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Effects of a nurse-led heart failure clinic on hospital readmission and mortality in Hong Kong

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Abstract

Background Heart failure (HF) is a physically and socially debilitating disease that carries the burden of hospital re-admission and mortality. As an aging society, Hong Kong urgently needs to find ways to reduce the hospital readmission of HF patients. This study evaluates the effects of a nurse-led HF clinic on the hospital readmission and mortality rates among older HF patients in Hong Kong. **Methods** This study is a retrospective data analysis that compares HF patient in a nurse-led HF clinic in Hong Kong compared with HF patients who did not attend the clinic. The nurses of this clinic provide education on lifestyle modification and symptom monitoring, as well as titrate the medications and measure biochemical markers by following established protocols. This analysis used the socio-demographic and clinical data of HF patients who were aged ≥ 65 years old and stayed in the clinic over a six-month period. **Results** The data of a total of 78 HF patients were included in this data analysis. The mean age of the patients was 77.38 ± 6.80 years. Approximately half of the HF patients were male (51.3%), almost half were smokers (46.2%), and the majority received \leq six years of formal education. Most of the HF patients (87.2%) belonged to classes II and III of the New York Heart Association Functional Classification, with a mean ejection fraction of 47.15 ± 20.31 mL. The HF patients who attended the clinic ($n = 38$, 75.13 ± 5.89 years) were significantly younger than those who did not attend the clinic ($n = 40$, 79.53 ± 6.96 years) ($P = 0.04$), and had lower recorded blood pressure. No other statistically significant difference existed between the socio-demographic and clinical characteristics of the two groups. The HF patients who did not attend the nurse-led HF clinic demonstrated a significantly higher risk of hospital readmission [odds ratio (OR): 7.40; $P < 0.01$] than those who attended after adjusting for the effect of age and blood pressure. In addition, HF patients who attended the clinic had lower mortality ($n = 4$) than those who did not attend ($n = 14$). However, such a difference did not reach statistical significance when the effects of age and blood pressure were adjusted. A significant reduction in systolic blood pressure [F (2, 94) = 3.39, $P = 0.04$] and diastolic blood pressure [F (2, 94) = 8.48, $P < 0.01$] was observed among the HF patients who attended the clinic during the six-month period. **Conclusions** The finding of this study suggests the important role of nurse-led HF clinics in reducing healthcare burden and improving patient outcomes among HF patients in Hong Kong.

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1 Introduction

Heart failure (HF), an inadequacy of the pumping function of the heart, is a major public health concern. The lifetime risk of developing HF is one in five, and it affects over 23 million people worldwide.^[1] In the developed countries, the prevalence of HF increases from 1% to 2% among the

adult population to more than 10% among the elderly population (aged ≥ 70 years).^[2] Despite the advances in HF management, HF carries substantial healthcare and social burdens because of its associated risk of morbidity and mortality. The cost for HF management has doubled in a decade in the United Kingdom, and 70% of the cost is attributed to hospitalization.^[3] In Hong Kong, the mean cost for the management of a HF patient with preserved ejection fraction is 19,969\$, 91.7% of which constitutes in-patient care.^[4] Owing to the age-related prevalence of HF and the readmission of one-fourth of HF patients within 30 days,^[5] HF is expected to continue imposing an increasing economic burden on the aging society of Hong Kong.

Synthesized evidence supports the idea that the second-

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dary prevention intervention delivered by nurses can improve the outcomes of all-cause mortality and reduce hospital readmission among HF patients.^[6] Compared with the standard follow-up, a multidisciplinary out-patient clinic led by specially educated and experienced cardiac nurses can significantly reduce HF-related hospital readmission (incidence rate ratio: 0.55, $P < 0.01$),^[7] and lead to a 55% decrease in admission/patient per month.^[8] Significantly lower all-cause mortality was also observed among HF patients who attended nurse-led HF clinic ($P < 0.03$).^[8] Clearly, HF patients can benefit from nurse-delivered HF management programs in nurse-led clinics. The concept of evidence-based management for HF patients by a nurse-led clinic was well received in Hong Kong and served as the foundation for the establishment of a nurse-led HF clinic in a local public hospital. The aim of the present study is to evaluate the effects of this nurse-led HF clinic on the hospital readmission and mortality rates among older patients with chronic HF.

2 Methods

This study is a retrospective data analysis of HF patients aged 65 years or above and had medical follow-ups in a cardiac out-patient or nurse-led HF clinic. The socio-demographic and clinical characteristics of the HF patients were retrieved from medical records. Patients' outcomes, namely, hospital readmission and mortality rate, were examined at baseline and six months afterwards.

