Review Article

Application of the Canadian Cardiovascular Society's heart failure guidelines in a heart function clinic

Brynn Victoria Margaret Aucoin, BSc[1], Robert S. Stevenson, MD CCFP FRCPC[2, 3]

1. Doctor of Medicine Candidarte 2021, Dalhousie University
2. Associate Professor, Dalhousie University
3. Cardiologist, Horizon Health-NB Heart Centre

Abstract

Keywords: Heart Failure, Guideline Adherence, Evidence Based-Practice
Purpose: Heart failure is a significant diagnosis that poses serious mortality and morbidity risks. Many studies have assessed the efficacy of evidence-based guidelines in improving patient outcomes in the management of heart failure; however, there is limited data on how these guidelines are applied in clinical practice.
Methods: A retrospective, cross-sectional approach was used to examine a physician's adherence to the Canadian Cardiovascular Society's (CCS) most recent practice guidelines on managing heart failure. Data was collected from electronic hospital health records and patient charts of patients enrolled in a heart function clinic. Qualitative and quantitative analyses were done to compare current clinical practices related to investigations, treatment, and follow-up to the guidelines.
Results: A total of 37 patients met inclusion criteria for this study (n=37). The majority of patients were males, 81%, with an average age of 71 years, 10 medications with 5.5 comorbidities. Recommendations regarding wait times, frequency of follow-up, and blood work were met 97%, 78%, and 64% of participants, respectively with most patients being reassessed more frequently than the guideline recommendation. Medical therapy recommendations were met in over 70% of participants. All participants had EF assessments as frequently or more frequently than guideline requirements.
Conclusion: Overall, the Heart Function Clinic practices assessed in this study align well with the current guidelines recommended by the CCS. Although this study is by no means comprehensive, it provides an initial glimpse into how practice guidelines may be applied in clinical practice and identifies areas where further work needs to be done.

Introduction

Heart disease is the second leading cause of death in Canada and poses significant costs to our healthcare system[1] through a high number of hospitalizations, high readmission rates, and outpatient visits[2]. Patients with heart failure (HF) have high rates of morbidity and mortality and its prevalence has been increasing in recent years. The incidence of HF is expected to continue to rise in the coming years[2] as well. Due to the increasing burden being placed on the healthcare system, and the burden this condition places on individuals and their families, it is essential that the care these patients receive is optimal, to improve patient outcomes and decrease stress on healthcare systems.

Evidence-based practice guidelines are created by the Canadian Cardiovascular Society (CCS) and are regularly updated and disseminated to reflect current knowledge which can help to provide the best possible care to patients and to improve outcomes. Adherence to heart failure guidelines in Austria, specifically regarding medical therapies, has been shown to decrease long-term mortality[3]. Evidence-based guidelines are the standard of care against which physicians are held when treating patients with HF and can improve patient outcomes and decrease cardiac events[4].

It has been shown that despite evidence supporting the efficacy of guidelines, many physicians do not meet recommended targets around HF management[5]. Multiple studies conducted in the US have consistently found low rates of physician adherence to evidence-based practice guidelines in the treatment of HF with rates ranging from 33% to 63%[6,7]. One study, by Atwater et al.[8], examined the rates of guideline adherence and suggested that they may be underestimated due to the lack of accountability for therapeutic contraindications. Another study, based on the European Society of Cardiology HF guidelines, found better adherence rates when contraindications to recommended therapies were taken into account[9].

In Canada, there is limited data on how evidence-based guidelines for the treatment of HF

are applied in clinical practice. By exploring the current practices regarding guideline adherence in the management of HF, it may be possible to improve the use of these evidence-based practice guidelines in the future..

Methods

This study is a retrospective, cross-sectional analysis conducted to examine one physician's adherence to national practice guidelines conducted at the Saint John Regional Hospital. Staff of the Heart Function Clinic screened potential participants to the inclusion criteria. Inclusion criteria were patients of the Principal Investigator who were ≥18 years old, diagnosed with congestive heart failure, being followed through the outpatient Heart Function Clinic at the Saint John Regional Hospital, and who consented to participate. Patients were classified into three groups based on their most recent left ventricular ejection fraction (EF) assessment, in accordance with the CCS guidelines, as either heart failure with preserved ejection fraction (HFpEF) with an EF ≥50%, heart failure with mid-range ejection fraction (HFmEF) with an EF 41%-49%, or heart failure with reduced ejection fraction (HFrEF) with an EF ≤40%.

