MINISTRY OF HEALTH
SINGAPORE

SINGAPORE MYOCARDIAL INFARCTION
REGISTRY REPORT NO. 1

TRENDS IN ACUTE MYOCARDIAL INFARCTION IN SINGAPORE 2007-2010

NATIONAL REGISTRY OF DISEASES OFFICE

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Suggested Source Citation

Singapore Myocardial Infarction Registry
National Registry of Diseases Office
Ministry of Health, Singapore

FOREWORD

Ischaemic heart disease, including acute myocardial infarction, is the second leading principle cause of death in Singapore. With ageing of our population, changes in lifestyle and growing prevalence of risk factors such as diabetes and obesity, the burden of heart disease and acute myocardial infarction will continue to be a major challenge for our nation for years ahead. In order to better understand and hence overcome this disease, the Singapore Myocardial Infarct Registry was first established in 1987.

The Singapore Myocardial Infarction Registry (SMIR) is unique, possibly the only nation-wide myocardial infarct registry in the world. Its staff have worked hard to put together data on acute myocardial infarction (AMI), commonly known as heart attacks, in Singapore using a comprehensive protocol that requires meticulous screening of cardiac enzymes, discharge coding and ECGs by a dedicated team of nurses. This first report of SMIR is the collective effort of those who have collected and analysed the data as well as those who have written and commented on report.

The data provided by the SMIR fulfils a critical function for our healthcare service planning, providing insight and understanding of the trends and pattern of myocardial infarction in Singapore. This publication will be invaluable for all of us involved in overcoming this disease, whether cardiologists, epidemiologists or health administrators, and will also serve as a useful reference for both physicians and public health professionals. I would like to express my gratitude to those who have worked on this report.

A/Prof Koh Tian Hai
Chairman
Singapore Myocardial Infarction Registry

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We would like to acknowledge Dr Jeannie Tey and Dr Stefan Ma from the Epidemiology and Disease Control Division, Ministry of Health, for kindly vetting the report.

TABLE OF CONTENTS

1. GLOSSARY

AMI	Acute Myocardial Infarction
CPK	Creatinine Phosphokinase
DOS	Department of Statistics
ECG	Electrocardiogram
EMR	Electronic Medical Records
ICD-9 410	International Classification of Diseases 9th Revision (ICD-9 Clinical Modification) code of 410
GP	General Practitioner
HIDS	Hospital In-patient Discharge Summary
HSA	Health Sciences Authority
MOH	Ministry of Health
MONICA	Monitoring Trends and Determinants in Cardiovascular Disease, World Health Organization
NRDO	National Registry of Diseases Office
NSTEMI	Non - ST Segment Elevation Myocardial Infarction
SCDB	Singapore Cardiac Databank
SMIR	Singapore Myocardial Infarction Registry
STEMI	ST Segment Elevation Myocardial Infarction
UICC	Union for International Cancer Control

2. INTRODUCTION

Globally, cardiovascular diseases, which include coronary heart diseases (heart attacks, also known as AMI), cerebrovascular diseases (stroke), hypertension (raised blood pressure) and heart failure are the world's largest killer, claiming 17.3 million lives in 2008, representing 30% of all global deaths. Of these deaths, about 7.3 million and 6.2 million were caused by coronary heart disease and stroke respectively (Fact Sheet, World Health Organization). In Singapore, cardiovascular diseases were the 2nd leading cause of death (18.7%) and 3rd leading cause of hospitalisation (3.7%) in 2010 (Health Facts Singapore, Ministry of Health).

The Acute Myocardial Infarction Registry was established by MOH in 1988, transferred to the Singapore Cardiac Databank (SCDB) in 2002 and subsequently to NRDO in April 2007. Data for AMI cases diagnosed prior to 2007 has been collected by SCDB. After the transfer to NRDO, it was re-named the Singapore Myocardial Infarction Registry (SMIR). SMIR continues to collect epidemiological data on AMI cases diagnosed in all the restructured hospitals[1] and a small number of AMI deaths that occur at home, are certified by medical practitioners in Singapore. AMI cases occurring in Private Hospitals are currently not included in the report.

All records in the SMIR undergo the processes of registration, verification, matching and classification before they are finalised.

As the number of patients with acute myocardial infarction increases year by year, it becomes more and more imperative to have data dealing with various aspects of the disease and maintaining this data in one central place in Singapore. Such an attempt to gather data at a national level will be time consuming and the cooperation of various healthcare professionals involved in the management of AMI patients from the all hospitals will be crucial to the success of the Registry.

This first report of the SMIR is the first national statistics on Acute Myocardial Infarction. The data contained in this document are from the period of 2007 to 2010 finalised in the SMIR as of 3rd November 2011. Availability of such national statistics on AMI will enable planning and projection for our future needs. Such data will be helpful for identification of useful trends to provide the basis for correct decision making. On the other hand, the emergence of early signs of unfavourable trends will forewarn decision makers and allow suitable preventive measures to be taken.

This report can be downloaded at National Registry of Diseases Office Website: www.nrdo.gov.sg.

1 Include the National Heart Centre(NHC)/Singapore General Hospital (SGH), Changi General Hospital (CGH), Tan Tock Seng Hospital (TTSH), Alexandra Hospital (AH) and National University Hospital (NUH).

Legislation

In 2007, the National Registry of Diseases Act was enacted to provide legislative cover for national disease registries including the SMIR. The Act establishes the National Registry of Diseases and provides for compilation of information on disease incidence of selected diseases for purposes of disease prevention and control.

Sources of data

The sources of data included the cardiac biomarkers (creatinine phosphokinase (CPK), CKMBmass; and Troponins T and I) listing generated by the laboratories in the restructured hospitals, Hospital In-patient Discharge Summary (HIDS), claims and death data.

In addition, the letters are sent to the medical practitioners to confirm AMI as the cause of death for the small number of cases that appears in the Death Registry before registering these cases i.e. for patients who died at home. These medical practitioners notify the registry in the form of hardcopy notification.

Over the years, enzyme listing has increasingly become an important source of case finding due to the use of more sensitive enzyme assays i.e. increase in the use of Troponin T and Troponin I in the diagnosis of AMI in patients in addition to CPK. Import of information on necropsies (HSA) conducted on AMI patients began from 2007.

Data processing and coding

a) Identification Key

The primary identification key for our Singapore residents is the National Registration Identity Card (NRIC) number. For non-residents, their passport numbers or foreign identification (FIN) numbers are used. There are unique numbers assigned to avoid duplication of records in our database, especially when we update our data from multiple sources. A master patient list is created by merging data from all sources using the patient NRIC numbers as identifiers.

b) Verification of information

All information from listings is extracted from clinical medical records. Registry Coordinators extract detailed information from the case-notes at the medical records offices of hospitals. For unmatched cases (single source which are mainly either the enzyme or HIDS), Registry Coordinators confirm diagnosis of AMI by viewing patients' electronic medical records (eMR), before extracting relevant clinical information from case-notes.

c) Coding

International Classification of Diseases 9th Revision (ICD-9 Clinical Modification) code of 410 was used to identify acute myocardial infarction (AMI) cases in the data sources. The MONICA (Monitoring Trends and Determinants in Cardiovascular Disease, World Health Organization) criteria were used for defining episodes. Recurrence of AMI after 28 days of a recorded AMI episode was counted as another episode.

d) AMI Definition

For the computation of the incidence of AMI, the population of AMI patients for a particular year was extracted based on the date AMI episode occurred. AMI episodes included in this report were diagnosed as:

1) Definitive AMI –
   - Definite ECG, or
   - Symptoms (typical or atypical), together with probable ECG and abnormal enzymes suggestive of myocardial necrosis, or
   - Typical symptoms and abnormal enzymes with ischaemic/ non-codable/ unavailable ECG.

2) Clinical AMI –
   - ECG changes suggestive of AMI but not supported with raised cardiac enzymes or typical symptoms, or
   - At least 2 of the following criteria: clinical history of prolonged chest pain >20mins; raised biochemical markers of myocardial necrosis or serial ECG tracings showing ST-T changes from baseline or Q waves duration that are 0.03 secs in 2 or more contiguous leads).

3) Death cases signed up by pathologists stating AMI as cause of death with Necropsy report reflecting pinpoint or total occlusion of the coronary arteries.

4) Death cases signed by pathologists or GPs as AMI but, without necropsy done.

e) Follow-up

All records are updated with date and cause of death information received from MHA.

f) Most of the data management is on an electronic platform. In 2004, the National Disease Registries System (NRDS) was developed to provide full support for the operations of AMI registry; merging the data from varied sources, ensuring valid data capture, data security and generation of timely reports. Electronic transmission of data

has been established between hospitals and the registry to ensure safe transmission of data. Registry coordinators from the AMI registry visit the medical records offices of the hospitals to collect additional information in their laptops.

Information submitted by medical practitioners who continue to notify AMI cases using hard copy notifications (i.e. AMI home death cases) are entered into the NRDS. The hardcopy forms are subsequently scanned and stored in an electronic repository.

g) Data requests

The data in the Singapore Myocardial Infarction Registry is a resource for epidemiological studies, public health research and policy making. Data request forms can be downloaded from NRDO's website. Upon approval, the information is usually released as aggregate data or key-coded records.

The data in the Registry is updated regularly and hence there amy be differences in the figures presented in this report when compared to previous reports. The information contained within this report should be considered to be more reliable where differences exist.

Denominators for AMI statistics

In this report, we are presenting population denominators from the Ministry of Health, which were in turn obtained from the Department of Statistics, Singapore to calculate incidence and mortality rates. This set of denominators is used by most government agencies and by adopting these denominators; we align our report with other official publications. In this report, only Singapore citizens and permanent residents (i.e. "Singapore residents") are included and age standardization is obtained by direct method using the UICC "World population".

Department of Statistics (DOS) releases mid-year population estimates annually and these population denominators obtained from DOS (termed as "DOS population denominators" in this publication) in the calculation of AMI overall; and age-specific incidence and mortality rates.

Calculation of rates

Incidence rate

For the computation of the incidence of AMI, the population of AMI patients for a particular year was extracted based on the date AMI episode occurred. AMI episodes included in this report were diagnosed as:

Death rate

Deaths were reported and updated till July 2011 for all patients registered in the SMIR within the period of analysis by matching the patients' NRIC with death information imported from the Death Registry, Ministry of Home Affairs.

Case fatality rate

Case fatalities were calculated for AMI episodes which met with a fatal end within 28 days after presentation with AMI.

3. AMI INCIDENCE 2007 - 2010: ALL RESIDENTS

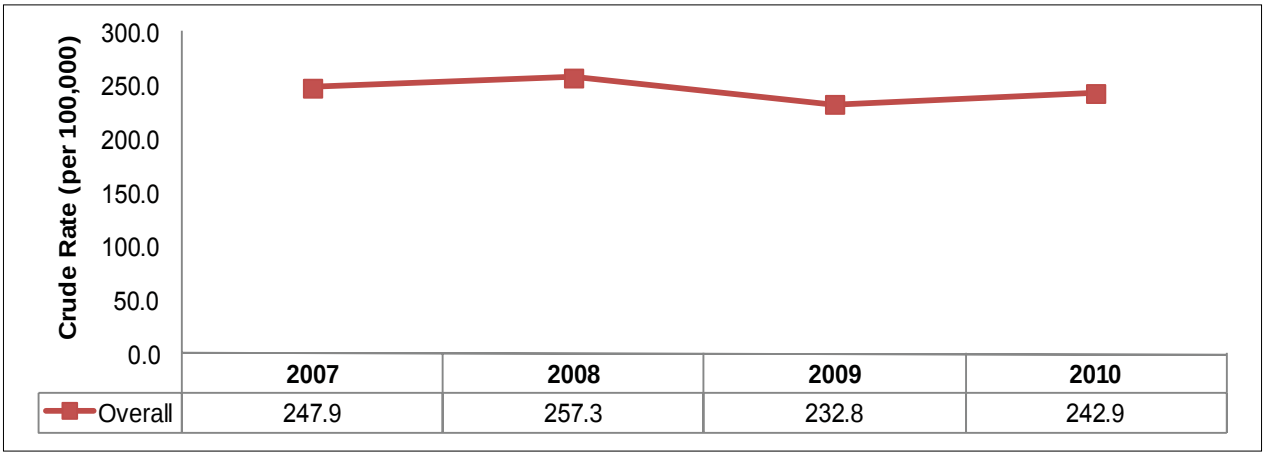
3.1 AMI Incidences, Overall, 2007 - 2010

The average number of AMI episodes from 2007 to 2010 has been approximately 7,003 a year. The number of AMI episodes in 2010 was 7,189 (Table 3.1.1). The crude AMI incidence rates ranged from 232.8 per 100,000 population to 257.3 per 100,000 population during the 4-year period. The incidence numbers and crude rates were the lowest in 2009 at 6,770 and 232.8 per 100,000 population respectively.

