

Trends in the Incidence and Management of Acute Myocardial Infarction From 1999 to 2008: Get With the Guidelines Performance Measures in Taiwan

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Background—The American Heart Association Get With the Guidelines (GWTG) program has improved care quality of acute myocardial infarction (AMI) with important implications for other countries in the world. This study evaluated the incidence and care of AMI in Taiwan and assessed the compliance of GWTG in Taiwan.

Methods and Results—We used the Taiwan National Health Insurance Research Database (1999–2008) to identify hospitalized patients ≥ 18 years of age presenting with AMI. The temporal trends of annual incidence and care quality of AMI were evaluated. The age-adjusted incidence of AMI (/100 000 person-years) increased from 28.0 in 1999 to 44.4 in 2008 ($P < 0.001$). The use of guideline-based medications for AMI was evaluated. The use of dual antiplatelet therapy (DAPT) increased from 65% in 2004 to 83.9% in 2008 ($P < 0.001$). Angiotensin-converting enzyme (ACE) inhibitor or angiotensin receptor blocker (ARB) was used in 72.6% in 2004 and 71.7% in 2008 ($P = \text{NS}$) and β -blocker was used in 60% in 2004 and 59.7% in 2008 ($P = \text{NS}$). Statin use increased from 32.1% to 50.1% from 2004 to 2008 ($P < 0.001$). The in-hospital mortality decreased from 15.9% in 1999 to 12.3% in 2008 ($P < 0.0001$). Multivariable analysis showed that DAPT, ACE inhibitor/ARB, β -blocker, and statin use during hospitalization were all associated with reduced in-hospital mortality in our AMI patients.

Conclusions—AMI incidence was increasing, but the guideline-based medications for AMI were underutilized in Taiwan. Quality improvement programs, such as GWTG, should be promoted to improve AMI care and outcomes in Taiwan. (*J Am Heart Assoc.* 2014;3:e001066 doi: 10.1161/JAHA.114.001066)

Key Words: epidemiology • incidence • myocardial infarction • population

Acute myocardial infarction (AMI) is a common cardiovascular disease that carries a high fatality rate. Important medical and interventional treatments with beneficial effects on reducing morbidity and mortality of AMI have been proved in randomized clinical trials and incorporated into clinical guidelines.^{1,2} Currently, AMI has been selected as a disease for performance monitoring in many Western countries. In the United States, the Get With the Guidelines (GWTG) program

has been initiated by the American Heart Association to improve guideline adherence for patients hospitalized with AMI.³ Participation in GWTG could increase the use of evidence-based treatments, enhance the adherence to practice guidelines, and improve the prognosis in patients.⁴ The success of the GWTG program has improved the quality of AMI care with important implications for other countries in the world. However, healthcare expenditures are different across

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An accompanying Table S1 is available at <http://jaha.ahajournals.org/content/3/4/e001066/suppl/DC1>

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countries around the world and could influence the compliance with GWTG standards in countries other than the United States. In Taiwan, healthcare expenditure constitutes about 6% of the gross domestic product and is about half of that in the United States.⁵ The mean cost of each AMI hospitalization in Taiwan is only about one third the mean cost of those in the United States.^{6,7} The overall incidence of AMI has declined over the past decade in the United States,⁸ but the temporal trend of AMI incidence in Taiwan is unknown. Since the implementation of National Health Insurance (NHI) in Taiwan in 1995, more than 98% of Taiwan's 23 million population has received healthcare coverage from this system.⁹ NHI data provide us an opportunity to evaluate the use of GWTG performance measures for AMI in Taiwan and assess whether they can become international standards in taking care of AMI patients across national and economic boundaries. In the present study, we used NHI data from 1999 through 2008 and sought to (1) analyze the secular trends in annual incidence of AMI in Taiwan, and (2) assess the use of evidence-based therapies after AMI as compared with Asian American AMI patients during a similar study period.¹⁰

Methods

Database

This study used claims data from the 1999 to 2008 National Health Insurance Research Database provided by the National Health Research Institute in Taiwan. The National Health Insurance Research Database includes data on every inpatient admission covered under the NHI program, which has enrolled nearly 99% of the Taiwanese population (23 million residents) and contracted with 97% of hospitals and clinics throughout the nation.⁹ The databases used in this study included all inpatient and outpatient medical claims between January 1, 1999 and December 31, 2008. From the databases, we can retrieve medical information including disease diagnosis, prescription drugs, procedures, and surgery incurred during a hospitalization or at an outpatient visit. For electronic processing in the NHI in Taiwan, all the healthcare service providers are requested to submit the diagnosis information using International Classification of Disease-Clinical Modification, ninth revision together with service claims.