Data were extracted from electronic hospital health records and charts from the Heart Function Clinic including patient demographics, current therapy, and past medical history. Qualitative and quantitative analyses were done to compare current practices

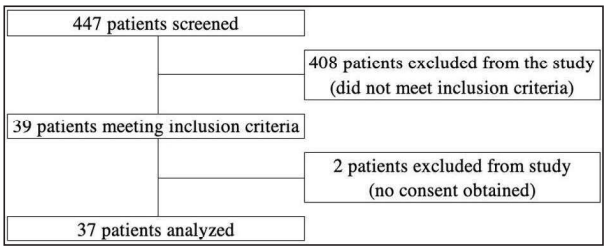

Figure 1. Study population flow.

against ten recommendations made in the Canadian Cardiovascular Society's most recent guidelines on the management of heart failure: *2017 Comprehensive Update of the Canadian Cardiovascular Society Guidelines for the Management of Heart Failure* and *The Canadian Cardiovascular Society Heart Failure Companion: Bridging Guidelines to Your Practice*[10,11]. The *Comprehensive update* is based on current medical literature, best evidence, and clinical consensus from a panel of experts. The *Companion* article is based on expert consensus. The ten recommendations were selected based on feasibility and access to appropriate data. The ten CCS recommendations analyzed include recommendations surrounding the timing of care and investigations as well as recommended medical therapy (Table 1).

The timing of visits and interventions recommended by CCS is based on level of acuity. Wait times are defined as the length of time between the referral and the patient's first visit in clinic. The CCS guidelines on wait times are stratified into a 4-tiered system. Urgency

Table 1. Canadian Cardiovascular Society recommendations on the management of heart failure. Recommendations taken from the *2017 Comprehensive Update on the Management of Heart Failure*[10] and the *Heart Failure Companion: Bridging Guidelines to your Practice*[11].

Routine referrals should be seen within 12 weeks, ideally within 6.
Stable HF patients should be seen in clinic every 3-4 months.
Bloodwork, including serum electrolytes, creatinine, and BUN, should be routinely measured every 1-3 months in stable patients.
Stable HF patients should have their LVEF reassessed every 2-3 years.
We suggest candesartan be considered to reduce HF hospitalizations in patients with HFpEF (Weak Recommendation; Moderate-Quality Evidence).
We recommend loop diuretics be used to control symptoms of congestion and peripheral edema (Strong Recommendation; Moderate-Quality Evidence).
We recommend systolic/diastolic hypertension be controlled according to current Canadian Hypertension Education Program hypertension guidelines (2017) to prevent and treat HFpEF (Strong Recommendation; High-Quality Evidence).
We recommend that most patients with HFrEF be treated with triple therapy including an ACEi (or an ARB in those who are ACEi-intolerant), a b-blocker and an MRA unless specific contraindications exist (Strong Recommendation; Moderate- Quality Evidence).
We recommend against the use of nonsteroidal anti-inflammatory drugs as well as cyclooxygenase-2 (COX-2) inhibitors in patients with HFrEF (Strong Recommendation; High-Quality Evidence).
We recommend against the routine use of calcium channel blockers (CCBs) in patients with HFrEF (Strong Recommendation; Moderate-Quality Evidence).

HF = heart failure; LVEF = left ventricular ejection fraction; BUN = blood urea nitrogen; HFrEF = heart failure reduced ejection fraction; ACEi = angiotensin converting enzyme inhibitor; ARB = angiotensin II receptor blocker; MRA = mineralocorticoid receptor antagonist; HFpEF = heart failure preserved ejection fraction.

Table 2. Study population characteristics.

	n=37
Age, mean (range)	71 (47-95)
Years since admission to the heart function clinic, mean (range)	2.6 (0.07-7.5)
Medications, mean (range)	10 (3-20)
Male	30 (81)
Ejection Fraction	
>50%	10 (27)
40-50%	13 (35)
<40%	14 (38)
NYHA functional classification	
1	0 (0)
2	25 (68)
2-3	9 (24)
3	3 (8)
4	0 (0)
Comorbidities	
Diabetes	18 (49)
Hypertension	24 (65)
Obesity	11 (30)
Dyslipidemia	13 (35)
Atrial fibrillation	12 (32)
Coronary artery disease	8 (22)
COPD	11 (30)
Chronic kidney disease	10 (27)

Values are reported as number (%) unless otherwise specified. NYHA = New York Heart Association; COPD = chronic obstructive pulmonary disease.

