

An Integrated Management Approach to Atrial Fibrillation

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Background—Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia resulting in mortality and morbidity. Gaps in oral anticoagulation and education of patients regarding AF have been identified as areas that require improvement.

Methods and Results—A before-and-after study of 433 patients with newly diagnosed AF in the 3 emergency departments in Nova Scotia from January 1, 2011 until January 31, 2014 was performed. The “before” phase underwent the usual-care pathway for AF management; the “after” phase was enrolled in a nurse-run, physician-supervised AF clinic. The primary outcome was a composite of death, cardiovascular hospitalization, and AF-related emergency department visits. A propensity analysis was performed to account for differences in baseline characteristics. A total of 185 patients were enrolled into the usual-care group, and 228 patients were enrolled in the AF clinic group. The mean age was 64 ± 15 years and 44% were women. In a propensity-matched analysis, the primary outcome occurred in 44 (26.2%) patients in the usual-care group and 29 (17.3%) patients in the AF clinic group (odds ratio 0.71; 95% CI [0.59, 1]; $P=0.049$) at 12 months. Prescription of oral anticoagulation was increased in the CHADS₂ ≥ 2 group (88.4% in the AF clinic versus 58.5% in the usual-care group, $P<0.01$).

Conclusions—Adoption of this integrated management approach for the burgeoning population of AF may provide an overall benefit to cardiovascular morbidity and mortality. (*J Am Heart Assoc.* 2016;5:e002950 doi: 10.1161/JAHA.115.002950)

Key Words: atrial fibrillation • quality and outcomes

Atrial fibrillation (AF) is the most common sustained arrhythmia, affecting 1% to 2% of the general population and 8% of patients over the age of 80 years.^{1,2} Recent studies have found that AF accounts for 0.5% of all emergency department visits and is a substantial burden on acute care resources.³ Approximately one third of patients with AF present to the emergency department (ED) due to symptoms.¹ Studies have shown that prescription of oral anticoagulation (OAC) is not optimal after discharge from the ED. The RELY AF-registry reported on 15 400 patients with AF who presented to the ED with either a primary or secondary diagnosis of AF.⁴ Data on the use of OAC at discharge from an ED and a CHADS score of ≥ 2 found it to be 65.7%; this study

included patients with a prior diagnosis of AF, rather than just new-onset AF, leaving more than one third of patients with known AF without appropriate OAC. A study by Atzema et al found that up to 34.9% of patients with CHADS₂ ≥ 2 and 55.7% of patients with CHADS₂ ≥ 1 were not on warfarin in the ensuing 30 days after presentation to the ED with AF in a survey of EDs in Ontario.³

There are many aspects of AF management that are best managed by those specifically trained to manage AF. It is well documented that there are a number of care gaps in management of AF at the general practitioner level.^{5,6} These issues relate to which patients to anticoagulate, when to perform a cardioversion, when to switch from rate to rhythm control, and when to refer for catheter ablation. Institution of a focused clinic, supervised by a physician, may facilitate education for patients and physicians alike, as the information that would be disseminated is originating from a single source. This would allow a unified approach, which is evidence based, to be delivered to the community regarding these new therapies, as well as providing further education regarding the current paradigms in AF care. Prior studies suggested that a combined specialist and nurse-based AF clinic was associated with significant reductions in ED visits, hospitalizations, and improved survival.^{7,8} This study was conducted to determine whether an integrated management approach with nurse-

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based, physician-supervised care results in reproducible findings in other healthcare jurisdictions.

Methods

Institutional ethics approval was obtained prior to conducting this study. Informed consent was obtained by study subjects in the AF clinic phase; a waiver of consent was obtained from the ethics board for those in the usual-care group.

Design

We performed a “before-and-after” study where patients who presented with new-onset AF to the emergency department (ED) were studied during 2 phases: the usual-care (before phase) and subsequently the AF clinic (after phase) (Figure 1).

Setting

Three EDs in the Halifax Regional Municipality, Nova Scotia were enrolled into the study. The AF clinic was located at the tertiary care hospital (QEII Health Sciences Center) in the region. The population of this region was 350 000 at the time of the study.

Patient Population

The study population consisted of patients aged ≥ 18 years who presented to 1 of the 3 EDs between January 1, 2009 and January 31, 2014, with a new diagnosis of AF confirmed electrocardiographically and who were referred and evaluated by a specialist. AF was confirmed to be a new diagnosis if the following criteria were met: the specialist note stated this explicitly and the patient was not previously on OAC. Patients were excluded if their primary residence was outside the jurisdiction of the EDs, had valvular AF, were found to have a prior diagnosis of AF, or had a physician-estimated life

expectancy < 6 months at the time of the AF diagnosis. Valvular AF was defined as a history of rheumatic heart disease, prior mechanical or bioprosthetic valve replacement, or known severe aortic stenosis or severe mitral regurgitation. The usual-care group was identified from a retrospective chart review of all patients who presented to the ED with an ED admission diagnosis of AF or uncontrolled AF. A total of 776 records were identified representing 451 unique patients. Of these, 137 were excluded due to concurrent hospitalization, 17 patients were under palliative care at the time of presentation, 61 patients were not referred on for specialty care, 8 patients had a prior diagnosis of AF at the time of the ED visit, leaving 228 unique patients who fulfilled the inclusion criteria. These patients were referred for specialty care (internal medicine, cardiology, or cardiac electrophysiology) through the usual-care pathway, either by the emergency physician or their own family physician for specialist assessment. These patients were followed prospectively for a minimum of 1 year after their initial ED visit.

