Discharge Against Medical Advice in Acute Ischemic Stroke: the Risk of 30-Day Unplanned Readmission

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BACKGROUND: Discharge against medical advice may be associated with more readmissions.

OBJECTIVE: To evaluate DAMA in patients with acute ischemic stroke (AIS) and identify the relationship between DAMA and 30-day unplanned readmissions.

DESIGN: A retrospective cohort study.

PARTICIPANTS: The National Readmission Database was used to identify inpatients with a primary diagnosis of AIS who were either discharged home or DAMA between 2010 and 2017 in the USA.

MEASURES: Demographic features, hospital type, comorbidities, stroke risk factors, severity indices, and treatments were compared between patients discharged routinely and DAMA. Multivariable logistic regression was used to evaluate predictors of DAMA, and a double robust inverse probability of treatment weighting method was used to assess the association between DAMA and 30-day unplanned readmissions.

KEY RESULTS: Overall, 1,335,484 patients with AIS were included, of whom 2.09% ($n = 27,892$) were DAMA. The prevalence of DAMA in AIS patients increased from 1.65 in 2010 to 2.57% in 2017. The rates of 30-day unplanned readmissions for DAMA and non-DAMA patients were 16.81% and 7.78%, respectively. Patients with drug abuse, alcohol abuse, smoking, prior stroke, psychoses, and intravenous thrombolysis had greater odds of DAMA. DAMA was associated with all-cause readmissions (OR, 2.04; 95% CI, 2.01–2.07) and remained a strong predictor for transient ischemic attack/stroke-specific and cardiac-specific causes of readmissions.

CONCLUSIONS: Although the DAMA rate is low in AIS patients, DAMA is a risk factor for all-cause and recurrent stroke-specific readmissions. Future studies are needed to address issues around compliance and engagement with health care to reduce DAMA.

KEY WORDS: discharge against medical advice; readmission; acute ischemic stroke; risk factor.

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INTRODUCTION

Nearly 10.3 million new strokes occur each year globally,¹ which cause 10% of all deaths,² and account for 5% of all disability-adjusted life-years.³ In the United States (U.S.), stroke is the fifth-leading cause of death with 800,000 people experiencing new or recurrent stroke every year.⁴ With aging population and declining stroke deaths, the number of people with stroke is projected to increase by 3.4 million between 2012 and 2030.⁵ Hospital readmission within 30 days is associated with adverse outcomes during index hospitalization and is a national policy concern due to the avoidable health insurance costs of approximate \$17.4 billion per year.⁶ It is also an important index of medical quality and hospital performance.⁷ Previous studies reported a 12% hospital readmission rate after stroke within 30 days of discharge⁸ and 42% within a year.⁹ The Centers for Medicare & Medicaid Services in the U.S. have set a quality measure to reduce the 30-day readmission of patients with acute ischemic stroke (AIS).¹⁰

Discharge against medical advice (DAMA) is when a patient leaves the hospital before the physician recommends discharge, which is seen in 1–2% of all admissions.¹¹ A study using the Nationwide Inpatient Sample found that the prevalence of DAMA increased from 2002 to 2011 in the U.S., with an average annual increase of 1.9%.¹² As early as the 1960s, DAMA has been reported to be associated with substance abuse and mental illness.¹³ Although relatively rare, DAMA is associated with a higher risk of readmission and a higher 30-day mortality rate. Southern et al. reported that the 30-day readmission rate for DAMA patients was 24.5% and the 30-day mortality rate was 1.3%, both twice the rate for non-DAMA patients.¹⁴ However, few studies have reported the relationship between DAMA and 30-day unplanned readmissions in AIS survivors. Baatiema et al.¹⁵ reported that DAMA was a barrier to evidence-based acute stroke care from the perspectives of stroke care professionals. The study, however, was a questionnaire to healthcare professionals; no patient was included. Parikh et al.¹⁶ reviewed over 300 patients with stroke patients and concluded that DAMA was associated with higher 30-day readmission, while this single-center study was limited by small sample size.

