Discharge Against Medical Advice After Percutaneous Coronary Intervention in the United States

Running title: Discharge against medical advice after PCI

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Abstract

Objective: This study aims to evaluate DAMA in PCI and how it affects readmissions.

Background: Discharge against medical advice (DAMA) is infrequent but associated with poor patient outcomes. DAMA in the context of PCI has not been described in the literature.

Methods: We analysed patients in the Nationwide Readmission Database between 2010-2014 with a PCI procedure who were either discharged home or against medical advice. The primary endpoint was all-cause 30-day readmissions and their causes. Descriptive statistics were used to compare DAMA with patients discharged home and multiple logistic regressions were used to determine patient characteristics associated with DAMA and readmission.

Results: Among the 2,021,104 patients in the analysis, the proportion of patients who DAMA was 0.5% (n=10,049). The 30-day readmission rate for patients who DAMA and those discharged home was 16.8% and 8.5% respectively ($p<0.001$). Important predictors of DAMA included diagnosis of acute myocardial infarction (OR 1.37, 1.25-1.51, $p<0.001$), smoking (OR 1.71, 1.57-1.86, $p<0.001$), drug abuse (OR 1.82, 1.60-2.06, $p<0.001$) and alcohol misuse (OR 1.53, 1.32-1.78, $p<0.001$). DAMA was the strongest predictor for readmission (OR 1.89, 1.71-2.08, $p<0.001$). DAMA patients were more likely to have neuropsychiatric reasons for non-cardiac causes of readmission (8.3% vs 2.4%) and acute myocardial infarction for cardiac causes of readmission (39.4% vs 19.5%) compared to patients discharged home.

Conclusions: DAMA occurs in approximately 0.5% of patients following PCI and is strongly associated with readmission within 30 days. Interventions should be developed to reduce DAMA in high-risk groups and initiate interventions to avoid complications and readmission when it occurs.

Condensed abstract (100 words)

Discharge against medical advice (DAMA) in the context of PCI has not been described in the literature. Among the 2,021,104 patients, the proportion of patients who DAMA was 0.5% (n=10,049). Important predictors of DAMA included diagnosis of acute myocardial infarction, smoking, and alcohol misuse. DAMA was the strongest predictor for readmission (OR 1.92, 1.74-2.12, p<0.001). DAMA patients were more likely to have neuropsychiatric reasons for non-cardiac causes of readmission and acute myocardial infarction for cardiac causes of readmission compared to patients discharged home. DAMA following PCI is rare but it is strongly associated with readmissions within 30 days.

List of abbreviations

DAMA = discharge against medical advice

PCI = percutaneous coronary intervention

NRD = Nationwide Readmission Database

AHRQ = Agency for Healthcare Research and Quality

HCUP = Healthcare Cost and Utilization Project

ICD-9 = International Classification of Disease – 9th Clinical Modification

CCS = Clinical classification software (CCS)

US = United States

OR = odds ratio

Perspective

What is known?

Discharge against medical advice (DAMA) is associated with poor patient outcomes and DAMA in the context of PCI has not been described in the literature.

What is new?

Our analysis of 2,021,104 patients reveals that the proportion of patients who DAMA was 0.5% and important predictors of DAMA included diagnosis of acute myocardial infarction, smoking, and alcohol misuse. DAMA was the strongest predictor for unplanned 30-day readmission (OR 1.89, 1.71-2.08, $p<0.001$) and DAMA patients were more likely to have neuropsychiatric reasons for non-cardiac causes of readmission and acute myocardial infarction for cardiac causes of readmission compared to patients discharged home.

DAMA following PCI is rare but it is strongly associated with readmissions within 30 days.

What is next?

Interventions should be developed to reduce DAMA in high risk groups and initiate interventions to avoid complications and readmission when it occurs.

Introduction

Discharge against medical advice (DAMA) refers to patients who leave the hospital before the treating physician's recommendation for discharge. It poses a problem for physicians treating hospitalized patients and has been noted to occur in 1-2% of all medical admissions.[1] Some groups within the general population such as those with mental health problems are more likely to DAMA.[2] Other factors that predict DAMA include self-financing healthcare, having Medicaid insurance and being young and male.[2] Since patients who DAMA have been shown to be at higher risk of adverse outcomes, it has been suggested that these patients should be targeted for post-discharge interventions.[3]

Historically, the literature related to DAMA originated from cohorts with psychiatric illnesses[4] and substance misuse.[5] A variety of factors precipitate DAMA including problems related to their illness such as substance seeking behaviour or other factors such as financial problems, family pressure on returning home and dissatisfaction with the hospital routine and treatment.[6] DAMA is commonly seen in emergency departments and is associated with higher likelihood of worse outcomes and medicolegal consequences. There is a growing literature suggesting that patients with cardiac problems also choose to DAMA.[7-9] No previous study has evaluated DAMA in patients who undergo percutaneous coronary intervention (PCI). In this study, we examine rates, trends and predictors of DAMA, and evaluate causes of and rates of readmission for patients who DAMA compared to those with discharge home in the Nationwide Readmission Database.

Methods

A full description of the methods is available in the Supplementary Methods.

Study design and participants

The Nationwide Readmission Database (NRD) is a publicly available database of all-payer hospital inpatients stays, which is developed by the Agency for Healthcare Research and Quality (AHRQ) as a part of the Healthcare Cost and Utilization Project (HCUP) in the Unites States. The data are drawn from 21 states that are geographically dispersed and accounts for approximately 49% of total US resident population and approximately 49% of hospitalizations.

In the current study, we included men and women aged 18 years or older who underwent first PCI between 2010 and 2014 and were either DAMA or were discharged home. First PCI was defined by first procedure of PCI within a calendar year. DAMA was defined from the variable "DISPUNIFORM" which represents the disposition of patient at discharge. We excluded patients who died during their index admission for PCI, those who had an elective readmission and those who were not discharged home or against medical advice.

Variables and outcomes

The data collected is described in the Supplementary Methods. We used International Classification of Disease – 9th Clinical Modification (ICD-9) and Clinical classification software (CCS) of diseases codes to determine comorbidities, in-hospital procedures and outcomes. The cost of clinical care was determined by the claims change multiplied by the cost-to-charge ratio. 30-day readmissions were defined as first rehospitalization after discharge within 30 days from admission for PCI. The causes of readmissions were determined from the principle diagnosis based on CCS codes as outlined in Supplementary

Table 1. The primary endpoint was all-cause 30-day readmissions and reasons for readmissions.

Statistical analysis

Statistical analysis was performed using Stata 14.0 (College Station, Texas, USA). A flow diagram was used to determine the proportion of patients at each stage of the analysis and those who were readmitted as well as those who died on readmission. Descriptive statistics were used to compare patients who were DAMA compared to those who were discharged home with further stratification depending on whether or not they were readmitted. Statistical differences between groups for continuous variables were tested using the t-test and for categorical variables the Chi^2 test. For all analyses, the survey estimation commands were used (e.g. svy: logistic for multiple logistic regression), following the recommendations from AHRQ for analysis of survey data to account for the complex survey design of the NRD database. Multiple logistic regressions were used to determine independent variables associated with DAMA and 30-day readmission. We performed sensitivity analysis in the subgroup of patients where elective cases were excluded. The major cardiac and non-cardiac causes of readmission for the DAMA and discharged home groups are presented in tables.

Results

A total of 2,021,104 participants were included in the analysis after exclusion of patients who died after first PCI (n=49,913), had an elective readmission (n=26,290), or were discharged to other places of care (n=276,410), Figure 1. The overall proportion of patients who DAMA over the whole study period was 0.5% (n=10,049). Figure 2 illustrates the temporal trends for DAMA at the index PCI procedure, increasing from 0.44 in 2010 to 0.59

in 2014 ($p<0.001$ for trend). The 30-day readmission rate for patients who DAMA and those who were non-DAMA was 16.8% and 8.5% respectively.

The participant characteristics and in-hospital outcomes for the index PCI admission for patients stratified by whether they DAMA are shown in Table 1. Patients who DAMA were younger (57.2 vs 63.7 years), less likely to be female (18.9% vs 30.6%), less likely to be admitted electively (8.2% vs 17.3%) and be in the lowest quartile of income (36.5% vs 27.8%). Those who DAMA were more likely to be admitted on a weekend (35.6% vs 28.8%) and receive Medicaid (19.8% vs 7.7%). Significant differences were observed for most comorbidities, as well as smoking (65.6% vs 42.7%, $p<0.001$), alcohol misuse (8.4% vs 2.6%) and drug abuse (10.7% vs 2.1%, $p<0.001$). A longer LOS (3.2 vs 3.0 days) and cost of index PCI ($20,441 vs $19,732) was observed in patients who DAMA.

