



## Original Article

# Characteristics of patients presenting to emergency department for primary atrial fibrillation or flutter at an academic medical center



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## ABSTRACT

**Objective:** In the United States, atrial fibrillation (AF) accounts for over 400,000 hospitalizations annually. Emergency Department (ED) physicians have few resources available to guide AF/AFL (atrial flutter) patient triage, and the majority of these patients are subsequently admitted. Our aim is to describe the characteristics and disposition of AF/AFL patients presenting to the University of North Carolina (UNC) ED with the goal of developing a protocol to prevent unnecessary hospitalizations.

**Methods:** We performed a retrospective electronic medical chart review of AF/AFL patients presenting to the UNC ED over a 15-month period from January 2015 to March 2016. Demographic and ED visit variables were collected. Additionally, patients were designated as either having primary or secondary AF/AFL where primary AF/AFL patients were those in whom AF/AFL was the primary reason for ED presentation. These primary AF/AFL patients were categorized by AF symptom severity score according to the Canadian Cardiovascular Society Severity of Atrial Fibrillation (CCS-SAF) Scale.

**Results:** A total of 935 patients presented to the ED during the study period with 202 (21.5%) having primary AF/AFL. Of the primary AF/AFL patients, 189 (93.6%) had mild-moderate symptom severity (CCS-SAF  $\leq 3$ ). The majority of primary AF/AFL patients were hemodynamically stable, with a mean (SD) SBP of 123.8 (21.3), DBP of 76.6 (14.1), and ventricular rate of 93 (21.9). Patients with secondary AF/AFL were older 76 (13.1),  $p < 0.001$  with a longer mean length of stay 6.1 (7.7),  $p = 0.31$ . Despite their mild-moderate symptom severity and hemodynamic stability, nearly 2/3 of primary AF/AFL patients were admitted.

**Conclusion:** Developing a protocol to triage and discharge hemodynamically stable AF/AFL patients without severe AF/AFL symptoms to a dedicated AF/AFL clinic may help to conserve healthcare resources and potentially deliver more effective care.

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## 1. Introduction

Atrial fibrillation (AF) is the most common sustained arrhythmia, with more than 2 million cases in the United States.<sup>1</sup> As

a result, U.S. national healthcare spending on AF management exceeds \$6 billion annually.<sup>2</sup> Over  $\frac{3}{4}$  of the total cost of AF care comes from AF-related hospitalizations. Patients often present to their hospital emergency department (ED) during episodes of AF, and nearly 70% of ED visits for AF result in hospitalization.<sup>3</sup> The high rate of admittance for AF patients presenting to EDs contributes to more than 400,000 AF-related hospitalizations each year.<sup>4</sup>

The development of strategies to reduce unnecessary AF hospitalizations without compromising patient care may help to reduce healthcare burden. Implementing triage protocols that

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redirect stable AF patients towards more personalized, outpatient care may reduce AF hospitalization and improve overall quality of care.<sup>5</sup> A 2013 population-based study found that over  $\frac{2}{3}$  of subjects in a cohort of AF patients evaluated at an ED in Ontario, Canada had no follow-up care within two weeks post-discharge.<sup>6</sup> The Mayo Clinic Rochester ED measured a 24% reduction in inpatient admissions for AF after implementing a protocol in which primary care providers collaborated with cardiologists to provide long-term follow-up for discharged patients.<sup>7</sup> Dedicated AF/AFL (atrial flutter) clinics may serve as a particularly effective option for transiting care to an outpatient setting. Herein we focus on characterization of patients with primary AF/AFL who may be amenable to a novel protocol of care.

To reduce unnecessary AF/AFL hospitalizations, it is critical to first understand the AF/AFL patient population presenting to the emergency department. This study reviewed the characteristics and disposition of AF/AFL patients presenting to the emergency department (ED) of an academic medical center. These results may provide a baseline in order to develop a strategy to reduce unnecessary hospitalizations.

## 2. Material and methods

### 2.1. Study design

We performed a retrospective electronic medical chart review of patients with AF/AFL presenting to the University of North Carolina (UNC) ED, a level 1 trauma center and academic medical center with an average of 65,000 patients per year, over a 15-month period from January 2015 to March 2016. This study was approved by the local institutional review board (IRB).

