A targeted educational intervention increases oral anticoagulation rates in high-risk atrial fibrillation patients

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BACKGROUND Anticoagulation is the cornerstone of atrial fibrillation (AF) management for stroke prevention. Recently, we showed that oral anticoagulation (OAC) rates of AF patients in a large U.S. multispecialty health system are >80%.

OBJECTIVE The purpose of this study was to improve OAC rates in AF patients via an educational intervention targeted to primary care providers with low OAC rates.

METHODS Primary care clinicians were stratified by proportions of their AF patients at elevated stroke risk not taking anticoagulation medication. Clinicians with the lowest rates of anticoagulation were assigned to a target group receiving an educational program consisting of E-mail messaging summarizing anticoagulation guidelines. All other clinicians were assigned to a comparison group (CG). Data from a 6-month lead-in phase were compared with a 6-month follow-up period to determine whether the proportion of AF patients treated with OACs had changed.

RESULTS Of the 141 primary care clinicians with patients who met the inclusion criteria, 36 (25.53%) were assigned to the educational group (EG) and 105 (74.47%) to the CG. At baseline, there was a significant difference in percent of high-risk AF patients who were untreated in the EG (20.65%) compared to the high-risk patients who were untreated in the CG (13.64%; $P = .001$). After the educational intervention, high-risk AF patients without anticoagulation decreased in both EG (15.47%; $P = .047$) and CG (10.14%; $P = .07$), with greater absolute reduction in the EG (5.19% vs 3.50%).

CONCLUSION A targeted education program was associated with increased anticoagulation rates for AF patients at high risk for stroke.

KEYWORDS Atrial fibrillation; Educational intervention; Oral anticoagulation; Population health; Primary care; Quality improvement

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Introduction

Atrial fibrillation (AF) is the most common cardiac arrhythmia, affecting well over 5 million people in the United States.[1] AF is a leading cause of stroke, with AF patients having a 4%–5% annual incidence of stroke and a 5- to 7-fold higher risk of stroke than patients without AF. Therefore, stroke prevention with oral anticoagulation (OAG) is a cornerstone of management.[2] The widely accepted CHA_2DS_2-VASc scoring system has been developed to risk-stratify patients with AF for risk of thromboembolism based on clinical variables. This scoring system has been codified in consensus guidelines, which have called for clinicians to use the CHA_2DS_2-VASc score to estimate stroke risk and guide use of oral anticoagulants for the prevention of stroke in patients with AF. AF patients with CHA_2DS_2-VASc score ≥ 2 have an indication for anticoagulation.[3] Quality measures have been developed based on this scoring system to assess clinical performance in the management of AF.[4]

We recently examined the rates of appropriate OAC use among patients with a diagnosis of AF within a large multispecialty health system in the northeastern United States. The analyses suggested that 80.4% of AF patients with an elevated CHA_2DS_2-VASc score (score ≥ 2) had been prescribed an OAC or had received a left atrial appendage occlusion. This rate of appropriate anticoagulation among patients with a diagnosis of AF was dramatically higher than contemporary estimates reported in the literature. However, we also found that a significantly higher percentage of patients with CHA_2DS_2-VASc ≥ 2 who had presented to cardiologists had been prescribed an OAC compared to patients who had been primarily managed by primary care clinicians, defined as those who had not seen a cardiologist in the 18 months before the analysis (83.95% vs 67.43%, respectively). Moreover, there was significant variation in OAC rates among patients followed by primary care clinicians (47%–92%) than observed among patients followed by cardiologists (78%–97%).[5] The purpose of this study was to determine whether appropriate anticoagulation management for patients with a diagnosis of AF and followed by primary care clinicians

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KEY FINDINGS

- Overall oral anticoagulation (OAC) rates in a large regional health system in the northeastern United States remain high.
- We confirm that there exist disparities between oral anticoagulation prescription rates among high-risk atrial fibrillation (AF) patients who are primarily managed by primary care clinicians within the same regional health system in the northeastern United States.
- An E-mail–based educational intervention to primary care clinicians with the lowest rates of OAC in high-risk AF patients is associated with increased OAC rates.

could be increased through a physician-focused messaging campaign.