Table 2 shows the patient variables according to 30-day readmission status stratified by DAMA status. Among patients who were not readmitted, patients who DAMA were more likely to be smokers (66.0% vs 42.8%), abuse alcohol (7.9% vs 2.6%), abuse drugs (10.3% vs 2.0%), previous MI (19.5% vs 14.2%), previous PCI (25.6% vs 21.2%), chronic lung disease (20.9% vs 14.8%) and less likely to receive drug eluting stent (60.2% vs 76.3%). For patients who were readmitted, those who DAMA were more likely to be smokers (63.7% vs 41.4%), misuse alcohol (10.7% vs 2.8%), drug abuse (10.7% vs 2.8%), have chronic lung disease (28.0% vs 22.2%), fluid and electrolyte disorders (21.8% vs 14.8%) and less likely to receive a drug eluting stent (54.4% vs 70.9%). A greater proportion of DAMA patients were uninsured and from the lowest median household income irrespective of readmission status. Table 3 shows the readmissions outcomes for patients according to whether or not the patient DAMA. DAMA was associated with greater death (3.2% vs 2.0%), in-hospital MACE (6.1% vs 2.4%) and discharge against medical advice in the readmission (13.9% vs 1.1%). Similar

increases were observed for both in the whole cohort of patients undergoing PCI and the subgroup of patients who were admitted with a diagnosis of acute myocardial infarction.

The predictors of DAMA are shown in Table 4. Predictors of DAMA included smoking (OR 1.71, 1.57-1.86), alcohol misuse (OR 1.53, 1.32-1.78), and dementia (OR 1.52, 1.03-2.24), whilst female gender (OR 0.58, 0.53-0.63) and elective admissions (OR 0.66, 0.57-0.76) were independently associated with reduced odds of DAMA. Among patients with acute myocardial infarction, the strongest predictor of DAMA was acute kidney injury (OR 2.51, 1.53-4.13), although drug (OR 1.83, 1.57-2.13) and alcohol (OR 1.28, 1.07-1.53) abuse and smoking (OR 1.77, 1.59-1.97) remained independent predictors of DAMA (Supplementary Table 2).

Table 5 shows the independent predictors of 30-day readmission. DAMA was the strongest predictor of 30-day unplanned readmissions (OR 1.89, 1.71-2.08) for all patients and for patients with admission for acute myocardial infarction (OR 1.96, 1.73-2.22, Supplementary Table 2).

The causes of unplanned 30-day readmissions were subsequently studied in patients who DAMA and those who were discharged home. Table 6 shows that the proportion of patients with non-cardiac readmissions was higher in patients who were discharged home (54.5% vs 45.5%) whilst the rates of cardiac and non-cardiac readmission were similar for the DAMA group (50.2% vs 49.8%).

Table 6 shows the most common non-cardiac and cardiac causes for readmission according to whether patients DAMA or non-DAMA. Non-specific chest pain was the commonest non-cardiac cause for readmission for both patients who DAMA and those discharge home (19.7% and 20.2% respectively). For non-cardiac readmissions, patients who DAMA were more likely to have neuropsychiatric causes for readmission 8.3% (4^{th} most common cause of readmission) compared to those patients discharged home (2.4%, 10^{th} most

common cause). The specific causes of psychiatric readmissions in the DAMA group was mainly due to depression, bipolar and mood disorders (43.3%) and paranoid schizophrenia, schizoaffective disorder and psychosis (16.7%) (Supplementary Table 3). In terms of cardiac readmissions, acute MI was the commonest diagnosis-code for both cohorts, although patients who DAMA were twice as likely to be readmitted with the diagnosis-code of acute MI (39.4% vs 19.5%) compared to those discharged home. For patients presenting with acute myocardial infarction at their index admission, DAMA was associated with increase rates of cardiac readmissions (56.6% vs 49.2%) (Supplementary Table 2). Non-cardiac chest pain was the most common reason for non-cardiac readmissions. The most frequent reasons for cardiac readmission for both DAMA and not DAMA in the acute myocardial infarction groups were diagnosis of acute myocardial infarction and coronary artery disease including angina.

Discussion

DAMA is a rare occurrence among patients who undergo PCI and is strongly related to smoking and alcohol misuse and is less likely to occur among patients who are female, privately insured, have a higher quartile of income or are admitted for elective PCI. Whilst the rates of DAMA appear to be rising, it is still a relatively rare occurrence. We show that patients who DAMA are a high-risk cohort. They have a 2-fold increased risk of readmission and are twice as likely to be readmitted with the diagnosis-code of acute MI and four times as likely to be readmitted with an acute neuropsychiatric episode. To the best of our knowledge, we show, for the first time, that DAMA is one of the strongest predictors of unplanned 30-day readmission after PCI. Our results provide evidence that patients who DAMA should be considered to be at high risk. Our findings support the need for a greater understanding of

patients who DAMA to further develop interventions to either reduce it or the development of pathways that allow follow up of patients that DAMA.

Our study provides novel insight into patients who DAMA after PCI, and temporal trends, predictors and outcomes associated with DAMA in PCI have not been explored before. It is unclear whether the observed changes are a result of changes in the demographics of the patients that present for PCI or because of changes in the care delivered which may influence patient decisions. We show evidence which is consistent with literature outside the PCI setting that being young and male are factors associated with DAMA. We also find that smokers and patients who misuse alcohol are at higher risk and decisions to DAMA in these patients may be motivated by substance seeking behaviour.

Our findings suggest that patients undergoing elective procedures are less likely to DAMA which suggests that there may be an element of selection bias for such procedures, with patients in which there may be issues around compliance or future engagement with healthcare less likely to be offered an elective PCI. In contrast, in PCI procedures undertaken in the acute setting of an acute MI, selection based on future compliance / engagement with healthcare services is not feasible, which may explain the increased risk of DAMA associated with the re-admission diagnosis-code of MI.

We show, for the first time, the reasons for readmissions after DAMA in patients who undergo PCI. A key finding here is that patients who DAMA have a four-fold increased rates of neuropsychiatric unplanned 30-day readmissions compared to patients discharged home. Our detailed analysis of specific causes of readmission suggests that depression, bipolar and mood disorders are most common reasons for readmission with previous literature reporting that coronary artery intervention can increase patients' anxiety and depression.[10] In the current study, both, smoking[11] and alcohol misuse[12] were independently associated with DAMA and these two factors have also been linked to mental illness. We also report that

patients who DAMA are twice as likely to be readmitted with the diagnosis-code of acute MI. This is an important finding, and may relate to failure to prescribe dual antiplatelet therapy (DAPT) to patients who DAMA, or failure for their continuing prescription once discharged which significantly increases the risk of stent thrombosis. It is unclear from this study, whether patients who DAMA were prescribed medications such as antiplatelet agents prior to DAMA or whether these patients had any follow up with medical services once discharged for continued receipt of pharmacotherapy. Interestingly, one study of general admissions suggests that only 21.4% of patients had medications prescribed when patients discharged against medical advice.[13]

DAMA in the context of PCI are unlike DAMA in the emergency department and general hospital admissions which have been reported in the literature.[14-16] A patient who is seen at the emergency department may not receive treatment and similarly a patient admitted to hospital may be admitted for investigations and observation initially. In contrast, patients who undergo PCI have received a treatment that requires ongoing management and medical therapy to ensure optimal future outcomes. In patients who DAMA at some point after the procedure, there is a breakdown in the care relationship and the patient chooses to discontinue care. This can have serious consequences as ongoing patient care is required after PCI, with prescription of dual antiplatelet therapy to reduce the risk of stent thrombosis or an echocardiogram to assess for left ventricular function after an acute event enabling prescription of evidence based therapies that reduce the risk of re-hospitalization,[17] or management of newly diagnosed diabetes mellitus and so forth. Furthermore, whereas a patient who DAMA in the emergency department and general hospital inpatient stay may carry the risks associated with the presenting condition, the patients who undergo PCI may carry the risks associated to their presenting condition but also those related to their treatment (PCI).