Intervention

The intervention phase began on November 1, 2011. Any patient referred from 1 of the 3 EDs for new-onset AF were eligible for inclusion into the intervention phase. These patients may not have been consecutive patients, since it was at the discretion of the ED physician to refer the patients on to the AF clinic. Patients who were hospitalized at the time of presentation or were found to be palliative were excluded from the study. This phase consisted of a nurse-run, physician-supervised clinic initiated by a referral from the ED, following the structure shown in Figure 2. Patients in the intervention group received a telephone call from the AF clinic nurse within 48 to 72 hours of the referral from the ED, prior to the first clinic visit. At the time of the phone call, patients were invited to a group education session to learn about the symptoms, investigations, and treatments of AF and were provided with contact information

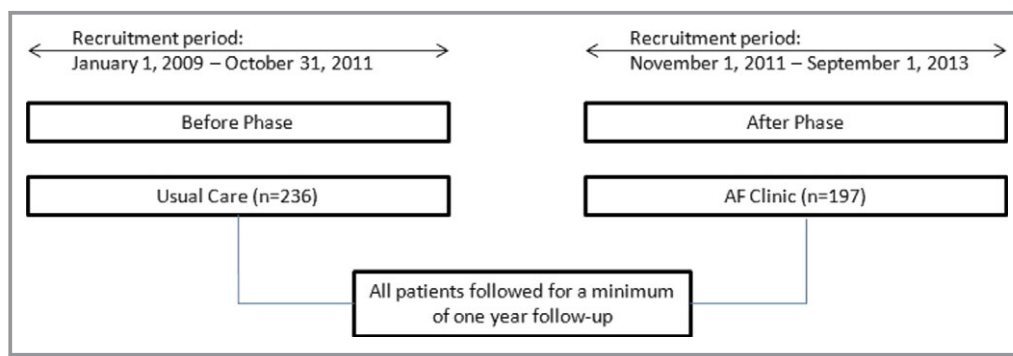


Figure 1. Study flow. AF indicates atrial fibrillation.

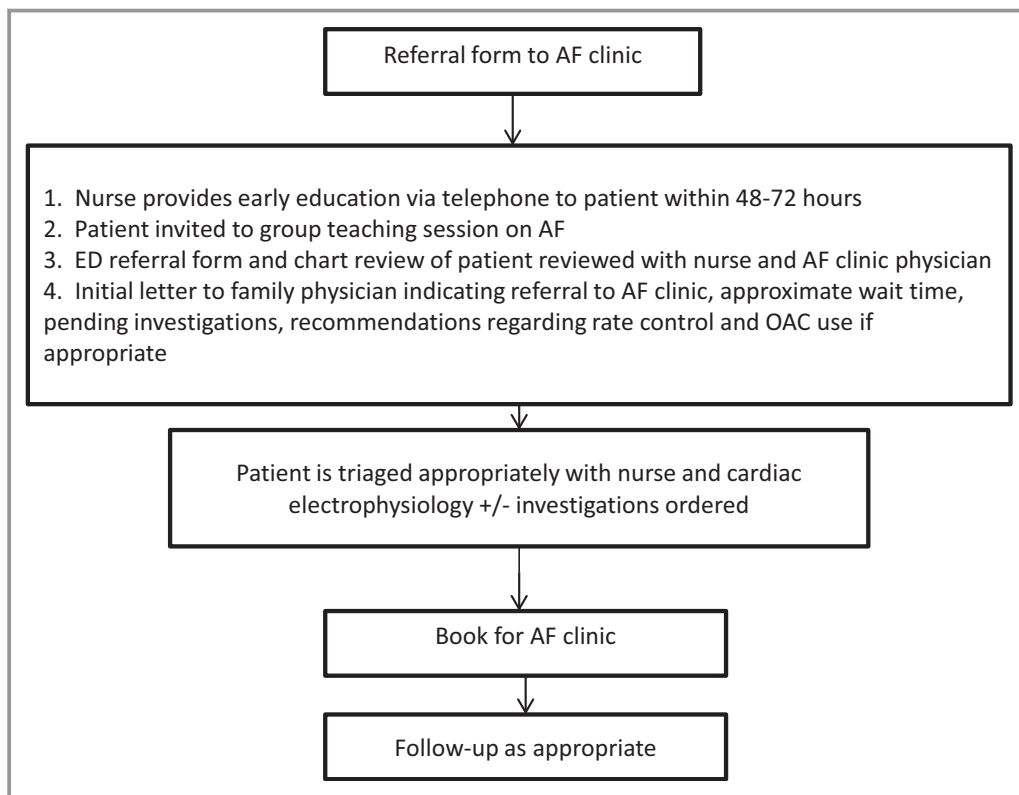


Figure 2. Integrated management approach to AF care. AF indicates atrial fibrillation; ED, emergency department; OAC, oral anticoagulation.

