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# An Exploration of Factors Related to Rehospitalisation for Patients with Chronic Heart Failure

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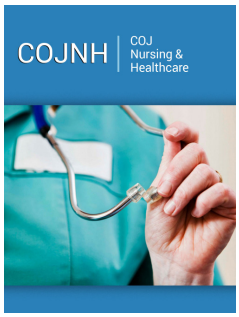


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**Abstract**

**Background:** The previous studies showed many factors impacting rehospitalisation, such as, demographic factors, clinical factors, and psychological factors, however, none studies focus on associations between patient activation, self-efficacy, heart failure knowledge, medication adherence and rehospitalisation among patients with chronic heart failure.

**Purpose:** To investigate the impacts of patient activation, self-efficacy, heart failure knowledge and medication adherence on rehospitalisation for chronic heart failure patients.

**Methods:** This was a secondary analysis of the longitudinal observational survey about factors influencing hospital readmission in chronic heart failure patients. A total of 432 participants were enlisted using convenience sampling from three university hospitals, Guangzhou, Southern China. The factors influencing rehospitalisation covered demographic and clinical variables, patient activation, heart failure knowledge, self-efficacy, and medication adherence. The univariate and multivariate logistic regression was used to examine the factors affecting hospital readmissions of chronic heart failure patients.

**Result:** The major factors influencing rehospitalisation for patients with chronic heart failure were as follows: poor NYHA function (OR=2.96, p=0.019), lower patient activation (OR=3.81, p<0.001), inadequate HF knowledge (OR=1.46, p=0.037), lower self-efficacy (OR=2.53, p<0.001), and non-adherence to medication (OR=2.28, p=0.011).

**Conclusion:** Poor cardiac function, lower activation, self-efficacy, inadequate heart failure knowledge and non-adherence to medication were associated with hospital readmissions in chronic heart failure patients, the findings indicate these factors should be underlined in preventing rehospitalisation in the population.

**Keywords:** Heart failure; Knowledge; Medication adherence; Patient activation; Rehospitalisation; Self-efficacy

## Introduction

Heart Failure (HF) is the end stage of heart disease and is found to be a leading reason for hospitalisation and readmission throughout the world, remains a significant burden on the family and health care system worldwide [1,2]. A number of evidences demonstrated that the hospital readmission is prevalent in patients with Chronic Heart Failure (CHF) after discharge within 30 days, three months and one year, which is a big challenge for health professional and health care system [3,4]. Therefore, it is beneficial to early identify factors influencing rehospitalisation for this population. The previous studies explored many factors impacting it, such as, demographic factors, clinical factors, and psychological factors, however, no studies focus on associations between patient activation, self-efficacy, HF knowledge, medication adherence and rehospitalisation among CHF patients.

## Background

Patient activation is defined as the knowledge, skills, beliefs, and behaviors that patients need to manage their own health and healthcare, to cooperate with health providers, to

preserve their health functioning, and to access care appropriate to their conditions [5]. An individual's level of activation may provide a gauge of his/her propensity to perform health behaviors that increase the chance of better health outcomes [6]. Emerging evidence reveals that patient activation is a factor that may predict hospitalisation, emergency room utilization in chronically ill populations [7,8]. HF is a long-term chronic condition, patients are required to have a high activation to conduct self-care behaviors, and they also need be motivated and involved in their health care [1,9]. Although many studies explored the levels of patient activation, the association between activation and health outcomes in patients with chronic diseases, yet little is known about what impacts of activation on hospital readmission in CHF patients. Self-efficacy is a key factor in determining health behaviors in healthy individuals or adults with chronic diseases. A number of studies show that increased self-efficacy has been related to improved medication adherence, physical activity, and self-care in patients with chronic illness [10,11]. Several studies report that lack of confidence is especially problematic for CHF patients during self-care after hospital discharge; they were prone not to take medication, and withdraw from cardiac rehabilitation program [11,12], which are common reasons for rehospitalisation in the population. Up to now, few studies investigated the effects of self-efficacy on hospital readmission in CHF patients.

