Heart, Lung and Circulation (2019) **28,** 605–614
1443-9506/04/$36.00
https://doi.org/10.1016/j.hlc.2018.02.024

ORIGINAL ARTICLE

The Translation of Knowledge Into Practice in the Management of Atrial Fibrillation in Singapore

Brigitte Fong Yeong Woo, BSc (Nursing), MRes [a*], Toon Wei Lim, MBBS, FRACP, PhD [b], Wilson Wai San Tam, PBSc, MPhil, PhD [a]

[a]Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, 117597, Singapore
[b]National University Heart Centre, 119228, Singapore

Received 20 October 2017; received in revised form 31 January 2018; accepted 15 February 2018; online published-ahead-of-print 12 March 2018

Background Atrial fibrillation (AF) is a clinically significant cardiac arrhythmia known to increase the risk of stroke by at least four times. Stroke-risk assessment and thromboprophylaxis are vital components in AF management. Guidelines are available to standardise AF management, but physicians' adherence to the recommended guidelines has been low.
The aims were to:
1. Examine and compare the level of knowledge and current practice in AF management between cardiologists and non-cardiologist physicians in Singapore;
2. Identify physicians' perceived barriers to prescribing oral anticoagulants (OACs) when indicated;
3. Identify strategies to optimise AF management.

Methods From June 2017 to August 2017, a cross-sectional online survey involving physicians was conducted in Singapore. The survey instrument was adapted from a previously developed instrument, and validated locally by five cardiologists. It explored the physicians' stroke-risk assessment practices, estimation of stroke risk and benefits of anticoagulation, likelihood of prescribing anticoagulation when indicated, perceived barriers to anticoagulation, and strategies to optimise AF management.

Results Sixty-three (63) physicians completed the survey (14 cardiologists and 49 non-cardiologist physicians). No significant difference was found between cardiologists and non-cardiologist physicians in their assessment and estimation of stroke risk for stable AF patients. However, when presented with an AF patient with stroke risk, cardiologists were more likely than non-cardiologist physicians to prescribe novel OACs (93% vs. 51%; $\chi^2 = 7.933$, $p = 0.004$). Compared to cardiologists, the majority of the non-cardiologist physicians thought the risk of falls were usually or always barriers to prescribing OACs (29% vs 69%; $\chi^2 = 7.579$, $p = 0.006$). Among the suggested strategies to support them in AF management, physicians have overwhelmingly rated two as ''quite useful'' and ''very useful'': the establishment of clinics for monitoring anticoagulated patients (100%); and involvement of pharmacists in managing patients on warfarin (98.4%).

Conclusions Physicians possess good knowledge about stroke-risk assessment in AF patients yet it is not translated into effective measures for stroke prevention. Physicians, especially non-cardiologist ones, were not anticoagulating AF patients when indicated. Although novel OACs are safer alternatives to warfarin, non-cardiologist

*Corresponding author at: Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore. Level 2, Clinical Research Centre, Block MD11, 10 Medical Drive, 117597, Singapore. Tel.: +65 91803325., Email: brigittewoo@u.nus.edu

physicians were less inclined to use them for stroke prevention. All physicians opined that establishing anticoagulation clinics and collaborating with pharmacists were useful strategies to optimise AF management. Existing barriers to anticoagulation impeded the translation of knowledge into practice in the management of AF patients in Singapore, for which optimal strategies to optimise AF management are ascertained.

Keywords Atrial fibrillation • Anticoagulation knowledge • Clinical practice

Introduction

Atrial fibrillation (AF), a heart rhythm disorder, occurs in up to 6% of the world's population [1] and its prevalence increases with age [2]. AF is a clinically significant cardiac arrhythmia as it is known to increase the risk of stroke by at least four times [3,4]. Functional decline (approximately 60%) and mortality (up to 20%) are often the outcomes of cardioembolic stroke [5]. Therefore, the assessment of stroke risk [6] and thromboprophylaxis are vital components in managing patients with AF [7].