to reach the AF clinic nurse if they had questions. In addition, stroke risk factors were reviewed, symptoms related to AF were discussed, and brief education was provided to the patient regarding AF. Using this information, the patients were then discussed by the AF clinic team, prior to the appointment, to ensure appropriate investigations were ordered and to determine the urgency of the first visit. Syncope, heart failure, or frequent repeat visits to the ED resulted in an urgent classification, where the patient was seen within 7 days. Patients with a high CHADS₂ score and who were not on OAC were also seen within 1 to 2 weeks. The first clinic visit consisted of an in-depth review of symptoms, comorbidities, and medications by the AF clinic nurse using a standard assessment form. A detailed management plan, including diagnostic investigations and treatments, was proposed and reviewed by a cardiac electrophysiologist. After the clinic assessment, the family physician resumed care of the patient, but received a detailed letter from the AF clinic outlining the present and future management plan. Recommendations for anticoagulation were made, which may have included warfarin or direct OAC. Warfarin initiation and subsequent INR monitoring was arranged by the family physician. Direct oral anticoagulants may have been prescribed either by the family physician or the AF clinic physician.

Follow-Up

All patients were followed in both groups for a minimum of 12 months from their initial presentation in the ED with AF. The patients in the usual-care group, although identified retrospectively, were followed prospectively from their ED visit for an additional 12 months after the last patient was enrolled into the group, while the patients in the intervention group were enrolled prospectively and followed henceforth for the same follow-up period of 12 months, after the final patient was enrolled. This was done to ensure consistency of the length of the follow-up period between groups. Mortality was determined through linkage with vital statistics of Nova Scotia. All other outcomes were obtained through the electronic health record (Horizon Patient Folder, McKesson), which contains comprehensive data on all inpatient and outpatient visits to the hospitals in the Halifax Regional Municipality, included in this study. Any other visits that may have occurred outside of Halifax Regional Municipality were captured at the time of follow-up visits with the specialist. Outcomes were recorded by a single trained data abstractor, to ensure that these were recorded in a similar fashion between the 2 groups. All data were entered into a computerized database that was created at the outset of the “before” arm.

Outcome Measures

The primary outcome was a composite of death from any cause, cardiovascular hospitalization, or AF-related ED visit at 12 months. Cardiovascular hospitalizations were defined as an admission or discharge diagnosis of AF, heart failure, acute coronary syndrome, or cerebrovascular ischemic event. An acute coronary syndrome was defined as chest pain with a troponin elevation or significant electrocardiographic changes of ischemic injury. A cerebrovascular ischemic event was a neurology-confirmed diagnosis of a transient ischemic attack or stroke. An AF-related ED visit was defined as an ED admission or discharge diagnosis of AF, or the ED admission complaint included palpitations, syncope, presyncope, chest pain, malaise, or symptoms suggestive of a thromboembolic event.

The secondary outcomes included the individual components of the primary outcome, stroke, major bleeding, minor bleeding, and the degree of adherence to practice guidelines. Major bleeding was defined as bleeding with hemodynamic instability or requiring transfusion of 2 or more units of packed red blood cells. All other bleeding was considered minor. Variables to assess guideline adherence included documentation of discussion or assessment of the following: alcohol use, hypertension, obstructive sleep apnea, thyroid function, ECG, and prescription of OAC by CHADS₂ score.⁹ These variables were indicated to have been adhered to if they were assessed at any clinic visit over the course of the follow-up.

All outcome measures were collected by trained data abstractors to ensure consistency of data collection. Random checks were performed to ensure accuracy of data collection.

Sample Size Estimation

The sample size for each arm was calculated to be 150 patients based on the following assumptions. A relative risk reduction of 40% was deemed the minimally clinically important difference and as a conservative estimate of the effect of a specialist visit on ER visits and hospitalizations (Gillis et al showed an 82% reduction in ER visits and 56% reduction in hospitalizations with the AF clinic). This assumed a 90% power, an α of 0.05, and a loss to follow-up of 20%.

Statistical Analysis

Baseline characteristics were summarized as mean \pm SD or prevalence (percentage), where appropriate. Categorical variables were compared using the χ^2 test, continuous variables using the 2-independent samples *t* test in each of the 2 groups. The Fisher's exact test was used when cell counts were less than 5. Cardiovascular event rates were compared

between patients in the AF clinic and usual care using a Wald χ^2 test. Results were presented as odds ratios (OR) and 95% CI. A propensity analysis was performed to control for confounding. This technique accounts for the nonrandom assignment to each group, mitigates potential confounding factors and selection biases, and increases statistical efficiency. The variables that were entered into the propensity score were sex, age, diabetes, hypertension, stroke, coronary artery disease with prior myocardial infarction, and congestive heart failure.^{10–12} These variables were chosen based on prior analyses demonstrating these to be associated with outcomes in AF. Propensity scores were used to match patients who were in the AF clinic to patients in the usual-care group using a SAS macro (SAS, Cary, NC). A greedy matching procedure selected match pairs initially identical to 5 decimal places of probability.^{13,14} If no match existed at 5 decimal places, then matching would occur at 4 decimal places, and so on. If no match existed at 1 decimal place, then that patient was excluded from the study.