The need for interventions for DAMA patients

Our findings suggest that an evidence basis around understanding reasons for DAMA in the context of PCI should be developed, with interventions developed to reduce DAMA or at least obviate the risks in situations where it does occur. A previous qualitative study proposed several strategies to reduce DAMA in cardiovascular disease.[9] First, patients highlighted that communications needed to be improved and healthcare providers should receive training in cultural diversity, interpersonal skills, customer service and also be more truthful and accurate regarding wait times. Nurses further suggested that the quality of verbal communication needed to be improved to manage patient's expectations in order to minimise false promises. The principles of these findings could potentially be applied to settings where PCI has been undertaken to potentially reduce rates of DAMA. Secondly, in cases where DAMA has occurred, interventions need to be developed to obviate potential risks, particularly around the prescription of DAPT and other cardiac medications in this patient group. This may require the development of targeted interventions across healthcare providers spanning the secondary and primary care interface, or the development of pharmacy outreach programs that enable prescription / continuation of therapies in the community. Finally, given that neuropsychiatric causes are an important cause of unplanned 30-day readmissions in patients who DAMA, involvement of psychiatric services, particularly in those with a history of mental health conditions or a history of substance abuse early on in the index admission for patients undergoing PCI particularly in the acute setting, may decrease the risk of DAMA or at least provide an arena for safer "discharge" planning, even in those who do subsequently DAMA. Another area of future work should explore the care that patients are deprived of by choosing to DAMA. There is likely a portion of patients who require further treatment and these patients may be at higher risk of adverse events but

also patients who have received PCI treatment and are recommended to stay in hospital for a period of observation.

Strengths and limitations of the study

Our study has several strengths. This is the first study to evaluate DAMA in the context of PCI in a large cohort that has sufficient sample size to capture these uncommon events. Secondly, the data from the NRD is largely complete which minimises biases related to missing data. Finally, we were able to adjust for a variate of confounders in our models to predict DAMA and 30-day readmission including many socioeconomic factors, comorbidities, hospital characteristics, procedural variables and outcomes.

There are several limitations in the current study. First, the overall data is derived from five unique datasets corresponding to each in the period between 2010 to 2014 and no linkage is possible between years. Secondly, the dataset does not capture pharmacotherapy data such as DAPT and thus prescription fill-rates and compliance are unknown in patients who DAMA. Thirdly, whilst we report a two-fold increased odds of re-admission with diagnosis-code of acute MI in patients who DAMA, there are no diagnostic codes for stent thrombosis and so we were unable to determine whether this increased risk relates to stent thrombosis events, or reflects in worse cardiovascular risk factor profile in patients who self-discharge for de-novo events. Fourthly, the study is a retrospective analysis of an administrative database which was collected from administrative claims sampled from 21 states but may not be generalizable to all settings, since regional heterogeneity was not explored. In addition, we were unable to capture out of hospital deaths so our results may underestimate the extent of poor outcomes associated with patients who DAMA. Also, we were not able to exclude the possibility that the same patient may appear in multiple years because the data is composed of five annual datasets, which cannot be linked across years. Furthermore, as with any such administrative database, coding errors are always a potential

source of bias, as is underreporting of secondary and co-morbid diagnosis. Finally, causes of readmission were identified using the primary discharge diagnosis codes which may be subject to reporting biases.

In conclusion, DAMA occurs in 0.5% of patients who undergo PCI and is strongly associated with a greater risk of 30-day unplanned readmission with higher mortality. We identified that patients who have previous myocardial infarction, are smokers and misuse alcohol and drugs are most likely to DAMA. This information may be useful for clinicians to identify those patients upon admission or shortly after that are at high-risk of DAMA allowing clinicians to better tailor care so that the management is supported and agreed by these patients and there is no breakdown in the therapeutic relationship.

Contributorship

CSK and MAM were responsible for the study design and concept. CSK performed the data cleaning and analysis. CSK and MAM wrote the first draft of the manuscript and all authors contributed to the writing of the paper.

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List of Tables and Figures

Figure 1: Flow diagram of participants

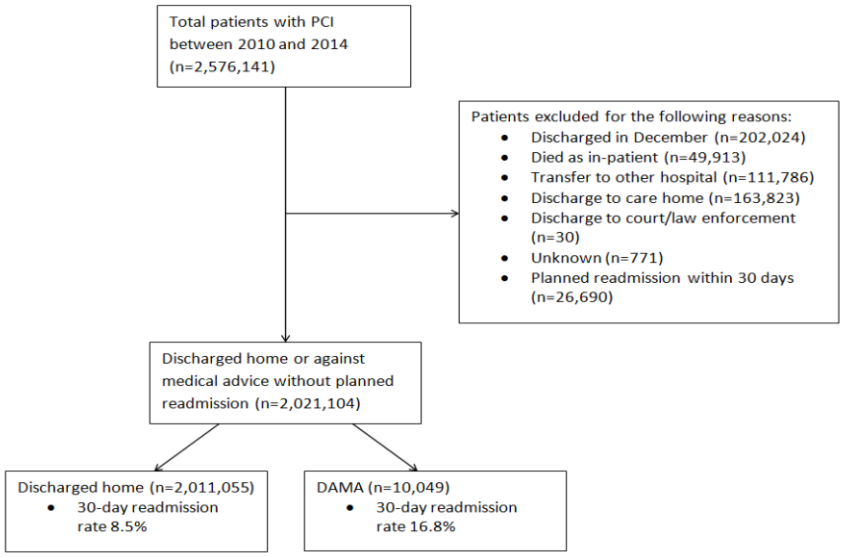

Figure 1 caption: Figure showing the flow diagram of patients included in the analysis and the proportion of patients who discharge against medical advice (DAMA) and patients who are discharged home and their respective 30-day readmission rates.

Figure 2: Percentage of patients who undergo percutaneous coronary intervention and discharge against medical advice (DAMA)

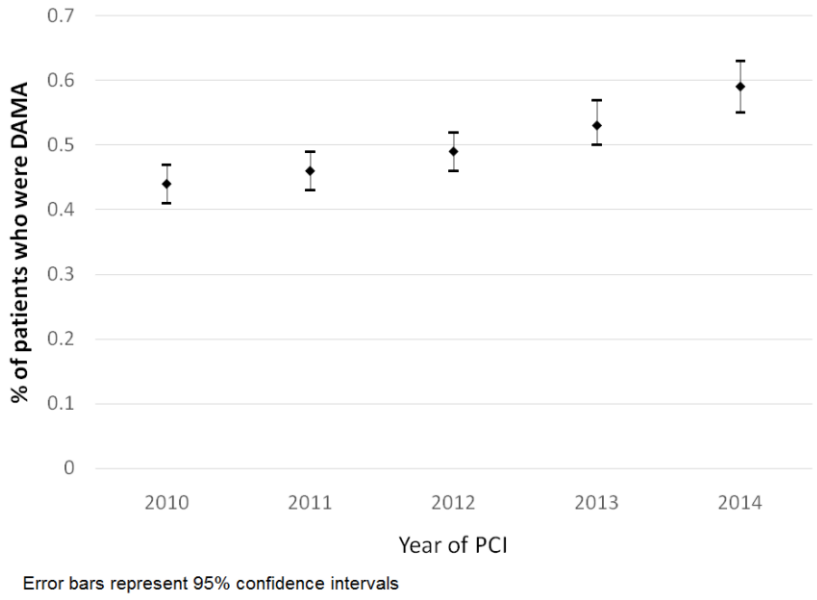

Figure 2 caption: Figure showing the increase in patients who discharge against medical advice (DAMA) over time.

