



# Thai Acute Decompensated Heart Failure Registry (Thai ADHERE)

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Available online 24 August 2010

## KEYWORDS

Thai ADHERE registry;  
Heart failure;  
Thai heart failure registry;  
Neurohormonal blockers

## Summary

**Background:** Heart Failure (HF) is the one of the malignant cardiac syndromes which has a high morbidity and mortality rate. In Thailand, HF is one of the major cardiovascular health problems and economic burdens disease. Thai ADHERE is the first HF registry in Thailand.

**Objective:** To assess patient with HF in Thailand in terms of patients' characteristics, clinical presentation, causes of heart failure, and precipitating causes of heart failure, hospital course, management, and in-hospital outcomes.

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**Material and methods:** Thai Acute Decompensated Heart Failure Registry or Thai ADHERE registry is a Phase IV, multicenter, observational, and open-label registry in 18 cardiac centers in Thailand using the US ADHERE protocol. Medical records of hospitalized patients with the principal discharge diagnosis of HF from March 2006 to November 2007 were validated and registered via an electronic web based system.

**Results:** There were 2041 HF admissions in 1612 patients with a median age of 67 years (mean  $64 \pm 14$  years). Age  $>75$  years was found in 24%, 49.6% were male patients, and 67% of these admissions had prior heart failure. Underlying diseases were hypertension [(HT) = 65%], coronary artery disease [(CAD) = 47%], dyslipidemia (50%), diabetes mellitus (47%), atrial fibrillation (24%) and chronic kidney disease (19%). Clinical features at presentation were dyspnea (97%), edema (60%), pulmonary rales (85%) and pulmonary congestion by chest X-ray (93%). Sixty-nine percent (69%) were in NYHA functional class IV and 44% had a left ventricular ejection fraction (LVEF) less than 40%. Common causes of heart failure were CAD (45%), valvular heart diseases (19%), cardiomyopathy (14%) and HT (12%). Precipitating causes of heart failure were heart disease itself 54% and 20% were related to inadequate diuretics and poor patient compliance with medications. Neurohormonal blockers (NHB) [angiotensin converting enzyme inhibitors (ACEI), angiotensinogen receptor blocker (ARB), aldosterone blocker (AA) and beta blockers (BB)], were given prior to hospitalization in comparison to at discharge in 26% vs. 35%, 12% vs. 12%, 13% vs. 17% and 26% vs. 24% respectively. In-hospital mortality rate was 5.5% and the median length of hospitalization was 7.5 days. Major causes of death were sepsis, worsening of heart failure, arrhythmic arrest and acute coronary syndrome. There was a higher mortality rate in those with poor LV systolic function compared to those with preserved LV systolic function (8.2% vs. 4.1%;  $p = .008$ ). At discharge, 23% of the patients were asymptomatic while 69% had symptomatic improvement.

**Conclusion:** Thai ADHERE registry revealed that Thai patients hospitalized for heart failure are younger and sicker than European and American patients. There is a high prevalence of HF with preserved ejection fraction. CAD was the most common cause of HF while HT was the most common underlying disease. There was a 5.4% mortality rate, which was higher in those with poor LV systolic function. There was underutilization of NHB (ACEI, ARB, BB and AA).

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## Introduction

Heart failure is the one of the malignant cardiac syndromes which has a high morbidity and mortality rate all over the world. In Thailand, heart failure is one of the major cardiovascular health problems and economic burdens. In Europe, the prevalence of symptomatic heart failure (HF) is estimated to range from 0.4% to 2.0% [1] in the general population and the mean age of the HF population is 70 years [1,2]. In the US, data from Heart Disease and Stroke Statistics\_2009 Update [3] indicate that: HF incidence approaches 10 per 1000 population after 65 years of age. Seventy-five percent of HF cases have antecedent hypertension follow closely by antecedent myocardial infarction. The range in incidence is 3.4–6.0 in whites and 8.1–9.1 in blacks per 1000 person-years. In 2005, 1 in 8 death certificates (292,214 deaths) in the United States mentioned heart failure.