Once the groups were identified, the remaining variables were examined for differences, as described above. Event rates were compared in this comparable population and effect summarized as OR and 95% CI. A *P* value <0.05 was considered statistically significant. All analyses were conducted using SAS version 9.4.

Results

There were 185 patients enrolled into the AF clinic group and 228 patients in the usual-care group. The mean follow-up time was 21.5 and 28 months in the AF clinic and usual-care groups, respectively. The median time between referral and first specialist clinic assessment was 74 days and 40 days in the AF clinic and usual-care groups, respectively (*P*=0.0001). A significant proportion of patients did not see a specialist within 60 days of diagnosis in both groups (54.6% in AF clinic, 33.3% in usual-care group, *P*<0.0001).

The baseline characteristics of each group are presented in Table 1. The patients in both groups had a mean age of 64 \pm 15 years and 44% were women. The baseline comorbidities were similar between the 2 groups except there was a higher proportion of patients with a prior history of myocardial infarction (12.3% versus 5.4%, *P*=0.02) and cardiac surgery (7.0% versus 2.2%, *P*=0.02) in the usual-care group, whereas a higher proportion of patients with hypertension were seen in the AF clinic group (43.2% versus 28.9%, *P*=0.003). There was no significant difference in the mean CHADS₂ (1.1 \pm 1.2 versus 1.2 \pm 1.2, *P*=0.49) or CHA₂DS₂-VaSC (2.1 \pm 1.8 versus 2.3 \pm 1.8, *P*=0.40) scores between the 2 groups.

At the time of discharge from the ED, the rate of sinus rhythm in both groups was similar (57.8% versus 49.2%,

Table 1. Baseline Characteristics

Baseline Characteristics	AF Clinic (n=185)	Usual Care (n=228)	P Value
Age, mean±SD	63.6±14.6	64±14.9	0.77
Female	71 (43.3%)	103 (45.2%)	0.76
Hypertension	80 (43.2%)	66 (28.9%)	0.003
Diabetes	24 (13%)	21 (9.2%)	0.27
Congestive heart failure	20 (10.8%)	21 (9.2%)	0.62
Stroke	12 (6.5%)	16 (7%)	1
Coronary artery disease with myocardial infarction	10 (5.4%)	28 (12.3%)	0.02
Valvular heart disease	6 (3.2%)	11 (4.8%)	0.47
Congenital heart disease	0 (0%)	3 (1.3%)	0.26
Cardiac surgery	4 (2.2%)	16 (7%)	0.02
Pacemaker	2 (1.1%)	7 (3.1%)	0.2
Peripheral vascular disease	6 (3.2%)	4 (1.8%)	0.35
Cerebrovascular disease	3 (1.6%)	8 (3.5%)	0.36
Chronic pulmonary disease	24 (13%)	23 (10.1%)	0.44
Sleep apnea	17 (9.2%)	12 (5.3%)	0.13
LVEF, mean±SD	57.5±8.3	55.9±9.5	0.08
Creatinine, mean±SD	107.3±142.3	100.4±122.9	0.6
TSH, mean±SD	2.6±2.4	2.6±1.8	0.93
T4, mean±SD	14.3±2.8	15.3±5.2	0.15
CHADS ₂ , mean±SD	1.1±1.2	1.2±1.2	0.49
Overall			
0	79 (42.7%)	120 (52.6%)	0.04
1	53 (28.6%)	59 (25.9%)	
≥2	53 (28.6%)	49 (21.5%)	
CHA ₂ DS ₂ -VASC, mean±SD	2.1±1.8	2.3±1.8	0.4
Overall			
0	43 (23.6%)	55 (24.4%)	0.29
1	35 (19.2%)	51 (22.7%)	
2	40 (22%)	56 (24.9%)	
≥3	64 (35.2%)	63 (28%)	

AF indicates atrial fibrillation; LVEF, left ventricular ejection fraction; TSH, thyroid-stimulating hormone.