Methods

This project was developed as a consequence of a previous investigation by the study team. A clinician-focused educational intervention to improve rates of OAC was designed by targeting primary care clinics that had the lowest rates of OAC among AF patients. A series of 3 brief educational E-mails was developed, targeted to internal medicine providers. Each E-mail addressed a different aspect of AF and OAC management: CHA_2DS_2-VASc score; current American College of Cardiology/American Heart Association guidelines on direct oral anticoagulant (DOAC) vs warfarin; and weighing the risks of bleeding vs stroke. We then analyzed anticoagulation rates before and after the intervention.

The principal population for this quality improvement project included all primary care clinicians in ambulatory practice located in the northeastern region of a large, national health care system, using the electronic medical record (Athenanet, Athenahealth, Inc., Watertown, MA), and following patients who had been diagnosed with nonvalvular atrial fibrillation (NVAF) from November 2021 to April 2022 as the lead-in period and November 2022 to April 2023 as the follow-up period. Clinicians were aligned with patients whose most recent outpatient encounter was with that primary care clinician during the 6-month lead-In period of November 2021 to April 2022. The same strategy was used to align patients and clinicians during the 6-month follow-up period of November 2022 to April 2023. As a result, analyses are indexed on providers, not patients.

Data collected from the electronic medical record for patients aligned with specific primary care clinicians were represented by a dashboard, which has been described previously.[5] In brief, the lead physician (JW), in close collaboration with programmers from the Information Technology division (SH), developed a dashboard to monitor anticoagulation management among the AF patient population followed in ambulatory practices across the region. Data were pulled from Athenanet and refreshed nightly. The veracity of data generated within the dashboard was checked at the time that it was introduced. For the purposes of this study, a random sample of 50 patients was drawn from the dashboard and assessed manually for AF diagnosis and medications.

Patients represented in the dashboard had an in-person or telehealth visit with a provider in the network within the previous 18 months. The data were solely from Athenanet and represented strictly outpatient data. The most recent active problem list and International Classification of Diseases, Tenth Revision (ICD-10) diagnosis codes during November 2021 to April 2022 (lead-in period) were used to define the patient population diagnosed with AF. Patients with all AF diagnoses (paroxysmal, persistent, chronic) and atrial flutter were included in the dashboard. Medications were considered active based on most recent office visit medication reconciliation and on bidirectional pharmacy information. The CHA_2DS_2-VASc score was calculated within the dashboard using ICD-10 diagnoses, Systematized Nomenclature of Medicine (SNOMED) codes, problem lists, and demographic data. Patients who had undergone percutaneous transcatheter atrial appendage closure were protected from thromboembolism and were not included in these analyses.

Data harvested from the dashboard included age, gender, ethnicity, race, ICD codes, medical specialty of primary care clinicians (family practice or general internal medicine), history of chronic diseases (diabetes, hypertension, heart failure, vascular disease, and stroke), and anticoagulation medications prescribed (apixaban, rivaroxaban, dabigatran, edoxaban, warfarin, enoxaparin, and no medication). A treatment strategy was defined for each patient. Treatment strategies were described as DOAC, warfarin, other medication, and no medication. The DOAC category included only apixaban and rivaroxaban, as 98.6% of patients who had been prescribed a DOAC had been prescribed either apixaban or rivaroxaban. Mean age was calculated for patients presenting to clinicians in each group, and the proportion of patients $\geq$80 years of age was calculated. Ethnicity and race were recoded using Centers for Disease Control and Prevention (CDC) categories for ethnicity and race. CHA_2DS_2-VASc scores were calculated for all patients with a diagnosis of NVAF within the dashboard. The number of comorbid conditions used for calculating the CHA_2DS_2-VASc score were counted, and the mean number of conditions identified for patients was defined as a measure of overall group health. Patients' risk for stroke (low, medium, high) was defined from the raw CHA_2DS_2-VASc score.