Table 1: Patient characteristics at index hospital admission according stratified by whether patients discharged against medical advice (DAMA)

Variable	Not DAMA n=2,011,055	DAMA n=10,049	p-value
Age (years)	63.7±12.0	57.2±11.9	<0.001
Women, %	30.6%	18.9%	<0.001
Elective	17.3%	8.2%	<0.001
Weekend	20.0%	23.4%	<0.001
Diagnosis of acute myocardial infarction	50.7%	65.7%	<0.001
Primary expected payer			<0.001
Medicare	49.3%	40.9%	
Medicaid	7.7%	19.8%	
Private	32.3%	16.1%	
Uninsured	6.1%	16.5%	
No charge	0.8%	1.7%	
Other	3.8%	5.1%	
Median household income (percentile)			<0.001
0-25th	28.8%	35.6%	
26-50th	25.3%	26.8%	
51-75th	24.0%	22.7%	
76-100th	22.0%	15.0%	
Smoker	42.7%	65.6%	<0.001
Alcohol misuse	2.6%	8.4%	<0.001
Dyslipidemia	72.8%	59.9%	<0.001
Hypertension	74.4%	70.7%	<0.001
Diabetes mellitus	35.7%	35.0%	0.34
Obesity	15.9%	15.4%	0.35
Heart failure	0.7%	1.6%	<0.001
Known coronary artery disease	94.6%	91.8%	<0.001
Previous myocardial infarction	14.3%	19.6%	<0.001
Previous percutaneous coronary intervention	21.3%	25.4%	<0.001
Previous coronary artery bypass graft	7.8%	7.5%	0.43
Previous valve disease	0.2%	0.4%	0.17
Atrial fibrillation	9.8%	7.9%	<0.001
Previous transient ischemic attack/stroke	6.1%	6.9%	0.018
Peripheral vascular disease	10.2%	10.7%	0.29
Pulmonary circulatory disorder	0.1%	0.3%	0.04
Peptic ulcer disease	0.02%	0.00%	0.33
Chronic lung disease	15.4%	22.0%	<0.001
Renal failure	11.4%	12.3%	0.064
Liver disease	1.2%	2.0%	<0.001
Hypothyroidism	8.5%	4.3%	<0.001
Fluid and electrolyte disorders	9.9%	13.8%	<0.001

Anemia	8.5%	9.7%	0.007
Cancer	1.6%	1.5%	0.5
Depression	6.1%	7.0%	0.025
Dementia	1.1%	0.9%	0.41
Charlson comorbidity index	1.2±1.3	1.3±1.4	<0.001
Mean number of comorbidities	4.7±2.0	5.0±2.1	<0.001
Bed size			0.02
Small	5.8%	4.8%	
Medium	20.7%	21.0%	
Large	73.5%	74.2%	
Location			0.43
Rural	0.2%	0.3%	
Urban	99.8%	99.8%	
Teaching status			<0.001
Nonteaching	45.4%	49.8%	
Teaching status	54.7%	50.2%	
In-hospital procedures and procedural details			
Multivessel disease	16.1%	12.6%	<0.001
Bifurcation	2.9%	2.2%	0.013
Circulatory support	2.1%	3.4%	<0.001
Vasopressor use	0.3%	0.3%	0.74
Intra-aortic balloon pump	1.8%	3.2%	<0.001
Fractional flow reserve	1.9%	1.1%	<0.001
Intravascular ultrasound	7.1%	5.3%	<0.001
Drug eluting stent	75.8%	59.2%	<0.001
In-hospital outcomes			
Complete heart block	0.8%	0.9%	0.37
Transient ischemic attack/stroke	2.5%	2.5%	0.97
Cardiogenic shock	1.7%	3.4%	<0.001
Cardiac arrest	1.2%	2.1%	<0.001
Acute kidney injury	0.4%	1.1%	<0.001
Major bleeding	0.4%	1.1%	<0.001
Blood transfusion	0.4%	1.1%	0.33
Vascular complication	0.6%	0.5%	0.26
Emergency coronary artery bypass graft	0.7%	0.5%	0.16
Length of stay, days	3.0±3.2	3.2±7.7	<0.001
Cost for first admission	$19732±12,168	$20441±17759	<0.001
Readmission			
30-day readmission	8.5%	16.8%	<0.001
Cost of readmission	$11380±15857	$13717±18774	<0.001

Percentages presented for categorical variables and means and standard deviations for continuous variables.

Table 2: Patient characteristics according to whether they discharged against medical advice and readmission status

Variable	Not readmitted			Readmitted		
	Not DAMA n=1,840,178	DAMA n=8,364	p-value	Not DAMA n=170,877	DAMA n=1,685	p-value
Age (years)	63.5±12.0	57.1±11.7	<0.001	65.2±12.6	58.0±12.6	<0.001
Women, %	30.0%	18.6%	<0.001	37.3%	20.7%	<0.001
Elective	17.8%	8.7%	<0.001	12.2%	6.0%	<0.001
Weekend	19.9%	23.5%	<0.001	21.0%	23.1%	0.18
Diagnosis of acute myocardial infarction	50.9%	66.1%	<0.001	48.9%	63.6%	<0.001
Primary expected payer			<0.001			<0.001
Medicare	48.4%	39.6%		58.2%	46.8%	
Medicaid	7.5%	19.2%		10.0%	22.7%	
Private	33.2%	16.7%		22.6%	13.0%	
Uninsured	6.2%	17.6%		4.9%	11.1%	
No charge	0.9%	1.8%		0.8%	1.4%	
Other	3.9%	5.1%		3.5%	5.0%	
Median household income (percentile)			<0.001			<0.001
0-25th	28.6%	35.1%		30.9%	38.1%	
26-50th	25.2%	27.3%		25.4%	24.2%	
51-75th	24.0%	23.0%		23.4%	21.2%	
76-100th	22.1%	14.6%		20.2%	16.6%	
Smoker	42.8%	66.0%	<0.001	41.4%	63.7%	<0.001
Alcohol misuse	2.6%	7.9%	<0.001	2.8%	10.7%	<0.001
Dyslipidemia	73.0%	59.8%	<0.001	70.4%	60.1%	<0.001
Hypertension	74.1%	69.7%	<0.001	77.9%	75.9%	0.22
Diabetes mellitus	35.0%	33.6%	0.085	43.0%	41.7%	0.51
Obesity	15.9%	15.3%	0.36	16.2%	15.7%	0.75
Heart failure	0.7%	1.5%	<0.001	1.3%	2.1%	0.082

Known coronary artery disease	94.6%	92.1%	<0.001	94.9%	90.5%	<0.001
Previous myocardial infarction	14.2%	19.5%	<0.001	15.8%	20.2%	0.001
Previous percutaneous coronary intervention	21.2%	25.6%	<0.001	22.3%	24.2%	0.22
Previous coronary artery bypass graft	7.7%	7.2%	0.33	9.4%	8.8%	0.59
Previous valve disease	0.2%	0.3%	0.5	0.4%	0.7%	0.3
Atrial fibrillation	9.3%	7.0%	<0.001	14.8%	12.4%	0.72
Previous transient ischemic attack/stroke	5.8%	6.1%	0.46	8.7%	11.0%	0.028
Peripheral vascular disease	9.8%	10.1%	0.53	14.1%	13.4%	0.58
Pulmonary circulatory disorder	0.1%	0.2%	0.11	0.3%	0.4%	0.41
Peptic ulcer disease	0.02%	0.00%	0.37	0.02%	0.00%	0.67
Chronic lung disease	14.8%	20.9%	<0.001	22.2%	28.0%	<0.001
Renal failure	10.6%	10.7%	0.92	19.6%	20.3%	0.66
Liver disease	1.1%	1.8%	<0.001	1.8%	3.1%	0.014
Hypothyroidism	8.3%	4.1%	<0.001	10.5%	5.4%	<0.001
Fluid and electrolyte disorders	9.4%	12.2%	<0.001	14.8%	21.8%	<0.001
Anemia	7.9%	8.3%	0.37	15.2%	16.4%	0.39
Cancer	1.5%	1.4%	0.56	2.5%	1.8%	0.27
Depression	5.9%	6.6%	0.09	8.4%	8.8%	0.75
Dementia	1.0%	0.8%	0.15	1.8%	1.8%	0.94
Charlson comorbidity index	1.1±1.3	1.3±1.4	<0.001	1.6±1.6	1.8±1.6	0.004
Mean number of comorbidities	4.7±2.0	4.9±2.1	<0.001	5.3±2.2	5.6±2.2	<0.001
Bed size			0.037			0.29
Small	5.9%	4.9%		5.1%	4.3%	
Medium	20.7%	21.4%		20.5%	18.8%	
Large	73.4%	73.6%		74.4%	76.9%	
Location			0.52			0.54
Rural	0.2%	0.3%		0.2%	0.3%	
Urban	99.8%	99.7%		99.8%	99.7%	

