Rate and Predictors of Early Readmission among Thai Patients with Heart Failure

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Background: Readmission to hospital after discharge has been recognized as a significant problem in patients with chronic heart failure (CHF). No studies report rate of early readmission (defined as readmission within 30 days after discharge) and its predictors among Thai patients with CHF.
Objective: To determine rate and predictors of early readmission among Thai patients with heart failure.
Material and Method: From an electronic medical database of a tertiary care hospital in Thailand, we retrieved data of all patients who were hospitalized with a principal diagnosis of CHF between January 1, 2005 and December 31, 2006. Patients were followed whether they were readmitted within 30 days after discharge.
Results: Seven hundred eighteen patients were included for analysis. Studied patients were mostly female (57.52%) with mean age of 64.91 ± 14.14 (SD) years. The median length of hospital stay (LOS) was five days. One hundred one patients (14.07%) had their first readmission from all causes within 30 days after discharge. An exacerbation of CHF was the most common cause. In a multivariate model, only the LOS >5 days predict higher risk of early readmission (adjusted OR = 1.41, 95% CI = 1.05-1.89, p = 0.023). No significant association between discharge medications and early readmission was found in the present study.
Conclusion: Early readmission rates appear modest among Thai patients with CHF. The LOS > 5 days was a positive predictor of early readmission while discharge cardiovascular medications were not associated with early readmission.

Keywords: Heart failure, Quality indicators, Quality of care, Readmission, Rehospitalization

Chronic heart failure (CHF) has been recognized as a severe condition affecting people around the world. In Thailand, the National Statistical Office (NSO) has reported that 6.9% of older people suffer from CHF[1]. Additionally, CHF is one of the top five causes of death among Thai population.

Despite major advances in therapeutic approach to management of CHF, hospital readmission rate after discharge remains high. Readmission has been proposed as a quality indicator in management of CHF patients. Studies from different countries reported readmission rate within one month after discharge (defined as early readmission) to vary from 13.2% to 23.6%[2-6]. No such a report on early readmission was available from patient data in Asian countries, including Thailand.

Several interventions have been shown to reduce readmission rate among CHF patients, thus potentially decreasing cost of care[6-9]. To be cost-effective in providing interventional programs, patients at higher risk should be targeted. In search of predictors for readmission, various processes of care and patient-related factors have been identified from previous research[6-12]. Most of these studies however focused on readmission that occurred at 3-6 months or one-year period after discharge. Thus, information related to predictors on early readmission is scarce at present.

To appropriately plan for improvement in care process to reduce early readmission among Thai CHF patients, we conducted the present study to: (1) determine early readmission rate after discharge

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among patients with principal diagnosis of CHF and (2) identify predictors of readmission within 30 days after discharge for this group of patients.

Material and Method
Study design and setting
The present study was a retrospective review of electronic medical database (EMD), conducted at a tertiary care hospital in a large metropolitan area of Phitsanulok Province, Thailand. The 1,000-bed hospital serves as an academic teaching hospital affiliated with Naresuan University and as the referral center in the lower northern part of Thailand. At the time of this study, data entry into the EMD at this hospital was performed by medical statistics staff or other trained personnel. Patient database comprised coding of principal and secondary diagnosis, laboratory and procedures and medications received during hospitalization. All data were retrieved by hospital staff who functioned as an electronic database specialist.

The present study protocol had been approved by the Institutional Review Board Committee on human research at Naresuan University (Protocol number: 5001030004) and by the research committee at the study hospital prior to data collection.

Patients
Data of all patients hospitalized with a principal diagnosis of CHF between January 1, 2005 and December 31, 2006 were retrieved from the EMD. Patients were identified as having CHF by the International Classification of Diseases tenth revision (ICD-10) code: I50.0. An index hospitalization was defined as the first admission of each patient during that year. Follow-up for each patient began on the discharge date of the index hospitalization and continued for 30 days. Patients were excluded from the study if they died during the index hospitalization.

Data collection
The independent variables of interest were available from the EMD. Information on patient demographics, including age, gender and address (classified as rural or urban area); medical history, including known diagnosis of atrial fibrillation, ischemic heart disease, stroke, renal failure, diabetes mellitus (DM), hypertension and dyslipidemia; and admission findings, including length of stay (LOS), the last serum potassium level and cardiovascular medications at discharge was collected during the index hospitalization. Previous admission for CHF in

the previous year prior to index hospitalization was also retrieved from the EMD. The database was then reviewed to document readmissions occurring at any time within 30 days after index discharge.