Patients with a high stroke risk but who had not been prescribed an OAC were counted, and the proportions of high-risk, untreated patients were calculated for each primary care clinician using the alignment strategy described. A stratification process such as that used to describe OAC prescribing trends from Medicare claims among U.S. clinicians was used to determine clinician eligibility for receiving the educational program,[6] while also ensuring that clinicians included in the analyses had an adequate sample of patients with which

to generalize their approach to anticoagulation management. Clinicians with at least 10 patients with a diagnosis of NVAF, and at least 10% of whom were high risk and untreated, were assigned to the education group (EG). The remaining primary care clinicians were assigned to the comparison group (CG). Before disaggregating patient groups by study phase, patients in the 2 clinician groups were compared using odds ratio and 95% confidence interval to determine their likelihood of being prescribed a OAC and to understand whether there was a difference in likelihood of high-risk patients not benefiting from an anticoagulation medication. In cross-tabulation calculations, cells with <5 records were excluded.

The educational program was delivered to EG clinicians. The program included a campaign of 3 E-mails, each of which included references to the published literature, relevant attachments to augment the messages, and an in-person summary presentation. The initial communication included a graph illustrating the proportion of high-risk patients with NVAF at each clinic who had been prescribed anticoagulation medications. Clinician group composition from the lead-in period was retained for the follow-up period. Mean values of continuous variables (age, count of comorbid conditions, and CHA_2DS_2-VASc scores) were used to calculate 2-sample Student *t* tests, to determine group differences. The Pearson χ^2 test was used to determine differences between variables with ≥2 categories. Measures to determine the effectiveness of the educational campaign included change from lead-in to follow-up in DOAC use for medium- and high-risk patients and change in proportion of high-risk patients who are untreated. Comparisons were made between groups and within groups during the lead-in and follow-up periods. This was a cross-sectional, comparative evaluation of a quality improvement project. This project was approved by the clinical trials office of St. Elizabeth's Medical Center as a quality improvement project that used retrospective, de-identified data on June 5, 2020. As such, it was considered exempt from requiring written informed consent. The study was conducted in accordance with the Declaration of Helsinki guidelines.

Results

During the lead-in phase (November 2021 to April 2022), of a total of 5362 AF patients (including patients seen primarily by cardiology and primary care), 4553 patients (84.9%) were treated with OAC. Of the 5362 AF patients, 4522 high-risk AF patients (CHA_2DS_2-VASc score ≥2) were identified using the AF dashboard. Of the high-risk AF patients, 4019 (88.9%) were anticoagulated. Among the 5362 patients, 1659 had their AF primarily managed by 141 primary care clinicians (defined as having seen a primary care doctor but not a cardiologist in the preceding 18 months). The 36 clinicians in groups with the lowest rates of high-risk patients appropriately treated with OACs were assigned to the EG, representing 447 of 1659 patients. The remaining 105 primary care clinicians were assigned to the CG, representing 1212 of 1659 patients.

Baseline characteristics of the patients in the CG and EG are summarized in Table 1. There were no significant differences in characteristics between the EG clinician patients and the CG clinician patients at baseline. The difference in mean CHA_2DS_2-VASc scores approached significance ($P = .056$) and when compared at each CHA_2DS_2-VASc score (0, 1, 2, 3, 4, etc) there was a significant overall difference between EG and CG ($P = .036$), with EG having a slightly greater proportion of higher CHA_2DS_2-VASc scores (Figure 1).

At baseline, there was a significant difference in percent of high-risk patients (CHA_2DS_2-VASc score ≥2) who were untreated in the EG (20.65%) compared to the high-risk patients who were untreated in the CG (13.64%; $P = .001$). After the 6-month intervention period (November 2022 to April 2023), the AF dashboard was used again to identify 2195 AF patients primarily managed by the 141 primary care clinicians first defined in the lead-in phase. There were 536 patients followed by the 36 EG clinicians and 1659 followed by the 105 CG clinicians. The proportions of high-risk AF patients without anticoagulation decreased in both the EG (20.65% decreased to 15.47%; $P = .047$) and the CG (13.64% decreased to 10.14%; $P = .07$), with a greater absolute reduction in the EG (5.19% vs 3.50%; $P = .002$P) (Figure 2).