Teaching status			<0.001			0.032
Nonteaching	45.3%	49.7%		46.1%	50.1%	
Teaching status	54.7%	50.3%		53.9%	49.9%	
In-hospital procedures and procedural details						
Multivessel disease	16.1%	12.6%	<0.001	16.2%	12.5%	0.008
Bifurcation	2.9%	2.3%	0.028	2.7%	2.1%	0.31
Circulatory support	2.0%	2.9%	<0.001	3.0%	5.6%	<0.001
Vasopressor use	0.3%	0.2%	0.25	0.4%	0.7%	0.19
Intra-aortic balloon pump	1.7%	2.8%	<0.001	2.7%	5.0%	<0.001
Fractional flow reserve	1.9%	1.1%	<0.001	2.1%	1.5%	0.31
Intravascular ultrasound	7.1%	5.3%	<0.001	7.2%	4.9%	0.017
Drug eluting stent	76.3%	60.2%	<0.001	70.9%	54.4%	<0.001
In-hospital outcomes						
Complete heart block	0.8%	1.0%	0.16	0.9%	0.6%	0.32
Transient ischemic attack/stroke	2.4%	2.2%	0.39	3.0%	3.8%	0.27
Cardiogenic shock	1.6%	2.8%	<0.001	2.5%	6.4%	<0.001
Cardiac arrest	1.2%	2.0%	<0.001	1.4%	2.6%	0.004
Acute kidney injury	0.3%	1.0%	<0.001	0.7%	1.8%	<0.001
Major bleeding	0.4%	1.0%	<0.001	0.7%	1.8%	<0.001
Blood transfusion	0.02%	0.00%	0.39	0.03%	0.00%	0.63
Vascular complication	0.6%	0.4%	0.13	0.8%	0.8%	0.87
Emergency coronary artery bypass graft	0.7%	0.5%	0.091	0.7%	0.8%	0.86
Length of stay, days	2.9±3.2	3.1±8.3	0.009	3.6±3.0	3.7±3.9	0.51
Cost for first admission	$19606±12182	$20030±18138	0.04	$21090±11938	$22469±15606	0.002
Readmission						
30-day readmission	-	-	-	100.0%	100.0%	-
Cost of readmission	-	-	-	$11380±15857	$13718±18774	0.001

Table 3: Readmission outcomes in all patients readmitted and those with elective index PCI and acute myocardial infarction for index PCI

All readmissions	Not DAMA at index PCI	DAMA at index PCI	p-value
Death in readmission	2.0%	3.2%	0.017
In-hospital MACE for readmission	2.4%	6.1%	<0.001
Cost of readmission	$11,380±15,857	$13,718±18,774	<0.001
Discharge against medical advice for readmission	1.1%	13.9%	<0.001
Acute myocardial infarction			
Death in readmission	2.4%	5.0%	<0.001
In-hospital MACE for readmission	2.5%	7.3%	<0.001
Cost of readmission	$11,936±15,941	$15,183±20,851	<0.001
Discharge against medical advice for readmission	1.1%	12.2%	<0.001

MACE defined as primary diagnosis of acute myocardial infarction, stroke or TIA, re-PCI, emergency CABG and in-hospital death.

Table 4: Multiple logistic regression to identify independent variables associated with patients who discharge against medical advice

Variables	Odds ratio (95%CI)	p-value
Age (per 1 year increment)	0.96 (0.95-0.96)	<0.001
Female	0.58 (0.53-0.64)	<0.001
Elective	0.66 (0.57-0.76)	<0.001
Diagnosis of acute myocardial infarction	1.37 (1.25-1.51)	<0.001
Primary expected payer vs Medicare		
Medicaid	1.23 (1.09-1.39)	0.001
Private	0.32 (0.28-0.36)	<0.001
Other	0.73 (0.61-0.87)	0.001
Median household income (percentile) vs 0-25th		
76-100th	0.88 (0.79-0.87)	0.041
Smoker	1.71 (1.57-1.86)	<0.001
Alcohol misuse	1.53 (1.32-1.78)	<0.001
Drug abuse	1.82 (1.60-2.06)	<0.001
Dyslipidemia	0.63 (0.58-0.68)	<0.001
Diabetes mellitus	1.12 (1.03-1.21)	0.008
Obesity	0.89 (0.80-0.98)	0.019
Heart failure	1.66 (1.17-2.37)	0.005
Known coronary artery disease	0.83 (0.73-0.95)	0.006
Previous myocardial infarction	1.33 (1.20-1.48)	<0.001
Previous percutaneous coronary intervention	1.34 (1.22-1.48)	<0.001
Previous coronary artery bypass graft	1.16 (1.01-1.37)	0.041
Peripheral vascular disease	1.19 (1.05-1.35)	0.006
Chronic lung disease	1.31 (1.20-1.43)	<0.001
Renal failure	1.18 (1.05-1.33)	0.005
Hypothyroidism	0.73 (0.61-0.87)	<0.001
Fluid and electrolyte disorders	1.12 (1.03-1.25)	0.041
Dementia	1.52 (1.03-2.24)	0.036
Teaching status	0.81 (0.74-0.89)	<0.001
Intravascular ultrasound	0.79 (0.66-0.94)	0.008
Drug eluting stent	0.64 (0.59-0.70)	<0.001
Acute kidney injury	2.45 (1.73-3.48)	<0.001
Emergency coronary artery bypass graft	0.42 (0.27-0.68)	<0.001

Table 5: Multiple logistic regression to determine independent variables associated with readmission within 30 days

A) All patients

Variables	Odds ratio (95%CI)	p-value
Discharge against medical advice	1.89 (1.71-2.08)	<0.001
Age (per 1 year increment)	1.00 (1.00-1.00)	0.011
Female	1.23 (1.21-1.26)	0.001
Elective	0.62 (0.59-0.64)	<0.001
Diagnosis of acute myocardial infarction	0.89 (0.87-0.91)	<0.001
Primary expected payer vs Medicare		
Medicaid	1.12 (1.08-1.17)	<0.001
Private	0.70 (0.68-0.72)	<0.001
Uninsured	0.74 (0.71-0.78)	<0.001
No charge	0.89 (0.80-0.99)	0.031
Other	0.82 (0.78-0.87)	<0.001
Median household income (percentile) vs 0-25th		
26-50th	0.97 (0.93-0.97)	<0.001
76-100th	0.96 (0.92-0.99)	0.012
Smoker	0.95 (0.93-0.97)	<0.001
Drug abuse	1.35 (1.28-1.43)	<0.001
Dyslipidemia	0.88 (0.86-0.90)	<0.001
Hypertension	1.07 (1.04-1.09)	<0.001
Diabetes mellitus	1.21 (1.18-1.23)	<0.001
Obesity	0.94 (0.91-0.96)	<0.001
Previous coronary artery bypass graft	1.09 (1.05-1.13)	<0.001
Atrial fibrillation	1.41 (1.37-1.45)	<0.001
Previous transient ischemic attack/stroke	1.19 (1.14-1.22)	<0.001
Peripheral vascular disease	1.18 (1.14-1.23)	<0.001
Chronic lung disease	1.38 (1.34-1.42)	<0.001
Renal failure	1.48 (1.44-1.53)	<0.001
Liver disease	1.37 (1.27-1.47)	<0.001
Hypothyroidism	1.04 (1.00-1.07)	0.035
Fluid and electrolyte disorders	1.21 (1.18-1.25)	<0.001
Anemia	1.36 (1.32-1.40)	<0.001
Cancer	1.39 (1.30-1.49)	<0.001
Depression	1.24 (1.20-1.29)	<0.001
Dementia	1.25 (1.16-1.35)	<0.001
Teaching hospital	0.97 (0.94-0.99)	0.017
Intra-aortic balloon pump	1.21 (1.01-1.46)	0.041
Fractional flow reserve	1.09 (1.02-1.17)	0.011
Drug eluting stent	0.84 (0.83-0.86)	<0.001
Cardiogenic shock	1.12 (1.04-1.20)	0.002
Vascular complication	1.13 (1.01-1.25)	0.032