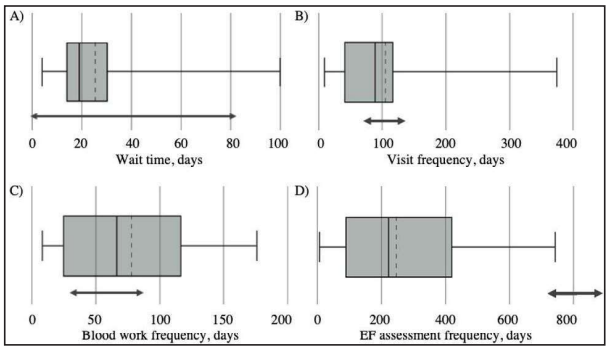

Figure 2. Comparison to Canadian Cardiovascular Society guidelines for the timing of events in heart failure management to current physician practice. Dotted lines indicate the group mean for each data set. Double-headed arrows indicate the Canadian Cardiovascular Society's recommendations on timing of the event. A) Individual data on wait time. Time from referral to clinic to the patient's first visit. B) Individual mean frequency of visits to the heart function clinic. C) Individual mean frequency of bloodwork. D) Individual mean frequency between ejection fraction (EF) assessments.

of referral is determined by NYHA classification, compensated vs decompensated HF, response to therapy, and recent HF exacerbations requiring an emergency department visit or hospitalization. Based on this classification system, it is recommended patients be seen within 24 hours if it is an emergent referral, within 2-weeks for urgent referrals, within 4-weeks for semi-urgent referrals, and within 6-weeks for routine referrals. The recommended frequency for follow-up visits is based on high, intermediate, or low risk individuals as evidenced in symptomatology, NYHA class, recent HF decompensations, titration of medical therapies, and comorbidities. High risk individuals are recommended to be seen every 1-4 weeks, with low risk individuals followed every 6-12 months.

Investigations such as bloodwork and EF assessment are recommended every 1-3 months and 2-3 years, respectively in stable HF patients. Routine bloodwork typically includes electrolytes, serum creatinine, and BUN. More frequent monitoring of bloodwork and EF is advised by the CCS for patients during acute illnesses, significant clinical changes or to monitor response to therapies.

This study was approved by the Horizon Health Network research ethics board file #2018-2612.

Results

Through the screening process, 447 patients were screened against the inclusion criteria. Of the 447 screened, 39 met inclusion criteria. The main reason for failing to meet inclusion criteria were patients not followed by the principal investigator. Informed consent was obtained from 37 participants (Figure 1). The study population had a median and mean age of 71 years with 81% of participants being male (Table 2). The average length of time from admission to the Heart Function Clinic was 2.6 years. Patients were on an average of 10 medications (Table 2), which are reported by medication class (Table 3).

Timing of events

The referral system in the clinic studied uses a 3-tiered system with urgent, semi-urgent, and routine referrals. Wait times in this clinic ranged from 4 days to 14.2 weeks, with an average wait time of 25 days (Figure 2a). The majority of patients, 66%, were seen within 4 weeks, with 30% being seen within 2 weeks, and 89% of referrals seen within 6 weeks. The frequency of follow-up visits ranged from 9 to 374 days with an average frequency of 105 days (Figure 2b).

The frequency of bloodwork in the study population ranged from 9 to 176 days, with an average frequency of 77 days for all participants (Figure 2c). Thirteen participants (35%) had an average frequency of bloodwork greater

Table 3. Medical therapy in heart failure patients. Patients are classified according to ejection fraction. Medical therapies are classified according to drug class.