P=0.09) (Table 2). There was similar use of rate control medications on arrival to (23.4% versus 30.3%, *P*=0.12) and discharge from the ED (66.9% versus 70.6%, *P*=0.45). The overall use of OAC was similar between the 2 groups on discharge (24.5.1% versus 26.7%, *P*=0.65) from the ED. On arrival to the first outpatient assessment, patients in the AF clinic and usual-care groups had similar use of OAC (28.1% versus 33.3%, *P*=0.29). Use of rate control medications was similar with the exception of digoxin, which was used more

Table 2. Medications at Initial Assessment

Medication on Arrival to First Assessment	AF Clinic (n=185)	Usual Care (n=228)	P Value
ACEI	39 (21.1%)	47 (20.6%)	0.9
ARB	23 (12.4%)	43 (18.9%)	0.08
Thiazide diuretic	53 (28.6%)	64 (28.1%)	0.91
Digoxin	0 (0%)	9 (3.9%)	0.005
β-Blocker	114 (61.6%)	143 (62.7%)	0.84
Calcium channel blocker	26 (14.1%)	49 (21.5%)	0.05
Anti-arrhythmics			
None	182 (98.4%)	220 (96.5%)	0.69
Amiodarone	1 (0.5%)	2 (0.9%)	
Sotalol	1 (0.5%)	4 (1.8%)	
Dronedaron	0 (0%)	1 (0.4%)	
Propafenone	1 (0.5%)	1 (0.4%)	
ASA	96 (51.9%)	107 (46.9%)	0.32
OAC			
None	133 (71.9%)	152 (66.7%)	0.29
Warfarin	21 (11.4%)	51 (22.4%)	
Dabigatran	19 (10.3%)	25 (11%)	
Rivaroxaban	12 (6.5%)	0 (0%)	

ACEI indicates angiotensin-converting enzyme inhibitor; AF, atrial fibrillation; ARB, angiotensin II receptor blocker; ASA, acetylsalicylic acid; OAC, oral anticoagulation.

commonly in the usual-care group compared to patients in the AF clinic (3.9% versus 0%, *P*=0.005).

Outcomes

The primary outcome occurred in 34 of 185 (18.4%) patients in the AF clinic, as compared to 65 of 228 (28.5%) patients in the usual-care group (OR 0.57; 95% CI [0.35, 0.9] *P*=0.017); (Table 3). During the course of the study no patients died in the AF clinic group, versus 1.8% in the usual-care group (*P*=0.95).

A total of 31/413 (7.5%) patients were hospitalized at least once for a cardiovascular cause during follow-up: fewer (11/185 [5.9%]) patients in the AF clinic group were hospitalized for a cardiovascular cause as compared to 20/228 (8.8%) patients in the usual-care group (OR 0.66, 95% CI [0.31, 1.41] *P*=0.28), although this was not statistically significant. A total of 79/413 (19.1%) patients had at least one AF-related ED visit in both groups, where a 50% reduction in this outcome was found for patients in the AF clinic group (25/185 [13.5%]) as compared to patients in the usual-care group 54/228 (23.7%) (OR 0.50, 95% CI [0.3, 0.85], *P*=0.01) (Table 3).

Lower rates of major bleeding, minor bleeding, and stroke were seen between the 2 groups, although these did not reach statistical significance (Table 3).

Table 3. Outcomes at 12 Months in Unmatched Groups

Outcome	AF Clinic (n=185)	Usual Care (n=228)	Odds Ratio (95% CI)	P Value
Death, CV hospitalization, AF-related ED visit	34 (18.4%)	65 (28.5%)	0.57 (0.35, 0.9)	0.017
Death from any cause	0 (0%)	4 (1.8%)	n/a	0.13*
CV hospitalization	11 (6%)	20 (8.8%)	0.66 (0.31, 1.41)	0.28
AF-related ED visit	25 (13.5%)	54 (23.7%)	0.5 (0.3, 0.85)	0.01
Stroke	4 (2.2%)	8 (3.5%)	0.61 (0.18, 2.05)	0.42
Major bleeding	0 (0%)	3 (1.3%)	n/a	0.26
Minor bleeding	4 (2.2%)	4 (1.8%)	1.24 (0.31, 5.02)	0.77

AF indicates atrial fibrillation; CV, cardiovascular; ED, emergency department; n/a, not applicable.

*P-value calculated using Fisher's exact test.

Propensity-Matched Analysis

A propensity-matched analysis was performed to control for potential confounding variables in this nonrandomized study. A total of 336 patients were included in this analysis, with a 1:1 matching procedure. The baseline characteristics of the matched groups are presented in Table 4.

The primary outcome was significantly reduced at 12 months in the AF clinic compared with the usual-care group (OR 0.59, 95% CI [0.35, 0.997] $P=0.049$) (Table 5). The number of ED visits demonstrated a nonsignificant reduction in the AF clinic compared to the usual-care group (13.1%

versus 20.8%, $P=0.06$). There were fewer cardiovascular hospitalizations in the AF clinic as compared to the usual-care group (OR 0.60, 95% CI [0.27, 1.37], $P=0.22$) (Table 5). The all-cause mortality was lower in the AF clinic versus the usual-care group (0% versus 1.6%, $P=0.96$). Both of these latter outcomes did not reach statistical significance when examined alone.