In Thailand there has been no epidemiologic HF data. This is the first epidemiologic study of heart failure in Thailand using the same protocol as the US ADHERE Registry [4,8].

The aim of this study is to assess the database of hospitalized patients with the diagnosis of heart failure (HF) or acute decompensated heart failure (ADHF) in Thailand in terms of patient characteristics, clinical presentations, and causes of heart failure, precipitating causes of heart failure, hospital course, management and hospital outcomes.

This registry includes 18 participating cardiac centers (10 university hospitals, 3 government hospitals and five private hospitals).

The Thai ADHERE investigators hope that this data will give information about heart failure management. The data should help us to improve our heart failure management, applying appropriate practice guidelines for HF and lowering the mortality and morbidity from HF in Thailand.

## Materials and methods

Thai Acute Decompensated Heart Failure Registry or Thai ADHERE registry is a phase IV multi-center prospective observational and open-label registry study. Methods are the same as US ADHERE [4,8]. In brief, it enrolled consecutively hospitalized patients age more than 18 years with a post discharge diagnosis of HF in 18 cardiovascular centers from March 2006 to November 2007. Patients with cardiogenic shock, perioperative heart failure and the patients who present HF as a co-morbid condition but not a principal focus of diagnosis or treatment were excluded. Data were collected from each medical summary beginning with the point of initial care and/or emergency department and ending when the patient was discharged or transferred out of the hospital or in-hospital death. Heart failure (HF) or decompensated HF was determined clinically by the cardiologists. ADHF is clinically defined as new-onset HF with decompensation or chronic HF with decompensation. Entry was based upon the presence of ADHF and not tied to the use of any specific therapeutic agent or regimen. Each institution was instructed to identify and capture all consecutive eligible subjects.

## Data collection

Data, captured via the case record form (CRF), include demographic characteristics, medical history, initial evaluation, clinical presentations, hospital course, medications given prior to admission and at discharge, procedures, disposition status, discharge instruction, causes and precipitating causes of heart failure and mortality. The data were collected via a web-based electronic data capture (EDC) system provided by Scios company. Participating centers entered data via customized electronic case report forms and all data were checked for validity. To preserve patient's anonymity, there was no collection of unique patient identifying information. The Longitudinal Unique Identifier (LUID) was generated individually and assigned to each patient. LUID which cannot be related back to an individual, is stored in the database along with all patient data and allows longitudinal tracking of hospital readmissions and patient outcomes.

The protocol was approved by the institutional review board (IRB) or ethics committee (EC) before starting the registry for all participating centers. Each patient's informed consent was also required.

## Statistical analysis

Data are presented as absolute numbers, percentage, median with inter quartile rank (IQR). The SPSS program version 13.00 was used to summarize and analyze all data.

## Results

From March 2006 to November 2007, there were 1612 patients with 2041 HF admissions in 18 cardiovascular centers.

Baseline clinical characteristics are shown in Table 1. The median age of the patients is 67 (IQR 57-75) years with a mean age of  $64 \pm 14$  years. Patients more than 75 years of age accounted for 23%. There was nearly an equal number of male and female patients (M:F = 49.6%:50.4%), and 66.5% had prior heart failure. Left ventricular function was assessed prior to admission in 60.4% and 43.6% of them had severe left ventricular systolic dysfunction which was defined as a left ventricular ejection fraction (LVEF) less than 40%. Underlying diseases were hypertension (64.8%), coronary heart disease (46.6%), previous myocardial infarction (26.7%), dyslipidemia (50.5%), diabetes mellitus (47.3%), atrial fibrillation (24%), chronic kidney disease (19.4%) and previous stroke or transient ischemic attack (12%). Former smokers were recorded in 36% but COPD or asthma was recorded in 7.9%.