Medication class	HFrEF, n=14	HFmEF, n=13	HFpEF, n=10
ARB	0 (0)	2 (15)	1 (10)
ACEi	3 (21)	2 (15)	6 (60)
ARNi	6 (43)	5 (38)	0 (0)
Documented contraindication to ARB/ACEi/ARNi	5 (36)	2 (15)	1 (10)
Beta Blocker	1 (7.1)	12 (92)	9 (90)
Documented contraindication to beta blockers	0 (0)	1 (7.7)	0 (0)
MRA	6 (43)	2 (5)	1 (10)
Documented contraindication to MRA	6 (43)	2 (5)	1 (10)
Diuretics	13 (93)	12 (92)	10 (100)
Nitrate	1 (7.1)	1 (7.7)	0 (0)
Digoxin	1 (7.1)	2 (15)	4 (40)
CCB	0 (0)	4 (31)	4 (40)
ASA	7 (50)	4 (31)	5 (50)
Statin	10 (71)	9 (69)	6 (60)

Values are reported as number (%). HF = heart failure; EF = ejection fraction; r = reduced, EF≤40%; m = mid-range, EF 41-49%; p = preserved, EF ≥50% ; ARB = angiotensin receptor blocker; ACEi = angiotensin converting enzyme inhibitor; ARNI = angiotensin receptor-neprilysin inhibitor; MRA = mineralocoritcoid receptor agonist; CCB = calcium channel blocker; ASA = acetylsalicylic acid.

than 90 days.

Frequency of echocardiography, as extrapolated from ejection fraction (EF) measurements, ranged from 7 days to 743 days. This was assessed using any EF evaluation completed since their admission to the heart function clinic. The average time between assessments was 274 days (Figure 2d).

The CCS recommendations regarding wait times, frequency of follow-up, and bloodwork were met for 97%, 78%, and 64% of patients, respectively with many patients being assessed more frequently than the recommended intervals.

Medical management of HFpEF

None of the participants were on candesartan at the time of this study including patients with HFpEF. A contraindication to the use of candesartan in the form of an alternative angiotensin II receptor blocker (ARB), or angiotensin converting enzyme inhibitor (ACEi), currently in use or an intolerance to candesartan was documented for 80% of patients with HFpEF (Table 4). Two patients with HFmEF were treated with candesartan. Overall, 89% of participants were prescribed an ACEi, ARB, or had documented reason for not being on one of these therapies.

All patients in this study with HFpEF were on a loop diuretic and 95% of participants overall were prescribed loop diuretics (Table 4).

Of the 10 participants with HFpEF, 8 had a documented history of hypertension. At their most recent clinic visits, 7 of those had BP readings ≤140/90mm Hg and one had BP ≤120mmHg systolic.

Medical management of HFrEF

Of the 14 patients with HFrEF, 43% were on triple therapy and an additional 29% had a documented contraindication to triple therapy such as intolerance to one of the classes of medication.

No participants were on a CCB at the time of this study and no patients were documented to be taking NSAIDs except for ASA. There were 14 patients (37% overall) taking ASA, including 35% of patients with HFrEF.

Discussion

The timing of events, as per CCS recommendations are reasonably well met. The majority of patients are seen within a timeframe appropriate to their referral urgency, and have appropriate frequency of follow-up with a few exceptions. Possible reasons for longer wait

times could be due to patient preference, coordinating visits with other appointments or tests, the availability of transportation options, or weather.

Ejection fraction assessment is done more frequently than the recommendations, but this may be due to certain patient factors. Seven patients only had one EF assessment and therefore could not be included in the analysis for frequency of assessment. Over 90% of patients had a prior emergency room visit or HF hospitalization which initiated their referral to clinic or occurred since their admission to clinic. EF may be reassessed more frequently to assess for changes that may occur such as in a heart failure decompensation or in order to monitor response to therapy. This suggests that this patient population is not made up of stable HF patients as would be expected of EF evaluations every 2-3 years. Due to the nature of HF patients and decompensations, it would be surprising to find any patients who would be considered stable for the duration of that time unless they were early on in their illness trajectory.

The majority of patients had routine bloodwork completed within the 1 to 3-month recommendation for stable HF patients. Some patients had more frequent bloodwork due to higher risk individuals' characteristics, medication titration, or comorbidities. One individual with the most frequent bloodwork assessment at every 9 days, had a recent admission during which bloodwork was drawn on a daily basis, leading to an overestimation of the true frequency of bloodwork for that individual. This could be true for other individuals as well in bloodwork frequency and frequency of EF assessment. Comorbidities, heart failure decompensations and medication titration could also play a role in the frequency of these investigations.