The recent study demonstrates adequate HF knowledge is a major aspect for HF patients in maintaining clinical stability, avoiding illness exacerbation [13,14]. HF knowledge deficiency is a barrier to perform effective treatment management in the population [15]. It is identified that enhancing HF patients' knowledge on pharmaceutical has clinical value in reducing re-hospitalisation and improving health outcomes [16]. Likewise, adequate HF knowledge of patients, including HF symptom, medication, self-care, and disease prevention could prevent illness progress and hospital readmission. HF patients encounter the complex medical regimens in exception of the long-term medication use; this is a big challenge for them to comply with medication regimen [17].

Optimal treatment adherence by HF patients maximises the benefits of therapy, and can alter disease trajectory, improve quality of life, and increase life expectancy [2]. Conversely, low adherence is related to poor health outcomes, such as reduced cardiac function, decline in daily life, and repeated hospital stays [1,18]. Prior studies have addressed the risk of hospitalisation related to medication non-adherence in adults with CHF [19]; however, the associations between hospital readmission and non-adherence to medication remain unclear in CHF patients. Despite a growing focus on hospital readmission and health outcomes in HF patients, the patient perspective on precipitating factors for rehospitalisation is not well-described [14]. As stated, above-mentioned studies, few data report the impacts of patient activation, self-efficacy, HF knowledge and medication adherence on rehospitalisation in CHF population. Therefore, the study was conducted aiming to analyses the associations between these variables and rehospitalisation in the population.

## Methods

To determine the factors associated with rehospitalisation in CHF population, we analyzed data from a longitudinal observational study that has been described elsewhere [20]. The methodology of that study was summarized as following.

### Design

A longitudinal observational study was adopted in that study, which examined the factors influencing rehospitalisation for CHF patients after hospital discharge within six months in three tertiary University hospitals, Guangzhou, southern China. A convenience sampling method was used to enlist the participants. Data collection was conducted by authors from May 2015 to April 2016, the first data were gathered on the day before hospital discharge, and the second data were collected six months after baseline data collection. The study was approved by the Ethics Committee of Guangzhou Medical University (No. 15028). This study was reported based on strengthening the reporting of observational studies in epidemiology guideline.

### Participants

The participants who met the following inclusion criteria were invited to attend the study:

A. A confirmed diagnosis of chronic heart failure by the cardiologist,

B. 18 years of age and older and

C. Approval to participate in the study.

Participants were excluded if they:

A. Were pregnant,

B. Had severe cognitive or psychiatric impairments, and

C. Could not speak mandarin or Cantonese.

The calculation of sample size had been reported elsewhere [20].

## Measures

### Socio-demographic and clinical questionnaire

A standard questionnaire was used to collect socio-demographic and clinical data. The former included age, marital status, gender, education, income, employment status and living with family members. The latter consisted of duration since HF diagnosis, New York Heart Association (NYHA) functional classification, medications, and comorbidities.

### Patient activation measure

The patient activation was assessed using Chinese version of Patient Activation Measure (PAM). It is a self-assessment scale to test the level of patients' engagement in their health care [21]. The short-form PAM was used in this study, including 13 items. The Cronbach's alpha of Chinese version of PAM-13 was 0.82, the test-retest reliability coefficient for 0.70, and the content index for 0.87 [22]. 13 items yield an overall score, which can be grouped into four

'stages of activation', stage 1:<47.0, stage 2: 47.1-55.1, stage 3: 55.2-67.0, and stage 4:>67.0. Participants in stage 1 do not feel that they can take an active role in their health care; they have learned to adopt new behaviors in stage 4, but may not maintain them under stress [23].

### Atlanta heart failure knowledge test

The HF knowledge of patients was measured with the second version of Atlanta Heart Failure Knowledge Test (AHKT-2) [24]. It covers a comprehensive knowledge related to HF, including pathophysiology, medications, HF symptoms, dietary recommendations, and health/adherence behaviors [24]. Questions are asked in multiple choice formats with nominal scaling, and the numbers of correct items are summed to generate an overall score, the high scores of AHKT-2 indicate the high level of HF knowledge. The Chinese version of AHKT-2 has solid evidence for adequate reliability and validity in Chinese HF populations [25], Cronbach's alpha for 0.72, test-retest reliability for 0.86, and content validity index for 0.92. The level of HF knowledge for respondents is classified into three levels according to their total scores, lower level (<18.0), moderate level (18.0-24.0), and higher level (>24.0) [25].