Clinical presentations and initial investigations on admission are shown in Table 2. These included dyspnea (96.7%), fatigue (36%), peripheral edema (59.5%), pulmonary rales (84.5%) and pulmonary congestion by chest X-ray (93%), 69% were in NYHA functional class IV and 43.6% had LV systolic dysfunction. Hypotension or systolic blood pressure less than 90 mm Hg was found in 3.6%, normal blood pressure and systolic hypertension were found in 59.5% and 36.9%, respectively. Approximately one fifth had atrial

**Table 1** Demographic characteristics and medical history of Thai ADHERE patients.

Characteristics	n = 2041	n (%)
Median age (yrs) IQR	67	(57–75)
Mean	$64 \pm 14$	
Patients > 75 years	484	(23.7)
Gender		
Male	1012	(49.6)
Female	1029	(50.4)
Race/ethnicity	Asian	(98.9)
HF history	Prior heart failure	(66.5)
	Pre-hospital LVEF assessed	(61.1)
	LVEF < 40% or mod/severe impairment	(39.6)
	Prior cardiac transplant or listed for transplant	(0.5)
Medical history	Coronary artery disease	(46.6)
	Myocardial infarction	(26.7)
	Hypertension	(64.8)
	Hyperlipidemia/dyslipidemia	(50.5)
	Stroke or TIA	(12.1)
	Atrial fibrillation	(24.1)
	Initial serum creatinine assessed	(98.1)
	Pacemaker or ICD	(3.0)
	Peripheral vascular disease	(3.3)
	Chronic renal insufficiency	(19.4)
	Chronic dialysis	(9.6)
	Diabetes	(47.3)
	COPD or asthma	(7.9)
	Never smoked	(57.2)
	Former smoker	(36.0)
	Current smoker	(6.8)

ICD = implantable cardioverter defibrillator, LVAD = left ventricular assist device, COPD = chronic obstructive pulmonary disease.

**Table 2** Clinical presentation and initial investigations in Thai ADHERE heart failure patients.

Presentation and investigation	n = 2041	n (%)
Dyspnea	1973	(96.7)
Dyspnea at rest	1283/1973	(65.0)
NYHA class assessed	1857	(90.7)
NYHA class II	272/1857	(14.7)
NYHA class III	298/1857	(16.2)
NYHA class IV	1283/1857	(69.1)
Fatigue	735	(36.0)
Rales	1726	(84.6)
Peripheral edema	1215	(59.5)
SBP > 140 mm Hg	753/2040	(36.9)
Initial ECG assessed	1955	(95.8)
Atrial fibrillation	451/1955	(23.1)
Other abnormal rhythm	212/1955	(10.8)
Initial CXR assessed	1928	(94.5)
Pulmonary congestion	1790/1928	(92.80)
Initial serum sodium assessed	2001	(98.0)
Sodium < 130 mmol/L	198/2001	(9.9)
Mean serum sodium (mmol/L)		136.8
Initial serum creatinine assessed	2002	(98.1)
Creatinine > 2.0 mg/dL	474/2002	(23.7)
Initial BNP assessed	5	(0.2)
Mean BNP (pcg/mL)		1951.1
LVEF assessed	1233	(60.4)
LVEF < 40% or Mod/Severe impairment	538/1233	(43.6)

NYHA = New York Heart Association, ECG = electrocardiogram, CXR = chest radiograph, BNP = B-type natriuretic peptide, LVEF = left ventricular ejection fraction, COPD = chronic obstructive pulmonary disease.

fibrillation and a similar proportion had chronic kidney disease. Hyponatremia was found in 10% of patients. However, only 0.2% was initially assessed using either brain natriuretic peptides (BNP) or N terminal pro-brain natriuretic peptides (NTpro BNP).

The majority of initial inpatient treatment (Table 3) was in the emergency department [(ED) = 76.9%] rather than in the outpatient department [(OPD) = 16.2%]. Patients were admitted to the ward 70.9% and ICU/CCU 24.6%, respectively. However about one third required either ICU or CCU beds during their admission.

