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ORIGINAL ARTICLE

Adherence to Treatment Guidelines in Heart Failure Patients in the Top End Region of Northern Territory

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Background Heart failure (HF) is associated with significant morbidity and mortality and recurrent hospitalisations, particularly in the Indigenous Australians of the Northern Territory. In remote Northern Australia, the epidemiology is less clear but anecdotal evidence suggests it may be worse. In addition, some anecdotal evidence suggests that prognostic pharmacological therapy could also be underutilised. Minimal HF data exists in the remote and Indigenous settings, making this study unique.

Methods A retrospective cohort review of pharmacological management of 99 patients from 1 January 2014 to 31 December 2014 was performed.

Results Ninety-nine (99) patients were identified. 59.6% were non-Indigenous vs 40.4% Indigenous. The majority was male (69.7%). Indigenous patients were younger; median age was 51.4 (43.4–60.6) vs 70.5 (62.2–77.0), $p < 0.001$. Major causes of HF were coronary artery disease (61%) and dilated cardiomyopathy (27%). Associated comorbidities included hypertension (52%), dyslipidaemia (38%), diabetes mellitus (40%) and atrial fibrillation (25%). The use of angiotensin converting enzyme inhibitors/angiotensin receptor blockers (ACEI/ARB) and β-blocker was 68% and 87%, respectively. Forty-one (41) patients not on an ACEI/ARB and/or β-blocker were identified. Seventeen (17) of those patients (42%) did not receive an ACEI/ARB because of renal failure. Four (4) patients (10%) did not take a β-blocker due to hypotension. Fourteen (14) patients (34%) were not prescribed an ACEI/ARB and/or β-blocker had no identifiable contraindications.

Conclusions Indigenous patients are over-represented at a younger age demonstrating the alarming rate of disease burden in NT's young Indigenous population. Generally, ACEI/ARBs were underutilised compared to β-blockers with renal impairment being the primary contraindication. There is a need to develop processes to further improve the use of heart failure medications and setting up a HF database could be the first step in progress.

Keywords Heart failure • Treatment guidelines • Australia • Indigenous population

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Introduction

Chronic heart failure (CHF) affects 1–2% of Australians and results in a significant burden to affected patients and health care systems [1,2]. It is associated with high morbidity and mortality by which 50–75% of patients die within 5 years of diagnosis [1]. It also accounts for a significant portion of Australia's health care budget due to recurrent hospitalisations and prolonged length of stay [1,2]. Despite major improvement in the pharmacological management of CHF, it is still associated with a high mortality rate [3].

The Northern Territory (NT) of Australia is unique in that it comprises 17% of Australia's landmass, yet has only two major hospitals, located in Darwin and Alice Springs [4]. Royal Darwin Hospital is the only major tertiary hospital with access to an onsite specialist cardiology service based in the Top End of Australia which serves a population of approximately 150,000 [5]. The NT has the highest rate of disease burden with cardiovascular disease being the leading cause and the Indigenous population representing 2.5 times the rate of non-Indigenous Australians [6]. 10.1% of Australia's Indigenous population resides in the NT, representing 29.6% of the NT population. The majority of the NT's Indigenous population live in remote (21.4%) and very remote (58.3%) areas [7], making access to health care and health services difficult [8]. In addition, Indigenous Australians in the NT are challenged with heart failure (HF) of increased severity, pre-existing comorbidities, and cultural and language barriers that affect the uptake of post-discharge services such as cardiac rehabilitation [8,9]. Consequently, the actual prevalence rate of HF in the NT is not accurately available, with previous studies to have likely underrepresented remote areas [10]. The financial burden of HF places a growing strain on the NT health care systems and it remains unclear what current management is being provided to reduce the ongoing disease burden. With increased survival and an ageing population, HF is an emerging epidemic and appropriate management is critical.

The National Heart Foundation of Australia developed evidence-based guidelines for the management of patients with HF [11]. Pharmacological therapy is a major component of HF management by serving to provide relief of symptoms, prevent disease progression, improve quality of life and prolong survival. The HF guidelines recommend angiotensin converting enzyme inhibitors (ACEI) and β-blockers for all patients with reduced left ventricular ejection fraction (LVEF) of less than 40% unless intolerance or contraindications exist. Angiotensin receptor blockers (ARB) may be used as an alternative for patients intolerant to ACEI due to kinin-mediated adverse effects, such as a dry cough [11]. Studies supporting the use of these treatments have reduced the high morbidity and mortality in HF patients [12–15]. Other pharmacological treatments include diuretics, aldosterone antagonists and digoxin which may be considered in individual patients as necessary [11].

