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Distribution, management and outcomes of AMI according to principal diagnosis priority during inpatient admission

Brief title: Diagnosis priority in administrative data and AMI outcomes

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Abstract

Background: In recent years, there has been a growing interest in outcomes of patients with acute myocardial infarction (AMI) using large administrative datasets. The present study was designed to compare the characteristics, management strategies and acute outcomes between patients with primary and secondary AMI diagnoses in a national cohort of patients.

Methods: All hospitalizations of adults (≥18 years) with a discharge diagnosis of AMI in the US National Inpatient Sample between January 2004 and September 2015 were included, stratified by primary or secondary AMI. The International Classification of Diseases, ninth revision and Clinical Classification Software codes were used to identify patient comorbidities, procedures and clinical outcomes.

Results: A total of 10,864,598 weighted AMI hospitalizations were analysed, of which 7,186,261 (66.1%) were primary AMIs and 3,678,337 (33.9%) were secondary AMI. Patients with primary AMI diagnoses were younger (median 68 vs. 74 years, $p<0.001$) and less likely to be female (39.6% vs. 48.5%, $p<0.001$). Secondary AMI was associated with lower odds of receipt of coronary angiography (aOR 0.19; 95%CI 0.18-0.19) and percutaneous coronary intervention (0.24; 0.23-0.24). Secondary AMI was associated with increased odds of MACCE (1.73; 1.73-1.74), mortality (1.71; 1.70-1.72), major bleeding (1.64; 1.62-1.65), cardiac complications (1.69; 1.65-1.73), and stroke (1.68; 1.67-1.70) ($p<0.001$ for all).

Conclusions: Secondary AMI diagnoses account for one-third of AMI admissions. Patients with secondary AMI are older, less likely to receive invasive care and have worse outcomes than patients with a primary diagnosis code of AMI. Future studies should consider both primary and secondary AMI diagnoses codes in order to accurately inform clinical decision-making and health planning.

What is already known about the topic?

- Previous studies examining AMI management strategies and outcomes using large administrative datasets have largely focused on cohorts identified using the primary or principal discharge fields, while there is paucity of data for the AMI patients coded as secondary diagnosis.
- This study examined the characteristics, management strategies and outcomes in AMI patients based on diagnosis coding priority by utilizing a large contemporary nationwide dataset.

What does this article add?

- First study to compare characteristics and management of AMI from administrative data according to admission diagnosis priority.
- Patients with secondary AMI diagnoses were most commonly admitted for infection (21.8%), respiratory disorders (11.8%), heart failure (9.9%), disorders of coronary circulation other than AMI (6.7%) and gastrointestinal disorders (5.5%).
- Secondary AMI diagnosis patients were less likely to receive invasive management.
- Secondary AMI diagnosis patients were more likely to develop adverse in-hospital outcomes, including mortality, major adverse cardiovascular and cerebrovascular events, major bleeding, cardiac complications and stroke.

Introduction

Acute myocardial infarction (AMI) is a leading cause of morbidity and mortality globally accounting approximately for 366,000 deaths in the United States (US) (1). In recent years, there has been a growing interest in outcomes research in AMI patients using large administrative datasets (2–10). While these datasets have been previously validated for the purpose of cardiovascular outcomes research, their accuracy is reliant on both the standard of clinical coding as well as physician judgement as to what constitutes the primary discharge diagnosis for the clinical episode (11,12).

Previous studies examining AMI management strategies and outcomes using large administrative datasets, such as the US National Inpatient Sample and the Centers for Medicare & Medicaid Services (CMS) datasets have largely focused on cohorts identified using the primary or principal discharge fields (13,14). The proportion of AMI coded as a primary vs. secondary diagnosis in large national datasets is unknown. There is also a paucity of data on the differences between patients with a secondary AMI diagnosis and those with a primary AMI diagnosis with regards to the characteristics, risk profiles and clinical outcomes.

It has previously been suggested that differences in patient clinical outcomes may exist between acute coronary syndrome (ACS) events documented as primary versus secondary diagnoses (15). However, such studies are limited by relatively small patient sample sizes, and do not study temporal patterns of how primary versus secondary AMI diagnoses have changed over time or their clinical outcomes. Furthermore, previous studies have not reported patient characteristics, treatment strategies or clinical outcomes stratified by the primary / principal diagnosis for patients coded with secondary AMI diagnoses.