Table 3.1.1 INCIDENCE OF AMI, OVERALL, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Overall	6815	7238	6770	7189

Figure 3.1.1 CRUDE INCIDENCE RATES (PER 100,000 POPULATION) OF AMI, OVERALL, 2007 - 2010



The number of AMI episodes increases as the age range increases. The largest number of AMI episodes occurred amongst patients ranging from age 75 to 79 (Table 3.1.2). The mean and median ages of incident AMI episodes ranged from 67 to 68 years and 68 to 69 years respectively during the 4 year-period (Table 3.1.3).

Table 3.1.2 INCIDENCE OF AMI, BY AGE GROUP, 2007 - 2010

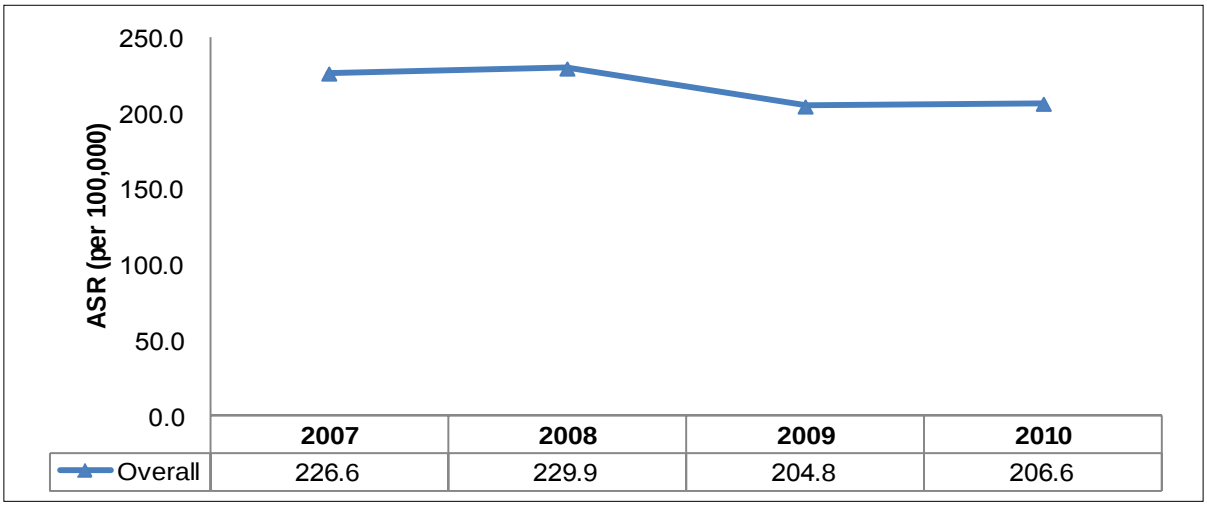
Year (Episodes)	2007	2008	2009	2010
18-19	0	0	1	0
20-24	0	3	0	3
25-29	10	7	12	9
30-34	25	26	28	25
35-39	92	94	84	91
40-44	234	225	222	215
45-49	470	415	425	455
50-54	641	697	650	733
55-59	710	764	752	796
60-64	646	787	783	805
65-69	810	820	721	650
70-74	857	876	826	888
75-79	893	943	905	896
80-84	674	789	680	792
>=85	753	792	681	831
Overall	**6815**	**7238**	**6770**	**7189**

Table 3.1.3 MEAN AND MEDIAN AGE, INCIDENT AMI, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Median Age (Years)	68.5	68.8	68.3	68.8
Mean Age (Years)	67.6	68.0	67.4	67.8

After age-standardisation, the incidence rates were observed to decrease from 226.6 per 100,000 population in 2007 to 206.6 per 100,000 per population in 2010 (Figure 3.1.2).

Figure 3.1.2 AGE-STANDARDISED INCIDENCE RATES (PER 100,000 POPULATION) OF AMI, OVERALL, 2007 - 2010



ASR = Age-Standardised Rate per 100,000 population per year (to 'World' population)

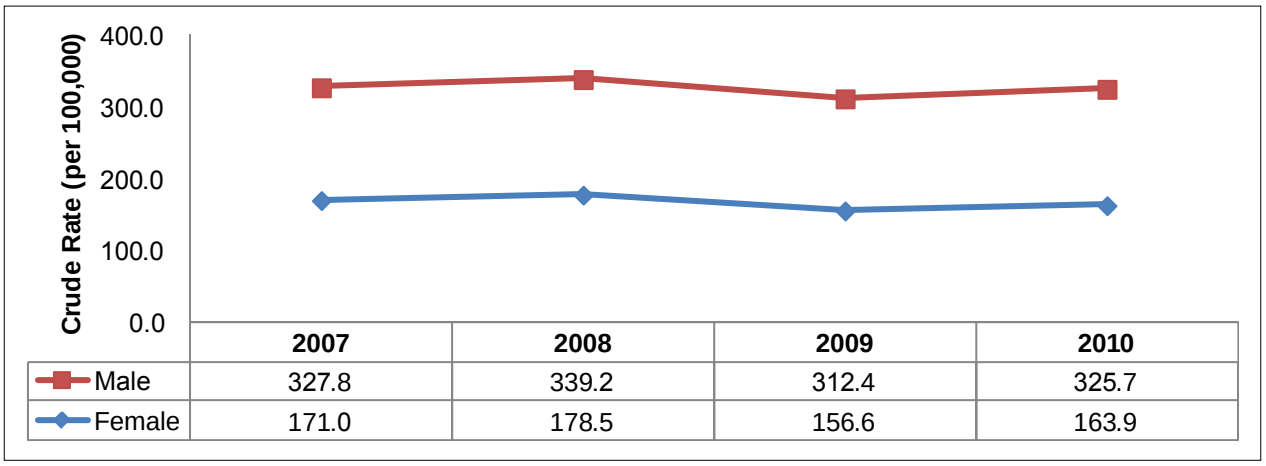
3.2 Incidence of AMI Patients, by Gender 2007 - 2010

The ratio of AMI episodes amongst men as compared to women was approximately 2:1 from 2007 to 2010. In 2010, the number of AMI episodes amongst men and women were 4,710 and 2,479 approximately (Table 3.2.1). The crude AMI incidence rates amongst males are approximately twice that of females. The crudes rates have been observed to be stable over the 4-year period in both genders (Figure 3.2.1).

Table 3.2.1 INCIDENCE OF AMI, BY GENDER, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Male	4418	4675	4444	4710
Female	2397	2563	2326	2479
Overall	**6815**	**7238**	**6770**	**7189**

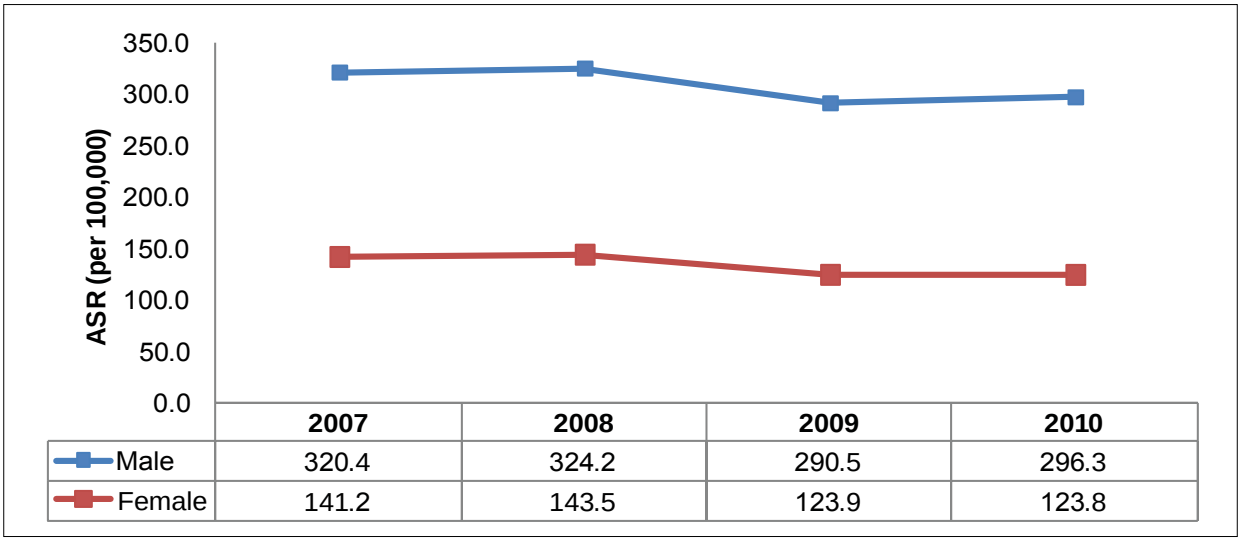
Figure 3.2.1 CRUDE INCIDENCE RATES (PER 100,000 POPULATION) OF AMI, BY GENDER, 2007 - 2010



	2007	2008	2009	2010
Male	327.8	339.2	312.4	325.7
Female	171.0	178.5	156.6	163.9

After age-standardisation, the incidence rates were observed to have decreased from 320.4 per 100,000 population in 2007 to 296.3 per 100,000 per population in 2010 among men and 141.2 per 100,000 population in 2007 to 123.8 per 100,000 population in 2010 among women (Figure 3.2.2).

Figure 3.2.2 AGE-STANDARDISED INCIDENCE RATES (PER 100,000 POPULATION) OF AMI, BY GENDER, 2007 - 2010



	2007	2008	2009	2010
Male	320.4	324.2	290.5	296.3
Female	141.2	143.5	123.9	123.8

ASR = Age-Standardised Rate per 100,000 population per year (to 'World' population)

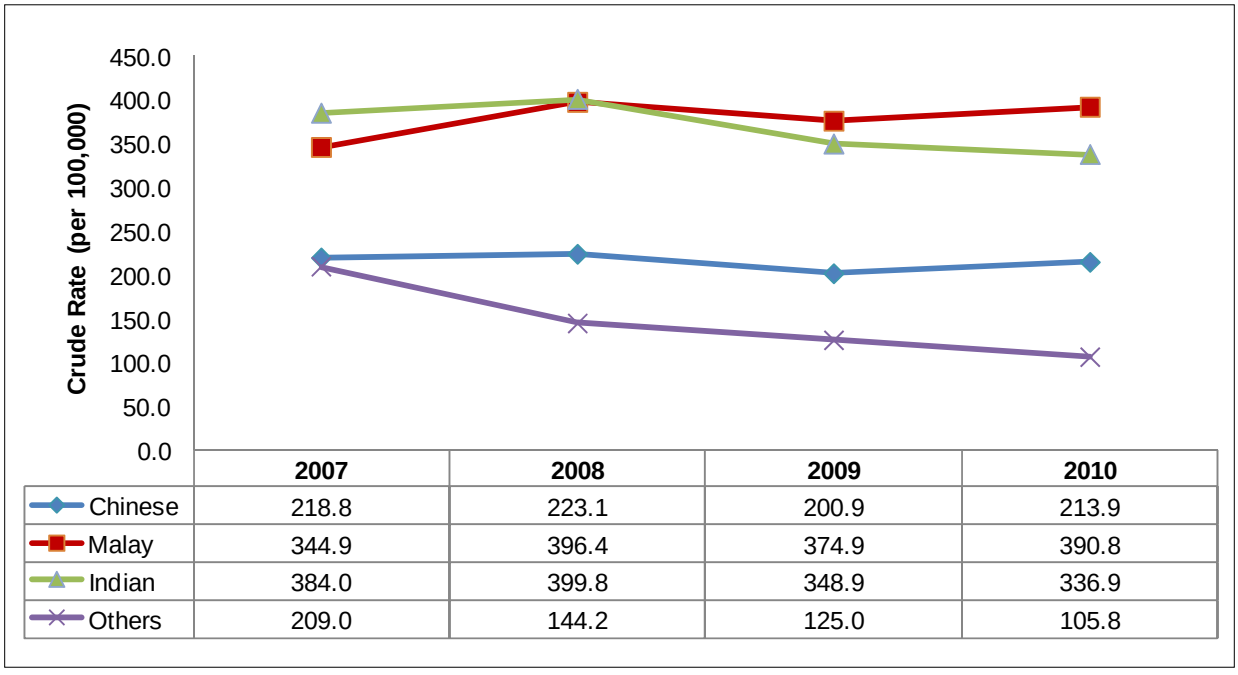
3.3 Incidence of AMI Patients, by Ethnic Group, 2007 - 2010

The proportion of AMI episodes amongst the various ethnic groups follows the ethnic distribution of the resident population in Singapore. The number of AMI episodes amongst the Malay ethnic group has increased steadily from 1,170 episodes in 2007 to 1,415 in 2010 (Table 3.3.1). The crude AMI incidence rate amongst the Chinese ethnic group has remained stable over the 4-year period. In 2007, the Indian ethnic group had the highest AMI incidence rates at 384.0 per 100,000 population in 2007, gradually decreasing to 336.9 per 100,000 population in 2007. The Malay ethnic group has emerged to have the highest crude AMI incidence rates of 390.8 per 100,000 population in 2010 (Figure 3.3.1).