### Self-efficacy for managing chronic disease scale

CHF Patients' confidence was assessed by a validated Self-efficacy for Managing Chronic Disease scale (SECD) with 6 items [26]. Responses are graded on a 10-point Likert-type scale ranging from not at all confident to totally confident in managing HF. The total mean score more than 7 implies adequate confidence of respondent [27]. SECD has been translated into Chinese and its psychological properties are confirmed in Chinese population with chronic diseases. The Cronbach's alpha of Chinese version of SECD was 0.91 [18].

### Medication adherence questionnaire of HF patients

The medication adherence of CHF patients was examined by self-developed questionnaire. It was developed based on the published medication adherence scales. It included 9 items to test the medication adherence of HF patients. The Likert-4 was used to evaluate patients' adherence level, from 1 (none) to 4 (all the time). The content validity of the questionnaire was tested by seven health care professionals in cardiovascular treatment and nursing. The content index was 0.94. Cronbach's alpha for the scale was 0.87. The cut-off point of adherence and non-adherence was 27 based on receiver operating characteristic curve, specificity for 56%, and sensitivity for 80%.

### Data analyses

The data analyses were conducted with the Statistical Package for the Social Sciences, version 19.0 (SPSS Inc, Chicago, Illinois). Data analyses began with a descriptive examination of all variables, including frequency distributions, means, and standard deviations. The t-tests and chi-square tests were used to compare participants' characteristics between rehospitalisation and non-rehospitalisation groups. To determine the factors related to rehospitalisation, the univariate logistic regression was first conducted, and then the multivariate logistic regression using the forward method was conducted to choose the statistical variables based on the univariate logistic analysis. Results were described using an odds ratio (OR) and 95% confidence interval (CI). The *p value* less than 0.05 is set to detect statistical difference for all the tests.

## Result

### Sample characteristics

Four hundred thirty-two HF patients attended the study. Of those participants, 330 CHF patients had no admission to hospital, 102 patients readmitted hospital. The average age of all participants was 68.01 (SD, 8.63) years, ranging from 43 to 77 years. Male participants accounted for 52.2%. 38.9 participants lived with family members. 6.5% patients were in NYHA functional class IV. Many CHF patients had comorbid, such as hypertension, diabetes mellitus, atrial arrhythmias, chronic obstructive pulmonary disease, chronic kidney disease, etc. The sample characteristics of all participants were shown in Table 1.

**Table 1:** The comparison of demographic and clinical characteristics in patients with heart failure in rehospitalization and non-rehospitalisation group.

| Variables | Total (n=432) | Re-hospitalisation (n=102) | Non-Rehospitalisation (n=330) | p[a] |
|---|---|---|---|---|
| | n (%) | n (%) | n (%) | |
| Age (years, Mean, SD) | 68.01 (8.03) | 68.42 (8.15) | 67.65 (9.32) | 0.183 |
| **Gender** | | | | 0.406 |
| Male | 225 (52.1) | 53 (51.7) | 172 (52.0) | |
| Female | 207 (47.9) | 49 (48.3) | 158 (48.0) | |
| **Marital status** | | | | 0.519 |
| Married | 358 (82.9) | 85 (83.3) | 273 (82.7) | |
| Divorced/Widowed | 47 (10.8) | 10 (9.8) | 37 (11.2) | |
| Single | 27 (6.3) | 7 (6.9) | 20 (6.1) | |
| **Education** | | | | 0.728 |