Study Design

We selected all adult patients (≥ 18 years) who were admitted to hospitals for AMI from January 1, 1999 to December 31, 2008. AMI admission was defined as a hospitalization with a primary or secondary discharge diagnosis code of ICD9-CM 410.x. We retained only those patients who were admitted at

an acute-care hospital. To avoid the possibility of wrongly selecting into the study patients who had not actually experienced an AMI (eg, prior AMI patients who were admitted for a diagnostic or therapeutic intervention and still coded for AMI), we excluded patients who were coded as AMI and survived but were hospitalized for < 2 days. For each patient, the comorbidities were retrieved from both the inpatient and outpatient claim databases for 12 months before the index date. We obtained information on each patient's age at the index MI admission, gender, days of hospitalization, and the use of AMI-related interventional procedures, including percutaneous coronary interventions (PCI) and coronary artery bypass graft. We specifically looked at the 4 performance measures during hospitalization according to the current guideline¹: (1) use of dual antiplatelet therapy (DAPT); (2) use of angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs); (3) use of β -blockers; and (4) use of statins. The composite performance measure of "four-combined care" was defined as the proportion of patients who received all the above 4 performance measures. During the same hospitalization, we also evaluated whether patients received other invasive procedures including ventilator support, intra-aortic balloon pump, and extracorporeal membrane oxygenation. We respectively ascertained medication use in-hospital and in the 180 days prior to the index date as proxies for several comorbidities using the anatomic therapeutic chemical classification system: oral antidiabetic drugs, insulin; several cardiovascular drug classes (α -blockers, β -blockers, calcium channel blockers, ACE inhibitors, ARBs, other antihypertensives, diuretics, nitrates, digitalis, vitamin K antagonist, statins, fibrates); medications indicated for asthma or chronic obstructive pulmonary disease (inhaled corticosteroids, β -receptor agonists); drugs reducing gastroesophageal reflux or ulcer disease (H₂-blockers, proton pump inhibitors, sucralfate, antacids); pain medications (nonsteroidal anti-inflammatory drugs, selective cyclo-oxygenase-2 inhibitors, opioids, and others); oral corticosteroids; and several psychoactive drug classes (benzodiazepines or anxiolytics, antidepressants, antipsychotics).

Comorbid Diseases

For each patient, the comorbidities for AMI were retrieved from both the inpatient and outpatient claims databases for 1 year before and during the index AMI hospitalization. Several proven diseases predisposing patients to AMI and other comorbidities were based on International Classification of Disease-Clinical Modification, ninth revision codes (Table S1). Hormone therapy included hormone replacement therapy and oral contraceptive use indicating the use of estrogen and/or progesterone. Chronic lung disease included emphysema, chronic bronchitis,

bronchiectasis, other obstructive pulmonary disease, and chronic respiratory failure. Serious neurologic diseases encompassed stroke or other central and peripheral nervous disease with associated extremity paresis or paralysis.

Statistical Analysis

The scale of the disease incidence for 10 years was examined by separation into attack and incidence, and the scale of disease incidence according to gender and age was

also investigated. Age was classified into 4 groups (18 to 54, 55 to 64, 65 to 79, and ≥80) and the ages of patients in each year were also calculated. The attack rate was calculated by dividing the number of total episodes (total attacks) by the population number, and the same patients could produce several attacks. The incidence rates were determined by dividing the number of patients with first attacks throughout their entire lives by the population number every year. The estimates of Taiwan’s civilian resident population from the Taiwan Department of Statistics

Table 1. Clinical Characteristics and Treatment of AMI in Taiwan From 1999 to 2008

	Overall N=108 741	Male N=78 779	Female N=29 962	P Value
Age, y (SD)	66.3 (13.4)	64.2 (13.5)	71.9 (11.5)	<0.001
Risk factors, %				
Hypertension	64.4	59.4	77.8	<0.001
Diabetes mellitus	37.8	32.3	52.1	<0.001
Dyslipidemia	32.2	29.8	38.6	<0.001
Cardiovascular history, %				
Coronary artery disease	47.5	45.4	52.9	<0.001
Atrial fibrillation	3.2	2.7	4.8	<0.001
Peripheral artery disease	2.6	2.1	3.7	<0.001
Stroke	11.9	10.8	14.9	<0.001
Comorbidity, %				
Chronic lung disease	32.2	31.3	34.6	<0.001
Chronic renal disease	18.9	16.6	24.7	<0.001
Cancer	15.5	14.9	17.2	<0.001
Peptic ulcers	22.9	21.4	26.6	<0.001
In-hospital drug use				
Aspirin	94.7	95.2	93.5	<0.001
Clopidogrel	63.2	63.3	62.8	0.1
Ticlopidine	11.4	12.0	9.7	<0.001
GP IIb/IIIa inhibitor	14.4	15.9	10.6	<0.001
DAPT	64.4	65.6	61.0	<0.001
β-Blocker	60.0	60.5	58.5	<0.001
ACEI or ARB	73.1	73.2	72.6	0.056
Statin	33.3	33.9	31.9	<0.001
In-hospital procedure or surgery				
Ventilator support	8.0	6.8	11.1	<0.001
IABP	4.8	5.1	4.3	<0.001
ECMO	0.4	0.5	0.3	<0.001
PCI	49.0	52.7	39.4	<0.001
CABG	6.4	6.8	5.5	<0.001

Data are presented as N (%) or mean values±SD. P value compared with male and female groups using a Student t test or χ^2 test. ACEI indicates angiotensin-converting enzyme inhibitor; AMI, acute myocardial infarction; ARB, angiotensin receptor blocker; CABG, coronary artery bypass graft; DAPT, dual antiplatelet therapy; ECMO, extracorporeal membrane oxygenation; GP, Glycoprotein; IABP, intra-aortic balloon pumping; PCI, percutaneous coronary intervention.

