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Are we optimizing the use of dual antiplatelet therapy in patients hospitalized with acute myocardial infarction?

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Abstract

Background—Dual antiplatelet therapy (DAPT) is a mainstay treatment for hospital survivors of an acute myocardial infarction (AMI). However, there are limited data on the prescribing patterns of DAPT among patients hospitalized with AMI during recent years.

Objective—To examine decade-long trends (2001–2011) in the use of DAPT versus antiplatelet monotherapy and patient characteristics associated with DAPT use.

Methods—The study population consisted of 2,389 adults hospitalized with an initial AMI at all 11 central Massachusetts medical centers on a biennial basis between 2001 and 2011. DAPT was defined as the discharge use of aspirin plus either clopidogrel or prasugrel. Logistic regression analysis was used to identify patient characteristics associated with DAPT use.

Results—The average age of the study population was 65 years, and 69% of patients were discharged on DAPT. The use of DAPT at the time of hospital discharge increased from 49% in 2001 to 74% in 2011; this increasing trend was seen across all age groups, both sexes, types of AMI, and in those who underwent a PCI. After multivariable adjustment, patients 65–74 years old (adjusted odds ratio (aOR) = 0.53, 95% CI: 0.36 – 0.80) and those who underwent coronary artery bypass surgery (aOR = 0.11, 95% CI: 0.07 – 0.18) were less likely to have received DAPT, while men (aOR = 14.60, 95% CI: 10.66 – 19.98) and those who underwent cardiac catheterization and stenting (aOR = 14.60, 95% CI: 10.66 – 19.98) were significantly more likely to have received DAPT at discharge than respective comparison groups.

Conclusions—Between 2001 and 2011, the use of DAPT increased markedly among patients hospitalized with AMI. However, a significant proportion of patients were not discharged on this

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Disclosures

The authors declare no conflicts of interest.

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therapy. Greater awareness is needed to incorporate DAPT into the management of patients hospitalized with AMI.

Keywords

Dual antiplatelet therapy; Acute myocardial Infarction; Aspirin; Clopidogrel; Prasugrel

Introduction

Despite advances in the management of patients with acute and chronic forms of coronary artery disease, this disease remains a leading cause of morbidity and mortality worldwide (1, 2). Antiplatelet medications are a mainstay therapy for the secondary prevention of an acute coronary syndrome as these therapies have been consistently shown to reduce cardiovascular morbidity and mortality (3, 4). Moreover, dual antiplatelet therapy (DAPT), where aspirin (ASA) is combined with the use of a P2Y₁₂ receptor inhibitor (clopidogrel, prasugrel or ticagrelor), provides platelet inhibition through different mechanisms than a single antiplatelet medication. Use of DAPT has been shown to lead to a greater reduction in recurrent major adverse cardiovascular events in patients with an acute coronary syndrome as well as among those undergoing a percutaneous coronary intervention with stable coronary artery disease compared with aspirin monotherapy (5–10). Currently, American College of Cardiology/American Heart Association and European Society of Cardiology guidelines recommend dual antiplatelet therapy for effective secondary prevention among hospital survivors of an acute coronary syndrome, regardless of the revascularization intervention implemented (11). On the other hand, the optimal duration of DAPT for subjects undergoing a percutaneous coronary intervention remains debatable (12, 13).

It remains of importance to continuously monitor the use of evidence-based therapy with antiplatelet medications, most notably DAPT, for the management of survivors of an acute coronary event. However, there are limited published data in the United States that has described changes over time in the use of, and factors associated with, DAPT in patients hospitalized with an acute myocardial infarction (AMI).

The primary objective of this observational study was to describe changes over time in the use of, and factors associated with, DAPT in residents of central Massachusetts hospitalized for an initial AMI at all 11 metropolitan Worcester medical centers on a biennial basis between 2001 and 2011. Our secondary study objective was to describe the characteristics of patients treated with DAPT versus aspirin monotherapy during the decade-long period under study and whether there have been changes in the characteristics of patients more or less likely to receive this beneficial therapy.