Guideline Adherence

There were 6 measures utilized for guideline adherence. In the AF clinic, significantly more patients were assessed for

Table 4. Baseline Characteristics of Propensity-Matched Group

Baseline Characteristics	AF Clinic (n=168)	Usual Care (n=168)	P Value
Age, mean±SD	62.8±14.5	61.9±15.4	0.56
Female	58 (39.5%)	64 (38.1%)	0.82
Hypertension	64 (38.1%)	62 (36.9%)	0.91
Diabetes	20 (11.9%)	18 (10.7%)	0.86
Congestive heart failure	17 (10.1%)	15 (8.9%)	0.85
Stroke	9 (5.4%)	11 (6.5%)	0.82
Prior myocardial infarction	10 (6%)	11 (6.5%)	1
Prior cardiac surgery	4 (2.4%)	7 (4.2%)	0.38
Pacemaker	2 (1.2%)	4 (2.4%)	0.68
Peripheral vascular disease	6 (3.6%)	3 (1.8%)	0.5
Cerebrovascular disease	2 (1.2%)	5 (3%)	0.45
Chronic pulmonary disease	22 (13.1%)	16 (9.5%)	0.39
Sleep apnea	16 (9.5%)	11 (6.5%)	0.42
LVEF, mean±SD	57.3±8.2	56±9.3	0.17
Creatinine, mean±SD	109.7±149.1	106.4±142.1	0.83
TSH, mean±SD	2.6±2.5	2.6±1.9	0.89
CHADS ₂ , mean±SD	1.0±1.2	1.1±1.2	0.4
CHADS-VASC, mean±SD	2.0±1.7	2.0±1.7	0.85

AF indicates atrial fibrillation; LVEF, left ventricular ejection fraction; TSH, thyroid-stimulating hormone.

Table 5. Outcomes in Matched Groups

Outcome	AF Clinic (n=168)	Usual Care (n=168)	Odds Ratio (95% CI)	P Value
Death, CV hospitalization, AF-related ED visit	29 (17.3%)	44 (26.2%)	0.59 (0.35, 0.997)	0.049
Death from any cause	0 (0%)	1 (0.6%)	n/a	1.0*
CV hospitalization	10 (6%)	16 (9.5%)	0.6 (0.27, 1.37)	0.22
AF-related ED visit	22 (13.1%)	35 (20.8%)	0.57 (0.32, 1.03)	0.06
Stroke	4 (2.4%)	4 (2.4%)	1 (0.25, 4.07)	1
Major bleeding	0 (0%)	3 (1.8%)	n/a	0.25*
Minor bleeding	3 (1.8%)	3 (1.8%)	1 (0.2, 5.03)	1

AF indicates atrial fibrillation; CV, cardiovascular; ED, emergency department.
 *P-value calculated using Fisher's exact test.

alcohol use (100% versus 66.7%, $P<0.0001$), smoking (100% versus 76.2%, $P<0.0001$), and sleep apnea (100% versus 17.3%, $P<0.0001$) compared to the usual-care group (Figure 3). Thyroid assessment was performed more frequently in the AF clinic as compared to usual care (79.2% versus 66.1%, $P=0.01$). Assessment of renal function (97.7% and 97.6%, $P=1.0$) and echocardiogram documentation (94.6% and 94.6%, $P=1.0$) were similar between the groups (Figure 3).

Prior to the first clinical assessment, 29.8% and 32.1% of patients in the AF clinic and usual-care groups were on an OAC ($P=0.72$). However, at the last assessment, significantly more patients in the AF clinic were recommended to be on an OAC as compared with the usual-care group (57.7% versus 39.3%, $P=0.001$) (Figure 4). The increased rate of OAC use in

the AF clinic group was observed across all CHADS₂ scores. A total of 52 (12.6%) patients decided not to remain on OAC, despite recommendations; there was no difference in the rate of discontinuation in the 2 groups (14.1% versus 11.4%, AF clinic versus usual care, $P=0.46$). Reasons for discontinuation are listed in Table 6. The most common reasons included patient choice (30.8%) and physician choice (30.8%).

Medical therapy was similar between the 2 groups at final assessment with the exception of digoxin, which was used more frequently in the usual-care group (4.2% versus 0.6% $P=0.07$). In addition, there was an increased use of antiarrhythmic drugs between the first and final assessment for both the AF clinic (1.7% versus 7.1%, $P=0.03$) and the usual-care group (3.6% versus 4.2%, $P=0.79$).

