, and hypercalcemia), dehydration, and drug-drug interaction is needed. Aim for a therapeutic digoxin serum level of 0.5–0.9 nmol/L.[38] Presence of underlying cognitive impairment making the elderly unlikely to recognize the symptoms of toxicity.

7.3 ACEI/ARB

ACEI or angiotensin receptor blocker (ARB) therapy should be initiated at a low dose with very gradual up titration, monitoring renal function and serum potassium levels closely. Small increases in the serum creatinine level (0.5 mg/mL) do not mandate discontinuation of ACEI or ARB but should prompt careful assessment of volume status and consideration of a reduction in diuretic dosages.[26]

A 20% increase in serum creatinine level can be expected. Target doses for the elderly have not been well established and based on the meta analysis, after the age of 75, the long term benefit declines.[39] ARB is usually a substitute for ACEI, if cannot be tolerated due to side effects such as cough and stress incontinence particularly in older women. Subgroup analysis suggests that ARB can be a better first of line therapy in the elderly.[40]

7.4 Spironolactone

There are benefits to the use of aldosterone antagonists for treatment of systolic HF. The Rales trial (mean age of 67) showed reduction in mortality by 30% and in hospitalizations by 35%.[41] Low doses (not more than 25 mg/d) are recommended in patients with severe systolic HF without significant renal dysfunction [contraindicated in chronic kidney disease (CKD) stage 4 and 5 not on dialysis]. Due to risk of hyperkalemia,[42] monitoring of serum potassium is essential with recommended intervals of 1, 2, 3, 6, 12 months and 6 months thereafter particularly in those over the age of 75. Gynaecomastia occurs in 10% of men as the testosterone level declines with aging.[43]

7.5 Beta-blockers

Beta-blockers have shown to improve survival by 26% and 49% (low dose and high dose respectively) if added to an ACEI by improving LV function.[44] They are contraindicated in 2nd and 3rd degree heart block and severe asthma. Patients with history of syncope or sick sinus syndrome need to be carefully monitored. Due to progressive decline in the number of functioning sinus node pacemaker cells and degeneration in conduction system-they are at higher risk of heart block. There have also been some anecdotal reports of cognitive impairment.[45]

The data on β-blockers in the elderly is limited. Its tolerability is slightly less in the elderly in comparison to younger patients (84% *vs*. 76%) making the slow initiation of paramount importance with very low dose and gradual increment over several weeks to target doses.[26]

In a randomized trial to determine the effect of nebivolol, a new selective β_1-receptor antagonist, the mortality and cardiovascular hospital admission in elderly patients with heart failure (SENIORS) was marginally reduced in comparison to placebo. This result was similar in both patients with preserved ejection fractions and in patients with reduced ejection fractions.[46]

8 Heart failure with preserved ejection fraction

Heart failure with preserved ejection fraction (HFpEF) accounts for about 10% of heart failure in patients < 65 years, but over 50% in patients ≥ 75 years.[8] It is more prevalent in elderly women than men and has similar clinical symptoms as systolic HF.[11] It may have better short-term but similar long-term prognosis compared to systolic HF.[12,15]

The general guidelines for the treatment of HFpEF is primarily directed to managing hypertension (consider using candesartan or perindopril), maintaining sinus rhythm and

controlling heart rate in atrial fibrillation with beta blocker.[26] Use diuretic to manage congestion but be watchful of over-diuresis, hypotension and electrolyte imbalance. Revascularization is recommended in patients with coronary artery disease and active ischemia contributing to HF symptoms.

9 Other management strategies

HF clinics have been expanding their role and resources to this population. For these types of clinics to be effective, early identification of high-risk patients in hospital needs to take place. The program needs to have multidisciplinary components with a significant role for the clinic nurse.[47] Home-based care with visiting nurses or interactive telecommunication maybe particularly well suited for rural areas.[48]

The multidisciplinary care is essential for patient education, promotion of self-management skills, improving medication and dietary compliance, encouraging daily weight and exercise, assuring close follow up, and introducing end-of-care issues