Emergency coronary artery bypass graft	0.86 (0.76-0.96)	0.010

B) Elective only

Variables	Odds ratio (95%CI)	p-value
Discharge against medical advice	1.91 (1.17-3.11)	0.010
Female	1.27 (1.19-1.35)	<0.001
Primary expected payer vs Medicare		
Private	0.73 (0.66-0.80)	<0.001
Dyslipidemia	0.89 (0.82-0.96)	0.003
Diabetes mellitus	1.13 (1.05-1.22)	0.001
Previous percutaneous coronary intervention	0.86 (0.80-0.93)	<0.001
Atrial fibrillation	1.38 (1.24-1.53)	<0.001
Previous transient ischemic attack/stroke	1.25 (1.09-1.43)	0.002
Peripheral vascular disease	1.18 (1.07-1.30)	0.001
Chronic lung disease	1.35 (1.23-1.48)	<0.001
Renal failure	1.46 (1.34-1.60)	<0.001
Liver disease	1.49 (1.11-2.00)	0.008
Fluid and electrolyte disorders	1.31 (1.14-1.52)	<0.001
Anemia	1.42 (1.24-1.62)	<0.001
Cancer	1.33 (1.03-1.72)	0.031
Depression	1.38 (1.20-1.60)	<0.001
Fractional flow reserve	1.31 (1.08-1.60)	0.007
Drug eluting stent	0.83 (0.77-0.91)	<0.001
Vascular complication	1.42 (1.06-1.88)	0.020
Emergency coronary artery bypass graft	1.41 (1.06-1.88)	0.018

C) Acute myocardial infarction

Variables	Odds ratio (95%CI)	p-value
Discharge against medical advice	1.96 (1.73-2.22)	<0.001
Female	1.29 (1.25-1.33)	<0.001
Primary expected payer vs Medicare		
Medicaid	1.19 (1.12-1.26)	<0.001
Private	0.70 (0.67-0.73)	<0.001
Uninsured	0.75 (0.71-0.80)	<0.001
Other	0.82 (0.76-0.88)	<0.001
Smoker	0.91 (0.89-0.94)	<0.001
Drug abuse	1.30 (1.20-1.40)	<0.001
Dyslipidemia	0.90 (0.87-0.93)	<0.001
Hypertension	1.09 (1.05-1.13)	<0.001
Diabetes mellitus	1.21 (1.18-1.23)	<0.001
Obesity	0.90 (0.87-0.94)	<0.001

Previous heart failure	0.76 (0.59-0.98)	0.033
Atrial fibrillation	1.40 (1.39-1.52)	<0.001
Previous transient ischemic attack/stroke	1.19 (1.13-1.26)	<0.001
Peripheral vascular disease	1.21 (1.15-1.27)	<0.001
Chronic lung disease	1.38 (1.32-1.43)	<0.001
Renal failure	1.52 (1.46-1.59)	<0.001
Liver disease	1.30 (1.16-1.45)	<0.001
Fluid and electrolyte disorders	1.21 (1.16-1.26)	<0.001
Anemia	1.36 (1.30-1.43)	<0.001
Cancer	1.54 (1.40-1.70)	<0.001
Depression	1.18 (1.11-1.25)	<0.001
Dementia	1.32 (1.18-1.47)	<0.001
Teaching hospital	0.96 (0.93-0.99)	0.023
Intra-aortic balloon pump	1.38 (1.03-1.84)	0.031
Fractional flow reserve	1.14 (1.00-1.30)	0.046
Drug eluting stent	0.82 (0.79-0.84)	<0.001
Cardiogenic shock	1.10 (1.01-1.20)	0.029
Emergency coronary artery bypass graft	0.85 (0.73-1.00)	0.047

Table 6: Cause of readmission by discharge against medical advice status

A) Causes of readmissions

Cause of readmission	Not DAMA (%)	DAMA (%)
Cardiac	45.5	49.8
Non-cardiac	54.5	50.2

B) Causes of non-cardiac readmissions

Cause of non-cardiac readmission	Not DAMA (%)	DAMA (%)
Non-specific chest pain	20.2	19.7
Infections	9.3	10.2
Respiratory	7.5	9.7
Neuropsychiatric	2.4	8.3
Gastrointestinal	11.4	6.9
Peripheral vascular disease	4.4	5.0
Renal failure	3.2	3.9
Bleeding	5.3	3.6
TIA/stroke	4.4	3.0
Hematological/neoplasm	2.7	2.2

C) Causes of cardiac readmissions

Cause of cardiac readmission	Not DAMA (%)	DAMA (%)
Diagnosis of acute myocardial infarction	19.5	39.4
Coronary artery disease including angina	42.4	29.3
Heart failure	19.1	17.6
Arrhythmias	14.0	11.5
Pericarditis	1.4	0.8
Valve disorders	0.7	0.6
Conduction disorders	0.7	0.0
Hyper/hypotension	0.0	0.0
Other cardiac	2.1	0.8

Supplementary Methods

Study design and participants

The Nationwide Readmission Database (NRD) is a publicly available database of all-payer hospital inpatients stays, which is developed by the Agency for Healthcare Research and Quality (AHRQ) as a part of the Healthcare Cost and Utilization Project (HCUP) in the Unites States. Its data are derived from State Inpatient Databases that contain unique patient number which can be used to track patients across different hospitals within a State whilst adhering to privacy guidelines. The data are drawn from 21 states that are geographically dispersed and accounts for approximately 49% of total US resident population and approximately 49% of hospitalizations. Following the recommendations of AHRQ we used the discharge weights provided in the dataset to estimate total sample sizes.

In the current study, we included men and women aged 18 years or older who underwent first PCI between 2010 and 2014 and were either DAMA or were discharged home. First PCI was defined by first procedure of PCI within a calendar year. DAMA was defined from the variable "DISPUNIFORM" which represents the disposition of patient at discharge. Patients who had a discharge destination of either DAMA or discontinued care were considered to be DAMA. We excluded patients who died during their index admission for PCI, those who had an elective readmission and those who were not discharged home or against medical advice (transfer to another institution, care home or unknown destination).

Variables and outcomes

We collected data on participant age, sex, year of procedure, elective procedure, weekend admission, primary expected payer and quartile of median household income and used International Classification of Disease – 9th Clinical Modification (ICD-9) and Clinical classification software (CCS) of diseases codes to determine comorbidities, in-hospital

procedures and outcomes. The comorbidities collected included smoking, alcohol misuse, dyslipidemia, hypertension, diabetes mellitus, obesity, heart failure, known coronary artery disease, previous myocardial infarction (MI), previous PCI, previous coronary artery bypass graft (CABG), previous valve disease, atrial fibrillation, previous TIA (transient ischemic attack) / stroke, peripheral vascular disease, pulmonary circulatory disorder, peptic ulcer disease, chronic lung disease, chronic kidney disease, liver disease, hypothyroidism, fluid and electrolyte disorders, anemia, cancer, depression and dementia. The hospital characteristics evaluated included the number of beds per hospital, location and teaching status. The in-hospital procedures and related variables collected were multivessel disease, bifurcation disease, circulatory support, vasopressor use, intra-aortic balloon pump, fractional flow reserve, intravascular ultrasound and drug eluting stent. The outcomes evaluated were in-hospital complete heart block, TIA/stroke, cardiogenic shock, cardiac arrest, acute kidney injury, major bleeding, blood transfusion, vascular complication, emergency CABG, length of stay (LOS) in days and cost for clinical care. The cost of clinical care was determined by the claims change multiplied by the cost-to-charge ratio. 30-day readmissions were defined as first rehospitalization after discharge within 30 days from admission for PCI. The causes of readmissions were determined from the principle diagnosis based on CCS codes as outlined in Supplementary Table 1. The primary endpoint was all-cause 30-day readmissions and reasons for readmissions.

Statistical analysis

Statistical analysis was performed using Stata 14.0 (College Station, Texas, USA). A flow diagram was used to determine the proportion of patients at each stage of the analysis and those who were readmitted as well as those who died on readmission. Descriptive statistics were used to compare patients who were DAMA compared to those who were discharged home with further stratification depending on whether or not they were

readmitted. Statistical differences between groups for continuous variables were tested using the t-test and for categorical variables the Chi^2 test. For all analyses, the survey estimation commands were used (e.g. svy: logistic for multiple logistic regression), following the recommendations from AHRQ for analysis of survey data to account for the complex survey design of the NRD database. Multiple logistic regression with adjustments for age, gender, year of PCI, elective procedure, weekend admission, primary expected payer, quartile of median household income, comorbidities, hospital characteristics, in-hospital procedures and in-hospital outcomes were used to determine independent variables associated with DAMA and 30-day readmission. The major cardiac and non-cardiac causes of readmission for the DAMA and discharged home groups are presented in tables.