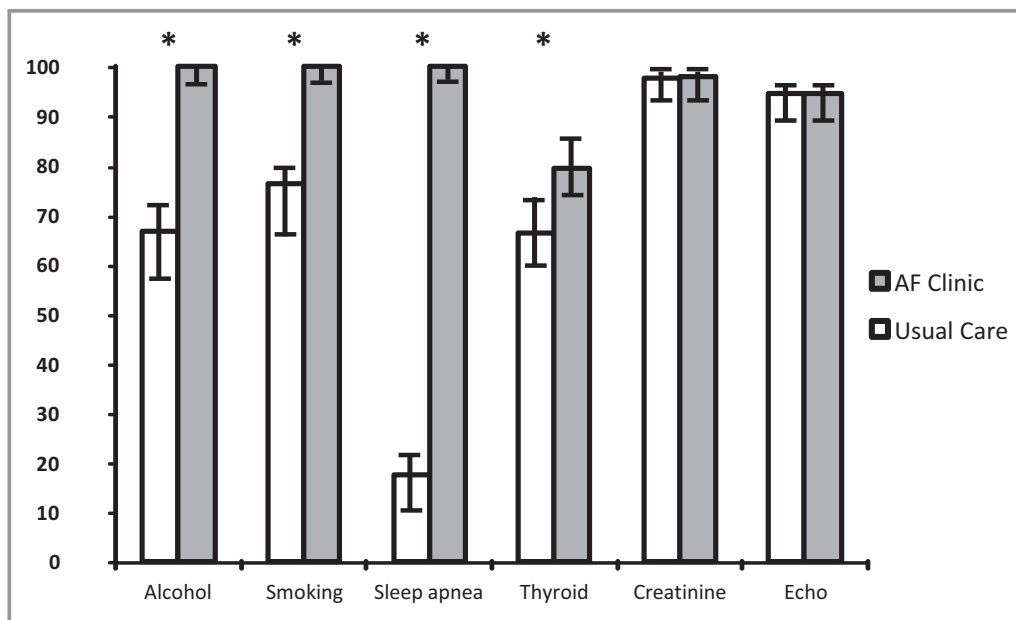


Figure 3. Guideline adherence. The gray bars indicate the percentage of patients assessed for each variable by the usual-care group; the black bars indicate the additional percentage of patients assessed by the AF clinic group. 95% CI are indicated on each bar (* $P<0.0001$). AF indicates atrial fibrillation.

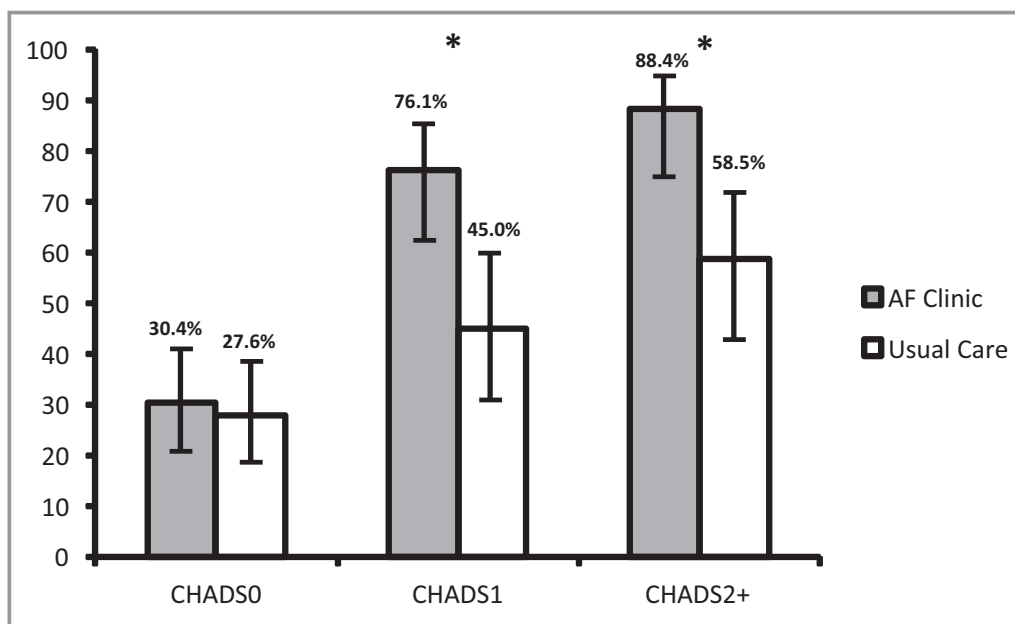


Figure 4. Prescription of oral anticoagulation in the matched groups. The blue bars represent the AF clinic, the red bars the usual-care group. 95% CI are indicated on each bar (* $P < 0.01$). AF indicates atrial fibrillation.

Discussion

This study examined the effects of an integrated management approach of patients with new-onset AF. We were able to demonstrate that patients with new-onset AF, managed in a specialized AF clinic, had a 41% relative risk reduction and 9% absolute risk reduction in the combined outcome of cardiovascular hospitalization and AF-related ED visits as compared to patients managed by usual specialty care. In addition, guideline adherence was significantly improved in the areas of OAC, etiology, and associated conditions with AF, as recommended by current AF guidelines.^{9,15}

In our study, the observed reduction in primary outcome events may be attributable to consistency of patient education delivered by a nurse, as well as during repeated

encounters. These encounters included the first telephone call 48 to 72 hours after the ED visit, the group AF education session, and finally the one-on-one nurse/physician patient encounter. These repeated opportunities for discussion around AF may have led to a better understanding of AF, in particular, when to seek treatment in the ED. The improved guideline adherence, particularly in OAC use, as well as risk factor management, demonstrates the importance of this approach to AF management.