Statistical analysis
Demographics and clinical characteristics of all patients were summarized as means $\pm$ SD or frequencies and percentages as appropriate.

Readmission rate was calculated by dividing the cumulative number of patients readmitted within 30 days after an index discharge by the total number of patients discharged alive, presented as percentage.

To determine predictors of early readmission, a bivariate analysis was performed using Chi-square or Fisher's exact test, as appropriate. All continuous variables were categorized to obtain nominal variables prior to data analysis. Any variables with a p-value of less than 0.10 in bivariate analysis were further entered into logistic regression with multivariate analysis to identify independent predictors of early readmission. A p-value of less than 0.05 was considered statistically significant in the final model. All statistical analysis was performed by STATA software.

Results
Patient characteristics
There were 371 and 471 patients admitted with a principal diagnosis of CHF in the years 2005 and 2006, respectively. No significant difference in terms of age, gender between patients in these two years was observed; therefore, all patients were pooled for analysis. From 842 patients, 124 died during index admission. Thus, 718 patients who were discharged alive were included in the final analysis.

Patients were mostly female (57.52%) and had a mean age of 64.91 $\pm$ 14.14 (SD) years. Two third of patients were from the rural area. Majority of patients (74.51%) have at least one co-morbidity. Hypertension was the most common co-morbidity (39.0%). The median serum potassium value was 4.0 mmol/L. The median length of stay was five days. Only 7.66% had a prior CHF admission in the past year. At discharge, 334 (46.52%) were prescribed angiotensin-converting-enzyme inhibitors (ACEIs), whereas 93 (12.95%) patients received beta-blockers (BBs). The characteristics of the study population are summarized in Table 1.

Early readmission rates and causes of readmission
Within 30 days after an index discharge, 14.07% (101/718) had their first readmission from all

Table 1. Patient characteristics at index hospitalization

Characteristics	n (%)
Age (years)	
< 65	323 (44.99)
65-74	199 (27.72)
75-84	144 (20.06)
≥ 85	52 (7.23)
Mean (SD)	64.91 (14.14)
Gender	
Female	413 (57.52)
Male	305 (42.48)
Marital status	
Married	533 (74.23)
Single	72 (10.03)
Widow	55 (7.66)
Divorced	7 (0.97)
Not identified	51 (7.10)
Resident areas*	
Rural	473 (65.88)
Urban	245 (34.12)
Co-morbidities	
Hypertension	280 (39.00)
Diabetes mellitus	177 (24.65)
Ischemic heart disease	165 (22.98)
Atrial fibrillation	151 (21.03)
Dyslipidemia	117 (16.30)
Renal failure	108 (15.04)
Stroke	30 (4.18)
Discharged cardiovascular medications	
Diuretics	547 (76.18)
ACEIs	334 (46.52)
Nitrates	208 (28.97)
Digoxin	137 (19.08)
BBs	93 (12.95)
Hydralazine	76 (10.58)
Spironolactone	68 (9.47)
CCBs	63 (8.77)
ARBs	12 (1.67)
Serum potassium** (mmol/L) (n = 684)	
≤ 4.0	343 (50.15)
4.1-5.0	305 (44.59)
> 5.0	36 (5.26)
Length of stay (days)	
1-5	447 (62.26)
6-10	198 (27.58)
> 10	73 (10.17)
Having CHF admission in the past year	55 (7.66)
Number of co-morbidities	
0	183 (25.49)
≥ 1	535 (74.51)

* Areas of residents were classified by patients' addresses; for example, if the patients live in Muang District, they would be identified as urban residents
** Last serum potassium result before discharge
ACEIs = angiotensin-converting-enzyme inhibitors; ARBs = angiotensin receptor blockers; BBs = beta-blockers; CCBs = calcium channel blockers

Table 2. The top ten causes of readmission within 30 days after an index discharge among CHF patients (n = 101)

Causes*	n (%)
Chronic heart failure	30 (29.70)
Angina pectoris	9 (8.91)
Chronic renal failure	5 (4.95)
Diarrhea	2 (1.98)
Septicemia	2 (1.98)
Thalassemia	2 (1.98)
Type 2 DM	2 (1.98)
Hypo-osmolality and hyponatremia	2 (1.98)
Mitral stenosis	2 (1.98)
Fibrosis and cirrhosis of liver	2 (1.98)

* Identified from ICD-10 code

causes. Of note, over a half of them (67.33%) were readmitted within the first two weeks after discharge. The most common cause of readmission was heart failure (29.70%) (Table 2). Other less common causes for readmission include angina and renal failure.