Using the National Readmission Database (NRD), this study intends to (1) depict the temporal trends of DAMA in AIS survivors in the U.S. from 2010 to 2017; (2) evaluate the association of DAMA with demographic characteristics, hospital type, comorbidities, stroke risk factors, severity indices, and treatment variables; (3) explore the rates and causes of readmission in DAMA and non-DAMA patients; (4) evaluate the association of DAMA with all-cause and specific-cause 30-day unplanned readmissions.

METHODS

Data Source

The NRD is part of a family of databases and software tools developed for the Healthcare Cost and Utilization Project (HCUP). It is a unique and powerful database that supports various types of analyses on national readmission rates for all payers and the uninsured. It is drawn from 21 states and contains data from approximately 18 million discharges each year. After weighting, it estimates roughly 36 million discharges.¹⁷ Our study was approved by institutional review board approval at Second Military Medical University.

Study Population

Inpatients with a primary diagnosis of AIS who were subsequently discharged home or DAMA between 2010 and 2017 were included. AIS patients were identified using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes (433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, and 436) and International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis codes (I21).¹⁸ These codes have a specificity of 95% and positive predictive value of 90% for AIS.¹⁹ The NRD variable “DISPUNIFORM” was used to identify DAMA. The exclusion criteria included (1) patients younger than 18 years, (2) died during the first index hospitalization, (3) discharged in December (because NRD does not provide cross-year follow-up data), (4) elective readmissions, and not discharged home or not DAMA.

Covariate Assessment

Demographic characteristics such as age, sex, weekend admission, elective admission, income by postal code, and insurance type were identified. Hospital characteristics included bed size and teaching status. We used the Elixhauser Comorbidity Index (ECI) to account for the burden of 29 common comorbidities.²⁰ Stroke risk factors, severity indices, and treatment variables were identified using ICD-9-CM and ICD-10-CM diagnostic or procedural codes (Table e-1).^{8,16,21,22}

Primary and Secondary Outcomes

All-cause 30-day unplanned readmission was the primary study outcome. Unplanned readmission was defined as the first readmission of an AIS patient within 30 days of discharge that was not elective. The secondary outcomes included the temporal trend of DAMA from 2010 to 2017, the rate of 30-day unplanned readmissions, and specific readmission causes. The specific readmission causes were determined according to the previously developed Clinical Classification Software (CCS) code-based approach.²³

Statistical Analysis

The NRD is based on complex sampling design, and we used the survey estimation commands recommended by the HCUP to obtain total national estimates.¹⁷ The baseline characteristics of the patients were summarized based on DAMA and readmission status. We calculated mean and standard error for continuous variables, and frequency and percentages for categorical variables. The χ^2 test and *t* test were used to compare the characteristics. We calculated weighted prevalence of DAMA for each year in all patients and subgroups of age, sex, and income. The trends in DAMA prevalence were analyzed using the Cochran-Armitage trend test.

Multivariable logistic regression analysis was used to identify statistically significant risk predictors of DAMA. Demographic characteristics, hospital characteristics, stroke risk factors, severity indices, and treatment variables were incorporated into the model for adjustment. Subgroup analyses based on demographic characteristics, hospital characteristics, stroke risk factors, severity indices, and treatment variables were performed. We constructed univariate logistic regression analysis (model 1), multivariable-adjusted logistic model (model 2), and double robust inverse probability of treatment weighting (IPTW) method²⁴ to assess the association between DAMA and 30-day unplanned readmissions. Model 2 was adjusted for demographics characteristics, hospital characteristics, individual comorbidities, stroke risk factors, and severity indices with known association with AIS. In model 3, we computed propensity scores using demographics characteristics, hospital characteristics, individual comorbidities, stroke risk factors, and severity indices with known association with AIS. Finally, we conducted sensitivity analyses in several settings: (1) excluded patients admitted electively in the index hospitalization; (2) excluded patients with admission ≤ 1 calendar day; (3) included patients who were discharged to a facility/short term rehab/home health care/others or unknown destination; (4) included patients who were discharged in December.

Two-sided *p* values ≤ 0.05 were considered statistically significant. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

Data Availability

The NRD data is a publicly accessible database that can be obtained at hcup-us.ahrq.gov.