The aim of the stroke-risk stratification scheme, CHA_2DS_2-VASc (Congestive heart failure, Hypertension, Age $\geq$ 75 [doubled], Diabetes mellitus, Stroke [doubled], Vascular disease, Age 65–74, and Sex [female]) is to determine the yearly risk of stroke and based on that, the decision can be made on whether or not to anticoagulate a patient with AF [6]. According to the 2017 Asia Pacific Heart Rhythm Society guidelines, in an Asian population, the use of oral anticoagulants (OACs) is recommended when the CHA_2DS_2-VASc score is ≥ 1 in males and ≥ 2 in females [7]. Likewise, the 2016 European Society of Cardiology (ESC) guidelines stated that there is increasing evidence [8–11] regarding the benefits of anticoagulating patients with only one risk factor (i.e. CHA_2DS_2-VASc score 1 in males and 2 in females) [6]. Specifically, the use of OACs to maintain a therapeutic international normalised ratio (INR) of 2.0 to 3.0 in AF patients with stroke risk is advocated [12].

Vitamin K antagonists (VKAs), such as warfarin, have been the conventional treatment for stroke prevention in AF patients since the 1960s [13]. Of late, novel anticoagulants (NOACs) have increasingly been used in preference to VKAs in stroke prevention for AF patients [14] as NOACs are associated with lower risks of intracranial haemorrhage [15]. NOACs, such as dabigatran and rivaroxaban, are shown to be non-inferior to warfarin in preventing stroke or systematic embolism [16,17]. Besides, NOACs are found to be superior to warfarin with respect to consistency of anticoagulation and fatal bleeding [16,17]. However, NOACs cost more than warfarin. Nonetheless, the reduction of stroke incidence and complications accompanying warfarin use will inevitably contribute to general health care cost reduction [18].

At present, consensus guidelines have been published to standardise AF management [6,7]. However, physicians' adherence to them has been notoriously low. A systematic review of 54 studies examining the AF treatment practice revealed that physicians' adherence to treatment guidelines was under 60% for AF patients with a high stroke risk [19]. Such a lack of adherence to guidelines could stem from poor knowledge of AF management or from existing barriers to optimal decisions in clinical practice [20]. It would be advantageous to confirm this postulation. It would also be useful to determine if there is any difference in the level of knowledge and practice in AF management between cardiologists and physicians who are not in cardiology. Non-cardiologist physicians also treat patients with AF and oftentimes are the first to screen or diagnose the patient with AF. Hence, it is pertinent to examine their level of knowledge and current practice in AF management too. In addition, to guiding the future design of strategies to improve the adherence to guidelines, identifying the barriers and facilitators to optimal AF management is necessary.

Therefore, the aims of the study are to:

1. Examine and compare the level of knowledge and current practice in AF management between cardiologists and non-cardiologist physicians in Singapore;
2. Identify physicians' perceived barriers to prescribing OACs when indicated;
3. Identify strategies to support physicians in optimising AF management.

Methods

Study Design

From 1 June 2017 to 13 August 2017, a cross-sectional online survey involving physicians was conducted. Approval from the National University of Singapore Institutional Review Board (NUS-IRB Reference Code: N-17-042E) was obtained.

Setting and Data Collection

The setting for this study was Singapore, a small Southeast Asian country with a population size of 5.61 million (2016) occupying 719.1 km^2 of land [21]. As of 2016, 12,337 physicians were in active practice (2016) [22].

The physicians were recruited from the Singapore Cardiac Society (SCS), which comprises cardiologists, cardiac surgeons, and other physicians involved in cardiovascular medicine such as family physicians, emergency physicians, intensivists, geriatricians, internal medicine physicians, infectious disease physicians, endocrinologists, neurologists, and rehabilitation physicians [23]. The SCS has 227 registered members (2017) [23]. The participants were recruited by email and through the SCS Facebook page. The online survey was created using the eSurvey tool provided by the University's Information Technology department. The eSurvey

tool aids in the creation of web-based surveys through built-in questions types (https://mysurvey.nus.edu.sg). The SCS members were encouraged to forward the invitation to their colleagues who fulfilled the inclusion criteria (snowball sampling). The study started in June 2017 and recruitment ended in August 2017.

Participants

Physicians who were registered medical practitioners in Singapore, spent at least 50% of their professional time on direct patient care, and managed at least five patients diagnosed with AF in the past 12 months were eligible for the study. Physicians who spent more than 70% of their professional experience away overseas in the past year were excluded.