### 2.2. Study population

All patients aged 18 years and older, who presented to the ED at UNC, were eligible for inclusion in the study. Patients younger than 18 years old or those who were incarcerated were excluded. Patients who had an electrocardiogram performed in the ED with a predominant rhythm of AF/AFL were identified for inclusion in the study. We characterized patients as having primary AF/AFL if the reason for presentation to the ED for AF/AFL as opposed to a patient presenting to the ED for another diagnosis but having and incidental finding of AF/AFL. The characterization of AF/AFL as the primary or secondary reason for presentation is challenging. Of these patients, AF/AFL was designated as either the primary or secondary ED diagnosis by coding experts on chart review. The designation of primary versus secondary AF/AFL as designated by coding experts was confirmed on review of the ED chart by a clinician (AG or KB) to ensure its accuracy. Patients were considered to have primary AF/AFL if the physician of record considered AF/AFL to the primary reason for seeking medical attention. This was independent of the underlying co-morbid conditions. The chart review performed by AG or KB took into account the complexity of patients. If the patients didn't meet the criteria for the primary AF/AFL, they were considered to have secondary AF/AFL. To determine the accuracy of the ED diagnosis of AF/AFL as the primary or secondary diagnosis designated by coding experts, the ED categorization of primary or secondary AF/AFL was compared with the clinical designation and a kappa value was assessed. Whenever the designation of primary or secondary AF was inconsistent between the two reviewers, a third reviewer resolved the disagreements. Further analyses only considered the ED designation of primary versus secondary AF/AFL.

### 2.3. Data collection

Patient demographics, including gender, self-described race, age, and primary insurance, were collected by retrospective chart review. In addition, other characteristics of the ED visit were collected by review of the ED chart. These other characteristics included ED referral source (self, emergency medical service, primary care provider, urgent care center, other, or unknown), presenting ventricular rate (by first EKG), ED administered cardiac medications, ED disposition (admitted, discharged, other), and hospital length of stay if admitted. Pre-existing co-morbidity data was collected for patients with primary AF/AFL and CHA<sub>2</sub>DS<sub>2</sub>VASc score was calculated. We also reviewed the primary diagnosis for patients who presented with secondary AF/AFL.

### 2.4. Categorization of study participants

Patients in the primary AF/AFL group were categorized by AF symptom severity score according to the Canadian Cardiovascular Society Severity of Atrial Fibrillation (CCS-SAF) Scale. The CCS-SAF score is a simple scale used in clinical practice by a healthcare provider to assess the severity of symptoms attributable to AF. This score can range from 0 (asymptomatic) to 4 (severe impact of symptoms on quality of life and activities of daily living) and is based on the severity of symptoms associated with AF and their effect on the patient's subjective quality of life.<sup>8</sup> If no score was designated by the treating ED provider, the CCS-SAF score was designated by retrospective review of the ED chart by a clinician (AG or KB).

### 2.5. Statistical analysis

Demographic and clinical variables were summarized by counts and percentages for categorical variables and means with standard deviations for continuous variables. Bivariable comparisons of demographic and clinical variables between patients presenting with primary versus secondary AF were performed using chi-squared tests for categorical variables and *t*-tests for continuous variables.

## 3. Results

Over a 15-month period, 935 patients presented to the UNC ED with an EKG diagnosis of AF/AFL (Tables 1 and 2). Of these patients, 202 (21.6%) had a primary diagnosis of AF compared to 733 (78.4%) with a secondary diagnosis of AF/AFL (Table 1). Comparing the ED designation of primary versus secondary AF with the clinician (AG or KB) designation of primary versus secondary AF/AFL yielded an accuracy of 87.9% (95% CI 85.7–89.8%, kappa 0.64, *p* < 0.001) for primary AF diagnosis.

The mean age of AF patients was 74 (13.8) years, and approximately  $\frac{1}{2}$  were male. A large proportion of patients presented to the ED by way of Emergency Medical Services (EMS), though for many, the referral source was unknown. Nearly  $\frac{3}{4}$  of patients were admitted to the hospital with an average length of stay of over 5 days.