RESULTS

A weighted sample of 3,662,381 patients with AIS was identified from 2010 to 2017. We excluded patients who died during hospital stay ($n = 182,509$), patients who were younger than 18 ($n = 5579$), patients who were admitted in December ($n = 318,656$), patients who were discharged to other places ($n = 1,992,175$), and patients who had a planned 30-day readmission ($n = 52,712$). The final number of patients with AIS included in the analysis was 1,335,484. DAMA patients constituted 2.09% ($n = 27,892$) of the final sample size. The rate of unplanned 30-day readmission for DAMA and non-DAMA patients was 16.81% and 7.78%, respectively (Fig. 1).

Baseline Characteristics

Table 1 and Table e-2 show that DAMA patients were younger (59.29 vs. 64.64 years, $p < 0.0001$), less likely to be female (33.78% vs. 43.89%, $p < 0.0001$), more likely to be covered by Medicaid and Uninsured (Medicaid: 23.05% vs. 10.17%, uninsured: 12.83% vs. 7.31%, $p < 0.0001$), had lower income (1st–25th percentile: 41.22% vs. 31.21%, $p < 0.0001$), and higher ECI (1.95 vs. 1.84, $p < 0.0001$). In addition, DAMA patients had higher rates of alcohol abuse (10.51% vs. 5.19%, $p < 0.0001$), drug abuse (12.68% vs. 3.45%, $p < 0.0001$), chronic pulmonary disease (18.20% vs. 13.41%, $p < 0.0001$), psychoses (6.35%

vs. 2.79%, $p < 0.0001$), smoking (52.74% vs. 38.92%, $p < 0.0001$), prior stroke (24.06% vs. 22.53%, $p = 0.0003$), and hemiparesis/hemiplegia (28.66% vs. 24.27%, $p < 0.0001$). The rate of intravenous thrombolysis was similar between AIS patients who were DAMA and non-DAMA. DAMA patients also had a shorter length of hospital stay (1.17 vs. 2.02 days, $p < 0.0001$) and lower hospitalization cost (\$6426 vs. \$7999, $p < 0.0001$) in the index hospitalization.

Table e-3 shows the baseline characteristics and in-hospital outcomes stratified by readmission and DAMA status. Among patients who were not readmitted, DAMA patients were younger, less likely to be female, had higher rates of alcohol abuse, and drug abuse. Similarly, among patients who were readmitted, DAMA patients were less likely to be female and had higher rates of alcohol abuse, drug abuse, chronic pulmonary disease, smoking, and psychoses. DAMA during the first admission was associated with a higher rate of DAMA for readmission (24.23% vs. 0.94%, $p < 0.0001$).

Trends of DAMA Prevalence

The prevalence of DAMA in AIS patients increased from 1.65 in 2010 to 2.57% in 2017 (p trend < 0.0001) (Fig. 2). Subgroup analysis showed (Fig. 2) that the prevalence of DAMA was higher in males and increased from 2.04 in 2010 to 2.95% in 2017 (p trend < 0.0001). Patients younger than 45 years also had a higher temporal trend of DAMA that increased from 3.06 in 2010 to 4.51% in 2017 (p trend < 0.0001). The prevalence of DAMA also increased over the years in patients with lower income (p trend < 0.0001). Figure e-1 shows the trends of demographic factors and clinically relevant factors of patients.

Figure 1 Selection flow diagram of target population.

Table 1 Baseline Characteristics of Acute Ischemic Stroke Patients According to Discharge Against Medical Advice Status