Table 1 Baseline characteristics of AF patients in CG and EG groups

	All patients (n = 1659)	Education group (n = 447)	Comparison group (n = 1212)	Difference *P* value
Age (y)	74.43 ± 11.22	75.07 ± 10. 92	74.20 ± 11.32	.077
Age ≥80 y	37.01	38.93	36.30	.326
Diabetes	23.69	26.17	22.77	.192
Hypertension	80.95	83.89	79.87	.090
Heart failure	17.60	16.33	18.07	.271
Vascular disease	19.47	21.03	18.89	.629
Stroke (previous)	12.84	11.86	13.20	.640
CHA_2DS_2-VASc score				
0	3.62	3.36	3.71	.818
1	9.70	7.83	10.40	.818
≥2	86.68	88.81	85.89	.818
Mean	3.49 ± 1.73	3.61 ± 1.65	3.46 ± 1.76	.056

Values are given as mean ± SD or % unless otherwise indicated.
AF = atrial fibrillation; CG = comparison group; EG = educational group.

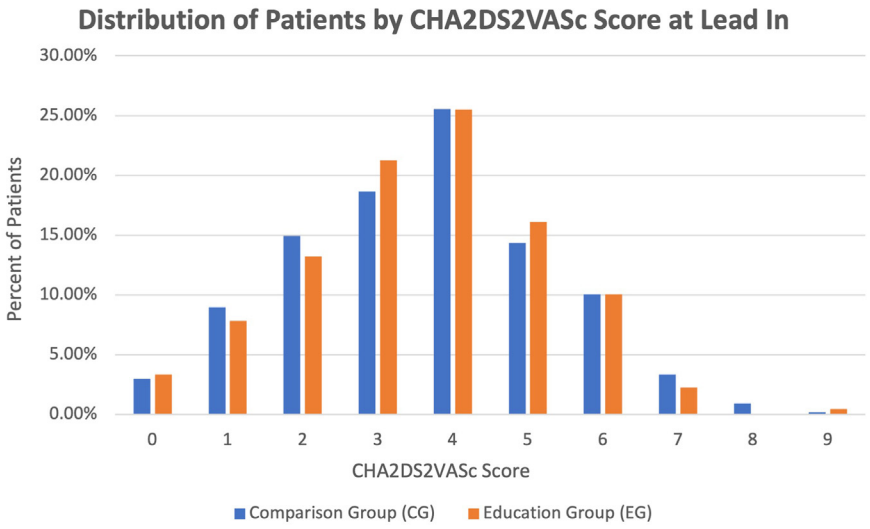

Figure 1 Distribution of patients by CHA_2DS_2-VASc score. There was a significant overall difference between the education group (EG) and the comparison group (CG) ($P = .036$) at lead-in, with the CG group having a slightly greater proportion of higher CHA_2DS_2-VASc scores.

The odds ratio of 1.622 (95% confidence interval 1.119) indicates that high-risk, untreated patients followed by the EG clinicians were 1.6 times more likely to have been prescribed an anticoagulation medication than high-risk patients in the CG.

Discussion

As previously shown, we confirmed that there are significant disparities between OAC prescription rates among high-risk AF patients who are primarily managed by primary care clinicians within the same regional health system in the northeastern United States.[5] This is despite the existence of the CHA_2DS_2-VASc score, a simple tool to guide anticoagulation use as well as updated guidelines reaffirming the benefits of anticoagulation in high-risk AF patients.[4] Awareness, familiarity, and agreement with clinical guidelines has been suggested as explanations for why some clinicians may not adhere to published, evidence-based guidelines such as those recommending OAC using the CHA_2DS_2-VASc score as a clinical guide.[7] This specific health system has been shown to have overall high rates of anticoagulation in high-risk AF patients[4]; however, disparities among clinicians are identifiable by reviewing appropriate anticoagulation rates among individual clinicians while excluding clinicians with a limited number of AF patients, as we did in this project.