This study also highlights that there were significant delays in receiving guideline-indicated therapies, including appropriate anticoagulation. Based on previously published data, the monthly incidence of stroke with nonvalvular AF ranges from 0.23% to 1.5%, depending on CHADS₂ score.^{16,17} Given wait times for specialist assessment, whether through a specialized AF clinic or usual specialist care, the incidence of stroke could be reduced by improving anticoagulation at the time of AF diagnosis. The delay in OAC prescription is highlighted in our study, as the rate of OAC use in patients discharged from the ED was similar at their first specialist clinic assessment, suggesting that both ED physicians and primary care physicians may be reluctant to initiate OAC, prior to specialist assessment. This creates a delay in receiving appropriate therapy, which could translate into important negative outcomes, in particular thromboembolic events.

There are only 2 other studies that have investigated outcomes associated with a multidisciplinary AF clinic.^{7,8} Gillis et al performed the seminal study in this area. It was an observational cohort study in Calgary, Alberta of a nurse-led

Table 6. Reason for Discontinuation of Oral Anticoagulation at Follow-Up

Reason	AF Clinic (n=26)	Usual Care (n=26)
CHA ₂ DS ₂ -VASc score is 0	4 (15.4%)	4 (15.4%)
High risk of bleeding	1 (3.9%)	2 (7.7%)
Patient's choice	7 (26.9%)	9 (34.6%)
Doctor's choice	8 (30.8%)	8 (30.8%)
Other	4 (15.4%)	1 (3.8)
Unknown	2 (7.7%)	2 (7.7%)

AF indicates atrial fibrillation.

AF clinic demonstrating an 82% reduction in ED visits in the 6 months post-AF clinic assessment, compared to 6 months pre-AF clinic assessment. The clinical approach by the Gillis group was very similar to the approach used in this study, but no comparison to a control group was made in that study; patients seen in the AF clinic were used as their own controls. Hendriks et al demonstrated a reduction in cardiovascular mortality in a randomized controlled trial of a nurse-led, physician-supervised AF clinic in the Netherlands, as compared to usual care. The Hendriks study utilized a computer-based algorithm to assist the nurse with the AF care. This computer-based algorithm is costly to apply widely and as such the outcomes observed by the study may not be generalizable. Our model utilized simple, widely available resources and demonstrated significant benefits over a control group, which mimics the current model of care used widely.

Other models of care utilizing a multidisciplinary approach have demonstrated both cost-effectiveness and significant impact on cardiovascular outcomes, including mortality.^{18,19} This is best exemplified in heart failure clinics, dedicated to the management of congestive heart failure, in both academic and community settings. This same model of chronic disease management may be just as applicable to AF management, as shown in this study.

The difficulty arises in how patients with cardiovascular disease and its associated risk factors should be managed. The use of specialized clinics may result in patients receiving care from various specialists, which may lead to multiple and potentially conflicting treatment recommendations. As the complexity of medical problems plaguing an individual patient increases, so does the number of specialty clinics that he/she may be exposed to. This results in greater need for centralization of a patient's care with their family physician. In our study, the AF clinic model worked collaboratively with the patient's family physician, as the recommendations from the clinic were often implemented by the patient's own physician. In our study, risk factor management, in particular sleep apnea, was improved by the integrated management approach, where a nurse was able to review these in detail with the patient, at repeated encounters. As a result, risk factors for AF progression including sleep apnea, hypertension, and obesity were better managed in this model, rather than by a specialist, operating alone.²⁰ The importance of risk factor management in AF was highlighted by the Atrial Fibrillation Network/European Heart Rhythm Association consensus conference.²¹ The model of care that we have studied is one that results in improved clinical outcomes, but providing this to all patients with AF remains a challenge in our resource-constrained environment. Further work to determine how this may be best accomplished within our current environment is necessary.

Limitations

This study was restricted to patients with newly diagnosed AF in the ED, and therefore the results cannot be universally applied to all patients with AF. Although the AF clinic provided education to patients and family physicians, we did not measure outcomes to assess whether this translated into increased patient and family physician knowledge. There is some potential selection bias in the manner in which patients were enrolled into each phase, where patients in the usual-care group were identified retrospectively. The outcomes, however, were determined in the same fashion in the 2 groups, through a chart review from the time of the ED visit, limiting the effect of this bias. It is possible that patients visited EDs or were hospitalized outside of the area and these were not captured if the patients were not seen in follow-up; this limitation, however, affected both groups equally. The study did span over time where the introduction of direct OAC occurred over that time. The use of these medications was limited in both arms, so this should not significantly affect the observations. This study was conducted in a universal healthcare provider system, and hence the resource restraints of this system affected the wait times for specialty assessment. Finally, this study did not examine the cost effectiveness of a nurse-led, specialized AF clinic. Despite these limitations, the process created is readily replicable given its simplicity, can be applied to an entire community, and demonstrated significant improvements in care.

Conclusions

An integrated approach to AF management as compared to usual specialist care was associated with a reduction in important cardiovascular outcomes and improvement in AF guideline adherence. This study provides important data demonstrating that an alternative care model can result in reduced morbidity, and potentially reduced mortality, in patients with AF.

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