Invasive medical procedures during hospitalization are shown in Table 4. Approximately 20% of patients needed mechanical ventilation (20.4%) and cardiac catheterization (19.2%). Cardiopulmonary resuscitation and dialysis were done in 4.1% and 5.2%, respectively.

Non-IV use is shown in Table 5. The majority of these medications were loop diuretics, aspirin, lipid lowering agents, nitrate and neurohormonal blockers (NHB) including angiotensin converting enzyme inhibitors (ACEI), angiotensinogen receptor blockers (ARB), beta blockers (BB) and aldosterone antagonist (AA). The NHB; ACEI, ARB, AA and BB were given prior to hospitalization vs. at discharge in 25.7% vs. 35.3%, 11.8% vs. 12.4%, 12.5% vs. 17.1% and 26.1% vs. 25.2%, respectively. Antiplatelets and lipid Lowering drugs were given prior to hospitalization vs. at discharge

**Table 3** Hospital course of Thai ADHERE patients.

Hospital course	n = 2041	n (%)
<i>Initial geographic point of care</i>		
ED	1569	(76.9)
OPD	331	(16.2)
Observation (observation unit, ward, others)	71	(3.5)
ICU/CCU on observational status	70	(3.4)
<i>First inpatient unit</i>		
Ward	1447	(70.9)
ICU/CCU	502	(24.6)
Step-down	84	(4.1)
Other	8	(0.4)
Used ICU/CCU bed during admission	672	(32.9)

**Table 4** Procedures during hospitalization of Thai ADHERE patients.

Procedures	n = 2041	n (%)
Dialysis	106	(5.2)
Mechanical ventilation	417	(20.4)
Cardiac catheterization	393	(19.2)
Defibrillation	50	(2.4)
Cardiopulmonary resuscitation	84	(4.1)
Defibrillation or CPR	94	(4.6)

in 63% vs. 78% and 44% vs. 53%, respectively. Digoxin and warfarin were given before admission vs. at discharge in 21.5% vs. 26.2% and 13.4% vs. 18.5%. Approximately 16%, 14% and 7.7% of the patients were intolerant of or had a contraindication to treatment with ACEI, ARB and BB, respectively.

Of IV-cardiovascular medications given during admission (Table 6), most were furosemides (96%) and dobutamine (23%). About one fifth received dopamine and nitroglycerin.

Discharge status, death and clinical symptoms at discharge are shown in Table 7. At discharge, 22.5% of the patients were asymptomatic while 69.2% had symptomatic improvement. The in-hospital mortality rate was 5.5%, with half having died from cardiac causes such as worsening of heart failure (22%), MI and acute coronary syndrome (13.3%), arrhythmias (9%) and left ventricular failure(4.4%).One third died from non-cardiac causes such as sepsis (26%), renal failure (4.4%) and pneumonia (3.5%). There was a statistically significant higher mortality rate in those with poor LV systolic function compared to those with preserved LV systolic function (8.2% vs. 4.1%;  $p = .008$ ). The median length of hospitalization was 7.5 days.

Table 8 shows causes of heart failure and precipitating causes of heart failure. Causes of heart failure in Thai registry were CAD (44.7%), valvular heart diseases (18.7%), cardiomyopathies (13.9%) and hypertensive heart disease (12.2%). Precipitating factors were new cardiac events (31.9%), concurrent illness (21.7%), noncompliance with diet recommendation (10.7%) or medications (4.3%) and inadequate diuretics (7.4%).