| | | | | |
|---|---|---|---|---|
| Secondary school and below | 142 (32.9) | 34 (33.7) | 108 (32.6) | |
| High school | 213 (49.3) | 49 (48.3) | 60 (49.6) | |
| College and above | 77 (17.8) | 19 (18.0) | 58 (17.8) | |
| **Employment Status** | | | | 0.272 |
| Full time | 92 (21.3) | 20 (19.6) | 72 (21.7) | |
| Part-time | 81 (18.7) | 21 (20.6) | 60 (18.2) | |
| Retire | 259 (60.0) | 61 (59.8) | 198 (60.1) | |
| **Income (Yuan, monthly)** | | | | 0.351 |
| 1000~ | 135 (31.2) | 31 (30.0) | 104 (31.5) | |
| 3000~ | 214 (49.5) | 51 (50.4) | 163 (49.3) | |
| 5000~ | 83 (19.3) | 20 (19.6) | 63 (19.2) | |
| **Living with Family Members** | | | | 0.034* |
| Yes | 168 (38.9) | 35 (34.8) | 133 (40.3) | |
| No | 264 (61.1) | 67 (65.2) | 197 (59.7) | |
| **Length of Time since Heart Failure Diagnosis (Years)** | | | | 0.685 |
| <1 | 72 (16.7) | 17 (17.0) | 55 (16.6) | |
| 1~ | 87 (20.1) | 22 (21.3) | 65 (19.8) | |
| 3~ | 160 (37.0) | 37 (36.0) | 123 (37.4) | |
| 5~ | 113 (26.2) | 26 (25.7) | 87 (26.2) | |
| **NYHA Class** | | | | 0.041* |
| I | 56 (12.9) | 12 (11.9) | 44 (13.2) | |
| II | 195 (45.1) | 41 (40.2) | 154 (46.6) | |
| III | 153 (35.4) | 42 (40.8) | 111 (33.7) | |
| IV | 28 (6.5) | 7 (7.1) | 21 (6.5) | |
| **Number of Medications taken Daily** | | | | 0.028* |
| <4 | 260 (60.2) | 50 (49.0) | 210 (63.5) | |
| 4~ | 143 (33.1) | 41 (40.3) | 102 (30.9) | |
| 7~ Comorbidies | 29 (6.7) | 11 (10.7) | 18 (5.6) | |
| **Hypertension** | | | | 0.164 |
| Yes | 371 (85.9) | 88 (86.0) | 283 (85.9) | |
| No | 61 (14.1) | 14(14.0) | 47 (14.1) | |
| **Diabetes mellitus** | | | | 0.426 |
| Yes | 62 (14.4) | 14 (13.8) | 48 (14.6) | |
| No | 370 (85.6) | 88 (86.2) | 282 (85.4) | |
| **Atrial Arrhythmias** | | | | 0.901 |
| Yes | 67 (15.5) | 16 (16.1) | 51 (15.5) | |
| No | 365 (74.5) | 86 (83.9) | 279 (74.5) | 0.258 |
| **COPD** | | | | |
| Yes | 49 (11.3) | 11 (10.3) | 38 (11.5) | |
| No | 383 (88.7) | 91 (89.7) | 292 (88.5) | |
| **Chronic Kidney Disease** | | | | 0.53 |
| Yes | 68 (15.7) | 17 (16.9) | 51 (15.4) | |
| No | 364 (84.3) | 85 (83.1) | 279 (74.6) | |
| **Peripheral Vascular Disease** | | | | 0.089 |
| Yes | 125 (28.9) | 29 (28.7) | 96 (29.1) | |
| No | 307 (71.1) | 73 (71.3) | 234 (70.9) | |
| **Others** | | | | 0.315 |

| | | | | |
|---|---|---|---|---|
| Yes | 86 (19.9) | 21 (20.8) | 65 (19.7) | |
| No | 346 (80.1) | 81 (79.2) | 265 (80.3) | |

a t-test or chi-squared test between Rehospitalisation and non-Rehospitalisation groups; SD=standard deviation, NYHA=New York Heart Association, COPD=chronic obstructive pulmonary disease.

*P<0.05.

### The comparison of demographic and clinical characteristics for CHF patients between rehospitalisation and non-rehospitalisation groups

As shown in Table 1, 34.8% of patients lived with family members in rehospitalisation group, 40.3% in non-rehospitalisation group lived with family members, the statistical difference was detected (p=0.034). CHF patients were in NYHA functional class III and IV in rehospitalisation group were 40.8%, 7.1%; that was 33.7%, 6.5% in non-rehospitalisation group, respectively. There was significant difference in statistics in NYHA functional class between two groups (p=0.041). CHF patients in rehospitalisation group took more pills daily than those in non-rehospitalisation group, the statistical difference was also observed (p=0.028).