Table 3.3.1 INCIDENCE OF AMI, BY ETHNIC GROUP, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Chinese	4627	4806	4442	4801
Malay	1170	1374	1329	1415
Indian	878	950	888	874
Others	140	108	111	99
Overall	**6815**	**7238**	**6770**	**7189**

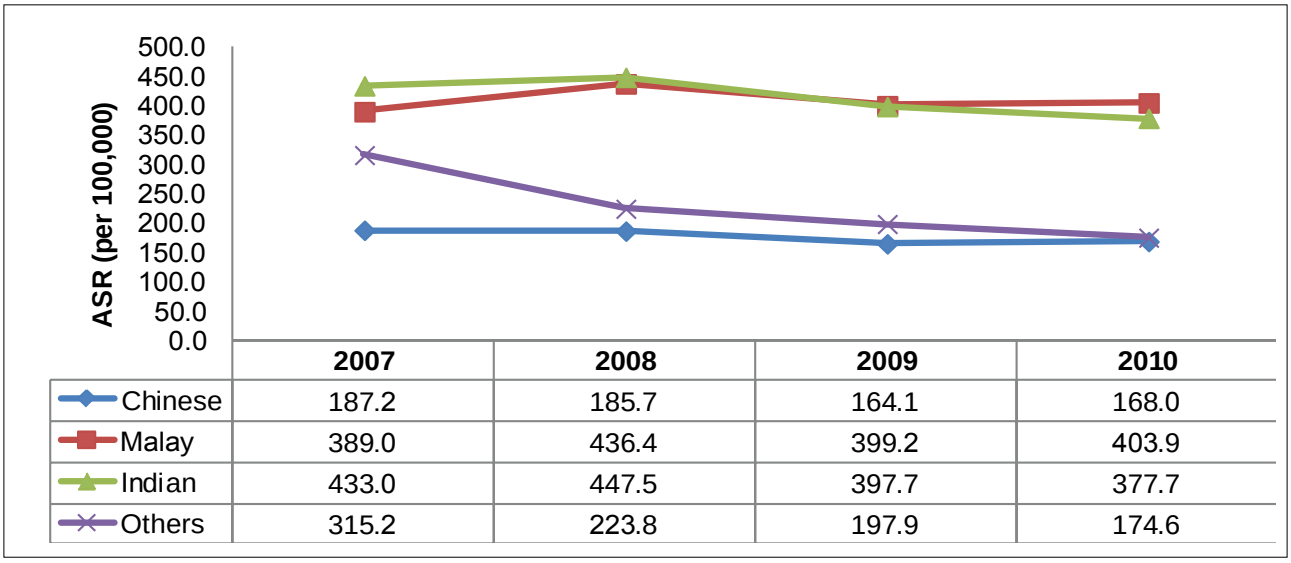
Figure 3.3.1 CRUDE INCIDENCE RATES (PER 100,000 POPULATION) OF AMI, BY ETHNIC GROUP, 2007 - 2010



	2007	2008	2009	2010
Chinese	218.8	223.1	200.9	213.9
Malay	344.9	396.4	374.9	390.8
Indian	384.0	399.8	348.9	336.9
Others	209.0	144.2	125.0	105.8

After age-standardisation, similar to the crude incidence rates, the Malay ethnic group emerged to have the highest incidence rates of 403.9 per 100,000 population as compared to all other ethnic groups in 2010 (Figure 3.3.2).

Figure 3.3.2 AGE-STANDARDISED INCIDENCE RATES (PER 100,000 POPULATION) OF AMI, BY ETHNIC GROUP, 2007 - 2010



	2007	2008	2009	2010
Chinese	187.2	185.7	164.1	168.0
Malay	389.0	436.4	399.2	403.9
Indian	433.0	447.5	397.7	377.7
Others	315.2	223.8	197.9	174.6

ASR = Age-Standardised Rate per 100,000 population per year (to 'World' population)

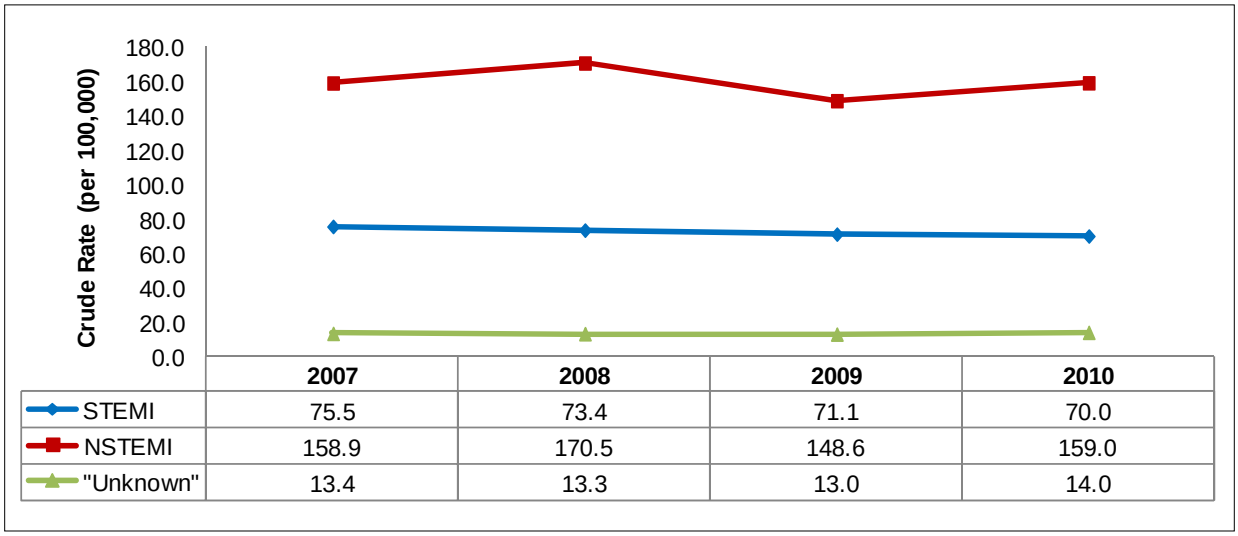
3.4 Incidence of AMI Patients, by AMI Type, 2007 - 2010

Number of Non-ST Segment Elevation Myocardial Infarction (NSTEMI) has consistently been approximately twice that of ST Segment Elevation Myocardial Infarction (STEMI). In 2010, the numbers of STEMI, NSTEMI and 'unknown' AMI subtype episodes were 2,071, 4,705 and 413 respectively. The crude STEMI incidence rate has gradually decreased 75.5 from per 100,000 population in 2007 to 70.0 per 100,000 population in 2010. Incidences of NSTEMI and crude NSTEMI incidence rates fluctuated during the 4-year period (Table 3.4.1 & Figure 3.4.1).

Table 3.4.1 INCIDENCE OF AMI, BY AMI TYPE, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
STEMI	2077	2065	2069	2071
NSTEMI	4370	4798	4323	4705
"Unknown"	368	375	378	413
Overall	**6815**	**7238**	**6770**	**7189**

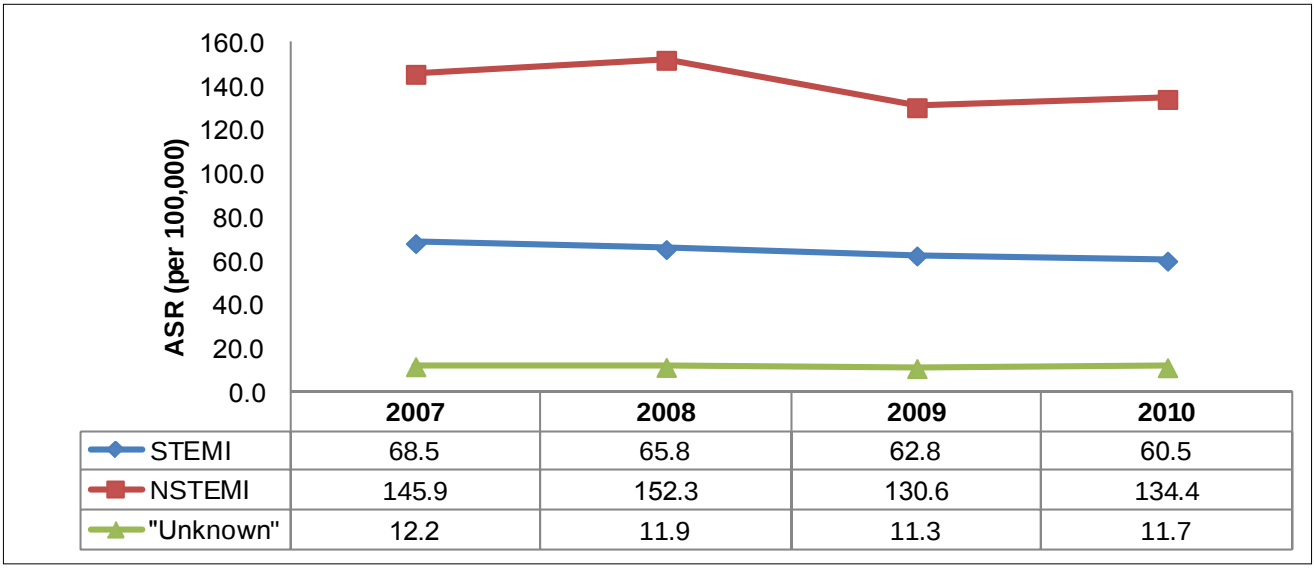
Figure 3.4.1 CRUDE INCIDENCE RATES (PER 100,000 POPULATION) OF AMI, BY AMI TYPE, 2007 - 2010



	2007	2008	2009	2010
STEMI	75.5	73.4	71.1	70.0
NSTEMI	158.9	170.5	148.6	159.0
"Unknown"	13.4	13.3	13.0	14.0

A similar gradual decrease in STEMI incidence rates were observed from 68.5 per 100,000 population in 2007 to 60.5 per 100,000 per population in 2010 after age-standardisation. Unlike as observed in the crude NSTEMI incidence rates, a decline in age-Standardised NSTEMI incidence rates was observed, from 145.9 per 100,000 population in 2007 to 134.4 per 100,000 population in 2010 (Figure 3.4.2).

Figure 3.4.2 AGE-STANDARDISED INCIDENCE RATES (PER 100,000 POPULATION) OF AMI, BY AMI TYPE, 2007 - 2010



	2007	2008	2009	2010
STEMI	68.5	65.8	62.8	60.5
NSTEMI	145.9	152.3	130.6	134.4
"Unknown"	12.2	11.9	11.3	11.7

ASR = Age-Standardised Rate per 100,000 population per year (to 'World' population)

4. AMI MORTALITY 2007 - 2010: ALL RESIDENTS

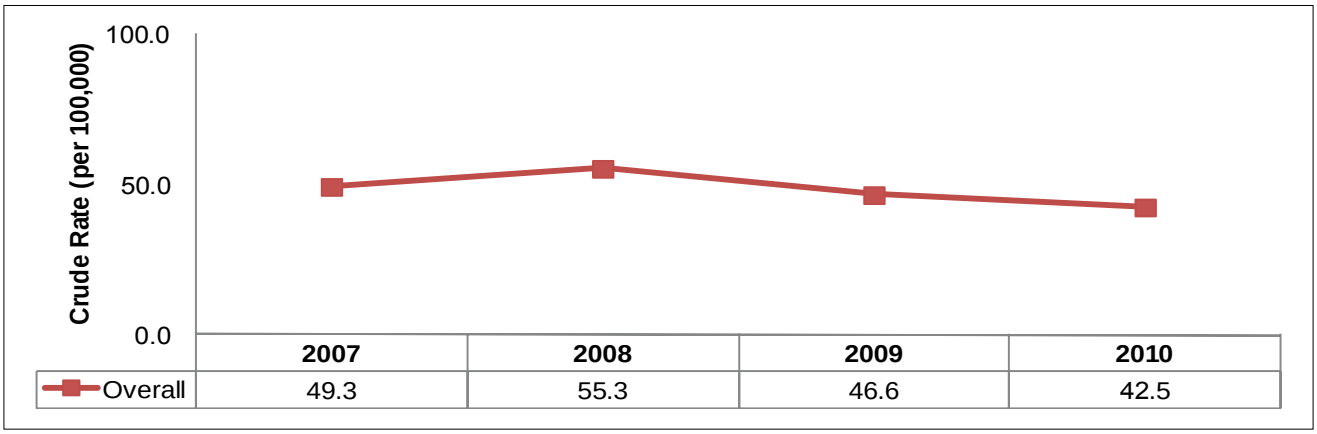
4.1 AMI Deaths, Overall 2007 - 2010

The number of deaths amongst AMI patients decreased from 1,557 in 2008 to 1,257 in 2010 (Table 4.1.1). Correspondingly, the crude AMI mortality rates decreased from 55.3 per 100,000 population in 2008 to 42.5 per 100,000 population in 2010. The number of deaths and crude death rates, as observed were highest in 2008 (Figure 4.1.1).