The present study aimed to address this knowledge gap by utilizing a large contemporary nationwide dataset to compare the characteristics, management strategies and outcomes between patients with primary vs. secondary AMI, and to examine the primary diagnoses of patients admitted with a secondary AMI. The overarching goal was to help guide the inclusion criteria of future studies when studying cohorts of AMI patients using administrative datasets.

Methods

Data

The National Inpatient Sample (NIS) represents the largest publicly available all-payer longitudinal databases of hospital inpatient discharges in the US. It was developed by the Agency for Healthcare Research and Quality (AHRQ), under the Healthcare Cost and Utilization Project, with a purpose of building a multistate database for medical research and decision making. It contains anonymized discharge-level data from >7 million hospitalizations annually, which can be used for the estimation of hospital utilization, quality and other related issues. It was designed to approximate 20% stratified sample of the US community hospitals, excluding rehabilitation and long-term acute care hospitals, and provides sampling weights to calculate national estimates that represent more than 95% of the US population.

Study design and population

All hospitalizations of adults (≥18 years) with a discharge diagnosis of AMI between January 2004 and September 2015 were included, stratified by diagnosis level variables (DX) in the dataset in to primary (DX1) and secondary (DX2-DX30) AMI. The International Classification of Diseases, ninth revision (ICD-9) and Clinical Classification Software (CCS) codes were used to identify patient comorbidities, procedures and clinical outcomes (**Supplementary Table 1**). Additional comorbidities were identified using the existing 29 AHRQ Elixhauser comorbidity measures. Cases excluded due to missing data represented 0.4% (n=68,183) of the original dataset (**Supplementary Figure 1**).

Outcomes

In-hospital adverse outcomes included major acute cardiovascular and cerebrovascular events (MACCE), all-cause mortality, major bleeding, acute stroke and cardiac complications. MACCE was defined as a composite of all-cause mortality, acute stroke/transient ischemic attack (TIA) and cardiac complications. Cardiac complications included hemopericardium, cardiac tamponade, coronary dissection, and any pericardiocentesis procedure. Differences in treatment were analysed, comparing the receipt of invasive management, in the form of coronary angiography (CA) and percutaneous coronary intervention (PCI).

Statistical analysis

Statistical Package for the Social Sciences (SPSS) statistical software (IBM Corp, Armonk, NY; version 25) was used for statistical analysis. Data were expressed as median (interquartile range) for continuous non-parametric data and as whole numbers (percentages) for categorical data. Quantitative data were analysed with the Mann–Whitney U test for non-normally distributed data, while the Chi-squared test was used for the comparison of categorical variables between the study groups. All analyses were conducted with appropriate sampling weights provided by the AHRQ, for each individual discharge. A trend analysis was conducted by assessing the interaction between AMI diagnosis priority and time (years) on clinical outcomes in a logistic regression analysis. Multivariable logistic regression analysis was used to determine the adjusted odds ratios (aOR [95% confidence interval (CI)]) of receipt of invasive managements and the likelihood of adverse outcomes in the secondary AMI diagnosis group, using the primary diagnosis group as the reference category. Variables adjusted for in the regression models are listed in Appendix A (Supplementary Material). Variables evaluating the socioeconomic characteristics of the patients such as 'primary expected payer' and 'median household income' were included in the multivariable logistic regression analysis to remove any confounding effects. Furthermore, hospital-related variables such as 'hospital bedsize', 'hospital region' and 'hospital location/teaching status' have been included in the analysis due to its possible impact on the outcomes of the studied population and to eliminate any hospital-related variability in the outcomes.

Results

Characteristics

Between January 2004 and September 2015, a total of 10,864,598 weighted AMI hospitalizations were recorded. Of these, 7,186,261 (66.1%) were primary AMI diagnoses and 3,678,337 (33.9%) were secondary diagnoses. There was an increase in the proportion of hospitalizations with secondary AMI, between 2004 and 2015 from 28.2% to 35.7% ($p<0.001$) (**Supplementary Figure 2**). Compared to primary AMI patients those with secondary AMI diagnoses were older (median 74 years vs. 68 years, $p<0.001$) and more likely to be female (48.5% vs. 39.6%, $p<0.001$) (**Table 1**).