Patients who attended the nurse-led clinic also had regular monitoring of their physiological parameters, including jugular venous pressure, blood pressure and body weight. The data measured at baseline, three months and six months afterwards were also retrieved from medical records for analysis.

2.1 Nurse-led HF clinic

The clinic was led by trained cardiac rehabilitation nurses. All nurses received 12-weeks in-service training, which was conducted at a specialist outpatient clinic of the hospital. During the training, the nurses were provided with cognitive input on the in-depth patho-physiology and management of HF, as well as hands-on practice for physical assessments, HF symptom monitoring and medication adjustment. Management guidelines for the initiation of treatment and the protocol for diuretic titration and biochemical marker measurement were established under the supervision of a consultant physician. The guidelines and all the protocols of patient assessment, symptom monitoring and prescribed treatment were approved by the departmental committee.

Patients who attended the clinic were referred either from out-patient clinics or wards before being discharged. All

new patients attending the HF clinic were reviewed by a consultant and a cardiac rehabilitation nurse, and a HF management plan was formulated upon discussion with the patients. For the first clinic appointment, patients' physical status, including blood pressure, pulse and jugular venous pressure, was monitored by a case manager, who is a cardiac rehabilitation nurse. An individualized care plan was formulated after assessing a patient's risk factors, severity of symptoms, treatment compliance and educational needs. Patients received regular follow-ups, in particular during the first week after discharge, for early detection of deterioration and treatment readjustment as needed.

Moreover, patients and their caregivers were provided with educational discussions on self-care, lifestyle modification and symptom to support them on HF self-management. Facilitating early management before hospitalization was required. Thus, nurses at the clinic educated patients on self-monitoring of symptoms, particularly the increase in shortness of breath, body weight and edematous change. Nurses could also adjust the diuretic dosage based on the condition of the patient in the clinic. Intensive follow-ups at the clinic and daily phone consultations were arranged for the patients until their conditions, such as shortness of breath and edematous status, became stable. Follow-up schedules for the patients ranged from weekly to bi-monthly; patients attended the nurse-led HF clinic for an average of six months.

2.2 Cardiac out-patient clinic

Patients who refused to attend the HF clinic could have medical follow-ups at the cardiac out-patient clinic. They usually received a regular medical consultation at the cardiac out-patient clinic every four to eight weeks after discharge. No structured educational or supportive intervention was provided.

2.3 Data analysis

Socio-demographic and clinical data were summarized with the appropriate descriptive statistics. Based on the levels of measurement of the variables, chi-square or Fisher's exact test and/or independent *t*-test was used to examine the homogeneity between the patients who attended the nurse-led HF clinic and those who did not. Baseline characteristics of between-group differences with P -value < 0.10 were considered as potential confounders.^[9] Normality of the continuous variables was assessed using the skewness and kurtosis statistics and evaluated graphically using the normality probability plot.

Logistic regression analysis was performed to determine the between-group differences in hospital readmission and mortality, while one-way ANOVA analysis was used to

examine the within-group changes of clinical parameters among patients who attended the nurse-led HF clinic. All the statistical analyses were conducted using SPSS 21. The level of statistical significance was set at 0.05 (two-sided).

3 Results

The data analysis included a total of 78 HF patients with a mean age of 77.38 ± 6.80 years. Approximately half of the HF patients were male (51.3%), almost half were smokers (46.2%), and the majority received ≤ 6 years of formal education. Most of the HF patients (87.2%) belonged to classes II and III of the New York Heart Association Functional Classification, with a mean ejection fraction of 47.15 ± 20.31 mL. As for different comorbidities, 63% of the patients suffered from hypertension and 40% had diabetes. Nearly one-third of the patients suffered from atrial fibrillation.

When comparing the difference in socio-demographic and clinical characteristics of patients who attended and did not attend the clinic, HF patients who attended the clinic ($n = 38$, 75.13 ± 5.89 years) were significantly younger than those who did not attend ($n = 40$, 79.53 ± 6.96 years) ($P = 0.04$). In addition, people who did not attend the clinic possibly had less social support (less frequently married, lived less frequently with their families and depended more on Comprehensive Social Security Assistance) than those who did attend. The patients who did not attend the clinic also had lower systolic blood pressure (SBP) and diastolic blood pressure (DBP) than those who attended ($P < 0.05$). No other statistically significant difference existed between the socio-demographic and clinical characteristics of the two groups (Table 1).