Table 4.1.1 AMI DEATHS, OVERALL, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Overall	1356	1557	1355	1257

Figure 4.1.1 CRUDE MORTALITY RATES (PER 100,000 POPULATION) OF AMI, OVERALL, 2007 - 2010



A decline in number of deaths was observed in the age range of 55 to 59 years of age from 104 in 2007 to 59 in 2010. The largest number of deaths occurred amongst patients at the age of 85 years and older (range from 233 to 259 deaths) over the 4-year period, with the exception of patients aged from 75 to 79 years in 2007 with 239 deaths (Table 4.1.2). The mean and median ages at death after suffering from an AMI ranged from 74 to 76 years and 75 to 77 years respectively during the 4-year period (Table 4.1.3).

Table 4.1.2 AMI DEATHS, BY AGE GROUP, 2007 - 2010

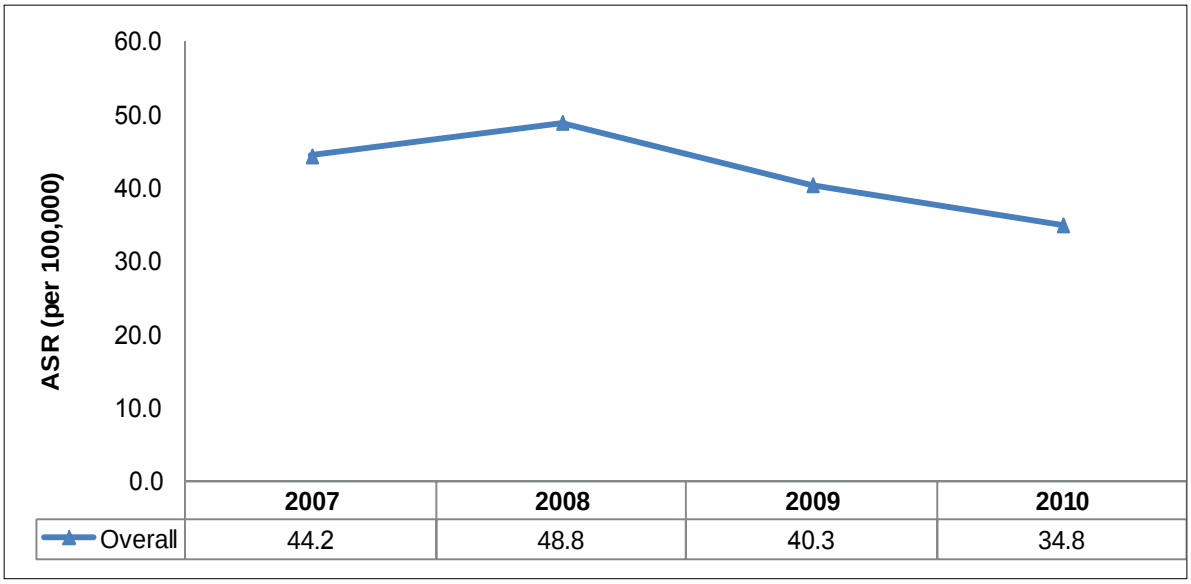
Year	2007	2008	2009	2010
18-19	0	0	0	0
20-24	0	0	0	1
25-29	1	1	1	1
30-34	2	3	1	2
35-39	11	10	5	1
40-44	18	33	15	14
45-49	48	50	35	40
50-54	73	81	88	55
55-59	104	106	88	59
60-64	86	131	124	125
65-69	143	176	140	106
70-74	202	194	181	148
75-79	239	245	252	212
80-84	196	225	166	234
>=85	233	302	259	259
Overall	**1356**	**1557**	**1355**	**1257**

Table 4.1.3 MEAN AND MEDIAN AGE, AT DEATH, 2007 - 2010

Year	2007	2008	2009	2010
Median Age (Years)	76.1	76.1	75.9	76.9
Mean Age (Years)	74.5	74.4	74.3	75.2

After age-standardisation, the mortality rates were observed to decrease from 44.2 per 100,000 population in 2007 to 34.8 per 100,000 per population (Figure 4.1.2).

Figure 4.1.2 AGE-STANDARDISED MORTALITY RATES (PER 100,000 POPULATION) OF AMI, OVERALL, 2007 - 2010



ASR = Age-Standardised Rate per 100,000 population per year (to 'World' population)

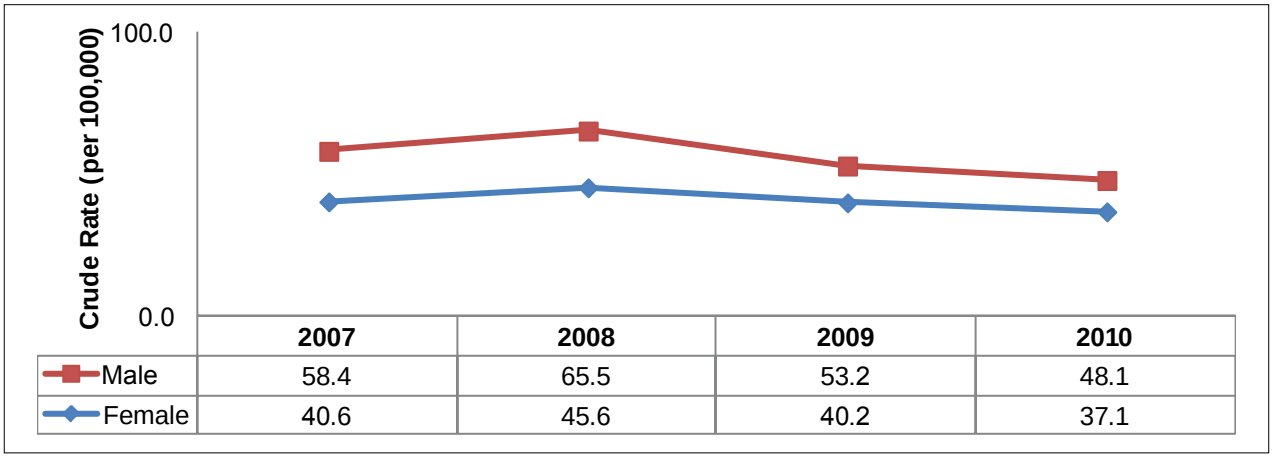
4.2 AMI Deaths, by Gender, 2007 - 2010

While the ratio of AMI incidence amongst males and females were approximately 2:1, the number of deaths amongst males was consistently less than 1.5 times that of females suffering from an AMI. As of 2010, the number of deaths amongst males and females suffering from an AMI were 696 and 561 respectively, with a ratio of 1.24:1 (Table 4.2.1). A sharper decline in crude mortality rates were observed amongst males with AMI from 65.5 per 100,000 population in 2008 to 48.1 per 100,000 population in 2010 (Figure 4.2.1).

Table 4.2.1 AMI DEATHS, BY GENDER, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Male	787	903	757	696
Female	569	654	598	561
Overall	**1356**	**1557**	**1355**	**1257**

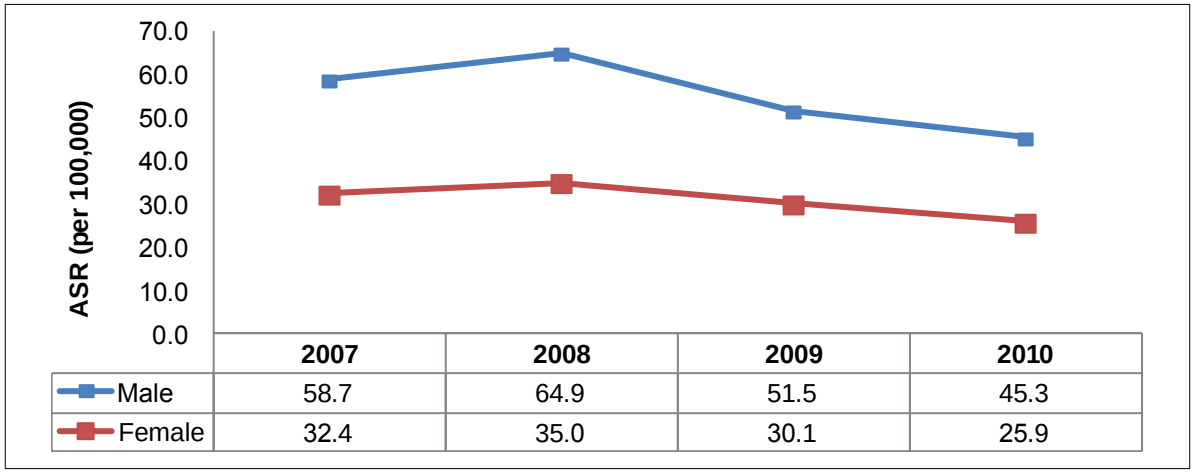
Figure 4.2.1 CRUDE MORTALITY RATES (PER 100,000 POPULATION) OF AMI, BY GENDER, 2007 - 2010



	2007	2008	2009	2010
Male	58.4	65.5	53.2	48.1
Female	40.6	45.6	40.2	37.1

After age-standardisation, the decline in mortality rates amongst males was similar to the trend observed when analysed by the crude rates. The age-Standardised mortality rates amongst females were lower than the crude rates with a gradual decrease in rates from 35.0 per 100,000 population in 2008 to 25.9 per 100,000 population in 2010 (Figure 4.2.2).

Figure 4.2.2 AGE-STANDARDISED MORTALITY RATES (PER 100,000 POPULATION) OF AMI, BY GENDER, 2007 - 2010



	2007	2008	2009	2010
Male	58.7	64.9	51.5	45.3
Female	32.4	35.0	30.1	25.9

ASR = Age-Standardised Rate per 100,000 population per year (to 'World' population)

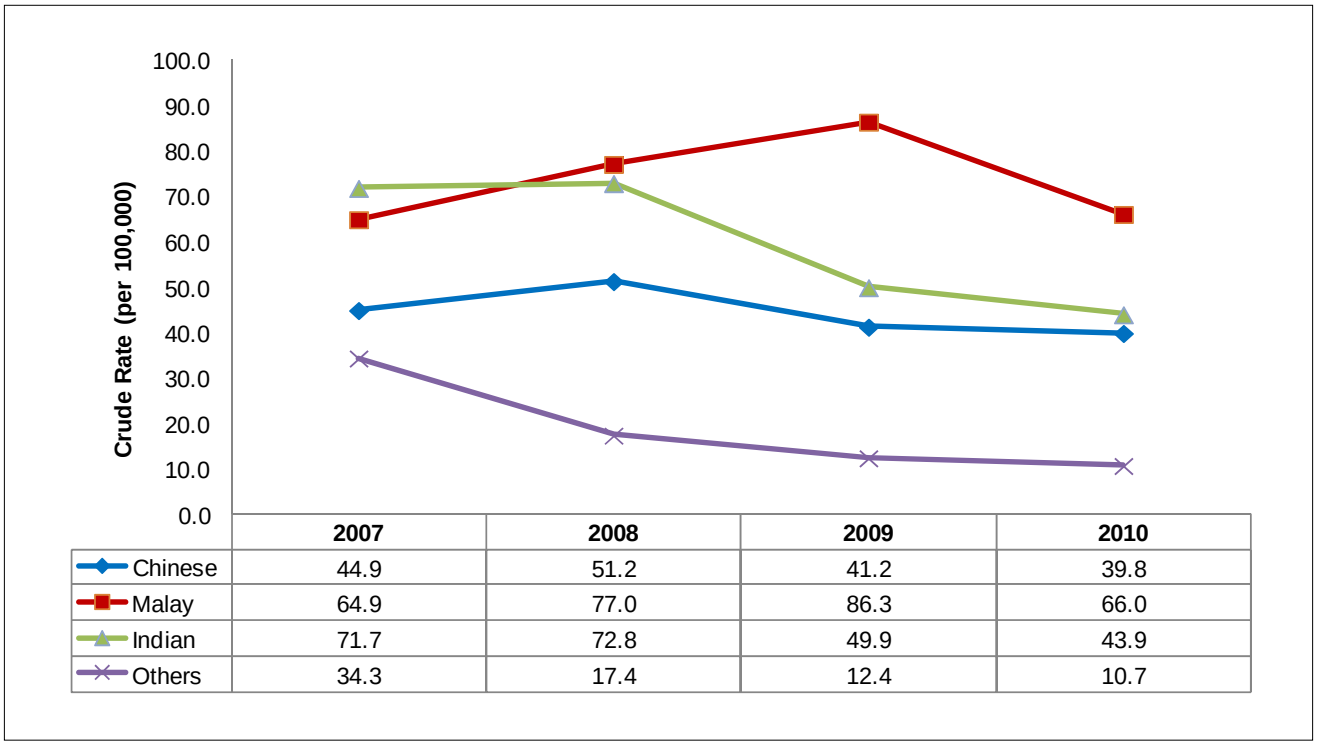
4.3 AMI Deaths, by Ethnic Group, 2007 - 2010

The numbers of deaths amongst the Chinese and Indian ethnic groups have decreased from 1,104 to 894 and 173 to 114 respectively from 2008 to 2010 (Table 4.3.1). Similar crude mortality rates trends were observed. The crude death rate in the Malay ethnic group was the highest in 2009 at 86.3 per 100,000 population (Figure 4.3.1).