Patients with a primary AMI diagnosis were more likely to be males, with a higher prevalence of smoking history, previous MI, dyslipidaemia, hypertension and obesity, whilst patients with secondary diagnoses were more likely to have comorbidities such as anaemia, atrial fibrillation (AF), valvular disease, congestive heart failure, peripheral vascular disorders, chronic renal failure, chronic pulmonary disease, metastatic cancer, and prior CABG. Compared to patients with a secondary diagnosis of AMI, patients with a primary diagnosis were more critically unwell, with a higher prevalence of cardiogenic shock and ventricular arrythmias. Patients with a primary AMI diagnosis were also significantly more likely to present with STEMI (28.3% vs. 10.1%, $p<0.001$, **Table 1**).

Amongst patients with secondary AMI diagnosis, the most frequent principal diagnosis was infection (21.8%), followed by respiratory disorders (11.8%), heart failure (9.9%), disorders of coronary circulation other than AMI (mainly coronary atherosclerosis of native vessels) (6.7%) and gastrointestinal disorders (5.5%) (**Figure 1)**. Further breakdown of the 'coronary circulation disorder' group reveals that this cohort of patients mainly had a coded primary diagnosis of coronary atherosclerosis of native vessels (**Supplementary Table 2**).

Invasive management

Patients with a primary AMI diagnosis were more likely to undergo CA (64.9% vs. 18.6%, $p<0.001$), PCI (43.3% vs. 8.5%, $p<0.001$), CABG (8.8% vs 3.4%, $p<0.001$) as well as the use of assist device (9.8% vs 5.2%, $p<0.001$) (**Table 2A, Figure 2A**). Following multivariable adjustment, patients with a secondary AMI diagnoses had significantly reduced odds of receipt of invasive coronary angiography (OR 0.18 95% CI 0.18-0.18) and PCI (OR 0.24 95% CI 0.23-0.24) in comparison to patients with a primary AMI diagnosis (**Table 2B and Figure 2B**).

Similarly, in the STEMI subgroup, patients with a primary AMI diagnosis were more likely to undergo CA (82.1% vs. 35.5%, p<0.001) and PCI (71.3% vs. 25.9%, p<0.001) (**Supplementary Table 3**). Following multivariable adjustment, patients with a secondary AMI diagnoses had reduced odds of receipt of invasive coronary angiography (OR 0.15 95% CI 0.15-0.15) and PCI (OR 0.20 95% CI 0.19-0.20) in comparison to patients with a primary AMI diagnosis (**Supplementary Table 4 and Supplementary Figure 3**).

The odds of receiving CA and PCI decreased between 2004 and 2015 amongst secondary AMI compared to primary AMI diagnosis (P<0.001 for trend) (**Supplementary Figure 4).**

Outcomes

Secondary AMI diagnoses had significantly higher all-cause mortality (16.5% vs. 5.8%), MACCE (23.3% vs. 9.6%, p<0.001), major bleeding (7.5% vs. 3.0%), as well as stroke (8.1% vs. 3.6%) (p<0.001 for all, **Table 2A, Figure 2A**). Patients with secondary AMI diagnoses had an increased length of hospital stay (6 vs. 3 days, p<0.001) and total direct hospitalization costs (44,610 vs. 44,099 USD, p<0.001) (**Table 2A**). Similar outcomes were observed in the STEMI subgroup (**Supplementary Table 3**).

Secondary AMI diagnosis patients had significant increased odds of MACCE (OR, 1.73; 95% CI, 1.72-1.74), all-cause mortality (OR 1.71; 95% CI, 1.70-1.72), as well as complications such as such as major bleeding (OR 1.63; 95% CI, 1.62-1.65), cardiac complications (OR 1.70; 95% CI, 1.66-1.74) and stroke (OR 1.68; 95% CI, 1.69-1.70) (p<0.001 for all), compared with primary AMI diagnosis (**Table 2B, Figure 2B**). Similar outcomes were observed in the STEMI subgroup (**Supplementary Table 4 and Supplementary Figure 3**).

Lastly, a stratification of outcomes amongst secondary AMI diagnosis by year from 2004 to 2015 shows a shift towards increased odds for MACCE, mortality, major bleeding, as well as stroke in this group (**Supplementary Figure 5**).