### The comparisons of patient activation, HF knowledge, self-efficacy and medication adherence in CHF patients between rehospitalisation and non-rehospitalisation groups

**Table 2:** The comparison of patient activation, heart failure knowledge, self-efficacy, and medication adherence for patients with chronic heart failure in rehospitalization and non-rehospitalization group.

| Variables | Total (n=432) | Re-hospitalisation (n=102) | Non-rehospitalization (n=330) | p[a] |
|---|---|---|---|---|
| **Patient Activation** | | | | |
| Stage 1 | 51 (11.8) | 17 (16.6) | 34 (10.2) | 0.010* |
| Stage 2 | 82 (19.0) | 22 (21.7) | 60 (18.2) | |
| Stage 3 | 170 (39.4) | 35 (34.2) | 135 (40.9) | |
| Stage 4 | 129 (29.8) | 28 (27.5) | 101 (30.7) | |
| Mean (SD) | 54.73 (9.95) | 52.32 (9.54) | 56.96 (10.80) | 0.006** |
| **HF Knowledge** | | | | 0.023* |
| Lower | 180 (41.7) | 48 (46.9) | 132 (40.0) | |
| Moderate | 176 (40.7) | 39 (37.9) | 137 (41.5) | |
| Higher | 76 (17.6) | 15 (15.2) | 61 (18.5) | |
| Mean (SD) | 17.34 (2.56) | 16.58 (1.72) | 19.14 (2.37) | 0.018* |
| **Self-efficacy** | | | | 0.040* |
| Lower | 207 (47.9) | 46 (45.2) | 161 (48.9) | |
| Higher | 225 (52.1) | 56 (54.8) | 169 (51.1) | |
| Mean (SD) | 7.04 (0.71) | 6.86 (0.81) | 7.35 (0.78) | 0.026* |
| **Medication Adherence** | | | | 0.032* |
| Adherence | 290 (67.1) | 64 (62.7) | 226 (68.4) | |
| Non-adherence | 142 (32.9) | 38 (37.3) | 104 (31.6) | |
| Mean (SD) | 28.14 (4.05) | 25.92 (3.36) | 29.57 (4.13) | 0.021* |

a t-test or chi-squared test between rehospitalisation and non-rehospitalisation groups; SD=standard deviation, HF=heart failure.

*p<0.05, **p<0.01.

The percentages of stage 1 and 2 in patient activation among CHF patients in rehospitalisation group were much higher than those in non-rehospitalisation group, the statistical differences were observed (p=0.010). Likewise, the percentages of lower level of HF knowledge, self-efficacy and non-adherence to medication for CHF patients in rehospitalisation group were also higher than those in non-rehospitalisation group, there were significant differences in statistics (p=0.023, p=0.040, p=0.032). Additionally, the total average scores of patient activation, self-efficiency, HF knowledge and medication adherence in rehospitalisation group were higher than counterparts in non-rehospitalisation group, there were statistical differences in these variables between two groups. The detailed results were presented in Table 2.

### Factors influencing rehospitalisation for CHF patients

The univariate and multivariate logistic regression were conducted to determine the predictors of rehospitalisation for CHF patients. The results of univariate logistic regression revealed the significant associations between living without family members (OR=2.26, p=0.012), took more pills daily (OR=1.73, p=0.023), poor NYHA function (OR=3.36, p<0.001), lower patient activation (OR=4.25, p<0.001), inadequate HF knowledge (OR=1.79, p=0.043), lower self-efficacy (OR=3.01, p<0.001), and non-adherence to medication (OR=2.86, p<0.001) and rehospitalisation (Table 3). After conducting multivariate logistic regression based on these significant seven variables, poor NYHA function (NYHA IV vs. I, OR=2.96, p=0.019), lower patient activation (Stage 1 vs. Stage 4, OR=3.81, p<0.001), inadequate HF knowledge (lower vs. higher, OR=1.46, p=0.037), lower self-efficacy (lower vs. higher, OR=2.53, p<0.001), and non-adherence to medication (non-adherence vs. adherence, OR=2.28, p=0.011) were remained and validated as significant factors influencing hospital readmission for CHF patients (Table 4).