Supplementary Table 1: Classification of Clinic Classification Software codes for Readmissions Causes

Causes of readmission	CCS code	Diagnosis
Respiratory	127	Chronic obstructive pulmonary disease and bronchiectasis
	128	Asthma
	130	Pleurisy, pneumothorax, pulmonary collapse
	131	Respiratory failure, insufficiency and arrest
	132	Lung disease due to external agents
	133	Other lower respiratory disease
	134	Other upper respiratory disease
	221	Respiratory distress syndrome
Infection	1	Tuberculosis
	2	Septicemia
	3	Bacterial infection
	4	Mycoses
	5	HIV infection
	6	Hepatitis
	7	Viral infection
	8	Other infection
	9	Sexually transmitted infection
	76	Meningitis
	77	Encephalitis
	78	Other CNS infection and poliomyelitis
	90	Inflammation or infection of eye
	122	Pneumonia
	123	Influenza
	124	Acute and chronic tonsillitis
	125	Acute bronchitis
	126	Other upper respiratory infections
	129	Aspiration pneumonitis
	135	Intestinal infection
	197	Skin and subcutaneous tissue infections
	201	Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted disease)
Bleeding	60	Acute posthemorrhagic anemia
	153	Gastrointestinal hemorrhage
	182	Hemorrhage during pregnancy; abrutio placenta; placenta previa
Peripheral vascular disease	114	Peripheral and visceral atherosclerosis
	115	Aortic, peripheral and visceral artery aneurysms
	116	Aortic and peripheral arterial embolism or thrombosis
	117	Other circulatory disease
	118	Phlebitis, thrombophlebitis and thromboembolism
	119	Varicose veins of lower extremities

Genitourinary	159	Urinary tract infection
	160	Calculus of the urinary tract
	161	Other diseases of kidney and ureters
	162	Other diseases of bladder and urethra
	163	Genitourinary symptoms and ill-defined conditions
	164	Hyperplasia of prostate
	165	Inflammatory conditions of the male genital organs
	166	Other male genital disorders
	170	Prolapse of female genital organs
	175	Other female genital disorders
	215	Genitourinary congenital anomalies
Renal disease	156	Nephritis; nephrosis; renal sclerosis
	157	Acute and unspecified renal failure
	158	Chronic kidney disease
Gastrointestinal	138	Esophageal disorders
	139	Gastroduodenal ulcer (except hemorrhage)
	140	Gastritis and duodenitis
	141	Other disorders of stomach and duodenum
	142	Appendicitis and other appendiceal conditions
	143	Abdominal hernia
	144	Regional enteritis and ulcerative colitis
	145	Intestinal obstruction without hernia
	146	Diverticulosis and diverticulitis
	147	Anal and rectal conditions
	148	Peritonitis and intestinal abscess
	149	Biliary tract disease
	150	Liver disease; alcohol-related
	151	Other liver diseases
	152	Pancreatic disorders (not diabetes)
	154	Noninfectious gastroenteritis
	155	Other gastrointestinal disorders
	214	Digestive congenital anomalies
	222	Hemolytic jaundice and perinatal jaundice
	250	Nausea and vomiting
	251	Abdominal pain
TIA/stroke	109	Acute cerebrovascular disease
	110	Occlusion of stenosis of precerebral arteries
	111	Other and ill-defined cerebrovascular disease
	112	Transient cerebral ischemia
	113	Late effects of cerebrovascular disease
Trauma	207	Pathological fracture
	225	Joint disorders and dislocations; trauma-related
	226	Fracture of neck of femur (hip)
	227	Spinal cord injury
	228	Skull and face fractures

	229	Fracture of upper limb
	230	Fracture of lower limb
	231	Other fractures
	232	Sprains and strains
	233	Intracranial injury
	234	Crushing injury or internal injury
	235	Open wounds of head; neck; and trunk
	236	Open wounds of extremities
	239	Superficial injury; contusion
	244	Other injuries and conditions due to external causes
	260	All (external causes of injury and poisoning)
Endocrine/metabolic	48	Thyroid disorders
	49	Diabetes mellitus without complication
	50	Diabetes mellitus with complication
	51	Other endocrine disorders
	53	Disorders of lipid metabolism
	58	Other nutritional and endocrine/metabolic disorders
	186	Diabetes or abnormal glucose tolerance complicating pregnancy; childbirth; or the puerperium
Neuropsychiatric	650	Adjustment disorders
	651	Anxiety disorders
	652	Attention-deficit, conduct, and disruptive behavior disorders
	653	Delirium, dementia, and amnestic and other cognitive disorders
	654	Developmental disorders
	655	Disorders usually diagnosed in infancy and childhood or adolescence
	656	Impulse control disorders, NEC
	657	Mood disorders
	658	Personality disorders
	659	Schizophrenia and other psychotic disorders
	660	Alcohol-related disorders
	661	Substance-related disorders
	662	Suicide and intentional self-inflicted injury
	663	Screening and history of mental health and substance abuse codes
	670	Miscellaneous mental health disorders
	79	Parkinson's disease
	80	Multiple sclerosis
	81	Other hereditary and degenerative nervous system conditions
	82	Paralysis
	83	Epilepsy, convulsions
	84	Headache including migraine
	85	Coma, stupor and brain damage
	95	Other nervous system disorders
	216	Nervous system congenital anomalies
	650	Adjustment disorders
	651	Anxiety disorders

	652	Attention-deficit, conduct, and disruptive behavior disorders
	653	Delirium, dementia, and amnestic and other cognitive disorders
	654	Developmental disorders
	655	Disorders usually diagnosed in infancy and childhood or adolescence
	656	Impulse control disorders
	657	Mood disorders
	658	Personality disorders
	659	Schizophrenia and other psychotic disorders
	660	Alcohol-related disorders
	661	Substance-related disorders
	662	Suicide and intentional self-inflicted injury
	663	Screening and history of mental health and substance abuse codes
	670	Miscellaneous mental health disorders
Hematological/neoplastic	11	Cancer of head and neck
	12	Cancer of esophagus
	13	Cancer of stomach
	14	Cancer of colon
	15	Cancer of rectum and anus
	16	Cancer of liver and intrahepatic bile ducts
	17	Cancer of pancreas
	18	Cancer of other gastrointestinal organs, peritoneum
	19	Cancer of bronchus, lung
	20	Cancer of other respiratory and intrathoracic
	21	Cancer of bone and connective tissue
	22	Melanoma of skin
	23	Other non-epithelial cancer of skin
	24	Cancer of breast
	25	Cancer of uterus
	26	Cancer of cervix
	27	Cancer of ovary
	28	Cancer of other female genital organs
	29	Cancer of prostate
	30	Cancer of testis
	31	Cancer of other male genital organs
	32	Cancer of bladder
	33	Cancer of kidney and renal pelvis
	34	Cancer of other urinary organs
	35	Cancer of brain and nervous system
	36	Cancer of thyroid
	37	Hodgkin's disease
	38	Non-Hodgkin's lymphoma
	39	Leukemias
	40	Multiple myeloma
	41	Cancer, other and unspecified primary
	42	Secondary malignancies

	43	Malignant neoplasm without specification of site
	44	Neoplasm of unspecified nature or uncertain behavior
	46	Benign neoplasm of uterus
	47	Other and unspecified benign neoplasm
	59	Deficiency and other anemias
	61	Sickle cell anemia
	62	Coagulation and hemorrhagic disorders
	63	Disease of white blood cells
	64	Other hematologic conditions
Rheumatology problem	54	Gout and other crystal arthropathies
Opthalmology problem	86	Cataract
	87	Retinal detachment defects, vascular occlusion and retinopathy
	88	Glaucoma
	89	Blindness and vision defects
	91	Other eye disorders
ENT problem	92	Otitis media and related conditions
	93	Conditions associate with dizziness or vertigo
	94	Other ear and sense organ disorder
Non-specific chest pain	102	Non-specific chest pain
Oral health problem	136	Disorders of teeth and jaw
	137	Diseases of mouth; excluding dental
Obstetric admission including pregnancy	174	Female infertility
	176	Contraceptive and procreative management
	177	Spontaneous abortion
	178	Induced abortion
	179	Postabortion complication
	180	Ectopic pregnancy
	181	Other complications of pregnancy
	184	Early or threatened labor
	185	Prolonged pregnancy
	187	Malposition; malpresentation
	188	Fetopelvic disproportion; obstruction
	189	Previous C-section
	190	Fetal distress and abnormal forces of labor
	191	Polyhydramnios and other problems of amniotic cavity
	192	Umbilical cord complication
	193	OB-related trauma to perineum and vulva
	194	Forceps delivery
	195	Other complications of birth; puerperium affecting management of mother
	196	Other pregnancy and deliver including normal
	218	Liveborn
	219	Short gestation; low birth weight; and fetal growth retardation
	220	Intrauterine hypoxia and birth asphyxia
	223	Birth trauma
	224	Other perinatal conditions