Predictors of early readmission

The associations between independent variables and early readmission are shown in Table 3. Based on bivariate analysis, variables associated with early readmission (p-value < 0.1) include LOS > 5 days (OR = 1.84; 95% CI = 1.18-2.87; p = 0.004), a history of DM (OR = 1.51, 95% CI = 0.92-2.43, p = 0.077), a history of renal failure (OR = 1.98; 95% CI = 1.13-3.37; p = 0.008) and digoxin (OR = 0.48; 95% CI = 0.22-0.93; p = 0.024). ACEIs and BBs were not significantly associated with early readmission and neither were other remaining medications.

In a multivariate analysis using logistic regression, the authors found that only LOS > 5 days was still associated significantly with early readmission (adjusted OR = 1.41; 95% CI = 1.05-1.89; p = 0.023). Other variables, namely DM, renal failure and digoxin, were not independent predictors of early readmission in the multivariate model.

Discussion

The present study has demonstrated that the early readmission rate was considered modest among Thai patients hospitalized with heart failure. The authors found that 14.07% of patients were readmitted from all causes within one month. Previous studies from Canada and Switzerland reported an early readmission rate of 22.0% and 13.2%, respectively[2,3].

Table 3. Crude odd ratios (crude ORs) and 95% confidence interval of predictors for all-cause readmission within 30 days among patients hospitalized with CHF

Study predictors	ORs (95%CI)	p-value
Female	1.33 (0.84-2.11)	0.200
Age > 65 years	0.89 (0.57-1.39)	0.580
Urban residents	1.26 (0.79-1.98)	0.304
LOS > 5 days	1.84 (1.18-2.87)	0.004*
Hypertension	1.25 (0.79-1.95)	0.310
Atrial fibrillation	1.05 (0.60-1.79)	0.842
Diabetes mellitus	1.51 (0.92-2.43)	0.077*
Dyslipidemia	0.59 (0.27-1.16)	0.113
Ischemic heart disease	1.34 (0.80-2.20)	0.222
Renal failure	1.98 (1.13-3.37)	0.008*
Stroke	0.67 (0.13-2.24)	0.513
Serum potassium > 5 mmol/L	0.52 (0.10-1.72)	0.282
HF admission in past year	0.98 (0.39-2.18)	0.962
ACEIs	0.76 (0.48-1.18)	0.198
Aldosterone antagonists	1.51 (0.73-2.94)	0.208
ARBs	1.23 (0.13-5.88)	0.794
BBs	1.21 (0.62-2.23)	0.540
CCBs	1.68 (0.80-3.29)	0.116
Digoxin	0.48 (0.22-0.93)	0.024*
Diuretics	0.70 (0.43-1.16)	0.134
Hydralazine	0.80 (0.34-1.69)	0.555
Nitrates	1.36 (0.84-2.17)	0.174

* Predictors with $p < 0.10$ were entered into multivariate analysis
LOS = length of stay, ACEIs = angiotensin-converting-enzyme inhibitors, ARBs = angiotensin receptor blockers, BBs = beta-blockers, CCBs = calcium channel blockers

A recent study conducted in the United States reported a 30-day readmission rate among CHF patients to be 23.6%[5]. Thus, our result appears consistent with data from Switzerland, though lower than those reported from Canada and the United States. One plausible explanation for the slight difference in early readmission rates includes the difference in characteristics among study population, for example, disease severity and etiology (*e.g.* systolic versus diastolic HF). Both of which could be judged from cardiac ejection fraction and were reported previously to be independent predictors of readmission within 6-month after discharge[10,12]. However, information on ejection fraction was not available through the EMD in our setting and hindered us from comparing risk of early readmission among patients in this study to others.

Another explanation for lower readmission rate pertains to its study design. The authors cannot rule out the possibility that some patients may die after discharge or be readmitted to other hospitals around the area, thus accounting for a lower rate of readmission. This limitation seems to impose on all retrospective studies on readmission using EMD as source of information.

Early readmission rate was selected as an outcome of interest in the present study. Although still controversial, early readmission may serve as an indicator of quality of care provided during hospitalization[13,14]. While several process indicators have been proposed as care indicators, for example receiving ACEIs and beta-blockers prior to discharge, outcome indicators such as mortality rate and patient quality-of-life are seldom specified as care indicators. These outcome indicators may seem less appealing for measurement since they are not routinely available without a specific system for data collection in place. If implemented, the system will incur higher cost for service evaluation. In contrast, early readmission rate is easily obtained and computed from an EMD with minimally increasing cost. Nevertheless, the disadvantages of using readmission as an outcome indicator should be mentioned. Its validity as a care indicator has been under scrutiny by several researchers with conflicting results[2,7-9]. Additionally, patients may be readmitted for other reasons not related to quality of inpatient care, for example lack of social support or inadequate care from primary care providers[15].