for the years 1999 through 2008 were used to calculate the age- and gender-specific attack and incidence of AMI per 100 000 population. This study evaluated the attack and incidence according to years and examined the trend of the disease incidence. By considering characteristics of population structure each year, age standardization was performed. The standardized population for age standardization was calculated by adding the population numbers from 1999 to 2008 according to age groups each year. A Poisson regression model was used to examine the temporal trends in the annual incidence of AMI, with categorical year variables. Trends in continuous variables and categorical data by calendar period were analyzed using Spearman nonparametric correlation analysis. We used a logistic regression model to quantify the effects on in-hospital mortality of age, gender, comorbidity (respiratory disease, diabetes, cancer, cerebrovascular disease, peripheral arterial disease, hypertension, heart failure, atrial fibrillation, and renal failure), revascularization procedures (PCI or coronary artery bypass graft), and use of ventilator, intra-aortic balloon pump, and extracorporeal membrane oxygenation. Men and women are considered separately in the models because gender was a significant predictor of outcome and because of an interaction previously seen between age and gender in the outcome after an AMI. All variables were entered simultaneously into the models. All of the tests were 2-tailed, and a $P < 0.05$ was considered statistically significant. We used SAS statistical software (version 9.1; SAS Institute, Cary, NC) for data collection and all statistical analyses.

Results

Baseline Characteristics

The study included 108 741 patients (78 779 male, 72.4%) enrolled from January 1, 1999 to December 31, 2008. The clinical characteristics and in-hospital treatment of AMI between male and female patients are shown in Table 1. Compared with male patients, females were older and had a higher prevalence of hypertension, diabetes mellitus, and dyslipidemia. Female patients also had more comorbidities, including coronary artery disease, atrial fibrillation, stroke/transient ischemic attack, chronic lung disease, and chronic renal disease. However, for in-hospital treatment of AMI, female patients received significantly less AMI standard therapies, including aspirin, β -blocker, ACE inhibitor or ARB, statin, and PCI.

Attack Rate and Incidence of AMI

When the crude attack rate for AMI was investigated according to year, there was an increase by ≈ 2.1 times from 30.1 cases per 100 000 persons in 1999 to 62.4 cases per 100 000 persons in 2008. The crude incident rate for AMI increased by 2.0 times from 27.5 cases per 100 000 persons in 1999 to 55.7 cases per 100 000 persons in 2008. In comparing the attack rate and incidence for each year according to gender and age, males showed higher rates than females and both of the rates became higher with older ages. The overall age-adjusted attack rate of AMI (/100 000

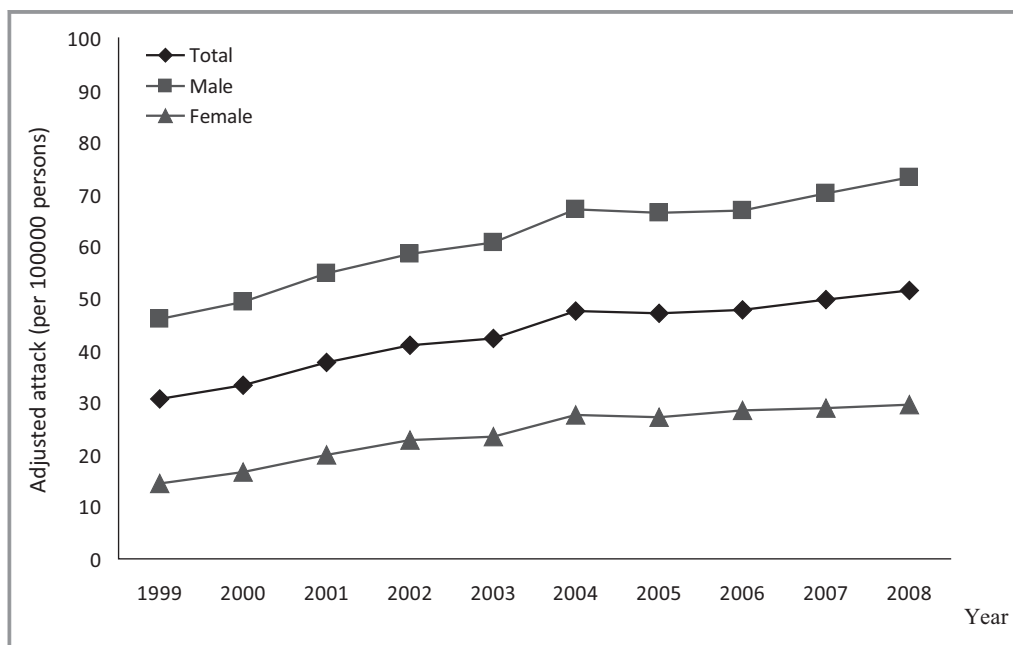


Figure 1. Age-adjusted attack rates (/100 000 person-years) of acute myocardial infarction has increased over the last 10 years by gender.