Characteristics, treatments and outcomes of secondary AMI diagnoses when stratified by the principal / primary diagnosis

Significant differences in median age were observed across the secondary AMI subgroups when stratified by the primary / principal diagnosis, with the youngest patients in the disorders of coronary circulation group (median age 65) whilst the oldest patients were observed in the heart failure and valve disorders group (median age 78) (**Supplementary Table 5**). Similarly, there were significant differences in the prevalence of cardiovascular risk factors and co-morbid conditions across the primary / principal diagnosis of the secondary AMI subgroups summarised in **Supplementary Table 5.**

Among the secondary AMI subgroups, patients with 'disorders of coronary circulation' had the highest utilization of CA, PCI and CABG, while the least likely patients to receive CA and PCI were in the 'infection' subgroup ($p<0.001$ for all) (**Supplementary Table 6 and Supplementary Figure 6**). Following adjustment for differences in covariates, patients with 'disorders of coronary circulation' exhibited increased odds of receipt of invasive coronary angiography (OR 1.57 95% CI 1.55-1.58) and PCI (OR 2.59 95% CI 2.57-2.62) in comparison to patients with a primary AMI diagnosis, while all other subgroups were less likely to receive invasive management (**Supplementary Table 7**).

Finally, within the secondary AMI subgroups, patients with 'disorders of coronary circulation' had the lowest rates of MACCE, mortality and major bleeding, while the highest rates of MACCE and mortality exhibited 'infection' subgroup ($p<0.001$ for all) (**Supplementary Table 6 and Supplementary Figure 6**). The secondary AMI subgroup with the highest rate of major bleeding was 'gastrointestinal, hepatic and bile disorders' subgroup ($p<0.001$) (**Supplementary Table 6 and Supplementary Figure 6**). After the covariate adjustments, patients with 'disorders of coronary circulation' had lower odds of MACCE (OR 0.96 95% CI 0.95-0.98), mortality (OR 0.49 95% CI 0.48-0.50) and major bleeding (OR 0.55 95% CI 0.53-0.57), but more cardiac complications (OR 3.39 95% CI 3.27-3.51), in comparison to patients with a primary AMI diagnosis (**Supplementary Table 7**). Other secondary AMI subgroups had increased odds for all-cause mortality compared to primary AMI diagnosis group (**Supplementary Table 7**).

Finally, a sensitivity analysis revealed a lower proportion of STEMI patients in the subgroup of patients with AF, irrespectively of the diagnosis coding priority (**Supplementary Table 8**).

Discussion

This is the first study comparing characteristics, management and outcomes of AMI according to diagnosis priority as coded within a large national dataset. Several important findings can be drawn. Firstly, up to one in three patients diagnosed with AMI nationwide have AMI coded as a secondary diagnosis. Thus, such patients would not be included in studies assessing AMI presentations, treatments and outcomes using administrative datasets when only a primary diagnosis code is considered as inclusion criterion. Secondly, there are significant differences in characteristics between patients presenting with primary and secondary AMI diagnoses, with the former group being younger, has a more predominance of males, and higher rates of previous MI and PCI, more likely to present with STEMI, and the latter group having a higher prevalence of non-cardiac comorbidities. Thirdly, patients with a secondary AMI diagnosis are less likely to undergo invasive management and were more likely to experience adverse outcomes such as all-cause mortality, MACCE, bleeding and stroke, compared with primary AMI patients, despite adjustments for baseline differences. Finally, we report that the characteristics, treatments and outcomes of patients diagnosed with a secondary AMI vary according to the principal diagnosis of this patient group, with patients with respiratory disorders and infection as the primary diagnosis least likely to receive invasive management and have worse outcomes.

Previous studies assessing AMI hospitalizations, their management and outcomes in different cohorts of patients have mainly focused on primary AMI diagnosis (2–7,16,17). However, the diagnosis priority as recorded administrative data may not necessarily reflect the acute cause of admission in these patients. Thus, failure to include patients with a secondary AMI diagnosis may result in the exclusion of a significant cohort of patients with AMI, leading to a significant underestimation of the AMI burden when evaluating in-hospital services as well as comorbid conditions and clinical outcomes associated with AMI. Furthermore, this may lead to potential miscalculation of the overall impact of AMI on health economics. This is particularly relevant when benchmarking services for the quality of care delivered in the management of AMI, where up to one third of all AMI admissions may not be considered and so any assessment of the quality of services is likely to be inaccurate.