3.1 Effects of the nurse-led HF clinic: between-group comparison

During the six months follow-up period, 131 hospital readmissions occurred among 78 patients; 75.5% of these hospital readmissions were of patients who did not attend the clinic. A significantly higher risk of hospital readmission was demonstrated among patients who did not attend the clinic (OR: 7.40; 95% CI: 2.26–24.25; $P < 0.01$) when the effects of age and blood pressure were adjusted (Table 2).

Fewer deaths occurred among the HF patients who attended the clinic ($n = 4$; 10.5%) compared with those who did not attend the clinic ($n = 14$; 35.0%). However, this difference did not reach a statistical significance when the effects of age and blood pressure were adjusted.

3.2 Effects of the nurse-led HF clinic: within-group comparison

Among 38 patients who attended the HF clinic, the clin-

ical parameters, namely, blood pressure, pulse rate, jugular venous pressure and body weight, were measured when they entered the clinic and also three and six months

Table 1. Clinical characteristics of HF patients.

	Attended nurse-led clinic	Did not attend nurse-led clinic	P- value
Age	75.13 \pm 5.89	79.53 \pm 6.96	0.04*
Male	22 (57.9%)	18 (45.0%)	0.26
Married	23 (60.5%)	18 (45.0%)	0.17
Lived with family	31 (81.6%)	26 (65.0%)	0.26
Financial status			
Old-aged assistance	18 (47.4%)	16 (40.0%)	0.51
Disability assistance	5 (13.2%)	5 (12.5%)	0.93
Comprehensive social Security assistance	4 (10.5%)	8 (20.0%)	0.25
Current smoker	19 (50.0%)	17 (42.5%)	0.51
Current drinker	4 (10.5%)	3 (7.5%)	0.64
Clinical characteristics [^]			
Body mass index, kg/m ²	23.72 \pm 3.58	23.81 \pm 4.33	0.92
SBP, mmHg	131.39 \pm 16.88	122.60 \pm 16.67	0.02*
DBP, mmHg	71.18 \pm 8.00	62.28 \pm 10.27	< 0.01**
NYHA functional classification			0.74
Class I	6 (15.8%)	4 (10.0%)	
Class II	18 (47.4%)	21 (52.5%)	
Class III	14 (36.8%)	15 (37.5%)	
EF [^]	47.29% \pm 21.52%	47.00% \pm 19.35%	0.96
Preserved EF ($\geq 50\%$)	18 (47.4%)	18 (45.0%)	0.83
Comorbidities			
Hypertension	23 (60.5%)	26 (65.0%)	0.68
Diabetes	15 (39.5%)	16 (40.0%)	0.96
Atrial fibrillation	13 (34.2%)	10 (25.0%)	0.37
Chronic renal failure	5 (13.2%)	11 (27.5%)	0.12
Chronic obstructive pulmonary disease	5 (13.2%)	2 (5.0%)	0.21
Medication			
Lasix	33 (80.8%)	30 (75.0%)	0.19
Aldactone	10 (26.3%)	11 (27.5%)	0.91
ACE-inhibitor	23 (60.0%)	23 (57.5%)	0.79
ARB	8 (21.1%)	6 (15.0%)	0.49
Oral nitrates and hydralazine	12 (31.6%)	19 (47.5%)	0.15
Beta-blocker	15 (39.5%)	17 (42.5%)	0.77
Aspirin	22 (57.9%)	24 (60.0%)	0.85
Warfarin	10 (26.3%)	5 (12.5%)	0.12
Digoxin	14 (36.8%)	13 (32.5%)	0.68

Data are presented as Mean \pm SD or n (%); $N = 38$ for who attended the nurse-led clinic and $n = 40$ for those who did not attend the clinic. [^]Independent t -test, otherwise chi-square statistics; * $P < 0.05$; ** $P < 0.01$. ACE-inhibitor: angiotensin-converting-enzyme inhibitor; ARB: angiotensin II receptor blockers; DBP: diastolic blood pressure; EF: ejection fraction; HF: Heart failure; NYHA: New York Heart Association; SBP: systolic blood pressure.

Table 2. Effects of the nurse-led HF clinic on patients' hospital readmission.

Variables	B	Exp (B)	95% CI for Exp (B)	P-value
Group [^]	2.00	7.40	2.26–24.25	0.001**
Age	–0.01	1.00	0.91–1.08	0.84
SBP	–0.05	1.00	0.96–1.03	0.77
DBP	–0.04	0.96	0.90–1.02	0.20

Nagelkerke $R^2 = 0.36^{**}$

	Chi-square	df	P-value
Goodness of fit (Hosmer and Lemeshow test)	9.81	8	0.30

[^]Reference group: patients who attended the clinic; ** $P < 0.01$. DBP: diastolic blood pressure; HF: heart failure; SBP: systolic blood pressure.