Compared with secondary AF/AFL patients, primary AF/AFL patients were younger and had a higher mean ventricular rate on EKG. Primary AF/AFL patients were less likely to be admitted, though still nearly  $\frac{2}{3}$  of patients were admitted, staying in the hospital for an average of over 3 days. Primary AF/AFL patients were more likely than secondary AF/AFL patient to present to the ED by self-referral or as referred by their primary care provider (Tables 1 and 2).

Of the 202 primary AF/AFL patients, 13 (6.4%) had a CCS-SAF score of 4, 108 (53.5%) had a CCS-SAF score of 3, 65 (32.2%) had a

**Table 1**  
Baseline demographic and clinical characteristics of patients presenting to the emergency department at University of North Carolina with primary atrial fibrillation or atrial flutter (n = 202).

Parameter	Type	All Patients (n = 935)	Primary AF/AFL <sup>a</sup> Patients (n = 202)
Gender	Male	488 (52.2%)	104 (51.5%)
Race	White	742 (79.4%)	171 (84.6%)
Mean Age (yrs.)	–	74 (13.8)	67 (14.6)
Referral Source	Self	107 (11.4%)	36 (17.8%)
	EMS <sup>b</sup>	261 (27.9%)	61 (30.2%)
	PCP <sup>c</sup>	74 (7.9%)	32 (15.8%)
	Unknown	155 (16.6%)	54 (26.7%)
	Urgent Care	9 (1.0%)	2 (1.0%)
	Blank	269 (28.8%)	4 (2.0%)
	Other	60 (6.4%)	13 (6.4%)
	Mean Ventricular Rate on ECG <sup>d</sup> (BPM)	–	100.8 (28.8)
Hospital Admission Disposition	Discharged	227 (24.3%)	71 (35.1%)
	Admitted	695 (74.3%)	130 (64.4%)
	Other	13 (1.4%)	1 (0.5%)
Mean Length of Hospital Stay (Days)	–	5.3 (7.0)	3.3 (4.0)
<b>Comorbidities</b>			
Congestive Heart Failure			36 (18%)
Hypertension			116 (57%)
Diabetes			62 (31%)
Stroke/TIA/Thromboembolism			38 (19%)
Vascular Disease			36 (18%)
Chronic Lung Disease			22 (11%)
Chronic Renal Disease			7 (3%)
Thyroid Disease			23 (11%)
Dyslipidemia			36 (18%)
Cancer within past 5 years			20 (10%)
Sleep Apnea			8 (4%)
CHA <sub>2</sub> DS <sub>2</sub> VASc Score(N ± SD)			2.5 ± 1.7

<sup>a</sup> AF/AFL: Atrial fibrillation or flutter.

<sup>b</sup> EMS: Emergency medical services.

<sup>c</sup> PCP: Primary care physician.

CCS-SAF score of 2, 14 (6.9%) had a CCS-SAF score of 1, and 2 (1%) had a CCS-SAF score of 0 (Fig. 1). Of the 202 primary AF/AFL patients, the mean 29 (14.4%) had a CHA<sub>2</sub>DS<sub>2</sub>VASc score of 0, 39 (19.3%) had CHA<sub>2</sub>DS<sub>2</sub>VASc score of 1, 45 (22.3%) had a CHA<sub>2</sub>DS<sub>2</sub>VASc score of 2, 37 (18.3%) had a CHA<sub>2</sub>DS<sub>2</sub>VASc score of 3, 21 (10.4%) had a CHA<sub>2</sub>DS<sub>2</sub>VASc score of 4, and 31 (15.3%) had a CHA<sub>2</sub>DS<sub>2</sub>VASc score of 5 or more (Fig. 1). The most common underlying condition was hypertension 116 (57%) followed by diabetes 62 (31%), and stroke/TIA/Thromboembolism 38 (19%) (Table 1). Primary AF/AFL patients were often treated with rate-controlling medications including metoprolol and diltiazem. After medication therapy, primary AF/AFL patients were hemodynamically stable, with a mean (SD) SBP of 123.8 (21.3), DBP of 76.6 (14.1), and ventricular rate of 93.0 (21.9). Of note who were found to have secondary AF/AFL were most likely to have an ED diagnosis of CHF exacerbation, pneumonia, sepsis of unclear source, and falls (Table 2).