Table 4.3.1 AMI DEATHS, BY ETHNIC GROUP, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Chinese	949	1104	911	894
Malay	220	267	306	239
Indian	164	173	127	114
Others	23	13	11	10
Overall	**1356**	**1557**	**1355**	**1257**

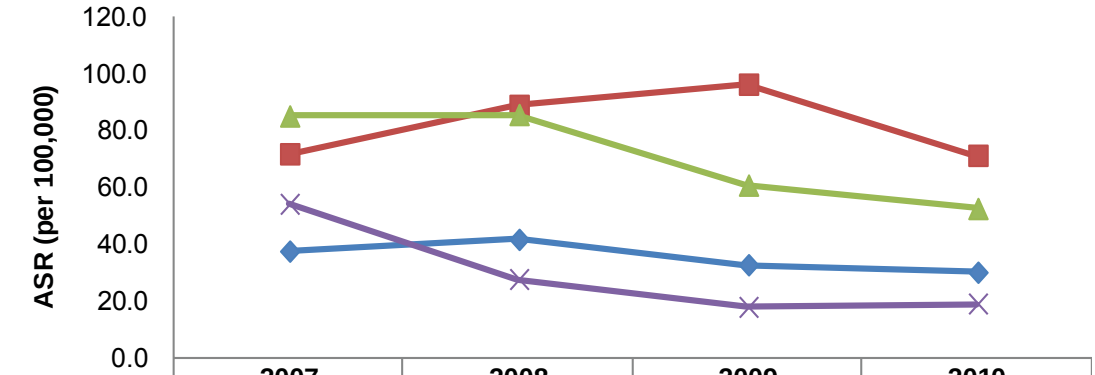
Figure 4.3.1 CRUDE MORTALITY RATES (PER 100,000 POPULATION) OF AMI, BY ETHNIC GROUP, 2007 - 2010



	2007	2008	2009	2010
Chinese	44.9	51.2	41.2	39.8
Malay	64.9	77.0	86.3	66.0
Indian	71.7	72.8	49.9	43.9
Others	34.3	17.4	12.4	10.7

The mortality trends after age-standardisation were similar to the crude mortality death rates trends amongst the Chinese, Malays and Indians. The age-standardised mortality rates trends were consistently lower than the crude death rates amongst the Chinese; however, the reverse was true for the Malay and Indian ethnic group (Figure 4.3.2).

Figure 4.3.2 AGE-STANDARDISED MORTALITY RATES (PER 100,000 POPULATION) OF AMI, BY ETHNIC GROUP, 2007 - 2010



	2007	2008	2009	2010
Chinese	37.2	41.3	32.4	29.8
Malay	71.4	88.4	95.9	70.9
Indian	84.7	85.2	60.4	52.2
Others	53.9	27.4	17.6	18.8

ASR = Age-Standardised Rate per 100,000 population per year (to 'World' population)

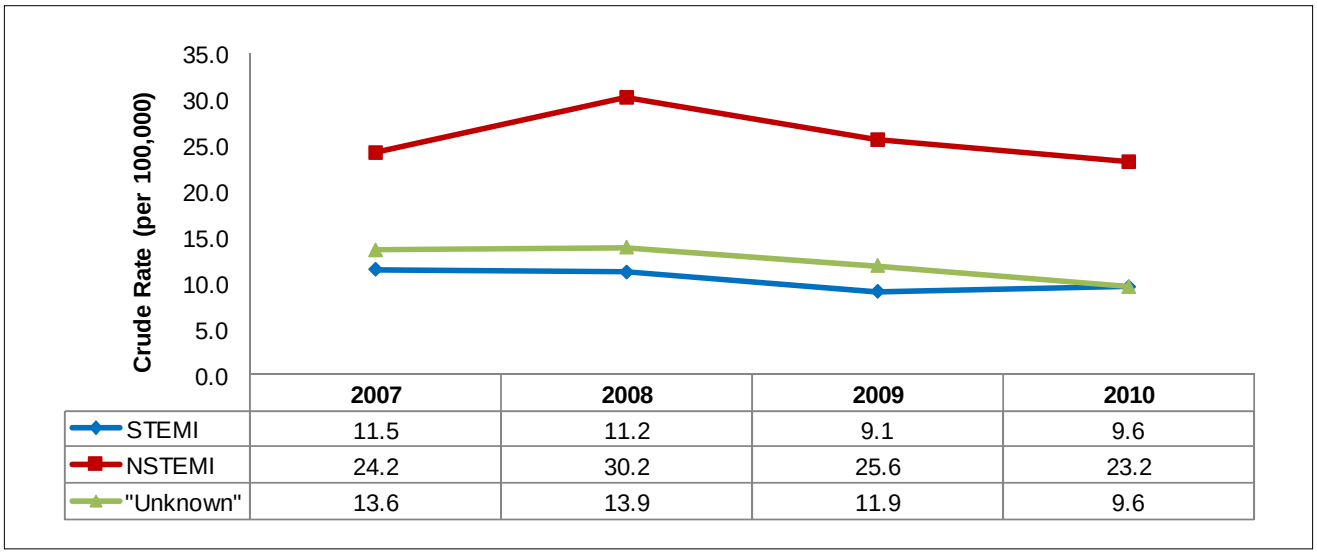
4.4 AMI Deaths, by AMI Type, 2007 - 2010

The number death amongst AMI patients diagnosed with NSTEMI is approximately twice the number of deaths amongst patients diagnosed with STEMI (Table 4.4.1). This trend is similar to the crude mortality rates between the 2 groups of AMI patients. The crude mortality rates amongst patients diagnosed with NSTEMI has decreased from 30.2 per 100,000 population in 2008 to 23.2 per 100,000 population in 2010 (Figure 4.4.1).

Table 4.4.1 AMI DEATHS, BY AMI TYPE, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
STEMI	316	316	265	285
NSTEMI	666	850	745	687
"Unknown"	374	391	345	285
Overall	**1356**	**1557**	**1355**	**1257**

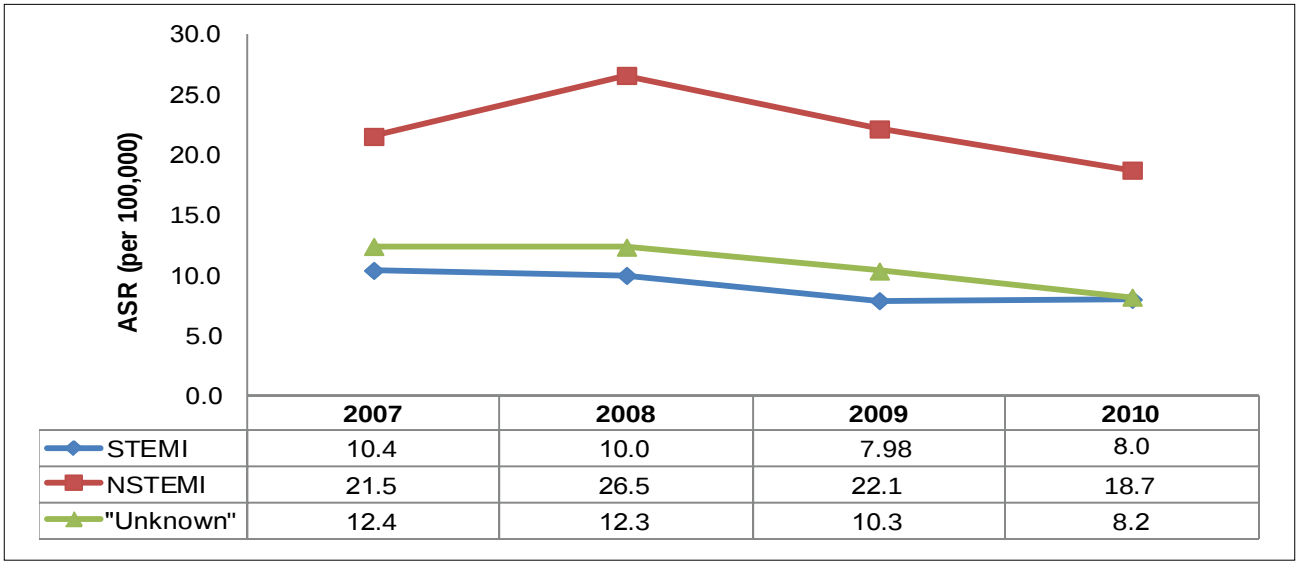
Figure 4.4.1 CRUDE MORTALITY RATES (PER 100,000 POPULATION) OF AMI, BY AMI TYPE, 2007 - 2010



	2007	2008	2009	2010
STEMI	11.5	11.2	9.1	9.6
NSTEMI	24.2	30.2	25.6	23.2
"Unknown"	13.6	13.9	11.9	9.6

Age-Standardised mortality rates amongst patients diagnosed with NSTEMI was observed to have declined from 26.5 per 100,000 in 2008 to 18.7 per 100,000 in 2010 (Figure 4.4.2).

Figure 4.4.2 AGE-STANDARDISED MORTALITY RATES (PER 100,000 POPULATION) OF AMI, BY AMI TYPE, 2007 - 2010



	2007	2008	2009	2010
STEMI	10.4	10.0	7.98	8.0
NSTEMI	21.5	26.5	22.1	18.7
"Unknown"	12.4	12.3	10.3	8.2

ASR = Age-Standardised Rate per 100,000 population per year (to 'World' population)

5. AMI CASE - FATALITY 2007 - 2010: ALL RESIDENTS

5.1 AMI Case-Fatality, Overall, 2007 - 2010

The number of AMI patients dying within 28 days after suffering from an AMI decreased from 1,088 in 2007 and 1,191 in 2008 to 914 in 2010 (Table 5.1.1). Number of AMI deaths amongst patients within 28 days of an AMI onset was consistently highest amongst patient aged 85 years and above during the 4-year period (Table 5.1.2). The mean and median ages of AMI deaths within 28 days of an AMI onset were 73 to 75 years and 75 to 76 years respectively from 2007 to 2010 (Table 5.1.3).