**Table 3:** Factors influencing rehospitalisation for patients with chronic heart failure based on univariate logistic regression model.

| Variables | OR | 95% CI | p |
|---|---|---|---|
| **Living with family members** | | | |
| Yes | 1 | | |
| No | 2.26 | 1.94, 2.75 | 0.012* |
| **Number of medications taken daily** | | | |
| <4 | 1 | | |
| 4~ | 1.5 | 1.36, 1.91 | 0.038* |
| 7~ | 1.73 | 1.41, 2.28 | 0.023* |
| **NYHA Class** | | | |
| I | 1 | | |
| II | 1.23 | 0.99, 1.60 | 0.057 |
| III | 2.97 | 2.08, 4.74 | 0.008** |
| IV | 3.36 | 3.02, 4.19 | <0.001** |
| **Patient Activation** | | | |
| Stage 4 | 1 | | |
| Stage 3 | 1.68 | 1.15, 1.87 | 0.048* |
| Stage 2 | 3.41 | 2.66, 3.75 | 0.006** |
| Stage 1 | 4.25 | 3.54, 5.10 | <0.001** |
| **HF Knowledge** | | | |
| Higher | 1 | | |
| Moderate | 1.16 | 0.97, 1.63 | 0.089 |
| Lower | 1.79 | 1.30, 2.58 | 0.043* |
| **Self-efficacy** | | | |
| Higher | 1 | | |
| Lower | 3.01 | 2.69, 3.55 | <0.001** |
| **Medication Adherence** | | | |
| Adherence | 1 | | |
| Non-adherence | 2.86 | 2.39, 3.46 | <0.001** |

OR=odds ratio, CI=confidence interval, NYHA=New York Heart Association.

*p<0.05, **p<0.01.

**Table 4:** Predictors of rehospitalization for patients with chronic heart failure based on multivariate logistic regression model.

| Variables | Reference | OR | 95% CI | p |
|---|---|---|---|---|
| Constant | | 0.07 | | <0.001** |
| **NYHA class** | | | | |
| III | I | 2.05 | 1.70, 2.41 | 0.041* |

| | | | | |
|---|---|---|---|---|
| IV | I | 2.96 | 2.42, 3.40 | 0.019* |
| **Patient Activation** | | | | |
| Stage 2 | Stage 4 | 3.02 | 2.72, 3.67 | 0.026* |
| Stage 1 | Stage 4 | 3.81 | 3.45, 4.49 | <0.001** |
| HF knowledge (lower) | Higher | 1.46 | 1.18, 1.72 | 0.037* |
| Self-efficacy (lower) | Higher | 2.53 | 1.97, 2.80 | <0.001** |
| Medication adherence (Non-adherence) | Adherence | 2.28 | 2.84, 3.75 | 0.011* |

OR=odds ratio, CI=confidence interval, NYHA=New York Heart Association.

*p<0.05, **p<0.01.

## Discussion

Despite many studies explore the factors influencing hospital readmission for CHF patients; however, these four significant variables are yet underemphasized in current efforts to reduce HF rehospitalisation. This study has several valuable findings, which will lend insight into possible interventions to reduce HF readmissions. The first significant finding is that this study showed a positive relationship between lower level of activation and rehospitalisation in HF patients. CHF patients with low patient activation (Stage 1) were 3.81 times more likely to be readmitted hospital than those with high activation (Stage 4). Consistent with prior studies, Mitchell et al. [28] found patients with chronic cardiopulmonary illnesses who reported lower PAM scores (Stages 1 and 2) were nearly two times more likely to be readmitted hospital within 30-days than peers with higher PAM scores.