Dermatology problem	198	Other inflammatory condition of skin
	199	Chronic ulcer of skin
	200	Other skin disorders
Poisoning	241	Poisoning by psychotrophic agents
	242	Poisoning by other medication and drugs
	243	Poisoning by nonmedical substances
Syncope	245	Syncope
Other non-cardiac	10	Immunization and screening for infectious disease
	45	Maintenance chemotherapy, radiotherapy
	52	Nutritional deficiencies
	55	Fluid and electrolyte disorders
	56	Cystic fibrosis
	57	Immunity disorder
	120	Hemorrhoids
	121	Other diseases of veins and lymphatics
	167	Nonmalignant breast conditions
	168	Inflammatory disease of female pelvic organs
	169	Endometriosis
	172	Ovarian cyst
	173	Menopausal disorders
	202	Rheumatoid arthritis and related disease
	203	Osteoarthritis
	204	Other non-traumatic joint disorders
	205	Spondylosis; intervertebral disc disorders; other back problems
	206	Osteoporosis
	208	Acquired foot deformities
	209	Other acquired deformities
	210	Systemic lupus erythematosus and connective tissue disorders
	211	Other connective tissue disease
	212	Other bone disease and musculoskeletal deformities
	217	Other congenital anomalies
	237	Complication of device; implant or graft
	238	Complications of surgical procedure or medical care
	240	Burns
	246	Fever of unknown origin
	247	Lymphadenitis
	248	Gangrene
	252	Malaise and fatigue
	253	Allergic reactions
	254	Rehabilitation care; fitting of prostheses; and adjustment of devices
	255	Administrative/social admission
	256	Medical examination/evaluation
	257	Other aftercare
	258	Other screening for suspected conditions (not mental disorders or infectious disease)
	259	Residual codes; unclassified

Heart failure	108	Congestive heart failure non-hypertensive
Arrhythmia	106	Cardiac dysrhythmias
	107	Cardiac arrest and ventricular fibrillation
Conduction disorder	105	Conduction disorders
Valve disorders	96	Heart valve disorder
Hyper/hypotension	98	Essential hypertension
	99	Hypertension with complications and secondary hypertension
	183	Hypertension complicating pregnancy; childbirth and the puerperium
	249	Shock
Pericarditis	97	Peri-, endo- and myocarditis, cardiomyopathy
Coronary artery disease including angina	101	Coronary atherosclerosis and other heart disease includes angina
Acute myocardial infarction	100	Acute myocardial infarction
Others (cardiac)	103	Pulmonary heart disease
	104	Other and ill-defined heart disease
	213	Cardiac and circulatory congenital anomalies

Supplementary Table 2: Sensitivity analysis of the subgroup of patients with acute myocardial infarction after exclusion of elective cases

A) Multiple logistic regression to identify independent variables associated with patients who discharge against medical advice

Variables	Odds ratio (95%CI)	p-value
Age (per 1 year increment)	0.96 (0.96-0.97)	<0.001
Female	0.60 (0.53-0.67)	<0.001
Primary expected payer vs Medicare		
Medicaid	1.21 (1.03-1.42)	0.019
Private	0.27 (0.23-0.31)	<0.001
Other	0.72 (0.58-0.90)	0.004
Smoker	1.77 (1.59-1.97)	<0.001
Alcohol misuse	1.28 (1.07-1.53)	0.006
Drug abuse	1.83 (1.57-2.13)	<0.001
Dyslipidemia	0.61 (0.55-0.67)	<0.001
Diabetes mellitus	1.12 (1.00-1.25)	0.043
Previous myocardial infarction	1.41 (1.23-1.48)	<0.001
Previous percutaneous coronary intervention	1.55 (1.37-1.76)	<0.001
Previous stroke/TIA	1.27 (1.06-1.51)	0.010
Peripheral vascular disease	1.23 (1.03-1.46)	0.019
Chronic lung disease	1.30 (1.15-1.46)	<0.001
Hypothyroidism	0.70 (0.54-0.90)	0.005
Teaching hospital	0.84 (0.76-0.93)	<0.001
Intravascular ultrasound	0.74 (0.59-0.93)	0.010
Drug eluting stent	0.64 (0.58-0.70)	<0.001
Acute kidney injury	2.51 (1.53-4.13)	<0.001
Emergency coronary artery bypass graft	0.45 (0.26-0.76)	<0.001

B) Multiple logistic regression to determine independent variables associated with readmission within 30 days

Variables	Odds ratio (95%CI)	p-value
Discharge against medical advice	1.96 (1.73-2.22)	<0.001
Female	1.29 (1.25-1.33)	<0.001
Primary expected payer vs Medicare		
Medicaid	1.19 (1.12-1.26)	<0.001
Private	0.70 (0.67-0.73)	<0.001
Uninsured	0.75 (0.71-0.80)	<0.001
Other	0.82 (0.76-0.88)	<0.001
Smoker	0.91 (0.89-0.94)	<0.001
Drug abuse	1.30 (1.20-1.40)	<0.001
Dyslipidemia	0.90 (0.87-0.93)	<0.001

Hypertension	1.09 (1.05-1.13)	<0.001
Diabetes mellitus	1.21 (1.18-1.23)	<0.001
Obesity	0.90 (0.87-0.94)	<0.001
Previous heart failure	0.76 (0.59-0.98)	0.033
Atrial fibrillation	1.40 (1.39-1.52)	<0.001
Previous transient ischemic attack/stroke	1.19 (1.13-1.26)	<0.001
Peripheral vascular disease	1.21 (1.15-1.27)	<0.001
Chronic lung disease	1.38 (1.32-1.43)	<0.001
Renal failure	1.52 (1.46-1.59)	<0.001
Liver disease	1.30 (1.16-1.45)	<0.001
Fluid and electrolyte disorders	1.21 (1.16-1.26)	<0.001
Anemia	1.36 (1.30-1.43)	<0.001
Cancer	1.54 (1.40-1.70)	<0.001
Depression	1.18 (1.11-1.25)	<0.001
Dementia	1.32 (1.18-1.47)	<0.001
Teaching hospital	0.96 (0.93-0.99)	0.023
Intra-aortic balloon pump	1.38 (1.03-1.84)	0.031
Fractional flow reserve	1.14 (1.00-1.30)	0.046
Drug eluting stent	0.82 (0.79-0.84)	<0.001
Cardiogenic shock	1.10 (1.01-1.20)	0.029
Emergency coronary artery bypass graft	0.85 (0.73-1.00)	0.047

C) Cause of readmission by discharge against medical advice status

Cause of readmission	Not DAMA (%)	DAMA (%)
Cardiac	49.2	56.6
Non-cardiac	50.8	43.4

Cause of non-cardiac readmission	Not DAMA (%)	DAMA (%)
Non-specific chest pain	19.6	21.5
Infections	10.1	11.0
Respiratory	7.2	8.8
Neuropsychiatric	2.2	6.1
Gastrointestinal	11.1	6.1
Peripheral vascular disease	4.5	3.9
Renal failure	3.2	5.5
Bleeding	5.3	2.2
TIA/stroke	4.9	3.3
Hematological/neoplasm	2.4	1.1

Cause of cardiac readmission	Not DAMA (%)	DAMA (%)
Diagnosis of acute myocardial infarction	14.7	47.5
Coronary artery disease	41.7	25.0

including angina		
Heart failure	12.5	17.8
Arrhythmias	13.0	7.6
Pericarditis	1.1	0.8
Valve disorders	0.8	0.4
Conduction disorders	0.9	0.0
Hyper/hypotension	0.0	0.0
Other cardiac	15.2	0.8

Supplementary Table 3: Causes of psychiatric readmissions

Causes of psychiatric readmissions	Not DAMA (%)	DAMA (%)
Depression, bipolar and mood disorder	24.3	43.3
Paranoid schizophrenia, schizoaffective disorder and psychosis	7.5	16.7
Alcohol intoxication, withdrawal and related disease	8.3	10.0
Illicit drug related illness (opioid, cocaine, etc).	8.3	10.0
Anxiety and panic disorder	16.0	6.7
Epilepsy, convulsions and seizure	13.0	0.0
Headache and migraine	5.5	0.0
Dementia	2.6	0.0
Stress	0.8	0.0
Other	13.6	13.3