The primary objective of this study was to evaluate the use of pharmacological treatment, particularly ACEI/ARBs and β-blockers, in HF patients from Royal Darwin Hospital and to compare this with the current National Heart Foundation guidelines and previous studies.

Methods

Study Design

This study is a retrospective cohort analysis of the pharmacological management in patients diagnosed with HF from Royal Darwin Hospital for the period between 1 January 2014 and 31 December 2014.

Inclusion and Exclusion Criteria

Inclusion criteria included a diagnosis of systolic HF, defined as LVEF of less than 40% or on the basis of clinically demonstrated symptomatic HF (e.g. dyspnoea, fatigue) and appropriate investigation (i.e. echocardiogram). Patients with a diagnosis of HF prior to 2014, diastolic HF and/or right ventricular HF were excluded.

Ethical Consideration

Ethical approval was granted by the Human Research Ethics Committee of the Northern Territory Department of Health and Menzies School of Health Research.

Data Source and Collection

Data was collected from the NT Cardiac and Department of Health Royal Darwin Hospital clinical systems. The Optimise Heart Failure Care Program, a pharmaceutical-based registry designed by Servier (pharmaceutical company) in Suresnes, France to evaluate and improve the quality of medical care for patients with HF, was used to standardise the data collected which was then exported onto a data collection spread sheet. Medical records of inpatients presenting with HF in 2014 were reviewed. Data collected included demographic information, coexisting comorbidities, smoking status, excess alcohol use, prescribed medications and use of ICD. Whether the patient was followed up for review was also observed through appointment letters and subsequent clinical notes. The haemodynamic variables (i.e. systolic and diastolic blood pressure, heart rate) and lifestyle risk factors (i.e. current smoker, excessive alcohol use) were assessed from clinical records during the most recent hospital visit for HF. These parameters were difficult to standardise as the data was not readily available and there was great variability between the period of diagnosis and the follow-up review. When multiple causes for HF were present, the most predominant condition was determined based on the structural assessment (i.e. left and right ventricular size, volume and wall thickness, valve structure) and functional Doppler flow study (i.e. ventricular systolic function, valvular function) on the echocardiogram report at the time of diagnosis. Contraindications to medication prescription were drawn by the researcher based on information derived from review of the patient's medical records.

Medications

The prescription of HF medications was recorded at first presentation of HF diagnosis. Adherence to treatment guidelines and contraindication of use of ACEI/ARBs and β-blockers were evaluated against the ''Guidelines for the prevention, detection and management of chronic heart failure in Australia'' by the National Heart Foundation of Australia [11].

Statistical Analysis

A descriptive analysis of the data was undertaken. Data are described as frequencies and percentages for categorical variables and continuous data were reported as mean (standard deviation) with 95% confidence intervals (CI) for normally distributed data and median (interquartile range) for data that was not normally distributed. For comparisons, we used two-sample t-test (Student's t-test) for continuous normally distributed data and Mann Whitney U test for non-normally distributed data. Comparisons between categorical data were performed using the χ^2 and Fisher's exact tests as appropriate. Statistical significance was determined by two tailed p-value of <0.05 and 95% confidence intervals where appropriate. All statistical analyses were performed using Stata (statistical software program) developed by StataCorp in Texas, USA (R) version 13.1 (SE Copyright 1985-2013).

Results

Baseline and Clinical Characteristics

There were 99 patients identified with a diagnosis of systolic HF from Royal Darwin Hospital during the study period. The baseline characteristics of the studied population are presented in Table 1. This population comprised 59.6% non-Indigenous and 40.4% Indigenous patients. The majority of the patients were male (69.7% vs. 30.3%, $p < 0.001$) with the major causes of HF being coronary artery disease and dilated cardiomyopathy, affecting 61% and 27% of patients respectively. Twenty-five per cent (25%) of patients had atrial fibrillation. Other common comorbidities included hypertension (52%), dyslipidaemia (38%) and diabetes mellitus (40%). Twenty-eight per cent (28%) of patients were current smokers and 20% consumed excess alcohol.

Table 1 Baseline characteristics of HF population (n = 99).