#### 4. Discussion

Nearly 1000 patients presented to the UNC ED with AF/AFL over a 15-month period. The current manuscript describes our baseline evaluation of patients presenting to the ED at an institution with a high rate of admissions. This study characterized the stability of the patients and help develop a protocol for discharge and early follow-up as a safe and effective alternative to admission. In our study, patients presenting to the ED with AF/AFL were elderly and most had Medicare as their primary insurance. The majority (over 3/4) of patients presenting to the UNC ED with AF/AFL received a non- AF/AFL primary diagnosis, but had concurrent AF/AFL on EKG. About 1/5 of patients presenting to the UNC ED with AF/AFL had AF/AFL as a primary diagnosis. Nearly 3/4 of patients with AF/AFL on initial EKG were admitted to the hospital from the ED, including nearly 2/3 of patients with AF/AFL as a primary diagnosis. The majority of

patients with primary AF/AFL were admitted despite having less than severe AF/AFL symptoms and being hemodynamically stable on presentation or after having received medical therapy in the ED. Prior studies have shown that a stable AF patient without severe AF symptoms could potentially be discharged from the ED with outpatient follow-up.<sup>9</sup> Our findings suggest that such a process of care could apply to a significant number of patients with AF/AFL presenting to the ED.

Patients with secondary AF/AFL presented to the ED experiencing exacerbations of non-AF chronic conditions, including congestive heart failure, chronic obstructive pulmonary disease, and chronic kidney disease, or with an event such as an acute pneumonia, stroke, myocardial infarction, or trauma leading to injury. Accordingly, secondary AF/AFL patients were more likely to be admitted to the hospital, and those admitted had a longer length of admission than primary AF/AFL patients. Primary AF/AFL patients had a higher mean ventricular rate than secondary AF/AFL patients. However, the average primary AF/AFL patient was hemodynamically stable (with or without therapy in the ED) and only rarely did primary AF/AFL patients experience severe AF/AFL symptoms such as syncope or significant shortness of breath. Yet, over a 15-month period at the UNC ED, 2/3 of primary AF/AFL patients were admitted and were hospitalized for an average of 3 days. Potential reasons for this high admission rate potentially include: 1) patient fear with cardiac symptoms, 2) patient or provider misconceptions on the need for urgent therapy, 3) poor standardization of treatment protocols.

A highly variable admission rate of AF/AFL patients suggests that ED physicians may have little guidance or protocols to make a decision about admission. Previous descriptive studies of AF in the ED have findings similar to ours. McDonald et al, in a population-based study of AF in US EDs over a 12-year period (1993–2004) found that the number of ED presentations of AF was increasing and that the

**Table 2**  
Baseline demographic and admission diagnosis of patients presenting to the emergency department at University of North Carolina with secondary atrial fibrillation or atrial flutter (n = 733).