Table 5.1.1 AMI DEATHS WITHIN 28-DAYS, OVERALL, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Overall	1088	1191	1018	914

Table 5.1.2 AMI DEATHS WITHIN 28-DAYS, BY AGE GROUP, 2007 - 2010

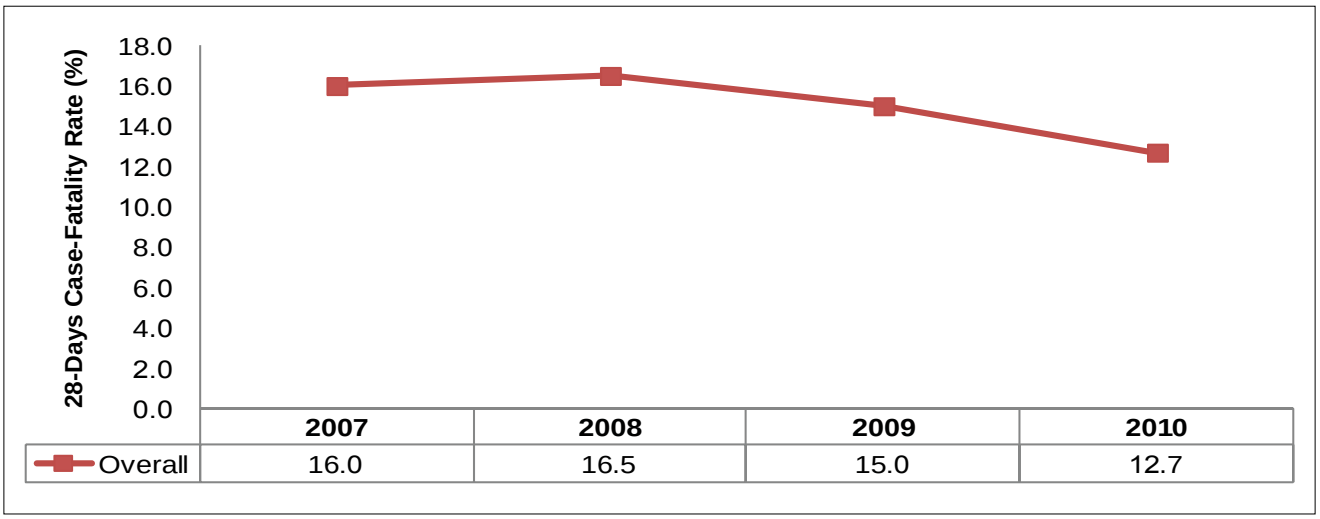
Year (Episodes)	2007	2008	2009	2010
18-19	0	0	0	0
20-24	0	0	0	1
25-29	1	1	1	1
30-34	2	3	1	2
35-39	10	8	5	1
40-44	16	27	14	13
45-49	41	37	31	31
50-54	64	68	72	48
55-59	85	88	74	41
60-64	73	104	89	91
65-69	111	131	99	68
70-74	163	147	126	105
75-79	178	180	190	150
80-84	155	170	128	162
>=85	189	227	188	200
Overall	**1088**	**1191**	**1018**	**914**

Table 5.1.3 MEAN AND MEDIAN AGE, AMI DEATHS WITHIN 28-DAYS, 2007 - 2010

Year	2007	2008	2009	2010
Median Age (Years)	75.2	75.2	75.4	76.9
Mean Age (Years)	73.2	73.4	73.5	74.9

The overall case - fatality rates, i.e. proportion of AMI deaths within 28 days amongst patients diagnosed with an AMI, has decreased from 16.0% in 2007 to 12.7% in 2010 (Figure 5.1.1).

Figure 5.1.1 CASE - FATALITY RATES (%) OF AMI, OVERALL, 2007 - 2010



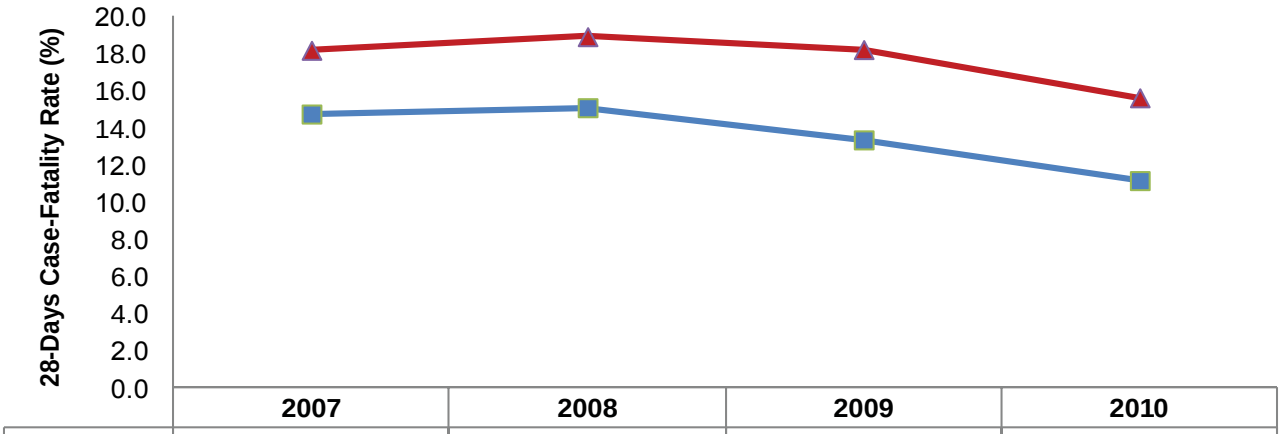
5.2 AMI Case-Fatality, by Gender, 2007 - 2010

The ratio of AMI deaths within 28 days of an AMI onset amongst males to females ranged from 1.36:1 to 1.50:1 during the 4-year period. The number of deaths within 28 days amongst males has seen a sharper decline in numbers as compared to females with 526 and 388 deaths, respectively, in 2010 (Table 5.2.1). Contrary to the higher incidence and mortality rates, the case - fatality rates amongst females were consistently higher than males during the 4-year period. The trend of case fatality rates by each gender corresponds to the overall trends, with a decreasing trend observed from 2008 onwards. In 2010, the case fatality rates amongst males and females were 11.2% and 15.6% respectively (Figure 5.2.1).

Table 5.2.1 AMI DEATHS WITHIN 28-DAYS, BY GENDER, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Male	652	706	594	526
Female	436	485	424	388
Overall	**1088**	**1191**	**1018**	**914**

Figure 5.2.1 CASE - FATALITY RATES (%) OF AMI, BY GENDER, 2007 - 2010



	2007	2008	2009	2010
Male	14.8	15.1	13.4	11.2
Female	18.2	18.9	18.2	15.6

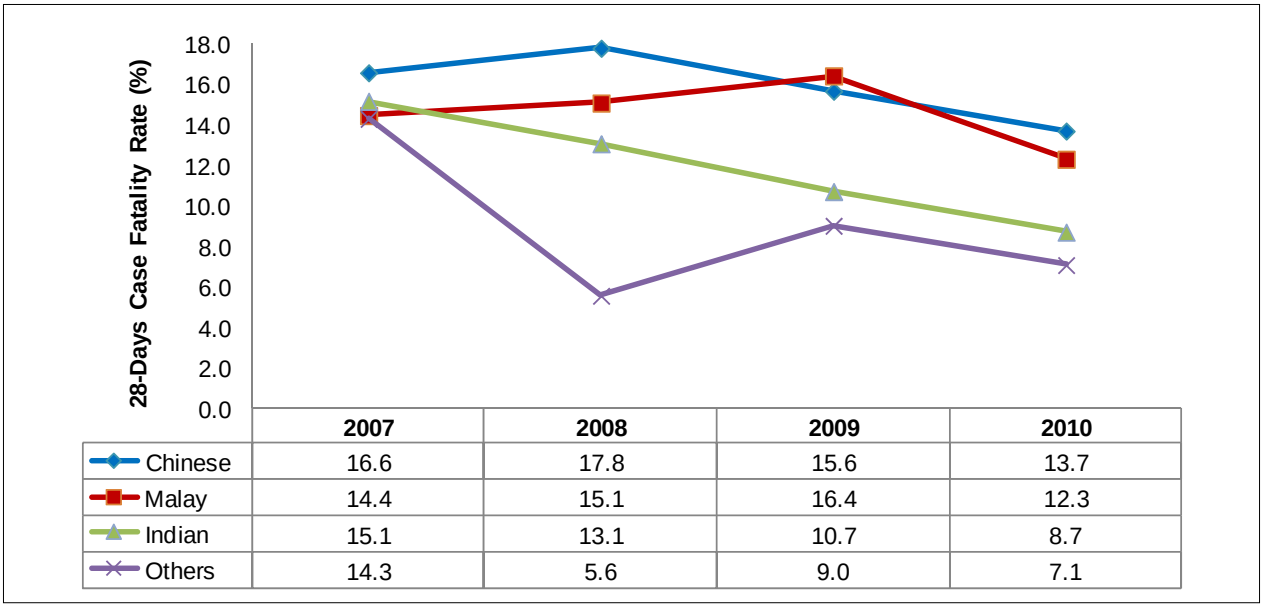
5.3 AMI Deaths, by Ethnic Group, 2007 - 2010

The number of AMI deaths within 28 days has decreased amongst all ethnic groups in 2010. The largest number of deaths within the stipulated period was highest amongst the Malay ethnic group in 2009 at 218 deaths, whereas for the Chinese, the numbers were highest in 2008 at 854 and 133 in 2007 for the Indians (Table 5.3.1). Correspondingly, there has been a consistent decline in case fatality rates from 15.1% in 2007 to 8.7% in 2010 amongst the Indians. The Chinese ethnic group have always had the highest proportion of case-fatalities within 28-days as compared to all ethnic groups except for the Malay ethnic group in 2009 (Figure 5.3.1).

Table 5.3.1 AMI DEATHS WITHIN 28-DAYS, BY ETHNIC GROUP, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
Chinese	766	854	695	657
Malay	169	207	218	174
Indian	133	124	95	76
Others	20	6	10	7
Overall	**1088**	**1191**	**1018**	**914**

Figure 5.3.1 CASE - FATALITY RATES (%) OF AMI, BY ETHNIC GROUP, 2007 - 2010



	2007	2008	2009	2010
Chinese	16.6	17.8	15.6	13.7
Malay	14.4	15.1	16.4	12.3
Indian	15.1	13.1	10.7	8.7
Others	14.3	5.6	9.0	7.1

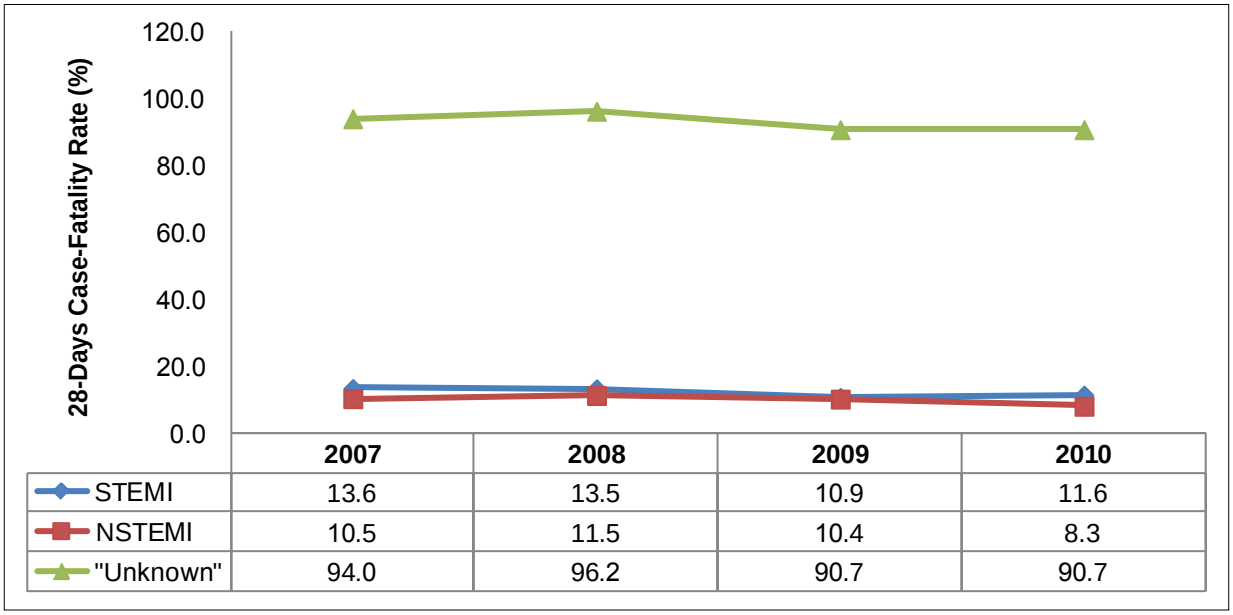
5.4 AMI Deaths, by AMI Type, 2007 - 2010

The number of AMI deaths within 28 days has decreased amongst all AMI subtypes in 2010. Despite the fluctuations observed in the incidence of NSTEMI numbers, the number of AMI deaths within 28 days amongst patients diagnosed with NSTEMI has decreased from 460 deaths in 2007 to 389 in 2010 (Table 5.4.1). The case - fatality rates have consistently been higher amongst patients suffering from STEMI as compared to NSTEMI, although the trend of the case - fatality rate for STEMI has decreased over the 4-year period. The case fatality rates amongst patients with unknown AMI subtypes were high, because a large proportion of these patients die before reporting at the hospital or are certified dead by a GP i.e. before a diagnosis can be made (Figure 5.4.1).