Characteristics	*n*	(%)
Ethnicity		
Indigenous	40	40.4
Non-Indigenous	59	59.6
Gender		
Male	69	69.7
Female	30	30.3
Aetiology		
Coronary artery disease	60	60.6
Dilated cardiomyopathy	27	27.3
Hypertension	3	3.0
Valve disease	1	1.0
Other	8	8.1
Heart rhythm		
Sinus rhythm	73	73.7
Atrial fibrillation	25	25.3
Paced	1	1.0
Comorbidities		
Hypertension	51	51.5
Dyslipidaemia	38	38.4
Diabetes	40	40.4
Current smoker	28	28.3
Excess alcohol	20	20.2

Comparison of Indigenous Versus Non-Indigenous Patients

The study compared variables between Indigenous and non-Indigenous populations as demonstrated in Table 2. The median age was 70.5 (62.2–77.0) for non-Indigenous patients and 51.4 (43.4–60.6) for Indigenous patients ($p < 0.001$). However, there was no statistical difference identified between both patient populations with regards to mean ejection fraction, blood pressure or heart rate.

Medication Prescriptions

Among the 99 patients identified in this study, one patient died prior to pharmacotherapy management and was excluded from the analysis. Sixty-seven (67) of 98 HF (68.4%) patients received either an ACEI (n = 57) or ARB (n = 10). Of those patients who did not receive an ACEI or ARB, contraindications were noted in 23 of 31 (74.1%) patients with renal failure being the most common. Four (4) of 31 (12.9%) patients had acute kidney injury and 13 of 31 (41.9%) had chronic kidney disease where six of 13 (46.2%) had stage 3, one of 13 (7.7%) had stage 4 and six of 13 (46.2%) had stage 5 kidney disease. Six (6) of 31 patients (19.4%) did not receive an ACEI/ARB due to low blood pressure. In the remaining eight of 31 (25.8%) patients without an ACEI/ARB, no definite contraindications were identified. β-blockers were used in 85 of 98 (86.7%) HF patients. Thirteen (13) out of 98 (13.3%) patients did not receive a β-blocker with contraindications due to low blood pressure identified in four of 13 (30.8%) of the patients. More than half the patients, nine of 13 (69.3%) not prescribed a β-blocker, had no identified contraindications. A total of 41 (41.4%) patients did not receive an ACEI/ARB and/or β-blocker whereby three of 41 patients did not receive either therapy (Table 3).

Comparison of Medication Prescription Between Indigenous and Non-Indigenous Patients

Pharmacological therapy was also compared between Indigenous and non-Indigenous groups (Table 4). Other medications such as frusemide and ivabradine used to treat heart failure and the requirement of an implantable cardioverter

Table 2 Analysis of variables by ethnicity.

	n	Overall	*n*	Indigenous	*n*	Non-Indigenous	P-value
Age in years [median(IQR)]	99	63.1 (51.3–75.0)	40	51.4 (43.4–60.6)	59	70.5 (62.2–77.0)	<0.001
Ejection Fraction (%) [Mean(SD)]	99	29.6 (8.4)	40	28.7 (9.7)	59	30.1 (7.5)	0.412
Systolic blood pressure (mmHg) [median(IQR)]	71	125 (110–138)	30	131.5 (110–147)	41	120 (110–136)	0.026
Diastolic blood pressure (mmHg) [Mean(SD)]	71	76.6 (13.2)	30	78.6 (13.5)	41	75.2 (12.9)	0.286

Table 3 Proportions and reasons for patients not taking ACEI/ARB and/or beta blocker.

	Number of patients (%)		Reasons for no ACEI/ARB and/or beta blocker	*N* (%)
	Yes	No		
ACEI/ARB	67 (68.4)	31 (31.7)	Acute kidney injury	4 (12.9)
			Chronic kidney disease	13 (41.9)
			- Stage 3	6 (46.2)
			- Stage 4	1 (7.7)
			- Stage 5	6 (46.2)
			Low blood pressure	6 (19.4)
			Reasons unclear	8 (25.8)
Beta blocker	85 (86.7)	13 (13.3)	Low blood pressure	4 (30.8)
			Reasons unclear	9 (64.3)

Abbreviations: ACEI/ARB, angiotensin converting enzyme inhibitors/angiotensin receptor blockers.

Table 4 Comparison of HF management by ethnicity.