Table 3. Changes in clinical parameters of patients attending the clinic across six months.

	Mean \pm SD	F value	P-value
SBP		3.39	0.04*
Baseline	131.39 \pm 16.89		
3 months	122.58 \pm 25.93		
6 months	119.50 \pm 13.74		
DBP		8.48	< 0.01**
Baseline	71.18 \pm 7.97		
3 months	66.19 \pm 7.43		
6 months	63.61 \pm 7.45		
Jugular venous pressure		1.38	0.26
Baseline	4.11 \pm 1.75		
3 months	4.10 \pm 1.87		
6 months	3.52 \pm 0.87		
Pulse		0.28	0.76
Baseline	75.26 \pm 13.27		
3 months	74.48 \pm 13.09		
6 months	72.93 \pm 11.33		
Body weight		0.30	0.74
Baseline	57.63 \pm 9.64		
3 months	57.10 \pm 9.50		
6 months	55.83 \pm 8.88		

* $P < 0.05$; ** $P < 0.01$. DBP: diastolic blood pressure; SBP: systolic blood pressure.

afterwards (Table 3). Statistically significant reduction in SBP [$F(2, 94) = 3.39$, $P = 0.04$] and DBP [$F(2, 94) = 8.48$, $P < 0.01$] were found. Gradual decreases in body weight, pulse rate and jugular venous pressure were observed over six months, particularly at the six-month follow-up. However, the differences across time did not reach statistical significance.

4 Discussions

HF is a major cause of disability and mortality among the

aging population and has a significant effect on healthcare system because of its associated hospitalization. Thus, secondary prevention is an important means to reduce the social and economic burden of HF. With the development of advanced practice nurses to manage complex health problems in the 20th century,^[10] nurse-led HF clinics have been developed to provide secondary care to HF patients in Hong Kong.^[11] Nurses of such clinics provide patients and families with knowledge, skills for symptom management, and support, as well as adjust medication and refer investigations for the patients.^[11,12] The findings of the current retrospective data analysis demonstrates the effects of the nurse-led HF clinic on the reduction of hospital readmission, and the improved control of the patients' blood pressure; these results agree with the accumulated evidence of the nurse-led clinic.^[6,8]

The patients who attended the nurse-led clinic were referred to the clinic after they were diagnosed with HF. The nurses of the clinic play an important role in information provision and skill enhancement on the self-management of HF symptoms by offering frequent and regular follow-ups. The individualized care plan developed by the nurses with the patients could be a more effective means to improve the cognitive and behavioral aspects of self-management.^[13] These characteristics may explain the gradual improvement in the risk factors, such as hypertension and body weight, found among the patients who attended the clinic. This reduction in risk factors could also explain the significantly lower risk of hospital readmission for those who attended the clinic compared with those who did not.^[14]

According to a prognostic model developed by Pocock, *et al.*^[15] for patient with chronic HF, being 10 years aged over 60 [hazard ratio (HR): 1.46. 95% CI: 1.62–1.84] and having lower diastolic blood pressure (per 10 mmHg decrease; HR: 1.10; 95% CI: 1.05–1.15) were associated with higher mortality rate over three years. Their findings could explain the higher mortality rate observed in the present study among patients who did not attend the HF clinic compared with those who did.

Although the information and skills for lifestyle modification provided to the patients in the clinic demonstrated improvement in their clinical outcomes, further studies are warranted because the data analysis is limited by its sample size and relatively short period of follow-up. Moreover, other characteristics, such as patients' satisfaction, the quality of their experience attending the clinic and the quality of healthcare received, can be further evaluated to enhance the attendance of the clinic and the adherence to treatment and lifestyle modification.^[16] Future studies should also consider the use of objective measurements of patient's medication

adherence, such as dose count and clinical outcomes, to reduce the recall or social desirability biases of patients.^[17] Studying the cost effectiveness of a nurse-led HF clinic, the perception of healthcare professions, and the quality of life of patients attending the clinic is likewise necessary.^[18] Given that physical inactivity, overweight and hyperlipidemia are found in most heart disease patients and can contribute to HF development,^[19] secondary prevention on risk factor control among patients with coronary heart disease is equally important on top of managing the risk factors of HF patients.

In conclusion, nurse-led HF clinics have a significant role in supporting the adherence to treatment and lifestyle modification of patients by providing continuous education and skills training. The significant reduction in hospital re-admission and improvement in clinical outcomes among HF patients who attended the nurse-led clinic demonstrated in this analysis support the effectiveness of the nurse-led HF clinics in tackling the economic challenges of the heavily government-subsidized healthcare system in Hong Kong.

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