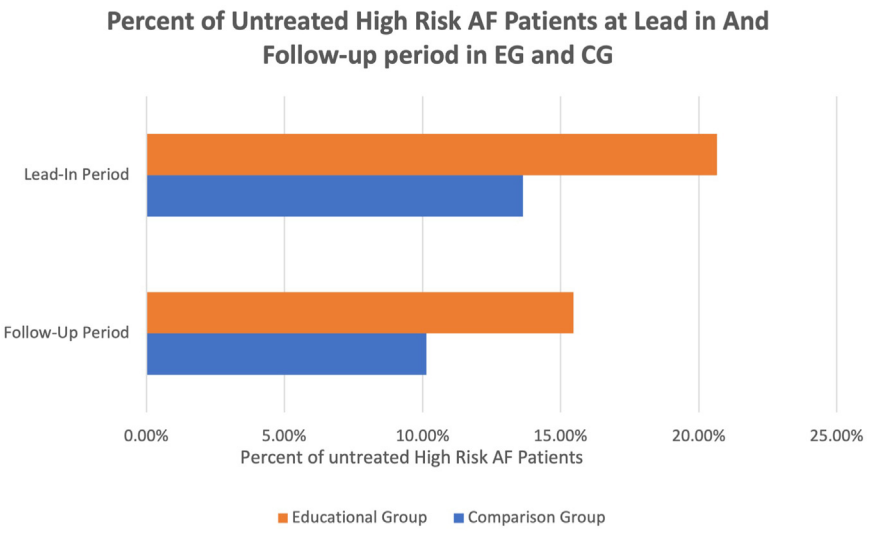

Figure 2 Percent of untreated high-risk atrial fibrillation (AF) patients at lead-in and follow-up period in the education group (EG) and the comparison group (CG). At baseline, there was a significant difference in percent of high-risk AF patients who were untreated in the EG vs CG. After the educational intervention, the percent of high-risk AF patients without anticoagulation decreased in both EG and CG.

We showed that an E-mail–based educational intervention directed to primary care clinicians who are managing AF patients can increase rates of OAC in their high-risk AF patients. These E-mails focused on 3 important aspects of stroke prevention: use of the CHA_2DS_2-VASc score; balancing risk of bleeding vs risk of stroke; and appropriate dosing of DOACs. Although we did not solicit feedback from clinicians, focusing on stroke and bleeding risk may have had a particularly strong impact, as literature suggests bleeding is a great concern of primary care physicians when considering DOAC among AF patients.[8] Given a high perceived risk of patient falling and bleeding, primary care physicians in an abundance of caution may be deterred from prescribing anticoagulation in AF patients.

We report an overall 5.19% reduction in high-risk AF patients not on anticoagulation in the EG after the educational intervention. Concurrently, in the CG there was a 3.50% reduction in high-risk AF patients not on anticoagulation. This finding suggests a small, incremental, baseline increase in OAC rates that is occurring outside of dedicated quality improvement projects, likely driven by the typical ways in which changes in practice may occur (eg, conferences, peer-to-peer interactions, dissemination of guidelines, elective didactics, etc). An average temporal increase in OAC use in the United States has been reported as approximately 1.27% per year during the period 2010 to 2020.[9] The temporal trend among community practices averaged an increase of 0.84% during the 10-year period from 2011 to 2020.[10] Assuming this baseline change rate would have occurred regardless of an intervention, this indicates that our intervention made an absolute 1.7% difference on top of baseline change. Although this appears small, our odds ratio was 1.622, indicating high-risk, undertreated patients in the EG were 1.6 times more likely to have been prescribed an anticoagulation medication than high-risk patients in the CG. Furthermore, the absolute change likely is an underestimation of net change, as our inclusion criteria for the EG were primary care clinicians who already had lower rates of OAC and may represent a group of clinicians resistant to baseline practice change rates. This increase in rates was observed during the follow-up period, with otherwise no concomitant change in patient demographic composition, comorbidity burden, or calculated stroke risk. There also were no other treatment strategy changes within the CG strongly indicating that our intervention was an important component of the increase in OAC rate. The small, but significant, difference in rates can influence hundreds to thousands of patients across a large health system. Moreover, brief E-mail interventions are low cost, fast, and direct, creating an extremely favorable cost-to-benefit ratio despite small absolute changes in percentages.