Parameter	Type	All Patients (n = 935)	Secondary AF/AFL <sup>a</sup> Patients (n = 733)
Gender	Male	488 (52.2%)	384 (52.4%)
Mean Age (yrs.)	–	74 (13.8)	76 (13.1)
Referral Source	Self	107 (11.4%)	71 (9.7%)
	EMS <sup>b</sup>	261 (27.9%)	200 (27.3%)
	PCP <sup>c</sup>	74 (7.9%)	42 (5.7%)
	Unknown	155 (16.6%)	101 (13.8%)
	Urgent Care	9 (1.0%)	7 (1.0%)
	Blank	269 (28.8%)	265 (36.2%)
	Other	60 (6.4%)	47 (6.4%)
Mean Ventricular Rate on ECG (BPM)	–	100.8 (28.8)	94.1 (25.9)
Hospital Admission Disposition	Discharged	227 (24.3%)	156 (21.3%)
	Admitted	695 (74.3%)	565 (77.1%)
	Other	13 (1.4%)	12 (1.6%)
Mean Length of Hospital Stay (Days)	–	5.3 (7.0)	6.1 (7.7)
<b>General Category</b>	<b>Primary Emergency Department Diagnosis</b>		<b>n (%)</b>
<b>Cardiovascular Diagnosis</b>	.		<b>161 (22%)</b>
	Congestive heart failure exacerbation		83
	Chest pain		34
	STEMI/NSTEMI		19
	Hypotension		8
	Bradycardia		6
	Cardiac arrest		6
	Other: Includes AICD discharge, aortic dissection, hypertensive urgency, and pericardial effusion		5
<b>Infectious Diagnosis</b>			<b>133 (18.1%)</b>
	Pneumonia		48
	Sepsis, unclear source		38
	Urinary Tract Infection		18
	Cellulitis		11
	Viral URI		4
	Other: Includes osteomyelitis, pyelonephritis, sinusitis, wound infection, diverticulitis, gastroenteritis, foot ulcer, and traumatic wound dehiscence		14
<b>Pulmonary Diagnosis</b>			<b>59 (7.5%)</b>
	Chronic obstruction disease exacerbation		22
	Shortness of breath		11
	Pulmonary embolism		8
	Other: Includes acute on chronic respiratory failure, hypoxia, asthma exacerbation, viral upper respiratory illness, bronchitis, and pleural effusion		18
<b>Neurological Diagnosis</b>			<b>114 (15.6%)</b>
	Stroke/transient neurologic deficits		45
	Altered mental status		27
	Pre-syncope/Syncope		23
	Other: Includes coma, headaches, vertigo, seizure, subarachnoid/intracranial hemorrhage, subdural hematoma, Wernicke-Korsakoff syndrome, unspecified neurological disease		19
<b>Trauma</b>			<b>74 (10.1%)</b>
	Ground level fall		55
	Other: Includes motor vehicle trauma, assault, burn, hypothermia, unspecified trauma		19
<b>Gastroesophageal Disease</b>			<b>60 (8.2%)</b>
	Nausea, vomiting, diarrhea and/or constipation		21
	Gastrointestinal bleed		15
	Other: Esophageal food impaction, esophageal strictures, gastritis, mesenteric ischemia, small bowel obstruction, bowel perforation, pancreatitis, appendicitis, cholecystitis, GERD, incarcerated hernia, hematemesis, splenic infarction		24
<b>Renal/Urological conditions</b>			<b>23 (3.1%)</b>
	Other: Acute renal failure, nephrolithiasis, hematuria, hypokalemia, hyperkalemia, hyponatremia, hypernatremia, rhabdomyolysis		
<b>Hematological Disease</b>			<b>18 (2.5%)</b>
	Other: Epistaxis, DIC, deep venous thrombosis, elevated INR, anemia, chest wall hematoma, splenic infarction, carotid artery aneurysm, venous stasis, SVC syndrome, lower limb ischemia, central venous thrombosis		
<b>Rheumatological &amp; Musculoskeletal Disease</b>			<b>15 (2.0%)</b>
	Other: Includes Failure to thrive, rash, generalized weakness, focal weakness, fatigue, pruritis, anaphylaxis, sarcoidosis flare		

(continued on next page)

Table 2 (continued)

Parameter	Type	All Patients (n = 935)	Secondary AF/AFL <sup>a</sup> Patients (n = 733)
<b>Endocrine</b>	Other: Includes disorders of glucose metabolism, dehydration, and thyroid disease		<b>11(1.5%)</b>
<b>Psychiatric Diagnosis</b>	Other: Includes aggressive behavior, delirium, suicidal ideations, anxiety disorder, depressive symptoms, visual hallucinations, and adjustment reaction		<b>7 (1.0%)</b>
<b>Miscellaneous Diagnosis</b>	Other: Includes social issues and post-op complications		<b>7 (1.0%)</b>
<b>Missing Data</b>			<b>54 (7.4%)</b>

<sup>a</sup> AF/AFL: Atrial fibrillation or flutter.

<sup>b</sup> EMS: Emergency medical services.

<sup>c</sup> PCP: Primary care physician.