Survey Instrument

The instrument encompassed two sections: the first gathered the physicians' demographic information whereas the second was concerned with the management of stable AF patients. The second section comprised 37 items, of which 35 items were adapted from the instrument developed by Gattellari et al. to examine AF management in Australian general practice [24], while the remaining two items were designed by the authors to explore the physicians' likelihood of prescribing OACs for stable AF patients with stroke risk. The second section had five domains and they were as follows:

Stroke-risk assessment

The physicians were requested to rate the likelihood of performing the tasks relevant to stroke-risk assessment of a patient with newly diagnosed AF on a five-point Likert scale. The tasks involved the recognition of diabetes, hypertension and congestive heart failure, cardiac assessment (assess cardiac symptoms/auscultate the heart), and diagnostic procedures (transthoracic echocardiogram [TTE]/transoesophageal echocardiogram [TEE]). These tasks contribute to stroke risk stratification in patients with stable non-valvular AF [6,25,26].

Estimate of stroke risk and benefits of anticoagulation

The physicians were asked to estimate the stroke risk of the patient presented in the two case scenarios and determine whether the benefits of anticoagulation would outweigh the risks. The case scenarios were adapted from the original instrument [24]. The genders of the patients in both scenarios were specified in the modified instrument to increase clarity to the readers. Based on the CHA_2DS_2-VASc score, the patient in Case 1 was classified to have low-moderate risk for stroke whereas the patient in Case 2 was classified to have high risk.

Likelihood of prescribing anticoagulation when indicated

The physicians were asked to indicate the likelihood of prescribing anticoagulation, and selecting NOACs over warfarin in a patient with stable AF and CHA_2DS_2-VASc score ≥ 1 to on a five-point Likert scale.

Barriers to anticoagulation prescription

Six (6) potential reasons for deterring physicians from prescribing anticoagulation to stable AF patients were presented. The physicians were asked to indicate how often each reason pertained to their patients when making decisions to prescribe anticoagulation.

Strategies to optimise AF management

The physicians were asked to rate the usefulness of strategies to support the management of AF patients on a four-point Likert scale. The proposed strategies included services (n = 3) and practice resources (n = 6).

Survey Instrument Development and Validation

The authors [24] granted permission for the use and modification of the items in the original instrument in this study. Practicing cardiologists, who were actively involved in the management of AF patients, assisted in the face and content validation of the instrument. These content experts assessed each item in terms of its clarity and relevance to the intent of the study. The content validity of each item was quantified by the content validity index (CVI), as determined by the level of agreement of the cardiologists for each item [27]. As five experts were involved in the validation, items with a CVI of 1.0 (perfect agreement) were kept without modification, those with a CVI of 0.8 (only one disagreed) were modified to improve clarity and relevancy, and those with a CVI less than 0.8 (more than one disagreed) were removed [27].

Sample Size

From Table 2 of Gattellari et al.'s paper [24], from which the survey items were adapted, we computed ''likely'' or ''highly likely'' for performing the tasks related to stroke-risk assessment in AF patients. We found the median percentage to be 70% and hence, was used in our sample size estimation. As physicians were recruited from the SCS, it was assumed at least 70% of the respondents would likely perform the tasks. Therefore, based on 95% confidence intervals and a 10% margin of error, a sample of 61 respondents was necessary [28].

Statistical Analysis

The responses from the completed surveys were exported into the Statistical Package for Social Sciences (SPSS), version 22.0 (IBM Corp., Armonk, NY, USA). Frequency and percentages were used to describe the sample and responses to the variables in the two domains, namely, strategies to support AF management and satisfaction with current services. Chi-square statistic was used to compare the responses between cardiologists and non-cardiologist physicians in their stroke-risk assessment, stroke-risk estimation and benefits of OACs, likelihood of prescribing OACs to stable AF patients with stroke risk, and barriers to prescribing OACs. Incomplete surveys were excluded from statistical analysis. The level of significance was set at $p < 0.05$.

Results

Response

Seventy-eight (78) physicians attempted the survey but only 63 completed it, of whom 14 were from cardiology while 49 were not. The non-cardiologist respondents varied from family physicians, emergency physicians, internal medicine physicians, intensivists, geriatricians, and others. The characteristics of the physicians are presented in Table 1. Most of them were full-time medical practitioners (91%) and had practiced for at least 5 years (76%).