**Table 5** Non-IV medications in Thai ADHERE patients.

Non-IV Medications	Chronic		During		Prescribed at discharge	
	n = 2041	n (%)	n = 1879	n (%)	n = 2041	n (%)
Loop diuretic	1167	(57.2)	1593	(84.8)	1486	(72.8)
Aldosterone receptor antagonist	256	(12.5)	393	(20.9)	349	(17.1)
ACE inhibitor	525	(25.7)	818	(43.5)	719	(35.3)
ARB	240	(11.8)	245	(13)	253	(12.4)
Nitrate	765	(37.5)	966	(51.4)	927	(45.4)
β-blocker	533	(26.1)	527	(28.0)	494	(25.2)
Digoxin	439	(21.5)	574	(30.5)	534	(26.2)
Warfarin	273	(13.4)	369	(19.6)	378	(18.5)
Clopidogrel	305	(14.9)	557	(29.6)	475	(23.3)
Aspirin	977	(47.9)	1227	(65.3)	1109	(54.3)
Lipid-lowering	892	(43.7)	1103	(58.7)	1081	(53)
Subcutaneous erythropoietin	52	(2.5)	56	(3.0)	61	(3)
None of the above	331	(16.2)	29	(1.5)	183	(9)

**Table 6** IV-cardiovascular medications in Thai ADHERE patients.

IV-cardiovascular medications	n = 2041	n (%)
Diuretic given	1961	(96.1)
Diuretic received beyond the first 24 h	1364/1961	(69.6)
Dobutamine given	465	(22.8)
Dopamine given	307	(15.0)
Milrinone given	7	(0.3)
Levosimendan given	2	(0.1)
Nitroglycerin given	438	(21.5)
Nitroprusside given	11	(0.5)
Other IV medications		
Morphine	277	(13.6)
Erythropoietin	24	(1.2)

## Discussion

Of the several surveys or registries of heart failure, the three large registries are the ADHERE [4,8] registry from USA, the Euro Heart Failure Survey (EHFS I) [5,6] and the Euro Heart Failure Survey II (EHFS II) [2]. In Thailand, the Thai ADHERE registry or Thai Heart Failure registry (THFR) is the first registry to provide data on hospitalized Thai patients with acute decompensated heart failure in terms of patient characteristics, clinical presentations, causes of heart failure, and precipitating causes of heart failure, hospital course, management and in-hospital outcomes.

Baseline clinical characteristics were compared to the three large registries [US ADHERE, the Euro Heart Failure Survey I (EHFS I) and the Euro Heart Failure Survey II (EHFS II)]. The mean age of Thai patients was 64 years while in US ADHERE it was 72.5 years, in EHFS I 71 years and in EHFS II 69.7 years. Thai patients older than 75 years were found in 23.7% (US ADHERE 30%, EHFS I 30%, EHFS II 21%). These data suggest that Thai patients are younger than US and European patients. Men accounted for about half of the patients which is comparable with US ADHERE and EHFS I (49.6% vs.

48% vs. 53%) but not EHFS II registry where there were more male patients (males = 61%). A prior history of heart failure was found less often in the Thai ADHERE registry (66.5%) than in US ADHERE [7] (75–77%). In EHFS II, prior heart failure in the last 12 months was seen in 44.5%.

Left ventricular function was assessed by echocardiography in 60.4% in the Thai registry and the percentage of LV systolic dysfunction (LVEF less than 40%) was 43.6%. This was comparable to the US ADHERE and EHFS I (46% and 45%) but EHFS II used LVEF < 45% as a cut point and LVSD was 65.7% (LVEF < 45%). All three series (THFR, US and EHFS I) suggested that more than half of the patients with heart failure have preserved LV systolic function (LVEF < 40% as the cut point).

The common underlying diseases were comparable among Thai ADHERE, US ADHERE and EHFS II including; hypertension (64.8%, 72%, and 62.5%), CHD (47%, 57% and 53.6%), diabetes (47.3%, 44% and 32.8%), Atrial Fibrillation (24.1%, 31% and 38.7%), chronic kidney disease (19.4%, 30% and 16.8%) and previous stroke or transient ischemic attack (12.1%, 17% and 13.3%) respectively. COPD or asthma was strikingly found much less in the Thai registry compared with the other two registries (7.9% vs. 31% vs. 19.3%). The percentage of underlying diseases and LVEF varies from region to region as a result of population demographics and the prevalence and treatment of risk factors [10]. The striking thing was that hypertension, coronary artery diseases and diabetes were the three most common underlying diseases in all regions. Thai patients had less underlying COPD or asthma as compared to western regions.