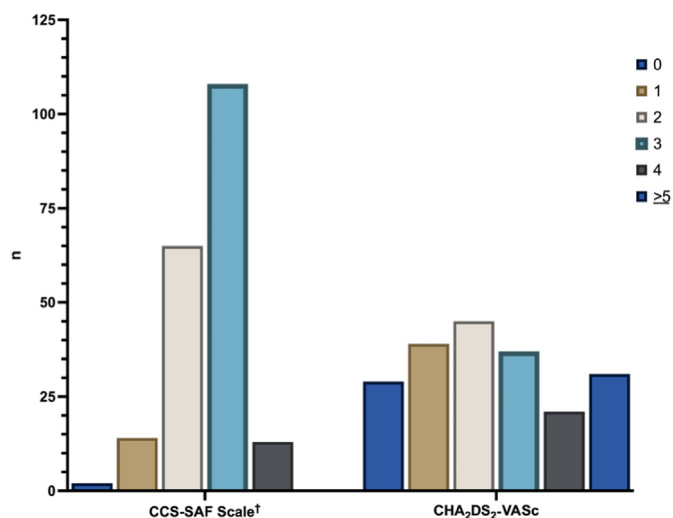


Fig. 1. Breakdown of the Canadian Cardiovascular Society of Atrial Fibrillation Scale (CCS-SAF) and CHA<sub>2</sub>DS<sub>2</sub>-VASc Score for atrial fibrillation among patients presenting to the emergency department patients with primary atrial fibrillation/flutter (n = 202).

overall admission rate remained quite constant at approximately 64% overall. However, the admission rate was quite variable region to region (range 48%–76%).<sup>10</sup> Atzema et al performed a population-based description of AF in the ED in Ontario, Canada between 2002 and 2010. Patients presenting with AF as a primary diagnosis were elderly (median age 72 years) and 50.8% were women. In addition, the crude rate of ED visits increased during the 8 years studied. However, in this study, admission rate in 2002 was lower (48.1%) and decreased over time to 38.4%, possibly because of increased use of cardioversion in the ED.<sup>11</sup>

Our study suggests that low-risk, hemodynamically stable AF patients may often be unnecessarily admitted. Given the wide variability in admission rate seen in our study compared to other population-based studies, it is likely that there is vast potential for improving the efficiency of ED triage and management. Hence, a care pathway which utilizes a triage tool for ED providers with transition of stable primary AF patients to a dedicated AF clinic with early follow-up could potentially reduce unnecessary AF admissions. Pilot studies such as this have been previously performed in the United States and shown to be successful.<sup>9,12,13</sup> Another review article evaluated triaging and disposition of patients presenting with AF and Atrial Flutter in ED.<sup>5</sup> However, many prior studies have relied on direct current or pharmacologic cardioversion in the ED as a means of restoring sinus rhythm in order to discharge patients from the ED. Other studies have relied on cardiology or electrophysiology consultation in the ED to expedite management in order

to discharge patients from the ED. Cardioversion and/or specialty consultation may be less available at community hospitals or during non-business hours, making adoption of such protocols less widespread. Our study suggests that a large proportion of patients could be discharged from the ED with early outpatient follow-up, even without specialist consultation in the ED. The results of this study helped us develop and introduce a structured process for caring for patients presenting to the ED with AF/AFL. The data of the triage protocol before and after the implementation of the protocol are published elsewhere.<sup>14</sup>

#### 4.1. Study limitations

Our study has several potential limitations. First, our study is a retrospective chart review in design and is therefore limited to the information provided in the patient charts. Due to this limitation, we were unable to describe comorbid conditions of patients presenting to the emergency department at University of North Carolina with secondary AF/AFL. However, we were able to list a composite of their primary diagnosis in Table 2 since for the majority of subjects, pertinent data was readily available. Second, the CCS-SAF scale utilized in this study has subjective components, and symptom severity is thus an estimate. Third, diagnosis coding in the emergency setting is done by coding experts based on chart review. This may have resulted in potential misdiagnosis of AF/AFL as the primary reason for AF/AFL presentation. However, diagnoses were retrospectively reviewed by two independent cardiologists for accuracy.

#### 5. Conclusions

Atrial fibrillation is the most common dysrhythmia and leads to frequent ED visits and subsequent hospitalizations. However, many hospitalizations may be unnecessary. Our study demonstrates that the vast majority of emergency department patients with a primary diagnosis of atrial fibrillation/atrial flutter are hemodynamically stable and without severe symptoms. A protocol to triage and discharge for appropriately stable patients with an early clinic follow-up at a dedicated atrial fibrillation clinic may help to conserve healthcare resources and potentially deliver more effective, high-quality care to patients.

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### Declaration of competing interest

A.G. reports having received lecture fees from Biotronik, Zoll, St. Jude Medical and research funding support from Bristol Myers Squibb Foundation.

Other authors have no conflict of interest to report.

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