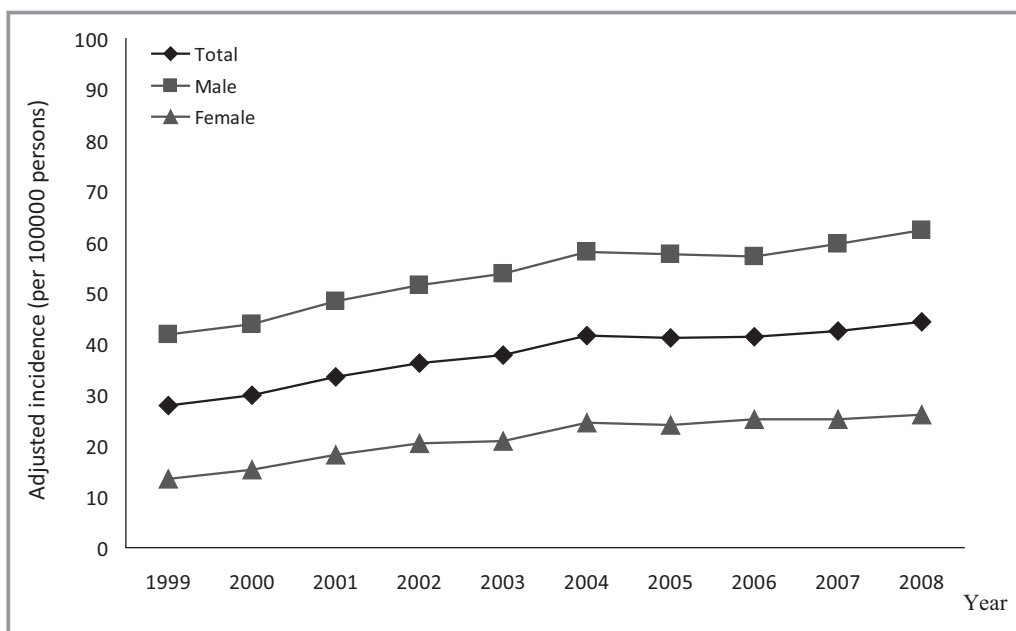


Figure 2. Age-adjusted incidence (/100 000 person-years) of acute myocardial infarction has increased over the last 10 years by gender.

person-years) increased 1.6-fold, from 30.7 in 1999 to 48.3 in 2009 ($P<0.001$) (Figure 1). The overall age-adjusted incidence of AMI (/100 000 person-years) markedly increased 1.6-fold, from 28.0 in 1999 to 44.4 in 2008 ($P<0.001$) (Figure 2). When age-adjusted attack rates and incidences were compared according to year, there was also an increasing

tendency during these years. This tendency was the same even after males and females were separated (Figures 1 and 2). The average age of the male and female AMI patients in the whole period was 64.2 ± 13.5 and 71.9 ± 11.5 years, respectively. In males, the age-adjusted incidence of AMI (/100 000 person-years) significantly increased 1.5-fold,

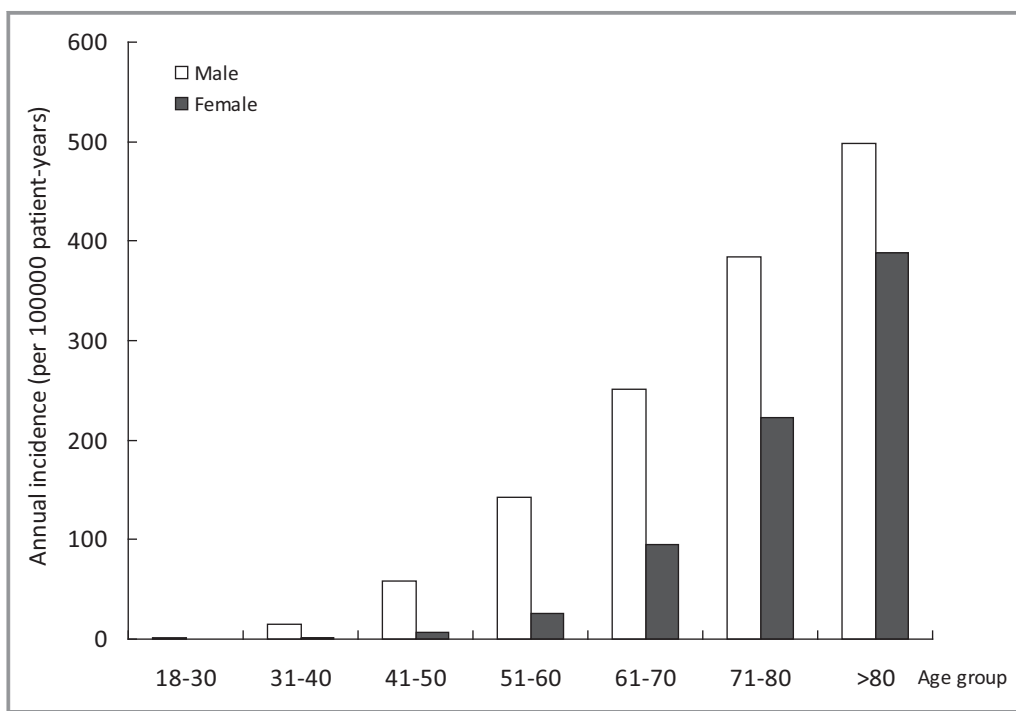


Figure 3. Age- and gender-specific incidence of acute myocardial infarction over the last 10 years.

from 41.8 in 1999 to 62.5 in 2008 ($P<0.001$), while in females, it tended to similarly increase 1.8-fold, from 13.5 in 1999 to 26.0 in 2008 ($P<0.001$). In men, the annual incidence of AMI drastically increased in patients older than 40 years. However, the significant increase in annual incidence of AMI in women occurred in patients older than 60 years (Figure 3). The overall increase in AMI incidence was predominantly driven by the increase of AMI in older individuals. Overall, AMI incidence per 100 000 young individuals (<65 years) increased 1.3% per year in men and 0.9% per year in women from 1999 to 2008, but it increased 3.2% per year in men and 3.5% per year in women in old individuals (>65 years) (Figure 4A and 4B).