Of note, our data show a remarkably high rate of OAC use in high-risk AF patients at baseline, and there is a limit to maximal achievable rates of anticoagulation, which likely is between 90% and 100%.[11]

Research suggests that 4 themes likely contribute to positive attitudes and facilitate implementing clinical practice guidelines within a system: access and ease of use; endorsement and dissemination by the health system; awareness of the guideline and belief in their relevance; and belief that the guideline supports improved patient care.[12] The availability of the CHA_2DS_2-VASc score within the electronic medical record partially addresses the first factor. The intervention described here is designed to facilitate the remaining 3 factors.

Improving OAC rates with educational interventions directed at patients has proven difficult. The IMPACT-AFib (Implementation of a Randomized Controlled Trial to Improve Treatment with Oral Anticoagulants in Patients With Atrial Fibrillation) trial was a prospective, multicenter, randomized clinical trial in which AF patients with CHA_2DS_2-VASc score ≥ 2 with no evidence of OAC use were randomized to either a single mailed educational intervention (targeted directly to patients) or usual care. The IMPACT-AFib trial and showed that the mailed intervention did not lead to a statistically significant difference in rates of OAC initiation.[13] In contrast, our intervention produced a difference, suggesting that interventions that are directed to clinicians, are repeated, and are more intensive may be important factors in designing educational interventions. This is consistent with a systematic review of interventions targeting the underuse of OAC for stroke prevention among patients with AF, which showed that educational interventions targeting clinicians about guideline/protocol implementation were more likely to lead to a significant increase in OAC rates. This review also found that interventions based on computerized decision support tools were less likely to lead to an increase in anticoagulation rates. However, the authors noted that interventions that had control groups or targeted high-risk AF populations were less likely to show a significant difference.[14] Therefore, future interventions should continue to target clinician education, be studied with adequate controls, and include high-risk AF patients who would benefit most from increased OAC rates.

This low-cost, easily accessible, and effective E-mail intervention serves to improve preventative care among underserved populations, who have limited access to subspecialty care and, like our study patient population, rely on primary care for preventative cardiovascular care.[15] A study assessing prescription of anticoagulation for AF by primary care physicians reported a rate of 47%,[16] indicating a critical area of improvement for a vulnerable patient population. Empowering primary care providers with educational interventions can improve guideline-based care, leading to more equitable health care delivery, reduction in health care disparities, and improved preventative care in the underserved.

Study limitations

First was selecting AF patients by diagnosis on active problem list or ICD-10 codes. Although While were made to ensure accurate identification of patients by many iterative

chart reviews after each refinement of programming algorithms, AF in our full patient population was not confirmed by electrocardiography, Holter monitoring, telemetry, or any form of adjudication. Correct labeling of AF can have large impacts on measurements of anticoagulation rates. A recent study eliminated falsely labeled AF and inactive AF patients in their review and found that OAC rates increased from 62.9% to 79.7%.[17] Although this had less of an effect on our study as a random sample of 50 patients was manually checked for AF to confirm the accuracy of the dashboard data, manual adjudication would be the most accurate way to assess for AF.