The authors prefer early (within 30 days) over other time periods *e.g.* 3, 6, or 12 months to measure readmission rate because early rather than late readmission is believed to reflect quality of hospital care. When period of follow-up becomes extended, other influences such as physicians' follow-up, change of therapeutic plans and even disease progression may affect rehospitalization[2,6,15]. Since the authors' intention is to initially improve quality of hospital care for CHF, early readmission appears a suitable outcome targeted. Reducing rate of early readmission may help to cut down cost of CHF care[16].

The median LOS for CHF patients in the present study was five days consistent with a finding in a recently published study from the United States[17]. Only the LOS >5 days was an independent predictor of early readmission (adjusted OR = 1.41, 95% CI = 1.05-1.89, p = 0.023) in the present study. LOS had been reported to be one of the predictors for readmission in a number of studies; however, none of them reports early readmission as their outcomes of interest.

Krumholz and colleagues reported LOS > 7 days as a predictor of readmission within 6 months[18]. In another study, Tsuchihashi reported that LOS > 14 days increased 1-year readmission rate (OR = 3.2, 95% CI = 1.2-8.5, p < 0.01)[19]. The current study extends previous findings to incorporate LOS as also a predictor of early readmission. A longer length of stay may indicate more severe CHF or patients with more complications, leading to increased risk of early readmission. Therefore, this observation suggests providing a closer attention prior to discharge among CHF patients with longer LOS.

CHF patients should receive ACEIs or BBs at discharge according to the current CHF guideline[20]. However, no significant association between early readmission and discharge cardiovascular medications, including ACEIs and BBs, was found in our study. Previous studies demonstrated benefits of ACEIs and BBs on mortality and rehospitalization among CHF patients when these agents were given prior to discharge[7,21]. Various reasons may contribute to the disparity observed in this and other studies. First, the shorter term of follow-up may not allow us to see benefits of medications that require longer time to take effects. In support of this notion, ACEIs received at discharge was not found to confer any benefit in lowering risk for readmission in shorter term study (i.e. 30 days of follow-up)[2]. Second, the much smaller number of patients receiving the therapeutic agents and the lower rate of events provide less statistical power to detect little difference in our study. Last, a lower risk for readmission among patients in this study may not allow us to detect smaller benefits conferred by these therapeutic agents.

Only 46.52% and 12.95% of the present cohort received ACEIs and BBs prior to discharge, respectively. A recent study conducted in the United States reported that 83% and 84% of CHF patients had received ACEIs/ARBs and BBs at discharge, respectively[9]. Thus, much smaller proportion of CHF patients received these two agents in our study. The low rate of ACEIs and BBs use was also observed in a much earlier study in Japan, reporting 54% and 18% use of ACIs and BBs, respectively. Receiving ACEIs and BBs at discharge have become a performance measure for patients hospitalized with CHF suggested by the American College of Cardiology/American Heart Association. Fonarow and colleagues have provided evidence that among five recommended performance measures, only the use of ACEIs/ARBs and BBs at discharge were significantly associated with improvements in patient outcomes, including

mortality and rehospitalization at 60 to 90 days follow-up[9]. The reasons for low rate of ACEIs and BBs use were not the main objective for investigation in this study. Therefore, whether the omission of both agents was appropriate cannot be determined. Several conditions may deter clinicians from prescribing ACEIs and BBs for CHF patients during hospitalization, for example, severe kidney disease, acute pulmonary congestion, and respiratory diseases. Nevertheless, the suboptimal use of both agents should be further examined and may become targets for performance improvement in the future.

The present study has some limitations. First, some variables of interest were not available from this source such as clinical severity and determination of left ventricular function. Both prognostic factors may influence the frequency of early readmission in CHF. Second, the authors could not separate between unplanned and planned readmission. Third, the authors were able to account only for patients who were readmitted to the study hospital; therefore, the present study may underestimate the rate of early readmission. Last, an extrapolation to different types of hospitals, e.g. non-tertiary care hospitals, may be limited due to the differences in patient population and services provided by hospitals.