Temporal Trends of Clinical Characteristics

We separated the study period into 3 periods and observed the temporal trends of AMI clinical features in Taiwan. During the study periods, there was an increase of the mean age for

AMI hospitalization. The percentage of female AMI patients was also increasing. The prevalence of risk factors for AMI including hypertension, diabetes mellitus, and dyslipidemia increased markedly. Atrial fibrillation and chronic renal disease also increased significantly (Table 2).

Temporal Trends of Care Quality and Clinical Outcome

For the 4 performance measures during hospitalization according to the current guideline, only the use of DAPT and statin increased significantly. There were no significant changes for the use of ACE inhibitor or ARB and β -blocker (Table 3). From 2004 to 2008, DAPT increased from 65% in 2004 to 83.9% in 2008 ($P<0.001$). ACE inhibitors or ARB were used in 72.6% in 2004 and 71.7% in 2008 ($P=NS$) and β -blocker was used in 60% in 2004 and 59.7% in 2008 ($P=NS$). Statin use increased from 32.1% to 50.1% from 2004 to 2008 ($P<0.001$). The proportion of patients who

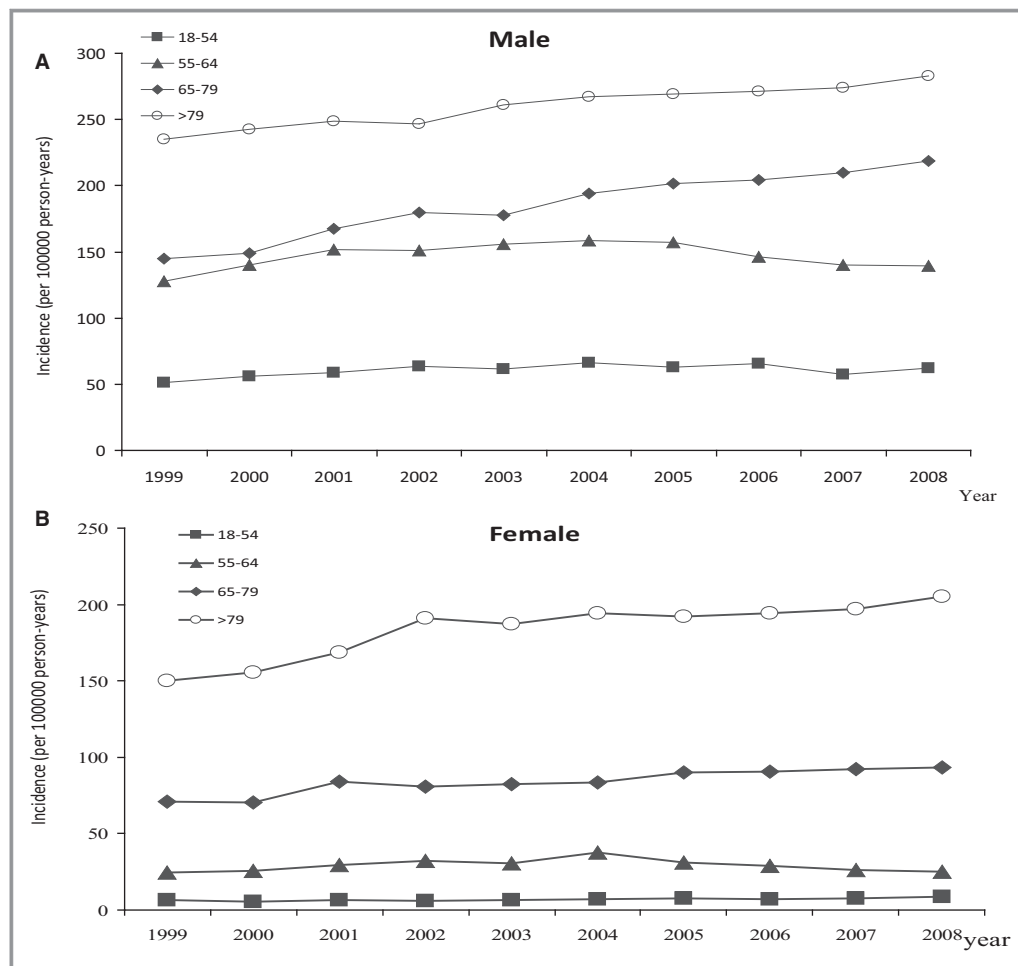


Figure 4. Serial changes in the age distribution of patients with acute myocardial infarction by gender: (A) male and (B) female.