Methods

Data for this investigation were derived from the Worcester Heart Attack Study (14). This is a population-based investigation that is examining long-term trends in the incidence, hospital, and post-discharge case-fatality rates of AMI on an approximate biennial basis among residents of central Massachusetts hospitalized at all 11 greater Worcester medical centers. While this study is ongoing, data collection activities for more contemporary study

years have not been completed and our most recent study year was 2011. We restricted the present study population to those hospitalized with a confirmed AMI on a biennial basis between 2001 and 2011 to provide a decade-long perspective into providers' prescribing practices. Potential study patients were identified through the systematic review of hospital discharge listings of patients with ICD-9 codes suggestive of possible AMI and who satisfied our geographic eligibility criteria (e.g., resident of Worcester metropolitan area). The medical records of eligible patients were individually reviewed for each study year, and a diagnosis of AMI was validated according to pre-defined criteria, which include patient's presenting symptoms, serial electrocardiographic findings, and changes in serum biomarkers (15). Patients with type II AMI and those with Takotsubo syndrome were not included in this study.

Data Collection

Demographic, clinical, and in-hospital management data were abstracted from the hospital medical records of geographically eligible patients with confirmed AMI during each study year by trained study physicians and nurses. Information was collected about patient's age, sex, comorbidities (e.g., diabetes, hypertension, stroke, chronic kidney disease, atrial fibrillation), AMI order (initial vs. prior) and type ((ST-elevation Myocardial Infarction (STEMI) vs. Non-ST-elevation Myocardial Infarction (NSTEMI)), in-hospital pharmacologic management and receipt of diagnostic/interventional procedures, and hospital discharge status.

Information was collected about the occurrence of clinically significant in-hospital AMI-related complications including stroke (16), atrial fibrillation (17), heart failure (18), and cardiogenic shock (19). Details regarding the antiplatelet regimen (DAPT or monotherapy) given at the time of hospital discharge were also obtained. Administration of DAPT was defined as the receipt of a combination of ASA and a P2Y12 receptor inhibitor (clopidogrel or prasugrel) at the time of hospital discharge, while antiplatelet monotherapy was defined as being prescribed either ASA or clopidogrel alone at the time of hospital discharge. Since ticagrelor, another P2Y12 receptor inhibitor, was not approved until 2013, we did not have data about the use of this drug in our study population.

Because we wanted to compare the characteristics of patients who received DAPT versus monotherapy, we excluded patients who did not receive any form of antiplatelet therapy. Moreover, since current clinical guidelines recommend DAPT for up to 12 months after a PCI with stent implantation before switching to monotherapy (11), we only included patients with an initial episode of AMI. In addition, because the addition of DAPT to oral anticoagulation therapy leads to a two to three-fold increase in bleeding risk (20), patients who were also treated with anticoagulant therapy were excluded from the present investigation. This study was approved by the Institutional Review Board at the University of Massachusetts Medical School.

Data Analysis

Differences in the distribution of selected demographic, medical history, and clinical characteristics between patients with AMI who received DAPT versus monotherapy were

examined using chi-square and t tests for discrete and continuous variables, respectively. The statistical significance of changes over the decade-long study period in the use of antiplatelet therapy was examined using chi-square tests for trends. A logistic multivariable regression approach was used to examine the association between a number of demographic and clinical characteristics with the receipt of DAPT during the patient's index hospitalization for an initial AMI. We included, in the regression models, factors that have been previously associated with the receipt of DAPT and factors that differed between our respective comparison groups (those who received DAPT versus monotherapy) at a p-value of < 0.20 .

Results

Study Population Characteristics

The study population consisted of 2,389 hospital survivors of an initial, independently validated AMI at all 11 central Massachusetts medical centers. In this population, 1,657 patients (69.4%) were discharged from participating central Massachusetts hospitals on DAPT (Table 1). Patients who received DAPT at the time of hospital discharge were younger, more likely to be male, who developed a STEMI, and who underwent a cardiac catheterization and a PCI (Table 1). Only 9.4% of those discharged from the hospital on monotherapy received clopidogrel alone, while the second antiplatelet drug used in the DAPT group was clopidogrel in 97.6% and prasugrel in 2.4% of patients. On the other hand, a smaller percentage of patients who received DAPT developed important hospital complications of AMI including heart failure. A greater proportion of patients who received monotherapy were previously diagnosed with various co-morbid medical conditions such as gastrointestinal (GI) bleeding and peptic ulcer disease, experienced a longer hospital stay, and were also more likely to have undergone coronary artery bypass graft (CABG) surgery and received thrombolytic therapy during their acute hospitalization (Table 1). Patients who were treated with DAPT had higher serum triglyceride and glomerular filtration rate (GFR) findings but lower serum levels of high-density lipoprotein and serum glucose. No differences were seen in the prior use of antiplatelet therapy between patients who were treated with DAPT versus monotherapy (Table 1).