Our study outlines the crucial health and financial burden associated with secondary AMI, which represented one third of all hospital admissions with AMI - findings which may require attention when considering resource allocation and strategic planning within healthcare. Of the few existing studies focusing on primary and secondary AMI, Sacks *et al.* examined trends in AMI hospitalizations, reporting an increased in secondary AMI diagnoses from 2002 to 2011, with the secondary AMI group accounting for 43% of all expenditures for hospitalizations with AMI (18). Shroff *et al.* analysed trends in discharge claims for AMI amongst dialysis patients, reporting a considerable increase in AMI claims for secondary diagnoses, with a corresponding decline seen for primary AMI diagnoses (19).

There are limited data on differences in management and outcomes of AMI between patients with primary and secondary AMI diagnoses. One recent study by Kerr *et al.* looked at primary and secondary ACS hospitalizations, reporting that patients with secondary diagnoses were less likely to receive CA but also revascularisation in the form of PCI or CABG (15). The secondary ACS diagnosis group also experienced a higher prevalence in all-cause mortality, cardiovascular mortality, stroke and bleeding (15). Although it was unclear whether these findings reached statistical difference, they are in line with the conclusions drawn from our study. Reasons for these findings could include the fact that patients in the secondary AMI group were significantly older than their primary counterparts, and thus likely to be frailer and have complex cardiac comorbidities in the first place. Another reason would be that the primary cause of admission might be associated with relative contraindications for invasive work up and management (e.g., intracranial bleeding, septic shock, etc.). Our findings of higher mortality in secondary diagnoses also correlate with some studies examining diagnostic coding position on outcomes of acute heart failure admissions. For instance, Shoaib *et al.* demonstrated that patients admitted to hospital with heart failure as a secondary rather than primary diagnosis have high mortality (20). Furthermore, it has been previously shown that socioeconomic characteristics such as 'primary expected payer' status and 'median household income' are associated with worse outcomes in patients with principal discharge diagnosis of AMI through disparities in the receipt of evidence-based therapies and guideline recommended care (21,22). However, in order to diminish the influence of these variables, we have conducted a multivariable logistic regression analysis and adjusted for them.

There are several reasons why an AMI admission may be coded as a secondary diagnosis coded rather than a principal diagnosis code. Firstly, it is possible that patients are admitted with other medical conditions and sustain an AMI during their in-patients stay. Not considering such cases will lead to a significant underestimate of the burden of AMI in the in-hospital setting and may lead to inaccurate benchmarking of services around quality of care, particularly when the odds of receipt of invasive management for the secondary AMI cases was significantly lower than those cases diagnosed as a primary AMI. Secondly, a secondary AMI diagnosis code may represent coding errors, although given the major differences in patients characteristics and clinical outcomes between primary and secondary diagnoses, this seems unlikely. Thirdly, a proportion of the AMI cases coded using a secondary diagnosis code, may in fact represent a type 2 MI, which are defined as myocardial necrosis caused by mismatch between oxygen supply and demand in the absence of coronary atherothrombosis, which is often precipitated by critical illness (23). Among studies using the 2007 and 2012 Universal Definition MI, the reported prevalence of type 2 MI ranged from 2 to 58% (24). Multiple mechanisms contributing to type 2 MI have been identified, and these include small vessel coronary obstruction, endothelial dysfunction, anaemia, hypotension as well as inflammation (25,26). AF often leads to high ventricular rates, atrial fibrosis and systemic inflammation, all of which could potentially mediate type 2 MI. Having in mind the global health burden of AF, these reports are additionally emphasized (27). Interestingly, a recent study showed that patients with AF were less likely to have STEMI than non-AF patients with different coronary involvement including less right coronary artery occlusions (28). Our analysis revealed consistent findings of lower proportion of STEMI patients in AF subgroup, irrespectively of the diagnosis coding priority. Other mechanisms identified in the respiratory disorder, heart failure, arrhythmia and gastrointestinal groups leading to possible type 2 MI are hypoxia, tachycardia and anaemia respectively, which all either result in reduced blood supply or increased physiological demand, leading to supply-demand mismatch (29). It is therefore important to differentiate between secondary AMI diagnoses and type 2 MI where treatments would be different particularly around the utilisation of revascularisation, as would be patient outcomes.