Kinney et al. [29] conducted a systematic review about association between patient activation and hospitalisation among populations with chronic diseases and concluded that chronically ill patients with lower patient activation were at an increased chance of hospitalisation and emergency room utilization. Among patients with cardiovascular disease in this review, those individuals who scored in the higher PAM stages (3 and 4) decreased the chance of hospital admission within one year than those counterparts with lower PAM scores (Stage 1 and 2). This is the first study to report that patient activation is a determinant of rehospitalisation in CHF patients; the results need be scrutinized in future study.

Patients commonly report lack of knowledge as precipitants to be admitted hospital, this study also found that lower level of HF knowledge was the crucial predictor of readmission for CHF patients. The inadequate HF knowledge in HF patients increased 1.46 times likelihood of readmission. The potential reason is that CHF patients with inadequate HF knowledge could not know about what measures should be taken to prevent HF exacerbation, such as dietary and fluid limitation, weight management, attending cardiac rehabilitation program, etc., which result in illness exacerbation and hospital readmission. Based on the results, making health education about HF knowledge should be routine to all CHF patients, including outpatient visits and hospitalisation, targeting improvement of HF knowledge, and ensuring prevention of readmission for the population.

Self-efficacy is considered an important determinant for rehospitalisation in the study, which is understandable given the diverse challenges associated with following a complex HF treatment regime and self-care. The results were supported from earlier studies that self-efficacy was an efficient instrument for the prediction of readmission in patients with coronary artery disease [30,31]. It was reported that the patients with high cardiac self-efficacy had significantly better functional status, better mental and physical health function and greatly reduced cardiac hospital admissions [32]. Several randomised controlled trials also confirmed that chronic disease patients with higher self-efficacy were less liable to be readmitted [32-34]. For example, Varaei et al. [32] conducted a randomised controlled trial to test the effects of a peer education on cardiac self-efficacy and readmission of the patients undergoing bypass surgery, and found that compared to the controlled group, the hospital readmission in cardiac self-efficacy group was greatly reduced. The last notable finding was that the non-adherence to medication is significantly associated with hospital readmission for CHF patients.

The result was supported through univariate and multivariate logistic regression models. CHF patients who could not comply with medication schedule were 2.28 times odds of readmission than adherents. The study from de Albuquerque & Colleagues [35] also revealed that inadequate drug therapy adherence was related to hospital readmission in patients with coronary heart disease in Brazil. Several studies found that lower level of medication adherence predicted hospitalisation in adults with chronic diseases, such as hypertension, diabetes mellitus, coronary heart diseases [19,34]. Furthermore, some studies demonstrated that medication adherence of chronically ill populations were decreasing after hospital discharge within six months [34]. Similarly, the phenomenon was also observed in CHF patients, which contribute healthcare professionals to understand the association between medication non-adherence and hospital readmission.

While this study brings insight into the hospital readmission of CHF patients, some weaknesses should be noted when extrapolating the results. First, the study only used the second data to analyse the factors influencing readmission from the original study, therefore, the causality between rehospitalisation and predictors cannot be determined. Second, the study is conducted in metropolitan city;

the findings might not be used in other regions. Third, the used measures are self-report; the data reflect the subjective statements of the participants.

## Conclusion

In summary, this study identified the following factors significantly associated with hospital readmission in CHF patients: poor cardiac function, lower levels of activation and self-efficacy, inadequate HF knowledge and non-adherence to medication, which suggests these factors, should be highlighted in preventing rehospitalisation in the population. The finding adds new information to the list of variables previously shown to predict rehospitalisation in adults with chronic heart failure. Patient activation, adherence behavior, self-efficacy for HF patients usually changes with illness recovery or progress over time, therefore, the impacts of these variables on rehospitalisation in HF patients should be tracked after hospital discharge using a longitudinal study.

## Relevance to clinical practice

The findings were derived from this study suggesting that

A. Health professionals regularly evaluate HF patients' activation before developing tailored interventions to reduce rehospitalisation;

B. Physicians and nurses must exert additional effort to improve patients' HF knowledge; and

C. Health workers should take effective measures to enhance patients' self-efficacy and medication adherence through communication, health education and other approaches to further prevent hospital readmission among HF patients.

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## Conflict of interest

None

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