Table 2. Temporal Trends of Clinical Characteristics for AMI Patients From 1999 to 2008

	Period 1 (1999–2002) N=32 356	Period 2 (2003–2005) N=34 561	Period 3 (2006–2008) N=41 824
Age, y	65.5 (12.9)	66.5 (13.3)*	66.9 (13.8)*†
Male	74.6	72.0*	71.2*†
Risk factors, %			
Hypertension	55.2	67.7*	68.8*†
Diabetes mellitus	30.5	39.8*	41.6*†
Dyslipidemia	22.3	33.3*	36.8*†
Cardiovascular history, %			
Coronary artery disease	34.3	39.9*	37.8*†
Atrial fibrillation	2.0	3.6*	4.0*†
Peripheral artery disease	1.4	2.7*	3.3*†
Stroke	9.1	13.1*	13.2*
Comorbidity, %			
Chronic lung disease	38.9	48.3*	43.9*†
Chronic renal disease	11.5	17.0*	18.1*†
Cancer	10.7	15.5*	15.8*
Peptic ulcers	17.8	25.7*	24.5*†

Data are presented as N (%) or mean values±SD. AMI indicates acute myocardial infarction.
 *P value (<0.05) compared with Period 2 and Period 1 groups or Period 3 and Period 1 groups using a Student t test or χ^2 test.
 †P value (<0.05) compared with Period 3 and Period 2 groups using a Student t test or χ^2 test.

received “four-combined care” increased from 2004 to 2008 (Figure 5). In 2008, the 4 major performance measures for AMI during hospitalization in Taiwan significantly fell behind those reported in Asian Americans (aspirin, 93.7% versus 96.5%; ACE inhibitor or ARB, 72.3% versus 91.9%; β -blocker, 60.2% versus 96.0%; and statin 46.1% versus 93.1%).¹⁰ For in-hospital procedure or surgery, there was an increased use of PCI for AMI during hospitalization in Taiwan, but the coronary artery bypass graft rate did not decrease significantly. In addition, more AMI patients received the support of a ventilator, intra-aortic balloon pump, or extracorporeal membrane oxygenation during hospitalization (Table 3). The duration of hospital stay was significantly shortened over the 10-year study period; the prevalence of discharge within 7 days

Table 3. Temporal Trends of Treatments for AMI Patients From 1999 to 2008

	Period 1 (1999–2002) N=32 356	Period 2 (2003–2005) N=34 561	Period 3 (2006–2008) N=41 824
In-hospital drug use, %			
Aspirin	97.4	93.6*	93.7*
Clopidogrel	11.5	69.2*	88.0*†
Ticlopidine	31.3	4.7*	1.5*†
GP IIb/IIIa inhibitor	8.8	17.5*	16.3*†
DAPT	39.3	66.1*	82.4*†
β -Blocker	59.0	60.7*	60.1*
ACEI or ARB	73.2	74.0*	72.2*†
Statin	18.0	32.7*	45.7*†
Four-combined care	10.4	19.3*	26.5*†
In-hospital procedure or surgery			
Ventilator support	4.3	9.5*	9.6*†
IABP	3.4	4.8*	6.0*†
ECMO	0.1	0.3*	0.7*†
PCI	40.6	48.3*	56.2*†
CABG	5.9	6.9*	6.4*†

Data are presented as N (%). ACEI indicates angiotensin-converting enzyme inhibitor; AMI, acute myocardial infarction; ARB, angiotensin receptor blocker; CABG, coronary artery bypass graft; DAPT, dual antiplatelet therapy; ECMO, extracorporeal membrane oxygenation; GP, Glycoprotein; IABP, intra-aortic balloon pumping; PCI, percutaneous coronary intervention.
 *P value (<0.05) compared with Period 2 and Period 1 groups or Period 3 and Period 1 groups using a Student t test or χ^2 test.
 †P value (<0.05) compared with Period 3 and Period 2 groups using a Student t test or χ^2 test.

after the onset of AMI significantly increased from 48.5% in 1999 to 57.2% in 2008 ($P<0.0001$).

The overall in-hospital mortality rate has markedly decreased from 20% in 1999 to 8% in 2008 ($P<0.0001$) (Figure 6). However, the mortality of female patients was always significantly higher than male patients over the 10-year study period. In 2008, the in-hospital mortality was 10.6% for males and 17.2% for females. Multivariable logistic regression analysis demonstrated that the determinants of in-hospital death in AMI patients in Taiwan included old age, female gender, hypertension, diabetes mellitus, old MI, and old stroke (Table 4). We also found that in-hospital use of DAPT (odds ratio [OR] 0.75, 95% CI 0.70 to 0.80), ACE inhibitor/ARB (OR 0.44, 95% CI 0.41 to 0.46), β -blocker (OR 0.69, 95% CI 0.66 to 0.74), statin (OR 0.62, 95% CI 0.58 to 0.66), and PCI (OR 0.61, 95% CI 0.57 to 0.65) were associated with significantly lower in-hospital mortality.