	Indigenous	Non-Indigenous	*n*	χ^2	P-value
ACEI/ARB	25 (37.3)	42 (62.7)	67	0.822	0.365
Beta blocker	36 (42.4)	49 (57.6)	85	0.948	0.330
Frusemide	21 (32.8)	43 (67.2)	64	4.333	0.037
Ivabradine	1 (20)	4 (80)	5	N/A	0.645
ICD presence	5 (45.5)	6 (54.5)	11	0.131	0.717

Abbreviation: HF, heart failure; ICD, implantable cardioverter defibrillator, ACEI/ARB, angiotensin converting enzyme inhibitors/angiotensin receptor blockers.

defibrillator (ICD) were also observed. Sixty-four (64) (64.6%) patients were given frusemide with a significantly greater requirement in the non-Indigenous population than Indigenous population ($p = 0.037$). Ivabradine was used in five (5.5%) of patients and an ICD in 11 (11.1%) patients. There was no statistically significant difference between Indigenous and non-Indigenous populations in the use of ACEI/ARB, β-blocker, ivabradine and ICD.

Mortality

Rates of mortality were assessed based on medical management status (Table 5). The use of both β-blocker and frusemide were associated with statistically significant lower mortality ($p = 0.045$ and $p = 0.008$). Comparisons between users and non-users of ivabradine and ICD were not analysed due to very small numbers in these groups.

Discussion

In this study, ACEI/ARB and β-blockers were underutilised in patients with systolic HF in Royal Darwin Hospital when compared against the National Heart Foundation guidelines, with rates of prescription of 68.4% and 86.7% respectively. However, when compared with previous studies conducted in rural towns of Australia, the use of both ACEI/ARB and β-blockers was higher in our study [3,16,17]. In a study conducted in rural New South Wales from 2003 to 2007 [3], the rate of prescription for ACEI/ARB and β-blockers was 58.2% and 34.7% respectively. In the Cardiac Awareness Survey and Evaluation (CASE) study conducted in 1998 throughout Australia [16,17], prescription rates were lower at 51.4% and 12.6% for ACEI/ARB and β-blockers respectively. The use of ACEI/ARB appears to be increasing gradually. However, β-blocker utilisation has increased immensely over this time period. This increasing trend may reflect the growing body of literature and increased evidence-based clinical practice guidelines over the years.

Rates of ACEI/ARB prescription were remarkably low, irrespective of ethnicity. A majority of the patients not prescribed an ACEI or ARB had contraindications. More than half of the patients had renal dysfunction, for which the NT holds the highest prevalent rate in Australia [18]. This makes it difficult to optimise HF treatment in renal patients, resulting in deprivation of the long-term benefits in this group. Those not prescribed an ACEI due to chronic kidney disease had moderate to endstage renal failure. Most guidelines regard a serum creatinine >220 μmol/L as the only

Table 5 Effect of HF management on mortality.

		Patient death (*n*)		χ^2	P-value
		Yes	No		
ACEI/ARB	Yes	12	55	2.230	0.135
	No	10	22		
Beta blocker	Yes	16	69	4.017	0.045
	No	6	8		
Frusemide	Yes	9	55	6.974	0.008
	No	13	22		

Abbreviations: ACEI/ARB, angiotensin converting enzyme inhibitors/angiotensin receptor blockers; HF, heart failure.

contraindication to ACEI use [19]. Although serum creatinine was not observed in this study, stage 3 to 5 kidney failure generally correspond with an elevated serum creatinine >400 to 800 μmol/L respectively [20]. From this it can be presumed that patients in this study were not prescribed an ACEI due to contraindications in elevated serum creatinine. However, providing education on this may be valuable to better train clinicians in managing heart failure in renal patients. Among the other patients not prescribed an ACEI/ARB, 26% had no contraindications. Possible barriers for prescribing these agents include the age of the patient, coexisting medical conditions and drug-drug interactions. Elderly patients were less likely to receive either ACEI/ARB or β-blockers [16,21,22]. The use of β-blockers in this study was higher overall, with fewer patients not receiving a β-blocker than an ACEI/ARB. Low blood pressure was the only contraindication identified in this study. Bradycardia (heart rate <50 bpm) is a common contraindication to β-blocker use [19] but was not found in this study. The majority of patients not on a β-blocker had no contraindications and were, therefore, undertreated, despite compelling evidence for a mortality and morbidity benefit of β-blockers in HF. β-blockers were previously known to be a contraindication in HF and some physicians may still be reluctant to incorporate this into their practice [23]. In addition, comorbidities such as asthma or COPD are generally perceived as a contraindication to receiving β-blockers. However, respiratory airway disease is not considered as an absolute contraindication and should be prescribed with caution in those with persistent symptoms [19,22,24].