In terms of devices such as implantable cardiac defibrillator (ICD) post myocardia infarction (MI),[49] in patients with NYHA class II or III CHF and left ventricular ejection fracture (LVEF) of 35% or less, single-lead, shock-only implantable cardiac defibrillator (ICD) therapy reduces overall mortality by 23%. Unfortunately, there was no effect on symptoms and quality of life. That being considered, one may want to have a well informed decision making process prior to undergoing such intervention with a cardiologist as the available ICD data is only up to age 75 years. The meta-analysis of primary prophylactic ICD studies suggest that this therapy may be less beneficial for elderly patients with severe left ventricular dysfunction than for younger patients (HR: 0.81, 95%CI: 0.62–1.05, $P = 0.11$).[50] Therefore, care consideration should be given between averting sudden death at the expense of prolonging life that may have no improvement in the HF symptoms and quality of life but high cost and risky procedure.

If device is considered, LV function should be checked in 3–6 months post MI to see if any improvement with maximal medical therapy noted and if patient remained a candidate for device implant.

Cardiac resynchronization (CRT) does improve patient quality of life and can be considered in medically refractory patients with EF $\leq$ 35% with wider QRS complex.[51,52]

Patients frequently do not understand the purpose or alternatives to device therapy. Therefore, discussion is needed about when to consider device deactivation and the trade-off between sudden death and pump failure. A process for elective defibrillation deactivation is needed such as when batteries die off or needs changing. Informed decision making for device based therapy about sudden death and pump failure is needed.

10 Tele-home monitoring

Tele-home monitoring is worth considering if available, as it has been found to improve outcomes such as reduction in hospitalization and mortality.[51] It has also been shown that the elderly (over the age of 75 years old) are capable users of such technology and have similar good outcomes as younger cohorts.[53,54]

11 End-of-life care

A palliative care approach is appropriate for CHF patients and is particularly relevant to those who are elderly with advanced disease. The end-of-life approach is aimed at improving the patient's quality of life and addressing their families' challenges associated with refractory symptoms. The prevention and relief of suffering by means of early identification and treatment of physical and psychological symptoms, and attention to social and spiritual needs are of paramount importance.[53]

Patient preferences were assessed in a recent study which showed patient's willingness to trade one year of life for gain in improved quality of life.[54] Palliative care should be an integral part of an interdisciplinary team approach to a comprehensive CHF care plan over the whole disease trajectory. Many patients suffer from chronic pain, depression and shortness of breath due to poor decongestion.[55,56]

Frailty is pertinent to the development, manifestations, and prognosis of heart failure.[57] The core phenotype of frailty is defined as slow walking speed, weakness, inactivity, sense of exhaustion and weight loss. Frailty contributes valuable prognostic insights incremental to existing risk models and assists clinicians in defining optimal care pathways for their patients. Patients with CHF who were frail had a higher risk of mortality at one year by a factor of 3 and had double the rate of hospitalization.[58] The Seattle heart failure model has been implemented as an interactive program that employs a score to estimate mean, 1-, 2-, and 5-year survival and the benefit of adding medications and/or devices for an individual patient. This model is available at www.SeattleHeartFailureModel.org.

End-of-life care discussion must be initiated by the patient's physician or health care team and are developed in

consultation with the patient or the substitute decision makers regarding appropriate treatment plans.[59] The specific plan in consultation with cardiologist, primary care physician and palliative care should address managing symptoms of angina with nitrates and use of O_2 or continuous positive airway pressure for sleep disordered breathing. Optimal use of opioids for dyspnoea and pain is appropriate. Depression and anxiety symptoms can be treated with selective serotonin reuptake inhibitor or anxiolytics and attenuate sympathetic nerve activity with beta blockers. Discussion with cardiologist on when to stop devices to allow natural death is part of advance planning.

Patient and family education about the course and prognosis of the disease and decision on CPR is needed. More research is needed to identify the indicators for end-of-life. More training is needed for health care professionals to understand and be proficient in using appropriate HF medication at this stage.

12 Conclusions

HF is a prevalent disease in the elderly population and will continue to increase. This population is unique with multiple co-existing conditions in addition to cognitive, functional changes and in particular, the presence of the frailty. Health care professionals need to be equipped with the knowledge and the tools to assure excellent comprehensive care not only addressing the HF issues but the individual as a whole. Supporting older adults with a multitude of geriatric syndromes will ensure maximum benefit from multiple complex medical regimens and better quality of life.

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