Causes of heart failure in the Thai registry were CAD (45%), valvular heart diseases (19%), cardiomyopathies (14%) and hypertensive heart disease (12%). Precipitating factors were new cardiac events, concurrent illness, non-compliance with dietary recommendations or medications and inadequate diuretics. All the above information suggest that coronary artery disease is the main cause of heart failure in Thailand. Heart failure from valvular heart disease, cardiomyopathy and hypertensive heart disease, precipitated by a lack of good control might result from poor compliance or inadequate education.

**Table 7** Discharge status, causes of death and clinical symptoms.

Discharge status	Number	Percent
Home	1800	88.2%
Transfer	117	5.7%
Death	113	5.5%
Others	11	0.5%
<i>Primary cause of death (n = 113)</i>		
Sepsis	29	(25.7)
Worsening heart failure	25	(22.1)
Pulmonary hypertension	1	(0.9)
Arrhythmic arrest	10	(8.8)
Acute coronary syndrome	9	(8.0)
Myocardial infarction	6	(5.3)
Sudden cardiac death, not MI	6	(5.3)
Other non-cardiac	6	(5.3)
Left ventricular failure	5	(4.4)
Renal failure	5	(4.4)
Sudden death, cause unknown	4	(3.5)
Pneumonia	4	(3.5)
Pulmonary embolism	1	(0.9)
Other cardiac causes	1	(0.9)
Unknown	1	(0.9)
<i>Clinical symptoms status</i>		
Improved but still symptomatic	1412	69.2%
Asymptomatic	460	22.5%
Worse	53	2.6%
No change	30	1.5%
Other (NA)	79	3.9%

**Table 8** Underlying and precipitating causes of heart failure in Thai ADHERE patients.

Causes	n = 2041	n (%)
<i>Cause of HF</i>		
Coronary heart disease	913	(44.7)
Valvular heart disease	382	(18.7)
Cardiomyopathy	283	(13.9)
Hypertensive heart disease	249	(12.2)
Myocarditis	5	(0.2)
Cor pulmonale	8	(0.4)
Pericardial disease	12	(0.6)
Other	123	(6.0)
No mention	66	(3.2)
<i>Precipitating cause of heart failure</i>		
New cardiac event	651	(31.9)
Concurrent illness	443	(21.7)
Non-compliance with dietary recommendation	218	(10.7)
Inadequate diuretics	152	(7.4)
Increased cardiac demand	102	(5.0)
Non-compliance with medication	87	(4.3)
Using new medications	35	(1.7)
No mention	353	(17.3)

Dyspnea was the most common symptom which was comparable with US ADHERE [1] (89%). Pulmonary rales and pulmonary congestion by chest X-ray were found more than US ADHERE [1] (rales; 84.6% vs. 67% and lung congestion; 93% vs. 74%). The prevalence of LV systolic dysfunction (LVSD) and systolic hypertension (SHT) are comparable to the ADHERE [1] (LVSD; THFR, 43.6% vs. ADHERE 47%), (SHT; THFR 64.8% vs. ADHERE 50%). Echocardiography was done in 60.4% which was comparable with US ADHERE [1] (57%) and EHFS II [4] (57%).

For the hospital course, the emergency department and ward were of the initial place of treatment in the majority of cases which was similar to US ADHERE [1] (76.9% vs. 70%). However more admissions to the intensive care unit or coronary care unit were found in this study compared with ADHERE [1] (24.6% vs. 13%). This is due to more sick patients in THFR.

Procedures during hospitalization showed the same percentage for use of mechanical ventilation in this registry compared with ADHERE US [1] (20% vs. 22%).