Trends in the use of DAPT among hospital survivors of AMI

The proportion of patients who presented with an initial AMI and received DAPT at the time of hospital discharge increased steadily over time from 49% in 2001 to 74% in 2011 (Figure 1). This increase was seen across all age groups, in both sexes, in patients with a STEMI or an NSTEMI, and in those who underwent a PCI (Figure 1).

After controlling for several demographic factors, comorbid conditions, hospital revascularization procedures, and complications of AMI, the odds of receiving DAPT at the time of hospital discharge significantly increased during the years under study (Table 2). This trend was also seen after stratifying for the type of AMI and the receipt of a PCI; increases in the administration of this therapy were observed in patients who developed either a STEMI or an NSTEMI and in those who did and did not undergo a PCI (supplementary Tables 1 and 2).

In examining possible changing trends in DAPT use across different patient groups (Table 3), the utilization of DAPT significantly decreased with advancing age, and was less often prescribed to women as compared with men. There was a significant increase during the years under study in the use of DAPT among patients with a STEMI or a NSTEMI, with different previously diagnosed comorbidities, among those with and without prior antiplatelet use, and among those who underwent a PCI. However, DAPT use in patients who underwent CABG surgery during their index hospitalization for AMI did not increase during the years under study, where it was administered to approximately 13 in every 100 patients who underwent this procedure during the most recent years under study (Table 3).

Factors Associated with Receipt of DAPT at the Time of Hospital Discharge

In the fully adjusted logistic regression model, patients who were between the ages of 65 and 74 years, those with a history of GI bleeding, and those who underwent CABG surgery were at significantly lower odds for receiving DAPT at the time of hospital discharge. On the other hand, men, and those who underwent a cardiac catheterization and a PCI were significantly more likely to have been administered DAPT than respective comparison groups; having undergone a PCI was the strongest predictor of DAPT use (Table 4). Similar results were seen after stratifying for type of AMI (supplementary Table 3). However, after stratifying the data according to whether or not patients underwent a PCI, none of these demographic or clinical factors were associated with DAPT use, and only younger patient age was associated with the receipt of DAPT in those who did not undergo a PCI during their acute hospitalization (supplementary Table 4).

Discussion

Platelet adhesion and activation and subsequent aggregation represent the key targets for the secondary prevention of an acute coronary event. At the cellular level, aspirin and thienopyridines inhibit platelet activation through different mechanisms, and prior studies have shown the synergistic effects of DAPT on decreasing platelet activity and improving anti-inflammatory effects compared with monotherapy alone in high-risk populations (21). Inasmuch, adding a thienopyridine to aspirin therapy has well-established benefits in the setting of an acute coronary syndrome, including patients who developed a STEMI or a non-STEMI (6, 22) and among those who underwent a PCI (10, 23), by reducing the risk of stent thrombosis, recurrent AMI, and cardiovascular mortality compared with aspirin alone. Hence, current guidelines recommend DAPT for at least 12 months among patients with an acute coronary syndrome regardless of the type of coronary revascularization procedure performed (11).

Trends in the use of DAPT among hospital survivors of AMI

To the best of our knowledge, there are limited data and comparable studies describing trends in the use of different antiplatelet regimens for patients with AMI in the U.S. (24). The results of the present study demonstrate that the use of DAPT among residents of central Massachusetts hospitalized at all 11 greater Worcester medical centers for a first AMI has steadily increased during the decade-long period under study. This was seen among patients of different ages, both sexes, with different comorbidities, and after adjusting for

several demographic factors, comorbid medical conditions, other hospital management practices, and occurrence of several clinically important complications. This finding may reflect an increased awareness among clinicians to prescribe DAPT over monotherapy and implementing more optimal patient management practices. Complying with the use of evidence-based, recommended therapy at the time of hospital discharge for patients with AMI has been associated with better outcomes (3, 25–29). This is why a combination of cardioprotective medications (e.g., beta blockers, angiotensin-converting enzyme inhibitors/angiotensin receptors blockers, aspirin, and statins) has been recommended in the most recent treatment guidelines (11), and their use has been increasing over time (30).