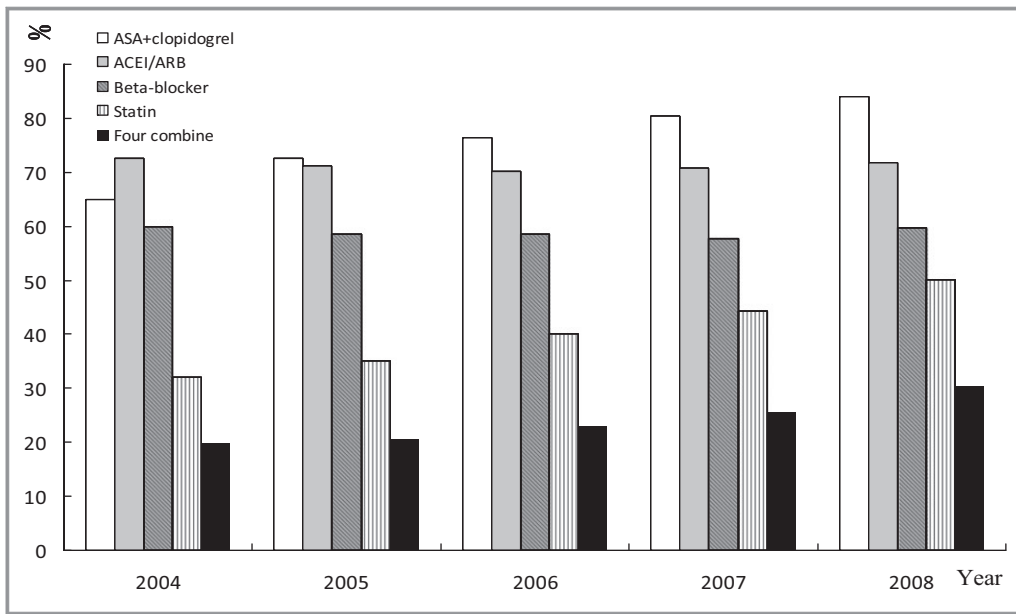


Figure 5. Serial changes in the use of guideline-based medications for acute myocardial infarction: 2004–2008. ACEI indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ASA, acetylsalicylic acid.

Discussion

The major findings of this study were the following: (1) AMI attack rates and incidence were still rising in the 10-year study period in Taiwan, and the AMI incidence was higher in men than women in all age groups; (2) guideline-based medications for AMI were underused in Taiwan; (3) female patients had higher in-hospital mortality rates and received less guideline-based treatment for AMI; and (4) the improvement of AMI mortality with guideline-based treatment in

Taiwan reflects that GWTG performance measures can also be applied in Taiwan to improve AMI care quality.

The epidemiological characteristics and real-world practice for AMI have not been well studied in Asian countries despite its importance in public health. Most of the available information comes from the data in highly selected medical centers or from AMI treatment networks rather than in an unselected nationwide database. Our study is a 10-year nationwide population-based cohort study that clearly demonstrates the temporal trends of epidemiological

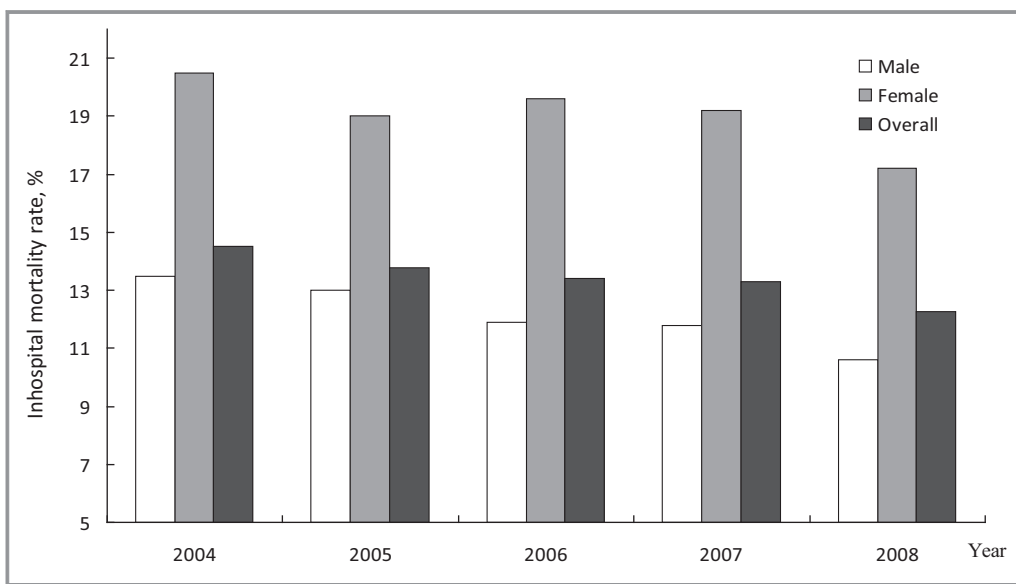


Figure 6. In-hospital mortality rate of acute myocardial infarction by gender: 2004–2008.

Table 4. Multivariable Logistic Regression Analysis of Variables Associated With In-Hospital Mortality

Clinical Characteristics	Odds Ratio (95% CI)
Male	0.86 (0.81 to 0.91)
Age, y	
45 to 54 vs Ref (<45)	1.27 (1.01 to 1.59)
55 to 64 vs Ref	1.85 (1.50 to 2.29)
65 to 69 vs Ref	3.56 (2.90 to 4.36)
>69 vs Ref	6.20 (5.05 to 7.63)
Hypertension	1.10 (1.02 to 1.18)
Diabetes mellitus	1.33 (1.25 to 1.40)
Old myocardial infarction	1.10 (1.03 to 1.18)
Old stroke	1.29 (1.21 to 1.39)
In-hospital medical therapy	
Dual antiplatelet use	0.75 (0.70 to 0.80)
ACEI/ARB	0.44 (0.41 to 0.46)
β -Blocker	0.69 (0.66 to 0.74)
Statin	0.62 (0.58 to 0.66)
In-hospital procedures	
Ventilator	6.66 (6.23 to 7.11)
IABP	4.74 (4.32 to 5.20)
ECMO	12.15 (9.39 to 15.72)
Percutaneous coronary intervention	0.61 (0.57 to 0.65)
Coronary artery bypass graft	1.21 (1.09 to 1.34)