The primary cause of admission amongst patients with secondary AMI diagnoses varied significantly, with the most common causes being infection, respiratory disorders, and heart failure. There were significant differences in patient characteristics and invasive management strategy for AMI between secondary AMI diagnosis subgroups when stratified according to primary admission diagnosis. However, these differences persisted in multivariable analysis, with respiratory and infection primary diagnoses associated with the highest odds of mortality while the gastrointestinal group was associated with an 8-fold increase in odds bleeding, suggesting that these adverse events were more likely as a result of their primary diagnosis than their secondary AMI.

Limitations

We acknowledge some limitations of our study. First, the NIS is an administrative dataset that is subject to coding inaccuracies and underreporting of secondary diagnoses (30). Although the identification of AMI diagnoses was based on the use of administrative codes, ICD-9 codes have previously been validated for the purposes of cardiovascular research (31,32). Furthermore, we acknowledge that an unknown proportion of secondary AMI diagnosis patients represented type 2 AMI, in the setting of acute illness such as infection, arrhythmias and respiratory disorders. Unfortunately, ICD-9 does not provide means to distinguish between type 1 and type 2 AMI, nor is it possible to assess the severity of coronary artery disease or the ability to risk stratify AMI patients with established risk scores such as GRACE or Killip class.

Thirdly, since the NIS dataset does not record pharmacotherapy, it was not possible for us to examine the differences in antiplatelet therapy commenced between the primary and secondary diagnosis groups. The NIS also fails to capture exact cause of death as well as long term outcomes in the primary and secondary AMI diagnosis groups, thereby limiting findings to in-hospital events. Nevertheless, we believe that our study provides insight into real world in-hospital clinical outcomes of a large cohort of patients with primary and secondary diagnosis AMI.

Conclusion

Our comparison between primary and secondary AMI diagnoses illustrates that up to one third of all AMI admitted to hospitals in the United States do not have AMI coded as a principal diagnosis. We find significant differences in characteristics, management strategy as well as in-hospital outcomes. Importantly this study highlights the significant healthcare burden associated with secondary AMI. It will be essential in future for studies to consider all AMI diagnoses in order to accurately inform clinical decision-making and health planning.

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Appendix A. Multivariable logistic regression model

The following variables were adjusted for in multivariable logistic regression analysis due to clinical importance and possible direct relation to the clinical outcomes: hospital factors: bed size of hospital, region of hospital, location/teaching status of hospital, and patient demographics: age, sex, race, weekend admission, primary expected payer, median household income, smoking status, previous myocardial infarction (MI), previous coronary artery bypass graft (CABG) surgery, history of ischaemic heart disease (IHD), previous percutaneous coronary intervention (PCI), previous cerebrovascular accident (CVA), atrial fibrillation (AF), thrombocytopenia, Elixhauser comorbidities (acquired immune deficiency syndrome, alcohol abuse, chronic blood loss anaemia, chronic pulmonary disease, coagulopathy, congestive heart failure, deficiency anaemias, depression, diabetes mellitus, drug abuse, hypertension, hypothyroidism, liver disease, lymphoma, fluid and electrolyte disorders, metastatic cancer, neurological disorders, obesity, paralysis, peptic ulcer, peripheral vascular disorders, psychoses, pulmonary circulation disorders, renal failure, rheumatoid arthritis/collagen vascular diseases, solid tumor without metastasis, valvular heart disease, and weight loss) and receipt of PCI.

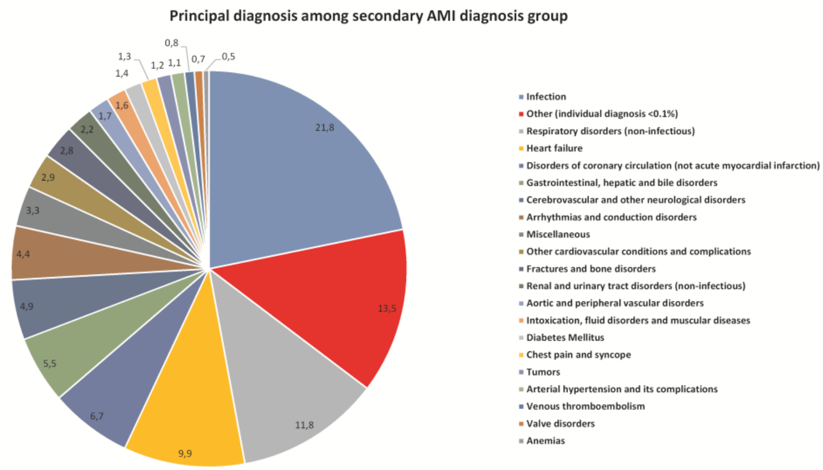
Table 1. Baseline characteristics of patients in the National Inpatient Sample discharged with a primary or secondary diagnosis of AMI