Conclusion

Early readmission rates appear modest among Thai patients hospitalized with CHF. While discharge cardiovascular medications were not associated with early readmission, the LOS > 5 days was a positive predictor. Thus, development of therapeutic programs may pay closer attention to patients with longer LOS in particular.

Potential conflicts of interest

None.

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อัตราและปัจจัยทำนายการเข้ารับการรักษาตัวซ้ำหลังออกจากโรงพยาบาลไม่นานในผู้ป่วยไทยโรคหัวใจล้มเหลว

กิตติภัค เจ็งฮั้ว, อรัมษ์ เจษฎาญานเมธา

ภูมิหลัง: *เป็นที่ตระหนักว่า การเข้ารับการรักษาในโรงพยาบาลซ้ำเป็นปัญหาในผู้ป่วยโรคหัวใจล้มเหลวเรื้อรัง ยังไม่มีการศึกษาที่รายงานอัตราและปัจจัยทำนายการกลับเข้ารักษาตัวซ้ำหลังออกจากโรงพยาบาลไม่นาน (นิยามว่าไม่เกิน 30 วัน หลังออกจากโรงพยาบาล) ในผู้ป่วยไทยโรคหัวใจล้มเหลวเรื้อรัง*

วัตถุประสงค์: *เพื่อให้ทราบถึงอัตราและปัจจัยทำนายการกลับเข้ารักษาในโรงพยาบาลซ้ำหลังออกจากโรงพยาบาลไม่นานในผู้ป่วยไทยโรคหัวใจล้มเหลวเรื้อรัง*

วัสดุและวิธีการ: *จากฐานข้อมูลอิเล็กทรอนิกส์ ผู้นิพนธ์ได้นำข้อมูลผู้ป่วยที่เข้ารับการรักษาตัวในโรงพยาบาล ซึ่งได้รับการวินิจฉัยด้วยโรคหลักเป็นโรคหัวใจล้มเหลว ตั้งแต่วันที่ 1 มกราคม พ.ศ. 2548 ถึง 31 ธันวาคม พ.ศ. 2549 มาทำการติดตามการเข้ารับการรักษาตัวซ้ำภายในช่วงเวลา 30 วัน หลังจากถูกจำหน่ายออกจากโรงพยาบาล*

ผลการศึกษา: *ข้อมูลผู้ป่วยทั้งหมด 718 คน ถูกนำมาวิเคราะห์ โดยผู้ป่วยส่วนใหญ่เป็นเพศหญิง (ร้อยละ 57.52) อายุเฉลี่ย 64.91 ± 14.14 ปี ค่ามัธยฐานของระยะเวลาการรักษาตัวในโรงพยาบาล คือ 5 วัน พบว่าผู้ป่วยทั้งหมด 101 คน (ร้อยละ 14.07) เข้ารับการรักษาตัวซ้ำภายในเวลา 30 วัน หลังถูกจำหน่ายออกจากโรงพยาบาลโดยมี ภาวะกำเริบของโรคหัวใจล้มเหลวเป็นสาเหตุที่พบได้มากที่สุด ในการวิเคราะห์โดยใช้ตัวแปรหลายตัวพบว่า ระยะเวลา การนอนในโรงพยาบาลนานกว่า 5 วัน เป็นปัจจัยที่ทำนายความเสี่ยงต่อการเข้ารับการรักษาตัวซ้ำหลังออกจาก โรงพยาบาลไม่นานได้อย่างมีนัยสำคัญทางสถิติ (adjusted OR = 1.41, 95% CI = 1.05-1.89, p = 0.023) แต่ ไม่พบความสัมพันธ์อย่างมีนัยสำคัญทางสถิติระหว่างยาที่ผู้ป่วยได้รับก่อนถูกจำหน่ายออกจากโรงพยาบาลกับ การเข้ารับการรักษาตัวซ้ำหลังออกจากโรงพยาบาลไม่นานในการศึกษานี้*

สรุป: *ในผู้ป่วยไทยโรคหัวใจล้มเหลวเรื้อรัง อัตราการเข้ารักษาตัวซ้ำหลังออกจากโรงพยาบาลไม่นานอยู่ในระดับ ไม่สูงนัก ระยะเวลาการนอนในโรงพยาบาลนานกว่า 5 วัน เป็นปัจจัยที่ทำนายความเสี่ยงต่อการเข้ารับการรักษาตัวซ้ำ แต่ไม่พบความสัมพันธ์ระหว่างยาที่ผู้ป่วยได้รับก่อนถูกจำหน่ายออกจากโรงพยาบาลกับการเข้ารับการรักษาตัวซ้ำ*