Data from several cardiovascular disease registries report overall usage of DAPT among patients discharged after an acute coronary syndrome in Europe and Canada to be between 60 and 80%, depending in part on the characteristics of the study population, period under observation, and the type of acute coronary event examined (31, 32). Similar to our study, increases in the use of DAPT among hospital survivors of an AMI has also been seen in studies from Denmark and Sweden (33, 34). In one study of 28,449 patients who survived a first AMI between 2009 and 2012 in Denmark, there was a slight increase in the proportion of patients who received DAPT from 68% in 2009 to 73% in 2012 (33). Similar findings have been observed in a retrospective cohort study which used data from a Swedish national registry of patients hospitalized with AMI (35). In this investigation, there was a decrease in the proportion of patients not receiving DAPT from 33% in 2009 to 25% in 2013. Based on these data, recommended treatment guidelines, and possible contraindications to the receipt of DAPT, we believe that at least 75 – 85 % of subjects admitted for AMI should be treated with DAPT, unless the subjects are at high risk for bleeding.

Factors Associated with the Receipt of DAPT

In examining differences in the characteristics of patients who received either DAPT or monotherapy, those who were treated with monotherapy appeared to be a sicker group of patients as reflected by their older age and presence of more co-morbid conditions. Moreover, we showed that being a man and undergoing cardiac catheterization and a PCI was associated with higher odds of being prescribed DAPT. On the other hand, patients who underwent CABG surgery were at significantly lower odds for receiving DAPT, after adjusting for multiple potentially confounding factors. Several of these factors, such as being a woman, of advanced age, and having chronic kidney disease have been associated with a higher risk for bleeding after an AMI (36–38). In addition, patients with a history of GI bleeding were less likely to have received DAPT during their acute hospitalization. This is likely explained by the fact that antiplatelet therapy increases the risk of GI bleeding, and the risk of GI bleeding is further increased in patients on DAPT, likely due to prostaglandin inhibition by aspirin and decreased platelet aggregation by both aspirin and P2Y₁₂ inhibitors (39). However, the resumption of antiplatelet therapy following an episode of GI bleeding has been shown to decrease mortality and the risk of recurrent ischemic events, despite increasing the risk of episodes of minor or major bleeding (40). Inasmuch, antiplatelet therapy, particularly DAPT, should be considered among patients who are at risk for adverse events or have a history of GI bleeding. The use of proton pump inhibitors should be strongly considered in these patients since these agents have been shown to reduce the risk

of GI bleeding in patients on DAPT and has been strongly recommended as a Class I indication (41, 42). Inasmuch, the reasons for not prescribing DAPT to certain patient groups may have been based on physicians' judgment given the high risk of bleeding among sicker patients, due to failing DAPT while in the hospital secondary to bleeding, medication costs, or less likely, to suboptimal care for these patients.

Despite the encouraging trends in increased use of DAPT over time, a considerable percentage of patients with a confirmed AMI failed to receive DAPT. In fact, we observed significant age and gender disparities in the use of DAPT as we noted that older patients and women were less likely to be prescribed this therapy than respective comparison groups. This is of particular concern since women and older individuals who develop an AMI have a worse prognosis and are at greater risk for developing a recurrent AMI compared with men and their younger counterparts (43, 44). Disparities in age and sex with respect to the management of AMI survivors have also been reported in other studies which have shown that women and older individuals were less likely to receive antiplatelet therapy and other cardio-protective medications than men and younger individuals (45).