Regarding the use of non-IV medications, particularly NHB, ACEI, ACEI or ARB and BB were given either prior to hospitalization or after discharge at a lower percentage than in US ADHERE [1], EHFS II [4] (ACEI before admission; 25.7% vs. 44% vs. 55%, ACEI or ARB before admission; 28.1% vs. 56% vs. 63.1%; BB before admission; 26.1% vs. 56% vs. 43.2%; ACEI at discharge; 35.2% vs. 54% vs. 71%; ACEI or ARB at discharge, 47.7% vs. 68% vs. 80.2% and BB at discharge; 24% vs. 64% vs. 61.4%). These data suggest that there was underutilization of NHB (ACEI, ARB, AA and BB) which is a class IA recommendation in all guidelines [11–13]. Various reasons for underutilization of NHB have been well described in EHFS I. Thai ADHERE data highlight the essential need for guidelines or education of medical personnel prescribe more NHB.

IV-cardiovascular medications during admission including furosemides, dopamine and dobutamine were given more in this registry comparing with the ADHERE [1] and EHFS II [4] (furosemide; 99.9% vs. 84% vs. 83.4%; dopamine; 15% vs. 6% vs. 11.3% and dobutamine; 22.8% vs. 6% vs. 10.2%) confirming that Thai patients hospitalized with heart failure were sicker than US and EU patients.

Among outcomes of ADHF in the Thai registry, the mortality rate was 5.5% which was higher than in the previous reports from US ADHERE [1] (3.8%) but was comparable with the report from EHFS II [4] (6.75%). The median length of stay (LOS), in THFR was shorter than in EHFS II [4] but longer than in US ADHERE [1] (THFR; 7.5 days, EHFS II 9 days and ADHERE 4.3 days).

From the US ADHERE [1,7,9] data, the predictors of mortality were high admission levels of blood urea nitrogen ( $\geq 43$  mg/dl) followed by low admission systolic blood pressure ( $< 115$  mm Hg) and then by high levels of serum creatinine ( $\geq 2.75$  mg/dl). In the Thai registry, multiple logistic regression analysis revealed Systolic blood pressure  $< 90$  mm Hg as the major predictor (odd ratio 3.45; 95%CI;  $p < 0.0001$ ) follow by chronic kidney disease (serum creatinine  $\geq 2$  mg/dL) (odd ratio 1.99; 95%CI;  $p = 0.002$ ), History of stroke or TIA (odd ratio 1.85; 95%CI;  $p = 0.02$ ), and NYHA class IV (odd ratio 1.69; 95%CI;  $p = 0.02$ ) [13].

## Limitations of the study

First is the limited number of participating hospitals or cardiac centers. Most of the recruitment of patients was in Bangkok Metropolitan rather than from all parts of Thailand. Second, the registry was done only in cardiac centers and many of them were government or university hospital with limited beds available only for very sick patients. Third, Thai ADHERE data came from medical records of hospitalized patients so it represented an epidemiologic study of hospital based heart failure thus it does not represent national data on heart failure.

## Conclusions

The Thai ADHERE registry revealed that Thai patients hospitalized for heart failure are younger and sicker than European and American patients. Male and female patients were equal in number. There is high prevalence of HF with preserved ejection fraction. CAD was the most common underlying and precipitating cause of HF while HT was the most common underlying disease. There was a 5.4% mortality rate, is higher in those with poor systolic blood pressure. There was underutilization of NHB (ACEI, ARB, BB and AA). Data from the Thai heart failure registry provides information on clinical practice in Thailand. Guidelines on heart failure treatment should help improve HF management and its outcomes in Thailand.

## Acknowledgements

Thai Acute Decompensated Heart Failure Registry (Thai ADHERE or THFS) was endorsed by the Heart Association of Thailand under the Royal Patronage of H.M. the King and the Heart Failure Council of Thailand (HFCT). The budget was supported by Clinical Research Collaboration Network, Janssen Cilag Thailand Ltd. and the Heart Association of Thailand under the Royal Patronage of H.M. the King. The case record form (CRF) was done via electronic mail conducted by personnel from the Scios Company.

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