	Not DAMA (N = 1,307,592)	DAMA (N = 27,892)	p value
Mean age (SE)	64.64 ± 0.05	59.29 ± 0.20	< 0.0001
Female	573,932 (43.89)	9422 (33.78)	< 0.0001
Type of insurance			< 0.0001
Medicare	668,338 (51.21)	12,509 (44.93)	
Medicaid	132,670 (10.17)	6418 (23.05)	
Private	352,737 (27.03)	3851 (13.83)	
Uninsured	95,388 (7.31)	3571 (12.83)	
Other	55,847 (4.28)	1491 (5.36)	
Income quartile			< 0.0001
1 st –25 th	401,413 (31.21)	11,290 (41.22)	
26 th –50 th	337,045 (26.20)	6928 (25.30)	
51 st –75 th	306,376 (23.82)	5615 (20.50)	
76 th –100 th	241,522 (18.78)	3553 (12.97)	
Elective	45,718 (3.50)	690 (2.48)	< 0.0001
Hospital bed size			< 0.0001
Small	112,780 (11.40)	2142 (10.83)	
Medium	240,802 (24.33)	5494 (27.78)	
Large	635,973 (64.27)	12,141 (61.39)	
Hospital teaching status			0.0021
Teaching	758,178 (57.98)	15,528 (55.67)	
Comorbidities			
Acquired immune deficiency syndrome	2367 (0.18)	173 (0.62)	< 0.0001
Alcohol abuse	67,888 (5.19)	2932 (10.51)	< 0.0001
Congestive heart failure	117,703 (9.00)	2746 (9.84)	0.0017
Chronic pulmonary disease	175,390 (13.41)	5076 (18.20)	< 0.0001
Diabetes	457,153 (34.96)	10,206 (36.59)	0.0005
Drug abuse	45,069 (3.45)	3536 (12.68)	< 0.0001
Obesity	170,677 (13.05)	3001 (10.76)	< 0.0001
Paralysis	96,176 (7.36)	1653 (5.93)	< 0.0001
Psychoses	36,503 (2.79)	1771 (6.35)	< 0.0001
Elixhauser comorbidity index	1.84 (0.93–2.96)	1.95 (1.01–3.16)	< 0.0001
Stroke risk factors			
Anticoagulation	83,932 (6.42)	1476 (5.29)	< 0.0001
Acute myocardial infarction	14,162 (1.08)	461 (1.65)	< 0.0001
Carotid dissection	6047 (0.46)	63 (0.23)	0.0002
Carotid stenosis	135,384 (10.35)	1909 (6.85)	< 0.0001
Smoke	508,858 (38.92)	14,712 (52.74)	< 0.0001
Atrial fibrillation	199,530 (15.26)	2990 (10.72)	< 0.0001
Dyslipidemia	703,483 (53.80)	11,029 (39.54)	< 0.0001
Prior stroke	294,628 (22.53)	6711 (24.06)	0.0003
Severity indices			
Aphasia	199,625 (15.27)	3598 (12.90)	< 0.0001
Hemiparesis/hemiplegia	317,310 (24.27)	7994 (28.66)	< 0.0001
DVT/PE	22,621 (1.73)	570 (2.04)	0.0189
Treatment operations			
Intravenous thrombolysis	94,593 (7.23)	2029 (7.28)	0.8742
Intra-arterial therapy	13,466 (1.03)	134 (0.48)	< 0.0001
Mechanical ventilation	7640 (0.58)	226 (0.81)	0.0022
PEG tube placement	5871 (0.45)	193 (0.69)	0.0045
LOS (days, median (25 th –75 th))	2.02 (1.18–3.75)	1.17 (0.34–2.80)	< 0.0001
Cost for first admission (dollars, median (25 th –75 th))	7999 (5613–12841)	6426 (4019–10633)	< 0.0001
Readmit	10,1713 (7.78)	4689 (16.81)	< 0.0001

Abbreviation: SE, standard error; DVT/PE, deep vein thrombosis/pulmonary embolism; PEG, percutaneous endoscopic gastrostomy; LOS, length of stay

Predictors of DAMA in AIS

In the multivariable analysis, female sex, hypothyroidism, atrial fibrillation, intra-arterial therapy, carotid stenosis, and herniation were associated with reduced odds of DAMA. Patients with drug abuse, alcohol abuse, a smoking habit, prior stroke, psychoses and intravenous thrombolysis had greater odds of DAMA (Table 2, Table e-4).

The Association of DAMA with 30-Day Readmission

In the double robust IPTW model, DAMA was associated with increased all-cause readmissions (odds ratio [OR], 2.04; 95% confidence interval [CI], 2.01–2.07, $p < 0.0001$). In addition, DAMA remained a strong risk factor for a specific cause of readmission (for stroke cause: OR, 2.12; 95% CI, 2.09–2.16; for cardiac cause: OR, 1.88; 95% CI, 1.82–1.95; Table 3).

Causes for 30-Day Unplanned Readmissions

The most common reason for 30-day unplanned readmission was transient ischemic attack/stroke irrespective of DAMA status. DAMA patients had a higher rate of readmission for transient ischemic attack/stroke, followed by neuropsychiatric diseases and infections. The top 10 causes contributed to more than 70% of all readmissions (Fig. 3).