Table 5.4.1 AMI DEATHS WITHIN 28-DAYS, BY AMI TYPE, 2007 - 2010

Year (Episodes)	2007	2008	2009	2010
STEMI	282	279	226	241
NSTEMI	460	551	450	389
“Unknown”	346	361	342	284
Overall	**1088**	**1191**	**1018**	**914**

Figure 5.4.1 CASE - FATALITY RATES (%) OF AMI, BY AMI TYPE, 2007 - 2010



	2007	2008	2009	2010
STEMI	13.6	13.5	10.9	11.6
NSTEMI	10.5	11.5	10.4	8.3
"Unknown"	94.0	96.2	90.7	90.7

6. RISK FACTOR PROFILE OF INCIDENT AMI (%), 2007 - 2010

6.1 Risk Factor Profile of Incident AMI (%), Overall, 2007 - 2010

The proportion of risk factors has been fairly consistent over the 4-year period except for patients with hyperlipidemia. Proportion of AMI patients with hyperlipidemia has decreased from 84.3% in 2007 to 67.7% in 2010 (Table 6.1.1).

Table 6.1.1 RISK FACTOR PROFILE OF INCIDENT AMI (%), OVERALL, 2007 - 2010

Risk Factors (%)	Overall			
	2007	2008	2009	2010
Smoker	45.5	46.1	46.0	46.2
Hypertension	72.8	72.6	71.5	72.0
Diabetes	50.4	51.2	50.3	48.6
Hyperlipaedemia	84.3	68.5	67.2	67.7
Past AMI Event	23.2	26.0	26.7	26.6
BMI $\geq$ 23	56.8	56.4	57.4	57.2

6.2 Risk Factor Profile of Incident AMI (%), Gender, 2007 - 2010

The proportion of smokers amongst females has decreased from 13.2% in 2007 to 11.7% in 2010. Corresponding to the overall decrease in proportion of hyperlipidemia, the proportion of the risk factor has decreased in both genders, whereas, patients coming in with AMI were increasingly more likely to have had a past AMI event in both genders, however this increase was gradual. Cigarette smoking and being overweight or obese was more common amongst men as compared to women. Whereas, the reverse was true for patients possessing other risk factors, i.e. women were more likely to have hypertension, diabetes, hyperlipidemia and a past AMI event (Table 6.2.1).

Table 6.2.1 RISK FACTOR PROFILE OF INCIDENT AMI (%), GENDER, 2007 - 2010

Risk Factor (%)	Male				Female			
	2007	2008	2009	2010	2007	2008	2009	2010
Smoker	63.5	65.1	64.1	64.6	13.2	11.7	11.9	11.7
Hypertension	67.2	66.9	65.7	66.6	82.8	82.8	82.5	82.2
Diabetes	45.8	46.3	45.6	43.8	58.7	60.0	59.3	57.6
Hyperlipaedemia	86.1	69.2	66.6	66.2	81.0	67.1	68.3	70.4
Past AMI Event	22.6	24.8	25.4	25.1	24.2	28.2	29.3	29.4
BMI ≥ 23	61.3	60.2	61.4	61.2	46.8	48.0	48.6	48.7

6.3 Risk Factor Profile of Incident AMI (%), Ethnic Group, 2007 - 2010

The proportion of smokers amongst AMI patients was consistently found to be highest amongst the Malay ethnic group at 52.9% in 2010, an increase from 48.8% in 2007. Hypertension was most common amongst the Chinese at 73.0% in 2010. Being overweight and obese was more common amongst the Indians and Malays, while Indians were more likely to be diabetic or hyperlipidemic (Table 6.3.1).

Table 6.3.1 RISK FACTOR PROFILE OF INCIDENT AMI (%), ETHNIC GROUP, 2007 - 2010

Risk Factor	Chinese				Malay				Indian				Others			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
Smoker	44.5	44.7	44.2	44.2	48.8	50.7	49.6	52.9	45.5	46.4	48.4	45.6	53.0	47.2	55.0	54.1
Hypertension	74.2	73.4	72.5	73.0	71.4	69.9	69.9	69.8	68.5	72.4	69.1	71.3	65.2	69.8	69.7	60.2
Diabetes	46.6	46.6	46.5	44.1	56.8	59.3	54.1	54.1	63.0	63.3	64.3	64.9	43.2	46.2	46.8	40.8
Hyperlipaedemia	82.5	65.1	65.0	65.2	87.8	74.9	69.6	72.2	89.2	76.5	74.0	74.4	83.3	67.9	72.5	64.3
Past AMI Event	21.7	24.1	25.1	24.5	24.4	28.5	28.2	29.7	29.9	31.5	31.8	33.6	22.7	28.3	32.1	22.4
BMI ≥ 23	52.8	51.9	52.4	52.7	65.2	64.9	66.7	65.3	65.6	65.0	65.8	65.7	60.0	56.9	73.1	66.7

6.4 Risk Factor Profile of Incident AMI (%), AMI Type, 2007 - 2010

A larger proportion of AMI patients diagnosed with STEMI were smokers with a proportion of 56.6% as compared to NSTEMI patients with a proportion of 42.3% in 2010. Except for obesity, risk factors such as hypertension, diabetes, hyperlidemia, past AMI events were more common amongst patients diagnosed with NSTEMI as compared to patients diagnosed with STEMI (Table 6.4.1).

Table 6.4.1 RISK FACTOR PROFILE OF INCIDENT AMI (%), AMI TYPE, 2007 - 2010

Risk Factor (%)	STEMI				NSTEMI				"Unknown"			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
Smoker	54.1	57.1	56.7	56.6	42.1	41.6	41.7	42.3	25.5	35.9	27.8	35.7
Hypertension	59.8	60.1	56.6	56.9	78.7	77.9	78.2	78.5	78.8	72.5	81.1	74.4
Diabetes	41.6	42.6	40.7	39.5	54.6	54.9	54.6	52.5	49.6	50.4	57.8	48.7
Hyperlipaedemia	87.8	69.1	60.8	59.9	83.5	68.7	70.7	71.4	56.9	51.9	55.6	62.1
Past AMI Event	10.5	14.6	12.1	14.4	29.2	30.9	33.9	32.0	22.6	27.5	22.8	26.4
BMI $\geq$ 23	63.7	62.8	64.2	63.5	53.4	53.3	54.3	54.8	46.5	42.1	39.4	39.9

7. SYMPTOMS, 2007 - 2010: ALL RESIDENTS

7.1 Symptoms of AMI Patients, Overall, 2007 - 2010

Top 3 symptoms reported by patients with AMI were chest pain, breathlessness and diaphoresis at proportions of 73.4%, 67.3% and 41.2% in 2010 respectively (Table 7.1.1).

Table 7.1.1 SYMPTOMS OF AMI PATIENTS (%), OVERALL, 2007 - 2010

Symptoms	Overall			
	2007	2008	2009	2010
Chest Pain	73.1	73.2	74.5	73.4
Breathlessness	66.2	65.6	64.9	67.3
Diaphoresis	38.8	38.6	40.7	41.2
Syncope	2.0	3.6	2.1	2.3
Back Pain	5.0	6.1	6.5	6.2
Epigastric Pain	8.0	7.0	6.7	7.0
Jaw Pain	2.6	3.2	3.7	3.7
Shoulder Pain	4.4	5.0	5.4	5.0

*The proportions of symptoms reported are not mutually exclusive.

7.2 Symptoms of AMI Patients, Gender, 2007 - 2010

Symptoms of chest pain and diaphoresis were more common among men whereas breathlessness and epigastric pain were more common among women suffering from an AMI (Table 7.2.1).

Table 7.2.1 SYMPTOMS OF AMI PATIENTS (%), GENDER, 2007 - 2010

Symptoms	Male				Female			
	2007	2008	2009	2010	2007	2008	2009	2010
Chest Pain	77.4	77.3	78.9	77.8	64.6	64.5	64.9	64.1
Breathlessness	63.1	63.1	63.0	64.8	72.3	70.8	69.2	72.5
Diaphoresis	43.1	43.8	45.4	46.6	30.2	27.8	30.6	29.8
Syncope	2.2	3.7	2.0	2.8	1.7	3.6	2.2	1.4
Back Pain	4.5	5.9	6.6	5.8	6.0	6.4	6.2	7.2
Epigastric Pain	7.3	6.3	5.8	5.8	9.4	8.5	8.7	9.4
Jaw Pain	3.0	3.7	4.1	3.8	1.9	2.2	2.9	3.3
Shoulder Pain	4.5	5.3	5.8	5.4	4.0	4.3	4.5	4.2

7.3 Symptoms of AMI Patients, Ethnic Group, 2007 - 2010

Symptoms of chest pain were more prevalent amongst Indians with a proportion of 79.6% in 2010, compared to Chinese and Malays with a proportion of 71.0% and 76.4% respectively. Symptoms of breathelessness were more common amongst the Malay and Chinese ethnic group (Table 7.3.1).

Table 7.3.1 SYMPTOMS OF AMI PATIENTS (%), ETHNIC GROUP, 2007 - 2010

Symptoms	Chinese				Malay				Indian				Others			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
Chest Pain	71.3	71.4	72.7	71.0	73.6	74.8	75.1	76.4	80.1	79.4	80.9	79.6	80.3	69.2	81.6	80.5
Breathlessness	67.0	65.6	65.7	68.2	67.8	68.5	66.1	68.2	62.1	61.0	60.3	61.9	53.0	69.2	61.2	63.4
Diaphoresis	37.8	38.9	39.9	39.9	40.8	38.0	39.5	43.4	40.6	38.5	45.5	44.1	39.3	36.3	46.9	43.9
Syncope	2.2	3.9	2.2	2.5	1.5	3.5	1.7	2.1	1.3	2.6	2.1	1.8	4.3	5.5	2.0	1.2
Back Pain	4.0	5.1	5.0	4.5	6.2	6.1	8.5	8.5	7.8	10.5	10.3	11.1	6.8	6.6	8.2	7.3
Epigastric Pain	7.6	6.9	6.0	6.9	10.4	7.6	8.9	7.8	6.5	7.1	6.0	6.1	8.5	5.5	11.2	4.9
Jaw Pain	2.1	2.8	3.4	3.6	2.6	2.7	2.8	1.9	4.9	6.0	6.0	6.2	4.3	2.2	5.1	7.3
Shoulder Pain	3.4	4.1	4.7	4.1	4.2	4.4	6.2	4.5	8.9	9.9	7.7	9.7	6.8	4.4	3.1	8.5

7.4 Symptoms of AMI Patients, AMI Type, 2007 - 2010

Symptoms of chest pain and diaphoresis were more prevalent amongst patients diagnosed with STEMI with a proportion of 88.0% and 61.8% respectively, while breathlessness was more common amongst patients diagnosed with NSTEMI with a proportion of 71.6% in 2010 (Table 7.4.1).