Characteristics	Diagnosis priority		*P*-value
	Primary AMI diagnosis (66.1%)	Secondary AMI diagnosis (33.9%)	
Number of weighted discharges	7,186,261	3,678,337	
Age (years), median (IQR)	68 (57, 79)	74 (63, 83)	<0.001
Age groups (years), %			<0.001
<60	33.2	19.9	
60-70	22.9	20.3	
71-80	21.8	26.4	
≥80	22.1	33.4	
Female sex, %	39.6	48.5	<0.001
Race, %			<0.001
White	76.7	76.3	
Black	9.8	11.2	
Hispanic	7.5	6.9	
Other	6.0	5.6	
STEMI, %	28.3	10.1	<0.001
Elective admission, %	6.9	16.2	<0.001
Weekend admission, %	26.0	23.5	<0.001
Primary expected payer, %			<0.001
Medicare	57.2	72.7	
Medicaid	6.2	6.3	
Private Insurance	27.6	15.7	
Self-pay	5.7	2.9	
No charge	0.6	0.3	
Other	2.7	2.0	
Median Household Income (percentile), %			<0.001
0-25th	27.5	27.2	
26th-50th	27.4	26.5	
51st-75th	23.7	24.2	
76th-100th	21.4	22.0	
Cardiogenic shock, %	5.0	4.3	<0.001

Cardiac arrest, %	3.1	4.9	<0.001
Ventricular tachycardia, %	6.0	5.9	<0.001
Ventricular fibrillation, %	2.7	1.9	<0.001
Cardiac tamponade, %	0.1	0.1	<0.001
Comorbidities, %			
Atrial fibrillation	16.6	26.0	<0.001
Dyslipidaemia	54.9	36.6	<0.001
Thrombocytopenia	3.3	6.2	<0.001
Dementia	5.8	10.5	<0.001
Smoking	34.9	21.6	<0.001
Previous AMI	10.4	7.9	<0.001
Previous PCI	11.8	11.7	<0.001
Previous CABG	7.5	9.2	<0.001
Previous CVA	4.0	4.8	0.038
Anemias	15.8	26.6	<0.001
Heart failure	31.3	47.6	<0.001
Valvular disease	0.3	9.6	<0.001
Hypertension	66.9	62.6	<0.001
Peripheral vascular disorders	10.9	13.1	<0.001
Pulmonary circulation disorders	0.1	5.0	<0.001
Chronic pulmonary disease	20.7	27.5	<0.001
Obesity	12.0	9.2	<0.001
Diabetes Mellitus	34.3	34.8	<0.001
Hypothyroidism	9.7	11.6	<0.001
Drug abuse	2.1	2.5	<0.001
Alcohol abuse	2.8	3.4	<0.001
Depression	6.4	8.1	<0.001
Liver disease	1.2	2.4	<0.001
Chronic renal failure	16.7	25.6	<0.001
Paralysis	1.6	3.9	<0.001
RA/collagen vascular diseases	2.2	2.7	<0.001
Solid tumor without metastasis	1.4	2.5	<0.001
Metastatic cancer	0.9	2.4	<0.001
Lymphoma	0.5	0.9	<0.001
Fluid and electrolyte disorders	19.4	41.1	<0.001

Bed size of hospital, %			<0.001
Small	10.7	12.8	
Medium	24.8	25.4	
Large	64.5	61.8	
Hospital Region, %			<0.001
Northeast	19.3	21.2	
Midwest	23.0	23.6	
South	40.1	37.5	
West	17.6	17.8	
Location/teaching status of hospital, %			<0.001
Rural	10.3	12.1	
Urban non-teaching	40.9	39.5	
Urban teaching	48.7	48.5	

Abbreviations: AIDS – Acquired Immunodeficiency Syndrome; AMI – Acute Myocardial Infarction; CABG – Coronary Artery Bypass Graft; CAD – Coronary Artery Disease; CVA – Cerebrovascular Accidents; IQR – Interquartile Range; PCI – Percutaneous Coronary Intervention; RA – rheumatoid arthritis; STEMI – ST-elevation Myocardial Infarction.