Sensitivity Analyses

In the sensitivity analyses, DAMA remained a strong risk factor for readmission after excluding patients admitted electively in the index hospitalization (OR, 2.04; 95% CI, 2.01–2.07), excluding patients with admission ≤ 1 calendar day (OR, 1.96; 95% CI, 1.93–1.99), including patients who were discharged to a facility/short term rehab/home health care/others or unknown destination (OR, 1.99; 95% CI, 1.96–2.02), and including patients who were discharged in December (OR, 1.58; 95% CI, 1.57–1.59) (Table e-5).

DISCUSSION

The analysis using the 2010 to 2017 NRD database showed that the prevalence of DAMA in AIS patients was 2.09%. The study also revealed an increasing rate of DAMA over the years. Male sex, lower income, prior stroke, intravenous thrombolysis, smoking, psychoses, and drug and alcohol abuse were predictors of DAMA. The rates of unplanned 30-day readmission for DAMA and non-DAMA patients were 16.81% and 7.78%, respectively. Although the DAMA rate was low, DAMA patients were twice more likely to be readmitted in 30 days compared to patients who were routinely discharged home after adjustment for confounders. DAMA patients also had a higher risk for recurrent stroke-specific and cardiac-specific readmissions.

Figure 2 Overall DAMA prevalence (a) and subgroups categorized by sex (b), age (c), and income (d) in AIS. DAMA, discharge against medical advice; AIS, acute ischemic stroke.

Evidence regarding the predictors of DAMA and its temporal trend in patients with AIS is lacking. In this study, the prevalence of DAMA increased from 1.65 to 2.57% over 8 years, similar to the prevalence in the general population reported by Spooner et al. using the 2002 to 2011 NIS database.¹² In our study, smoking, psychoses, and drug and alcohol abuse were associated with DAMA occurrence, which was probably explained by the substance-seeking behavior.²³ Substance use disorder has previously been reported to be one of the most common diagnoses in DAMA and was estimated at a proportion of 14%.¹² In addition to the desire for substance, low self-control, low personal responsibility, aggression, impulsivity, and related cognitive impairment are all factors contributing to DAMA.²⁵ In addition, the impact of socioeconomic factors and medical insurance status on DAMA cannot be ignored. Our study shows that low income and uninsured are related to DAMA. However, DAMA is less likely in patients with paralysis, heart conditions (valvular diseases, atrial fibrillation), dyslipidemia, or intra-arterial therapy. We speculate that associated comorbidities may contribute to the burden of AIS, which affected the decision of patients to leave the hospital. Surprisingly, prior stroke is associated with increased DAMA; most probably the patient's prior experience leads to the belief that further observation is not necessary once the acute episode is treated.

Due to the limitations of the database, we were unable to determine whether it is a personal reason that patients choose

DAMA. Patients may choose DAMA for a variety of reasons unrelated to personal health and treatment, such as emergencies, financial issues, and legal issues (court appearances) and family issues (male and younger patients due to family and work needs), which are beyond the control of medical personnel.²⁶ Duno et al.²⁷ found in analyzing DAMA causes in patients that social factors such as prefer to stay at home, personal or family reasons were the most common DAMA causes rather than medical reasons such as dissatisfaction with medical care, disagreement with diagnosis or treatment procedures. DAMA may be related to medical staff mainly because of poor communication, the unwillingness of patients to be used for teaching purposes, or the dissatisfaction of patients with the treatment process or care. In addition, the long waiting time caused by the heavy workload of medical staff is also one of the reasons for DAMA.²⁸

The prevalence of DAMA in teaching hospitals is lower. The possible reason for this might be that teaching hospitals are highly specialized centers offering tertiary care, and DAMA is less likely because patients may fear a lack of better medical care elsewhere.²⁹ Emphasizing patient-centric care as a response to AMA discharge can help promote high-quality care for this patient group and reduce subsequent adverse effects. Clinicians must weigh multiple considerations for the benefit of their patients and maintain professional standards of clinical care. In response to the patient's desire to leave the hospital, the doctor should first determine what is a medically safe treatment plan, which

Table 2 The Predictors of Discharge Against Medical Advice in Acute Ischemic Stroke Patients