Another important limitation was that our EG and CG had different selection criteria. The EG represented primary care clinicians with low rates of OAC, whereas the CG represented all other primary care clinicians in the health system who primarily managed their patients' AF, meaning the CG were not true controls. Despite this, the baseline characteristics were largely similar between patients in the EG and CG (Table 1). There were slightly higher CHA_2DS_2-VASc scores in the EG: the mean difference approached significance ($P = .056$) and, when compared at each CHA_2DS_2-VASc score (0, 1, 2, 3, 4, etc), there was a significant overall difference between the EG and CG ($P = .036$), with the EG having a slightly greater proportion of higher CHA_2DS_2-VASc scores (Figure 1). These differences ultimately are small in magnitude and likely not clinically meaningful. Another limitation is that the EG had lower rates of OAC use than the CG. The greater improvement in OAC use in the EG compared to the CG may represent regression to the mean, as the improvement in the EG brought them much closer to the overall mean rates of anticoagulation in our primary care database.

Because our study was indexed to providers and not patients, in theory patients moving between practices in the 6-month follow-up period could influence our data, as patients moving from the EG to the CG group would falsely raise OAC rates in the EG group (and vice versa). Although our dashboard data did not allow us to assess for primary care clinician–patient stability (due to deidentification of data), we find this confounder unlikely because these primary care groups were separated by geography across a broad area in the northeastern United States. Likewise, many of these primary care providers have been closed to accepting new patients, making patient transfers between groups difficult. This remains an important consideration, and future studies should control for provider–patient panel stability.

The 6-month time course for the follow-up may have been too short. After receiving an intervention, a 6-month follow-up period may not be sufficient time for the practice change to be reflected in patient anticoagulation rates, especially as many patients come for yearly follow-up visits outside of the 6-month follow-up window. This effect likely would underestimate our impact on anticoagulation rates. However, the occurrence of this phenomenon in the face of the positive changes we identified here suggests that OAC guideline adherence among the EG clinicians will increase over time. Finally, our study was aimed at a population of patients whose AF is managed by primary care clinicians and who did not see a cardiologist in the preceding 18 months in the northeastern United States. Whether this study is applicable to AF patients managed by other specialties or is applicable to other geographic regions is unclear. We have shown previously that use of DOACs is high in this large northeastern system.[5] In areas with greater utilization of vitamin K antagonists, which have challenges of monitoring international normalized ratios and higher risks of bleeding, changing OAC practices may be more difficult. Therefore, it would be useful to replicate this project in other U.S. regions with less overall adherence rates to OAC clinical guidelines.

Future directions include soliciting and addressing clinician feedback. It is unclear how many clinicians opened and read the E-mails with their attached graphics as well as how many found them useful. It would be valuable to assess for reasons behind underutilization of anticoagulation for stroke prevention (eg, underutilization of risk scores, insurance issues, patient fears of bleeding, etc) that would tailor future intervention. Future interventions should include methods to determine reasons of underutilizations (eg, focus groups or chart review) and continue to focus on clinician education, with more intensive educational programs including in-person visits to practices with presentations. To better control for differences between the CG and EG and to accurately assess impact, future educational interventional studies should use a randomization process and lengthen the follow-up window (respectively) to allow for the greatest number of patient follow-up. An important avenue for future efforts includes sustainability and long-term effects. This study was designed with a 6-month lead-in and 6-month follow-up period to assess the immediate effects of our educational intervention. Longer follow-up could determine whether our intervention led to sustained anticoagulation. We believe our intervention has a high likelihood of sustainability because it uses limited resources, is brief, blends in with current workflow, and is easily understood. It can be repeated and customized several times with little cost. Finally, another future direction could include giving primary care clinicians access to the dashboard, as continuous feedback could spur clinicians to modify their practices.

Conclusion

A targeted education program using a series of E-mails was associated with an increased rate of anticoagulation therapy for patients at high risk for stroke. Although this was a small absolute percentage and there were several limitations, this program represents an extremely low-cost, fast, and targeted intervention to increase OAC rates.

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Patient Consent: This study was considered exempt from requiring written informed consent.