Moreover, the increase in DAPT use that we observed during the years under study was only seen among those who underwent a PCI and not in those who underwent CABG surgery in whom the rates of DAPT use remained surprisingly low over time. However, data on the benefits of prolonged DAPT therapy (more than one month) following hospital discharge have been available since the early 2000's based on findings from the CURE (Clopidogrel in Unstable Angina to prevent Recurrent Events) (6, 10) and CREDO (The Clopidogrel for the Reduction of Events During Observation) (23) trials. Recommendations from the American Heart Association (AHA) for the use of DAPT after CABG surgery have been included in published guidelines since 2002 (46–49). Indeed, DAPT should be resumed after CABG surgery as per the most recent guidelines (Class I recommendation), given the improvement in short and long-term outcomes provided by DAPT compared with aspirin alone (11).

Despite the fact that the most recent year under study was 2011, there is usually a considerable lag time between guideline updates and widespread adoption of various AMI therapies, including DAPT, in clinical practice, which may explain the suboptimal utilization of DAPT during the period under study. For patients with a NSTEMI, recommendations for long-term DAPT use post discharge have been established since 2002 (47). However, for patients with a STEMI, the recommendations for DAPT use have gained more strength in the last 5–10 years. Since the publication of the 2004 guidelines for the treatment of patients with a STEMI (46) that recommended DAPT only among those who received a stent, 2 trials have provided data supporting the expansion of the use of DAPT to those with a STEMI, irrespective of the type of reperfusion therapy utilized (50, 51). Not until 2007 did the ACC/AHA guidelines recommend the continued and long-term use of DAPT post discharge among survivors of an STEMI, regardless of revascularization therapy (Class IIa; Level of Evidence: C)) (52); this recommendation became more solid and with a higher class recommendation (Class I) and level of evidence (B) in the 2009 ACC/AHA guidelines for the management of STEMI (53) and has been maintained in the most recent guidelines (11).

Study Strengths and Limitations

The current study has several strengths. First, we included patients from a well characterized urban community in central Massachusetts hospitalized with an independently validated first AMI at all hospitals in central Massachusetts. Moreover, this is the first U.S. study to examine trends in the discharge use of DAPT among a large number of patients hospitalized with AMI over a decade-long period who resided in a defined community. Additionally, we were able to control for a number of potentially confounding factors in examining patient characteristics associated with the receipt of DAPT in patients hospitalized with AMI. The limitations of our study include the absence of data on the duration of DAPT and dose of aspirin given. Moreover, we did not have data on the use of ticagrelor in the population under study as well as information on recently introduced direct oral acting anticoagulants.

In conclusion, the use of DAPT for the secondary prevention of AMI among patients with an AMI has increased over time, reflecting enhanced prescribing of evidence-based therapy. Despite the significant benefits on patient survival that have been observed with the use of DAPT compared with antiplatelet monotherapy, we observed that a significant proportion of patients discharged from the hospital after an AMI were not prescribed DAPT. Inasmuch, there is a need to increase awareness among physicians to incorporate DAPT in the management of this vulnerable group of patients, while varying the duration of DAPT according to the risk of bleeding in the context of current guidelines.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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List of Abbreviations

AMI	acute myocardial infarction
ASA	aspirin
CABG	coronary artery bypass graft
DAPT	dual antiplatelet therapy
GFR	glomerular filtration rate
GI	gastrointestinal

PCI	percutaneous coronary intervention
STEMI	ST segment elevation myocardial infarction
NSTEMI	non-ST segment elevation myocardial infarction

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Highlights

- The use of DAPT after discharge increased between 2001 and 2011.
- Very limited data is available about the trends in the use of DAPT after AMI.
- Being male and undergoing PCI are positively associated with receiving DAPT.
- Females, older patients, and CABG patients are not optimally managed with DAPT.

Figure 1.

Trends in the receipt of DAPT at the time of hospital discharge among hospital survivors of an initial acute myocardial infarction (Worcester Heart Attack Study). A, by age group; B, by sex; C, by AMI type; D, by coronary revascularization procedure

Table 1.