	OR (95 % CI)	p value
Age, per 1-year increase	0.97 (0.97, 0.97)	< 0.0001
Weekend admission	0.97 (0.91, 1.03)	0.2901
Female	0.67 (0.64, 0.71)	< 0.0001
Elective	0.77 (0.64, 0.92)	0.0039
Insurance		
Medicaid vs Medicare	1.14 (1.05, 1.23)	0.0012
Private vs Medicare	0.36 (0.34, 0.40)	< 0.0001
Uninsured vs Medicare	0.90 (0.83, 0.99)	0.0229
Others vs Medicare	0.71 (0.63, 0.80)	< 0.0001
Income quartile		
26 st –50 th vs 1 st –25 th	0.87 (0.81, 0.93)	< 0.0001
51 st –75 th vs 1 st –25 th	0.84 (0.78, 0.91)	< 0.0001
76 st –100 th vs 1 st –25 th	0.76 (0.70, 0.82)	< 0.0001
Hospital bed size		
Medium vs small	1.17 (1.05, 1.30)	0.0036
Large vs small	0.95 (0.87, 1.05)	0.3488
Teaching status	0.82 (0.77, 0.87)	< 0.0001
Alcohol abuse	1.24 (1.13, 1.36)	< 0.0001
Chronic pulmonary disease	1.34 (1.26, 1.43)	< 0.0001
Drug abuse	1.87 (1.72, 2.02)	< 0.0001
Hypertension	0.86 (0.81, 0.92)	< 0.0001
Hypothyroidism	0.78 (0.70, 0.85)	< 0.0001
Obesity	0.76 (0.70, 0.82)	< 0.0001
Paralysis	0.58 (0.51, 0.66)	< 0.0001
Psychoses	1.55 (1.39, 1.73)	< 0.0001
Pulmonary circulation disorders	0.60 (0.47, 0.76)	< 0.0001
Diabetes	1.18 (1.12, 1.24)	< 0.0001
Acute myocardial infarction	1.53 (1.25, 1.86)	< 0.0001
Smoke	1.30 (1.24, 1.37)	< 0.0001
Atrial fibrillation	0.90 (0.83, 0.98)	0.0169
Dyslipidemia	0.62 (0.59, 0.65)	< 0.0001
Prior stroke	1.19 (1.12, 1.27)	< 0.0001
Aphasia	0.90 (0.84, 0.96)	0.0032
Hemiparesis/hemiplegia	1.18 (1.10, 1.26)	< 0.0001
DVT/PE	1.26 (1.03, 1.55)	0.0271
Intravenous thrombolysis	1.20 (1.09, 1.33)	0.0001
Intra-arterial therapy	0.54 (0.37, 0.78)	0.0012

Abbreviation: DVT/PE, deep vein thrombosis/pulmonary embolism

may include not only inpatient treatment but also outpatient follow-up. Then, the doctor should fully discuss the risks of any evidence-based DAMA and the benefits of staying

in the hospital to continue treatment. Finally, clearly understand the needs of the patient and negotiate a discharge treatment plan agreed by both the patient and the doctor, so as to reduce the occurrence of DAMA and minimize the adverse effects of DAMA.

The results of this study emphasize the importance of developing interventions to reduce DAMA in patients with AIS. First, if doctors can identify patients at greatest risk of readmission (DAMA, etc.), these patients can be targeted for aggressive follow-up. Although being male and having a history of alcohol abuse were significant predictors of 30-day unplanned readmission, these characteristics were of little value in selecting individuals for intervention because they accounted for a high proportion of patients.³⁰ Therefore, future research needs to establish a more accurate prediction model. The results of the accurate prediction model can be used to establish a rating system to help doctors identify individuals with high-risk of DAMA. Moreover, health care providers should improve the quality of oral communication to manage patient expectations and minimize false promises.³¹ Health care providers must be trained in cultural diversity, interpersonal skills, and customer service.³² Since neuropsychiatric causes are an important reason for readmission in DAMA patients, providing follow-up mental health services could be helpful.²⁶ Providing preventive drugs before discharge or continuing treatment in the community could minimize the risk of readmissions in DAMA patients.³³ In addition, establishing a reasonable discharge plan with minimal harm to the patient may reduce the adverse effects on the patient. Many health systems have transitional care or post-discharge clinics.³⁴ These clinics are usually staffed by hospital doctors, and these clinics can enhance patient follow-up. Telephone follow-up is also an appropriate option.