Ethics Statement: This project was approved by the clinical trials office of St. Elizabeth's Medical Center as a quality improvement project that used retrospective, deidentified data. The study was conducted in accordance with the Declaration of Helsinki guidelines.

Data Availability: The data underlying this article will be shared on reasonable request to the corresponding author.

References

1. Colilla S, Crow A, Petkun W, Singer DE, Simon T, Liu X. Estimates of current and future incidence and prevalence of atrial fibrillation in the U.S. adult population. Am J Cardiol 2013;112:1142–1147.
2. Hart RG, Pearce LA. Current status of stroke risk stratification in patients with atrial fibrillation. Stroke 2009;40:2607–2610.
3. January CT, Wann LS, Calkins H, et al. 2019 AHA/ACC/HRS focused update of the 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society in Collaboration With the Society of Thoracic Surgeons. Circulation 2019;140:e125–e151.
4. Heidenreich PA, Estes NAM 3rd, Fonarow GC, et al. 2020 update to the 2016 ACC/AHA clinical performance and quality measures for adults with atrial fibrillation or atrial flutter: a report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. J Am Coll Cardiol 2021;77:326–341.
5. Dutta R, Hurley S, Atkins D, Weinstein J, Wylie J. High rates of oral anticoagulation in atrial fibrillation patients observed in a large multi-specialty health system in the Northeast. J Interv Card Electrophysiol 2023;66:1119–1124.
6. Wheelock KM, Ross JS, Murugiah K. Clinician trends in prescribing direct oral anticoagulants for US Medicare beneficiaries. JAMA Netw Open 2021;4:e2137288.
7. Langlois MR, Watine J, Twomey PJ, Oosterhuis WP. Why are clinical practice guidelines not followed? Clin Chem Lab Med 2016;54:1133–1139.
8. Baker DW, Hayes RP, Massie BM, Craig CA. Variations in family physicians' and cardiologists' care for patients with heart failure. Am Heart J 1999;138(5 Pt 1):826–834.
9. Ko D, Lin KJ, Bessette LG, et al. Trends in use of oral anticoagulants in older adults with newly diagnosed atrial fibrillation, 2010-2020. JAMA Netw Open 2022;5:e2242964.
10. Navar AM, Kolkailah AA, Overton R, et al. Trends in oral anticoagulant use among 436 864 patients with atrial fibrillation in community practice, 2011 to 2020. J Am Heart Assoc 2022;11:e026723.
11. Kirchhof P, Camm AJ, Goette A, et al; EAST-AFNET 4 Trial Investigators. Early rhythm-control therapy in patients with atrial fibrillation. N Engl J Med 2020;383:1305–1316.
12. Bierbaum M, Rapport F, Arnolda G, et al. Clinicians' attitudes and perceived barriers and facilitators to cancer treatment clinical practice guideline adherence: a systematic review of qualitative and quantitative literature. Implement Sci 2020;15:39.
13. Pokorney SD, Cocoros N, Al-Khalidi HR, et al. Effect of mailing educational material to patients with atrial fibrillation and their clinicians on use of oral anticoagulants: a randomized clinical trial. JAMA Netw Open 2022;5:e2214321.
14. Pritchett RV, Bem D, Turner GM, et al. Improving the prescription of oral anticoagulants in atrial fibrillation: a systematic review. Thromb Haemost 2019;119:294–307.
15. Cook NL, Hicks LS, O'Malley AJ, Keegan T, Guadagnoli E, Landon BE. Access to specialty care and medical services in community health centers. Health Aff (Millwood) 2007;26:1459–1468.
16. Martinez KA, Eckman MH, Pappas MA, Rothberg MB. Prescribing of anticoagulation for atrial fibrillation in primary care. J Thromb Thrombolysis 2022;54:616–624.
17. Naccarelli GV, Ruzieh M, Wolbrette DL, et al. Oral anticoagulation use in high-risk patients is improved by elimination of false-positive and inactive atrial fibrillation cases. Am J Med 2021;134:e366–e373.