Table 7.4.1 SYMPTOMS OF AMI PATIENTS (%), AMI TYPE, 2007 - 2010

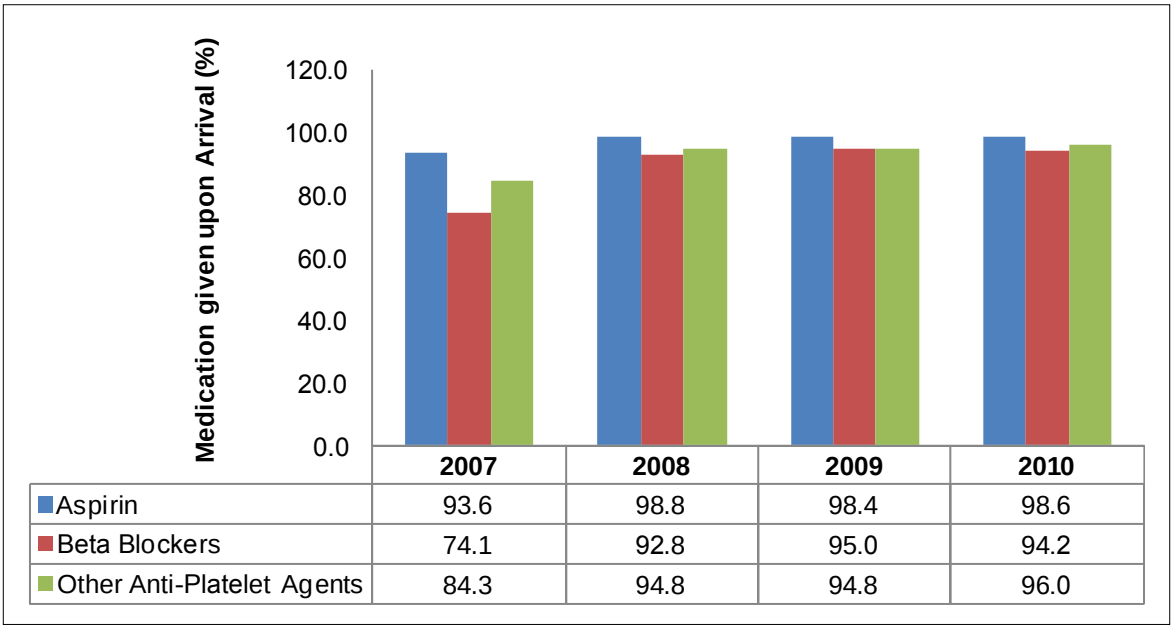
Symptoms	STEMI				NSTEMI				Unknown			
	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
Chest Pain	86.5	87.9	88.3	88.0	66.4	66.4	67.7	67.7	61.1	55.5	47.6	43.9
Breathlessness	58.5	56.3	57.6	58.4	70.8	70.5	69.2	71.6	54.4	60.4	62.1	70.3
Diaphoresis	58.3	58.7	61.4	61.8	29.3	29.2	30.0	31.8	15.4	18.9	16.9	22.6
Syncope	2.8	4.4	2.6	3.4	1.5	3.2	1.8	1.7	5.4	4.9	0.8	3.8
Back Pain	5.7	7.8	7.4	7.2	4.7	5.3	6.1	6.0	2.7	3.0	4.0	1.4
Epigastric Pain	8.1	7.2	6.4	6.0	8.0	7.0	7.0	7.5	4.7	5.5	3.2	6.6
Jaw Pain	3.2	4.2	4.5	5.3	2.5	2.9	3.3	3.0	0.0	0.6	0.0	0.5
Shoulder Pain	4.8	6.0	5.8	6.3	4.2	4.7	5.4	4.6	0.7	0.0	0.0	1.4

8. MEDICATION (%) 2007 - 2010: ALL RESIDENTS

8.1 Medication (%), 2007 - 2010

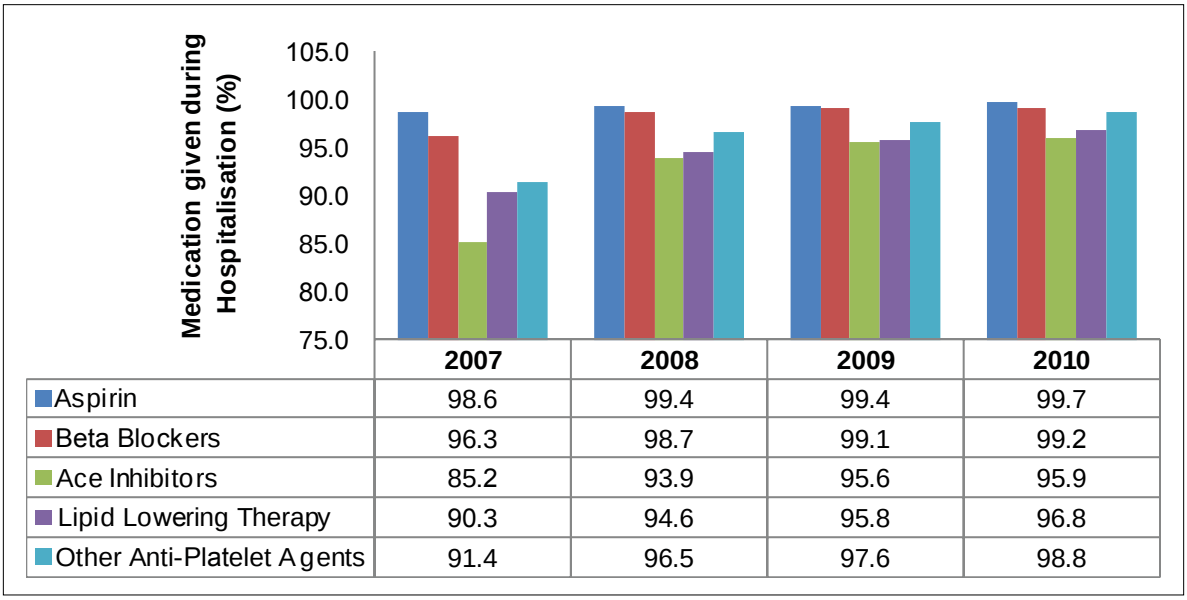
AMI patients admitted in the hospitals are given medications upon arrival, during hospitalisation and upon discharge. Patients who were included in this analysis were aged 18 years and above, given medications, managed in the hospital, confirmed as an AMI case at admission, did not have any contraindications and were alive at discharge. Over the 4-year period, proportion of patients given medication such as aspirin, beta blockers, ace inhibitors, lipid lowering therapy and other anti-platelet agents have improved and exceeded 94.0% in 2010 (Figures 8.1.1, 8.1.2 & 8.1.3).

Figure 8.1.1 MEDICATION ON ARRIVAL (STAT DOSES) (%), OVERALL, 2007 - 2010



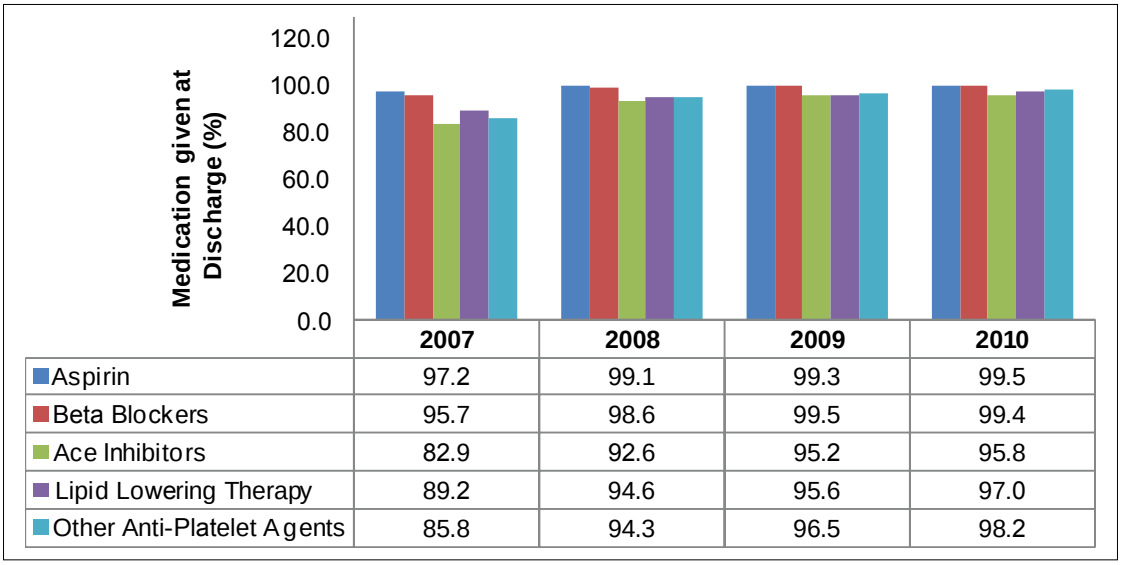
	2007	2008	2009	2010
Aspirin	93.6	98.8	98.4	98.6
Beta Blockers	74.1	92.8	95.0	94.2
Other Anti-Platelet Agents	84.3	94.8	94.8	96.0

Figure 8.1.2 MEDICATION DURING HOSPITALISATION (%), OVERALL, 2007 - 2010



	2007	2008	2009	2010
Aspirin	98.6	99.4	99.4	99.7
Beta Blockers	96.3	98.7	99.1	99.2
Ace Inhibitors	85.2	93.9	95.6	95.9
Lipid Lowering Therapy	90.3	94.6	95.8	96.8
Other Anti-Platelet Agents	91.4	96.5	97.6	98.8

Figure 8.1.3 MEDICATION UPON DISCHARGE (%), OVERALL, 2007 - 2010



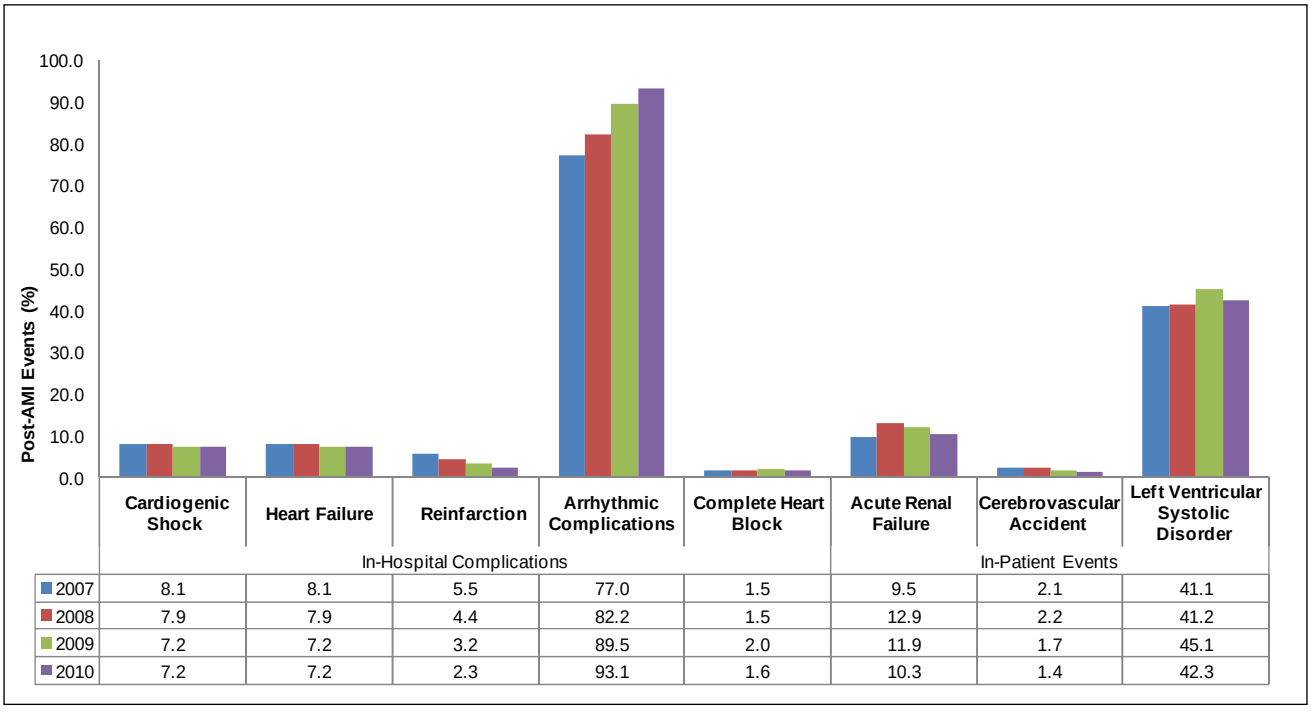
	2007	2008	2009	2010
Aspirin	97.2	99.1	99.3	99.5
Beta Blockers	95.7	98.6	99.5	99.4
Ace Inhibitors	82.9	92.6	95.2	95.8
Lipid Lowering Therapy	89.2	94.6	95.6	97.0
Other Anti-Platelet Agents	85.8	94.3	96.5	98.2

9. IN-PATIENT COMPLICATIONS AND EVENTS (%) 2007 - 2010: ALL RESIDENTS

9.1 In-Patient Complications and Events (%), 2007 - 2010

The SMIR collects in-hospital complication and events of patients who have been hospitalized post-AMI. Arrhythmic complications were found to be the most common complication after an AMI, whereas, left ventricular systolic dysfunction was more common occurrence after a patient was hospitalized (Figures 9.1.1).

Figure 9.1.1 IN-PATIENT COMPLICATIONS AND EVENTS (%), OVERALL, 2007 - 2010



	Cardiogenic Shock	Heart Failure	Reinfarction	Arrhythmic Complications	Complete Heart Block	Acute Renal Failure	Cerebrovascular Accident	Left Ventricular Systolic Disorder
	In-Hospital Complications					In-Patient Events		
2007	8.1	8.1	5.5	77.0	1.5	9.5	2.1	41.1
2008	7.9	7.9	4.4	82.2	1.5	12.9	2.2	41.2
2009	7.2	7.2	3.2	89.5	2.0	11.9	1.7	45.1
2010	7.2	7.2	2.3	93.1	1.6	10.3	1.4	42.3

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September 2012