Figure 3 The top 10 causes for 30-day unplanned readmission.

Table 3 The Association of Discharge Against Medical Advice with All-Cause Readmission and Specific Causes of Readmission

	Model 1		Model 2		Model 3	
	OR (95 % CI)	p value	OR (95 % CI)	p value	OR (95 % CI)	p value
All cause	2.36 (2.21, 2.52)	< 0.0001	2.19 (2.04, 2.34)	< 0.0001	2.04 (2.01, 2.07)	< 0.0001
Stroke cause	2.35 (2.17, 2.54)	< 0.0001	2.26 (2.08, 2.45)	< 0.0001	2.12 (2.09, 2.16)	< 0.0001
Non-stroke cause	2.29 (2.12, 2.48)	< 0.0001	2.05 (1.89, 2.23)	< 0.0001	1.91 (1.88, 1.95)	< 0.0001
Cardiac cause	2.07 (1.74, 2.46)	< 0.0001	1.93 (1.62, 2.31)	< 0.0001	1.88 (1.82, 1.95)	< 0.0001
Non-cardiac cause	2.48 (2.33, 2.63)	< 0.0001	2.29 (2.14, 2.44)	< 0.0001	2.11 (2.08, 2.13)	< 0.0001

Abbreviation: OR, odds ratio; CI, confidence interval

Model 1: DAMA as the single predictor

Model 2: adjusted for age, weekend admission, female, elective, insurance, income, hospital bed size, teaching status, acquired immune deficiency syndrome, alcohol abuse, deficiency anemias, rheumatoid arthritis, chronic blood loss anemia, congestive heart failure, chronic pulmonary disease, coagulopathy, depression, drug abuse, hypertension, hypothyroidism, liver disease, lymphoma, fluid and electrolyte disorders, metastatic cancer, other neurological disorders, obesity, paralysis, peripheral vascular disorders, psychoses, pulmonary circulation disorders, renal failure, solid tumor without metastasis, peptic ulcer disease, valvular disease, weight loss, diabetes, anticoagulation, acute myocardial infarction, carotid dissection, carotid stenosis, smoke, atrial fibrillation, dyslipidemia, hypercoagulability, prior stroke, aphasia, cerebral edema, coma, hemiparesis/hemiplegia, herniation, deep vein thrombosis/pulmonary embolism, intravenous thrombolysis, intra-arterial therapy, mechanical ventilation, percutaneous endoscopic gastrostomy tube placement

Model 3: double robust inverse probability of treatment weighting method

The current study also has several limitations. First, there is a possibility that the ICD codes and CCS used to identify variables might be affected by coding errors. In clinical real-world practice, a stroke patient might decide to DAMA, realize that he/she still has significant residual stroke symptoms, and then come back to the hospital and get readmitted. This would count as a readmission for recurrent stroke, while in reality, the patient is still being treated for the same stroke. This limitation cannot be overcome in this kind of retrospective setting. However, the misclassification rate would be small.³⁵ Second, out-of-hospital deaths were not recorded, due to which the study results may underestimate the extent of poor prognosis in DAMA patients. Third, the measurement of comorbidities measured by the Agency for Healthcare Research and Quality could lead to incomplete assessment of common comorbidities in stroke since stroke outcomes are strongly influenced by the presence of medical comorbidities.²¹ Fourth, the dataset lacked variables that distinguished emergency department stay from medical wards admission. The prevalence of DAMA may be higher in emergency admissions than in admission to the wards.

CONCLUSIONS

To conclude, DAMA is a strong risk factor for 30-day unplanned readmissions among patients with AIS. To reduce DAMA, the future study can be considered in terms of both patients and healthcare providers. For patients, given the association between low income and uninsured and DAMA, policymakers could expand medical coverage. For healthcare providers, targeted education is recommended for residents, caregivers, and nurses, such as training in cultural diversity, interpersonal skills, and customer service. In addition, it is important to develop strategies to improve patient compliance.

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Compliance with Ethical Standards:

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