Medical management of patients with HFpEF saw no patients prescribed candesartan despite the recommendation that it may lower rates of hospitalization. It is possible that prescriber preference favours other medications in the ARB class or an ACEi. The recommendation for the use of candesartan is a weak recommendation according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) standards which could also contribute to providers choice for alternative agents. Provider preference shows ACEis were more popular overall in this patient population, with most patients with HFpEF being on an ACEi instead of an ARB. Loop diuretic use was seen across all patients in this study and given its importance in symptom management is most likely well tolerated with few therapeutic contraindications.

Hypertension Canada recommends a target BP of ≤140mmHg for all patients with hypertension and no other risk factors. However, intensive BP control to a pressure of ≤120mm Hg systolic is recommended for patients with risk factors, such as heart failure, other cardiovascular diseases and renal insufficiency. According to this lower targeted BP, only one of the 8 patients with HFrEF and hypertension had a blood pressure that was being adequately controlled.

Rates of NSAID avoidance may be overestimated as some NSAIDs, such as ibuprofen and naproxen, are available over the counter and require patient education to ensure they are properly avoided. The same would not be true for CCB use, as these medications require a prescription which lends more support that this finding is accurate.

Triple therapy was prescribed, or therapeutic contraindications were documented for 72% patients with HFrEF. This demonstrates the possibility of 28% of patients with HFrEF in this study population being undertreated. However, with retrospective data from electronic health records and patient files from the Heart Function Clinic alone, therapeutic contraindications and patient preference may not have been clearly documented. This could lead to underestimations of prescribing practices in guideline adherence as contraindications may be underreported. The rate of adherence to guidelines regarding triple therapy prescribing found by Atwater et al[8] was similar to the current study, at 43% prior to accounting for therapeutic contraindications and rising to 72% when they were taken into account.

The choice of therapy in HF management is based in part on EF at the time of initiation; however, EF can improve with treatment or worsen with progression of disease. Based on this, it is difficult to determine whether members of the three groups classified as HFrEF, HFmEF, and HFpEF in this study started with a higher or lower EF and how this may have impacted changes in therapy over time.

Limitations

Limitations to this study include a small, predominantly male study population. The choice of inclusion criteria, in particular to only include patients of the principal investigator at this time, was to ensure consent, data collection and data analysis could be completed in a timely and accurate manner with the resources available. Due to the small size, subgroup analysis would not have been possible with any significance. Suggested factors that may contribute to physician non-adherence to guidelines, as demonstrated by Calvin et al. were age, comorbidities, NYHA class, and minority status[7]. These factors were not independently assessed in this study due to the sample size but could be contributing factors in areas where adherence was reduced. Frankenstein et al[13] found that a patient's

sex could impact optimal dosing of medications with female patients receiving suboptimal medical therapy more often than males. Other studies have assessed the role of suboptimal dosing of medical therapies as an important predictor in improving outcomes for HF patients[5]. Dosing of medications was not assessed in this study but could be an area for further assessment.

Additional limitations include sample population characteristics. There was a wide range in the time from admission to clinic, ranging from less than 1 month to greater than 7 years. When patients initially enter the clinic, they may initially be seen frequently and have many investigations completed, especially with adjustments to medications. Over time, if they remain stable, these visits and investigations may become less frequent which could explain some of the wide time ranges in the results. The comorbidities of this patient population may also play a role in their frequency of visits, investigations, and medications. Again, due to the small sample size, these possible confounding factors could not be analyzed independently.

Broadening the inclusion criteria to include all patients in the heart failure clinic could lead to a better understanding of more generalized HF management practices and may allow for subgroup analysis which was not possible with this study.

Conclusion

There are more than 195 recommendations made by the CCS in the *2017 Comprehensive Update* and *Companion* guidelines regarding the current best practices in the management of heart failure. Of the ten CCS recommendations assessed in this study, most recommendations are being partially met with four recommendations regarding medical management being strictly adhered to. Further work is necessary to determine if these trends are more broadly seen in the management of heart failure across Canada and how specific patient or physician characteristics may play into the adherence to these guidelines.

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