β-blockers have been long known to prolong survival when used with ACEI in patients with HF [11]. However, the long-term safety and efficacy of diuretics in HF have been controversial. Previous studies have demonstrated an association between diuretic use in HF patients and increased risks of mortality [25,26]. This may be confounded by the fact that patients with severe HF are more likely to be treated with diuretics and thus, the higher risks of mortality with diuretic use may reflect disease severity. Results from this study exhibited a significant correlation between the use of frusemide and a reduction in mortality. This is consistent with findings of smaller studies, which suggested that diuretic use appeared to slow disease progression and reduce the risk of death in HF patients [27]. Alternatively, diuretic use may have been withheld in patients in this current study with severe renal function. These conflicting results contribute to the uncertainty that exists between the safety and efficacy of diuretic use in improving clinical outcomes in patients with HF. Future studies are needed to elucidate the effectiveness of diuretics for the management of congestive HF. The small sample size may also explain these conflicting findings.

The National Heart Foundation guidelines state that the use of diuretics is reserved for symptom relief only despite optimal treatment with ACEI/ARB and β-blockers. Although diuretics are not first-grade recommendation for the management of HF, they are usually prescribed in combination with an ACEI or ARB, as ACEI/ARB therapy alone is often unlikely to provide adequate symptom relief [11]. In this study, 64 patients received diuretics in addition to ACEI/ARB and β-blockers. The rate of diuretic use in this study was two times higher among non-Indigenous than Indigenous Australians. However, there was no significant difference in the severity of heart failure between Indigenous and non-Indigenous patients based on the ejection fraction. A possible explanation for the underuse is that diuretics can result in a substantial reduction in glomerular filtration rate in some HF patients and thus potentiate the side effects of ACEI/ARB[25]. Given the high prevalence of renal disease in this study, diuretics may have been withheld to protect renal function. Previous studies have shown renal disease rates of 4–10 times higher in Indigenous than non-Indigenous groups [18], which may explain the low use of diuretics in Indigenous Australians in this study. Further research would need to be conducted in order to validate this.

Indigenous patients are overrepresented in this study given the proportion of Indigenous Australians in the NT. The percentage of Indigenous Australians is higher than that of the overall population. Age at initial HF diagnosis was significantly different between Indigenous and non-Indigenous patients. The age gap of almost 20 years demonstrates the alarming rate at which the Indigenous population are challenged with an earlier onset of disease burden in the NT.

The Heart of the Heart Study conducted in several Indigenous communities in Central Australia showed similar findings with a mean age of 44 years of newly diagnosed HF amongst Indigenous Australians [28]. Indigenous Australians are known to suffer higher rates and earlier onset of chronic diseases, contributing to 80% of the disparity in life expectancy between Indigenous and non-Indigenous populations [4]. The disproportionately higher disease burden in young Indigenous patients is associated with the geographical barriers in accessing health care and socioeconomic disadvantages. In addition, Indigenous Australians are challenged with a greater burden of CHF due to increased risk factors such as smoking and alcohol use, and high rates of rheumatic heart disease and ischaemic heart disease at younger ages [8–10]. In this study, coronary artery disease was the most common aetiology of HF consistent with previous studies [3,16,22,29]. Despite the high incidence of rheumatic heart disease in the NT Indigenous population, this study suggests that the high rate of coronary artery disease among young Indigenous Australians is advancing the population into HF also at an earlier age. Additionally, the structural damage from a combination of both coronary artery disease and rheumatic heart disease could explain the acceleration of HF in the younger Indigenous population. Given the increased morbidity and mortality associated with HF regardless of cause, optimal tertiary prevention and equitable access to HF specialist services across the NT are necessary to improve Indigenous health outcomes.