Baseline characteristics of hospital survivors of an initial acute myocardial infarction according to the receipt of antiplatelet therapy at the time of hospital discharge (Worcester Heart Attack Study)

Characteristic	DAPT (n = 1,657)	Monotherapy (n = 732)	p-value
Age, mean (SD), years	61.8 (13.5)	70.9 (13.7)	<0.001
Male (%)	66.2	48.4	<0.001
White (%)	88.3	88.8	0.72
ST-segment elevation myocardial infarction (%)	46.7	25.4	<0.001
Medical history (%)			
Chronic kidney disease	9.7	15.7	<0.001
Chronic obstructive pulmonary disease	8.3	17.6	<0.001
Diabetes mellitus	25.5	30.9	<0.01
Heart failure	5.7	16.0	<0.001
Hyperlipidemia	58.6	50.6	<0.001
Hypertension	62.3	69.1	<0.01
Peripheral vascular disease	9.7	13.2	<0.05
Percutaneous coronary interventions	7.6	6.8	0.5
Stroke	4.2	9.2	<0.001
GI Bleeding	1.9	4.8	<0.001
Peptic Ulcer Disease	2.2	4.9	<0.001
Antiplatelet therapy	29.7	33.6	0.056
Hospital length of stay, days, mean (SD)	3.9 (3.1)	5.9 (4.5)	<0.001
Laboratory Data			
Serum cholesterol mg/dL, mean, (SD)	181.5 (43.0)	180.0 (48.0)	0.53
Serum triglycerides mg/dl, mean (SD)	148.7 (110.7)	136.6 (97.2)	<0.05
Serum LDL mg/dl, mean (SD)	111.9 (39.03)	110.0 (44.74)	0.40
Serum HDL mg/dl, mean (SD)	41.4 (11.8)	44.6 (20.73)	<0.001
Serum glucose, mg/dL, mean (SD)	158.5 (72.4)	168.9 (78.9)	<0.01
Hematocrit, %	41.2 (5.1)	40.2 (23.0)	0.10
Troponin I, mean, (SD)	10.5 (54.8)	11.7 (58.7)	0.64
eGFR mL/min/1.73m ² , mean, (SD)	66.1 (19.5)	56.4 (21.3)	<0.001
Diagnostic/Interventional Procedure (%)			
Cardiac catheterization	90.1	48.9	<0.001
Coronary artery bypass surgery	1.7	16.7	<0.001
Percutaneous coronary intervention	81.4	13.0	<0.001
Thrombolytic therapy	3.7	4.8	0.23
Hospital Complications (%)			
Cardiogenic shock	2.3	2.9	0.40
Heart failure	17.1	36.6	<0.001
Stroke	0.5	1.1	0.09

Table 2.

Trends in the receipt of DAPT at the time of hospital discharge among hospital survivors of an initial acute myocardial infarction (Worcester Heart Attack Study)

Study year	Odds ratio (95% confidence interval)*
2001	Reference year
2003	2.09 (1.41; 3.08)
2005	3.27 (2.15; 4.98)
2007	4.35 (2.84; 6.66)
2009	3.20 (2.08; 4.94)
2011	3.15 (2.07; 4.81)

* Adjusted for age, sex, race, previously diagnosed comorbid conditions (hypertension, diabetes, heart failure, chronic kidney disease, heart failure, peripheral vascular disease, stroke, chronic obstructive lung disease, GI bleeding, peptic ulcer disease), hospital development of a STEMI, coronary revascularization procedure, and the development of hospital complications (stroke, heart failure, and cardiogenic shock)

Table 3.

Changes over time in the receipt of DAPT at the time of hospital discharge for an initial acute myocardial infarction according to select patient characteristics (Worcester Heart Attack Study)