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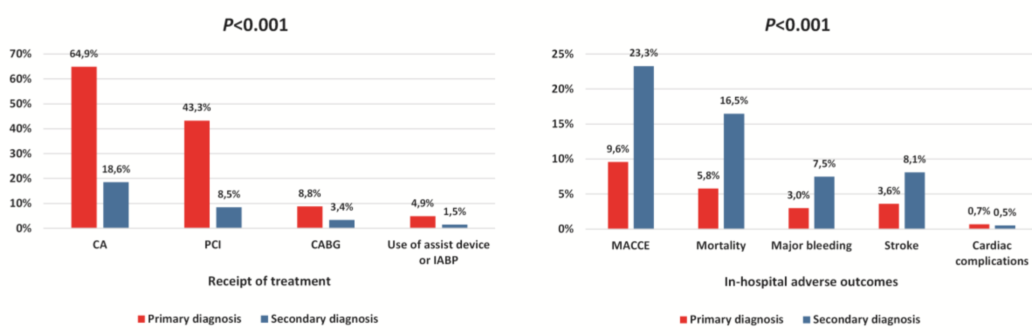

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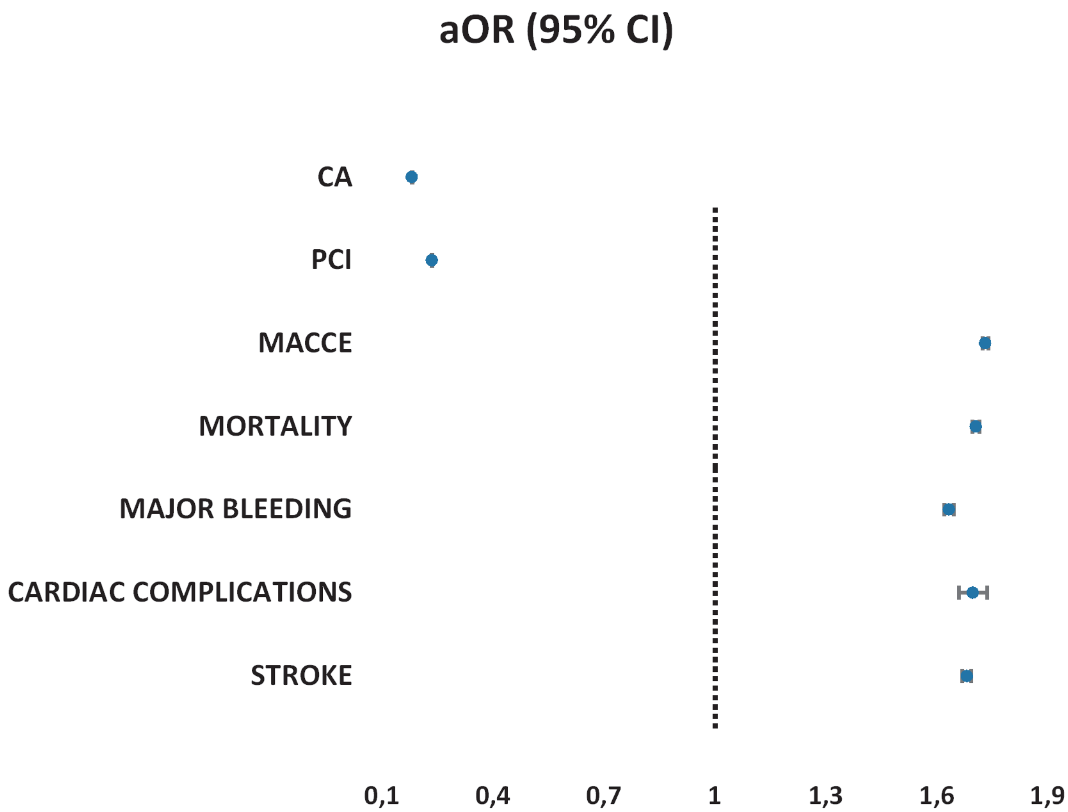

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