There are significant barriers in access to appropriate health care for Indigenous and remote patients. Cardiac services in the rural and remote communities are not readily available and require patient transport to one of the major health centres in the NT [9]. However, the costs associated with health care and transport can prevent low-income Indigenous Australians from accessing needed health services [10]. Language and cultural barriers and the physical distance from home and family are all impediments to access to care [10]. With transthoracic echocardiography services available only in Royal Darwin and Alice Springs Hospitals, remote patients are generally required to travel to tertiary hospitals for investigation and diagnosis of HF [9]. Initial management and pharmacological treatment are commenced prior to the patient returning home with subsequent review at 3 and 6 months. There are outreach clinics conducted by cardiologists from NT Cardiac, which have become well established in numerous regional and remote communities facilitating continuous active follow-up [30]. Although, despite these efforts, many communities still have impaired access to health and cardiac services. Patients who reside in isolated communities are likely to be less responsive to seeking further clinical intervention resulting in subsequent loss to follow-up [8]. Thus, the socioeconomic disadvantage in the NT has a significant impact on the prevalence and outcome of cardiovascular disease. The complex demography of the NT in terms of remoteness and dispersed distribution of the population over a vast area creates a need to improve community-based health services. This is essential, not only for the preventative care of HF and other cardiac diseases, but also for appropriate early management, active follow-up and chronic care.

This study highlights the treatment gaps and provides awareness of the discrepancies in heart failure outcomes between Indigenous and non-Indigenous Australians in the NT. Since 2014, when this study was conducted, there have been educational forums conducted by NT cardiologist specialists involving general practitioners and multidisciplinary team care in understanding and optimising heart failure therapy. Additional roles have been created to assist with care coordination including a dedicated heart failure nurse and three additional clinical nurse coordinators, equating to a total of five cardiac specialised nurses for the NT. Currently, the Northern Territory Government has invested approximately three hundred million dollars for an integrated clinical information system with electronic medications linking both acute and primary care sectors in order to allow clinical audits and data analytics seamless and efficient. There is a plan to conduct a follow-up audit to assess the progress of this study.

Limitations

The limitations of this study include those of all retrospective studies including medical record omission upon retrospective review. As a result, the patient sample may not be an accurate representation of the whole population. In addition, the large proportion of newly diagnosed HF in a younger population amongst Indigenous Australians raises the possibility of a significant amount of unidentified HF diagnoses in this population. The authors note that Darwin is unique in its demography and population but does have a tertiary hospital with specialist cardiology services which rural towns that this study was compared to, do not have. The comparative data in the papers cited are also 10 years older than the sample presented in this study.

The risk of data abstraction error was minimised by a single data abstractor who used precise definitions of variables and a standardised method to collect data. However, with any electronic record review, patient medical records are incomplete and some key variables were missing. The missing data may have a significant impact on the conclusions drawn from the existing data. More than half of the patients without a β-blocker had no perceived contraindications and the reasons for non-adherence to treatment guidelines might not have been apparent to the data abstractor on retrospective review. This study only collated data from medical records of medication prescription at the time of hospitalisation. While this is the time that evidence-based medication is likely to be prescribed, medications may have been administered in stages and implemented post-discharge, particularly with more complex clinical cases. Lastly, this is a study of medication prescription by health professionals, which may suggest that patient adherence to medication rates are likely to be lower.

Despite the validity of the data found, this study could have been improved by obtaining renal data such as the creatinine or glomerular filtration rate at the time of diagnosis given that renal failure is a common companion to heart failure. Knowing this might help guide educators and better train clinicians managing heart failure in Indigenous patients given the high rates of renal disease. In addition, collecting data on the use of multidisciplinary health care, including Indigenous health workers and heart failure nurses, could have contributed to a more comprehensive data set. Multidisciplinary team care has been shown to improve outcomes in heart failure and is of particular importance as part of overcoming cultural barriers and facilitating engagement among NT Indigenous Australian patients. The follow-up audit could include assessing multidisciplinary involvement which would help drive improvement in service delivery for patients and their families in the NT.

Conclusion

The results from this study indicate that the prescription rate of ACEI/ARB and β-blockers in CHF patients in the Top End region of the NT are suboptimal. Contraindications to ACEI/ARB were the major reason for non-prescription, however, in the majority of cases for non-use of β-blockers, reasons were not identified. The Indigenous population was also considerably younger in this study and thus contributes significantly to the disease burden and reduced life expectancy of Indigenous Australians. Nonetheless, health care professional education on optimal pharmacological management in patients with CHF and increased focus on improving community-based health services is necessary in order to drive quality improvement in both patient outcome and clinical practice. A dedicated HF service with an inclusion of HF nurse practitioners and Aboriginal health practitioners could further improve implementation of optimal HF therapies.

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