Characteristic	2001/2003 (n=891) % receiving	2005/2007 (n=767) % receiving	2009/2011 (n=731) % receiving	p for trend
Age (years)				
<55	76.1	90.7	88.5	<0.001
55–64	67.8	82.5	82.1	
65–74	60	76.5	66.7	
≥ 75	35.1	62.3	61.0	
Male	65.6	83.9	79.6	<0.001
Female	46.5	66.2	68.3	
White	57.4	76.7	75.3	0.17
Non-White	63.9	76.1	74.2	
STEMI (%)	71.4	85.7	88.1	<0.001
NSTEMI	48.3	70.6	67.8	
Medical history				
Chronic kidney disease	46.2	62.1	64.1	<0.05
Chronic obstructive pulmonary disease	39.5	63.3	57.0	<0.05
Diabetes mellitus	53.1	70.0	73.3	<0.001
Heart failure	21.8	54.0	64.0	<0.001
Hyperlipidemia	63.2	77.2	76.1	<0.001
Hypertension	55.0	73.9	73.3	<0.001
Peripheral vascular disease	45.6	74.0	62.8	<0.05
Percutaneous coronary intervention	49.0	81.4	78.6	<0.05
Prior antiplatelet therapy	52.4	77.3	71.6	<0.001
Stroke	43.1	57.1	53.5	0.37
Prior GI Bleeding	36.3	51.5	58.3	0.18
Peptic Ulcer Disease	46.9	56.2	57.1	0.48
Diagnostic/Interventional Procedure				
Cardiac catheterization	72.9	86.3	83.5	<0.001
Coronary artery bypass surgery	14.1	32.5	12.8	<0.05

Characteristic	2001/2003 (n=891) % receiving	2005/2007 (n=767) % receiving	2009/2011 (n=731) % receiving	p for trend
Percutaneous coronary intervention	89.2	95.7	95.3	<0.001
Thrombolytic therapy	62.1	75.0	100	0.43
Hospital Complications				
Cardiogenic shock	73.7	65.2	52.9	0.4
Heart failure	40.5	56.5	62.4	<0.001
Stroke	44.4	50.0	60.0	0.86

Table 4.

Multivariable-adjusted regression analyses of factors associated with the receipt of DAPT at the time of hospital discharge among hospital survivors of an initial acute myocardial infarction (Worcester Heart Attack Study)

	Model 1 *	Model 2 †	Model 3 ‡
Characteristics	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Age (years)			
55–64	0.62 (0.46 – 0.84)	0.65 (0.48 – 0.89)	0.76 (0.52 – 1.12)
65–74	0.43 (0.32 – 0.59)	0.48 (0.35 – 0.65)	0.53 (0.36 – 0.80)
75	0.25 (0.19 – 0.33)	0.30 (0.23 – 0.40)	0.70 (0.48 – 1.02)
Male	1.52 (1.25 – 1.85)	1.51 (1.24 – 1.84)	1.36 (1.05 – 1.76)
STEMI	2.30 (1.87 – 2.82)	2.14 (1.74 – 2.64)	1.13 (0.85 – 1.50)
Prior chronic obstructive pulmonary disease	-	0.60 (0.45 – 0.80)	0.70 (0.49 – 1.00)
Prior chronic kidney disease	-	0.88 (0.65 – 1.19)	1.36 (0.95 – 1.97)
Prior diabetes mellitus	-	1.03 (0.82 – 1.29)	1.1 (0.83 – 1.45)
Prior heart failure	-	0.61 (0.44 – 0.85)	0.92 (0.60 – 1.40)
Prior peripheral vascular disease	-	1.04 (0.77 – 1.41)	1.24 (0.85 – 1.80)
Prior stroke	-	0.70 (0.48 – 1.04)	0.88 (0.55 – 1.38)
Prior GI Bleeding	-	0.53 (0.31 – 0.90)	0.68 (0.34 – 1.35)
Prior Peptic Ulcer Disease	-	0.69 (0.41 – 1.15)	0.73 (0.37 – 1.45)
Heart Failure post-AMI	-	-	0.80 (0.60 – 1.10)
Stroke post-AMI	-	-	1.46 (0.42 – 5.10)
Cardiogenic Shock	-	-	0.64 (0.29 – 1.40)
Cardiac Catheterization	-	-	2.29 (1.65 – 3.16)
CABG	-	-	0.11 (0.07 – 0.18)
PCI	-	-	14.60 (10.66 – 19.98)

* **Model 1:** Controlled for age, sex, STEMI, and study year

† **Model 2:** Model 1 plus presence of a history of the following co-morbidities: hypertension, diabetes mellitus, chronic kidney disease, heart failure, peripheral vascular disease, stroke, chronic obstructive lung disease, GI bleeding, peptic ulcer disease

‡ **Model 3:** Model 2 plus hospital development of a STEMI, coronary revascularization procedure, and the development of hospital complications (stroke, heart failure, and cardiogenic shock)