ACEI indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pumping.

features and management of AMI in Taiwan. The overall age-adjusted incidence of AMI (/100 000 person-years) increased from 28.0 in 1999 to 41.3 in 2008, indicating a steady trend of increased AMI incidence in Taiwan. The rising incidence of AMI in Taiwan is completely different from that reported from Western countries and Japan. Data from the United States,^{8,11} Sweden,¹² and the Netherlands¹³ with study periods similar to our study demonstrated a significant decline of AMI incidence after the year 2000. In Japan, data from the MIYAGI-AMI study demonstrated that AMI incidence progressively increased from 1979, but after 2000, AMI incidence reached a stable state and there was no further increase of AMI incidence in Miyagi Prefecture.¹⁴ In Kumamoto Prefecture in Japan, a steady trend of decreasing incidence of AMI after 2004 was observed in the Kumamoto Acute Coronary Events study.¹⁵ Although the AMI incidence in Taiwan is still lower than that in Western countries, it is already higher than the incidence in Japan (40.7 versus 27.0/100 000 person-years in 2008).¹⁴

The rising incidence of AMI in Taiwan is related to the aging population,¹⁶ as demonstrated by the increased trend of AMI

incidence being most obvious in the old-age group. However, the increased prevalence of risk factors in Taiwan, such as diabetes mellitus¹⁷ and cholesterol¹⁸ and the low hypertension control rate,¹⁹ also plays an important role. The link between control of major coronary risk factors and the reduction of AMI incidence has been reported in previous studies.^{20,21} More effort should be put into risk-factor control in our population to attenuate the rising incidence of AMI in Taiwan.

Concerning guideline-based medications for AMI, our study shows that there was continued improvement in the temporal use of DAPT and statins from 1999 to 2008 in Taiwan, but there was no further improvement in the use of ACE inhibitors or ARB and β -blockers. In 2008, 83.9% of patients received DAPT, 71.7% received an ACE inhibitor or ARB, 59.7% received β -blockers, 50.1% received statins, and 30.3% received the 4-combination therapy during hospitalization for AMI in Taiwan. Overall, the guideline-based medications for AMI were significantly underused in Taiwan when compared with the data reported from the United States, especially for β -blockers and statins. In 2006, data from the National Registry of Myocardial Infarction in the United States demonstrated that 94% of patients received aspirin, 74% received an ACE inhibitor or ARB, 92% received β -blockers, and 88% received lipid-lowering agents.²² In another survey of 4412 Asian Americans in the GWTG program in 2008, the use of guideline-based medications for AMI was even higher: 94% of patients received aspirin, 78% received an ACE inhibitor or ARB, 94% received β -blockers, and 91% received lipid-lowering agents.¹⁰ In other Asian countries, β -blockers and statins are also less prescribed than in the United States. In Japan,²³ 49.5% received β -blockers and 77.8% received statins, and in Korea,²⁴ 72.7% received β -blockers and 77.2% received statins for AMI treatment. According to the Taiwan NHI regulation before August 2013, statins were indicated in AMI patients with serum low-density lipoprotein levels >130 mg/dL or total cholesterol >200 mg/dL. We thought that this regulation could be an important factor in the low use of statins in Taiwan's AMI patients. The Taiwan Acute Coronary Syndrome registry study reviewed 2744 AMI patients from October 2008 to January 2010 and found there was also no evident improvement in using guideline-based medications for AMI after 2008. Only 77.2% of AMI patients received DAPT, 64.7% received ACE inhibitor or ARB, 55.2% received β -blockers, and 62.5% received statins during hospitalization.²⁵ Our study clearly demonstrated the benefit of using guideline-based medications to reduce the in-hospital mortality rate of AMI in Taiwan. Increasing the prescription rate of guideline-based medications through quality-improvement programs such as GWTG and revision of regulations regarding statin use are necessary to enhance adherence to the guidelines in the treatment of AMI in Taiwan.

The major strength of our study is that the nationwide population-based data we used could provide more accurate assessment of incidence and treatment conditions of AMI in Taiwan. Currently, we are trying to differentiate ST-segment elevation and non-ST-segment elevation MI in our database. Therefore, the differences of incidence and guideline-based therapies between ST-segment elevation and non-ST-segment elevation MI in Taiwan need further studies. In our database, only revascularization procedures were recorded and there was no detailed information of door-to-balloon time for primary PCI. The Taiwan Acute Coronary Syndrome registry study reported that 95.4% of our patients with ST-segment elevation MI received primary PCI and the median door-to-balloon time was 96 minutes at that time.²⁵ Whether there is any improvement of this performance measure for AMI care will require future registry study in Taiwan.

In conclusion, there was a progressive increase of AMI incidence in Taiwan from 1999 to 2008. Underutilization of the guideline-based medications for AMI is a major problem in Taiwan. The influences of guideline-based medications on in-hospital mortality of AMI in Taiwan present an important clinical implication that quality-improvement programs, such as GWTG, are necessary to enhance adherence to the guidelines in the treatment of AMI in Taiwan.

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Disclosures

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