Stroke-Risk Assessment

There was no significant difference between cardiologists and non-cardiologist physicians in the likelihood of performing all stroke-risk assessment (refer to Table 2). When reviewing a patient newly diagnosed with AF, most physicians were likely or highly likely to determine the blood glucose level, measure the blood pressure, refer the patient for a TTE, assess cardiac symptoms, auscultate the patient's heart, and use the CHA_2DS_2-VASc score to assess the stroke risk. Most physicians were least likely to refer the patient for a TEE. Interestingly, there was no general consensus regarding referring the patient to a cardiologist.

Estimate of Stroke Risk and Benefits of Anticoagulation

No significant differences were noted in the estimation of stroke risk and benefits of OACs between cardiologists and non-cardiologist physicians in both cases (refer to Table 3). All physicians made an accurate estimation of the stroke risk of the patient in Case 1 (low-moderate risk). All but one non-cardiologist physician made an accurate estimation of the stroke risk of the patient in Case 2 (moderate-high risk).

For the patient described in Case 1, compared to the cardiologists (21%), a greater proportion of the non-cardiologist physicians (41%) indicated that the risks of OACs would outweigh the benefits. In contrast, compared to the non-cardiologist physicians (14%), a greater proportion of the cardiologists (36%) indicated that the benefits of OACs would outweigh the risks in Case 1. Nonetheless, the differences were not statistically different.

For the patient described in Case 2, compared to the non-cardiologist physicians (71%), a greater proportion of cardiologists (86%) indicated that the benefits of OACs would outweigh the risks. Nevertheless, the difference was also not statistically significant.

Likelihood of Prescribing Anticoagulation to Stable AF Patients With Stroke Risk

As mentioned, anticoagulation should be considered when CHA_2DS_2-VASc score ≥ 1 in males and ≥ 2 in females [6,7]. When reviewing a patient with AF, CHA_2DS_2-VASc score ≥ 1, and no information provided on the patient's gender, the cardiologists (93%) were more likely than the non-cardiologist physicians (67%) to prescribe OACs, although this difference was not statistically significant. When asked specifically to indicate their likelihood of choosing NOACs over warfarin for the same patient, cardiologists (93%) were statistically significantly more likely than non-cardiologist physicians (51%) to choose NOACs over warfarin (refer to Table 4).

Table 1 Characteristics of the respondents.

Demographic variable	Physicians n = 63 (%)
Sex	
Male	41 (65.1)
Female	22 (34.9)
Age*	
25–34 years	40 (63.5)
35–44 years	11 (17.5)
45–54 years	9 (14.3)
55–64 years	2 (3.2)
≥65 years	1 (1.6)
Race	
Chinese	58 (92.1)
Malay	1 (1.6)
Indian	3 (4.8)
Others	1 (1.6)
Work hours	
Full-time	57 (90.5)
Part-time	6 (9.5)
Type of practice	
Cardiologist	14 (22.2)
Cardiac Surgeon	1 (1.6)
Family Physician	19 (28.6)
Emergency Physician	8 (12.7)
Internal Medicine Physician	6 (9.5)
Intensivist	4 (6.3)
Geriatrician	3 (4.8)
Infectious Disease Physician	1 (1.6)
Endocrinologist	1 (1.6)
Neurologist	1 (1.6)
Rehabilitation Physician	1 (1.6)
Others+	4 (6.3)
Sector of practice	
Private	4 (6.3)
Institutional	59 (93.7)
Years in practice	
≤5 years	15 (23.8)
5 to 10 years	25 (39.7)
10 to 15 years	8 (12.7)
≥15 years	15 (23.8)

*Age on January 1, 2017.
+Others: Did not belong to any of the abovementioned and did not specify type of practice.

Table 2 Physician self-reported likelihood of performing the following tasks when reviewing a patient newly diagnosed with AF (n = 63).

Task	Physician			χ^2	df	P-value
	Total n = 63 (%)	Cardiologist n = 14 (%)	Non-Cardiology n = 49 (%)			
Determine blood glucose level				0.096	1	0.502^
Likely/Highly like	47 (74.6)	10 (75.0)	37 (75.5)			
Others*	16 (25.4)	4 (25.0)	12 (24.5)			
Measure blood pressure				0.290	1	0.778^
Likely/Highly likely	62 (98.4)	14 (100)	48 (98.0)			
Others*	1 (1.6)	0 (0.0)	1 (2.0)			
Refer the patient for a transthoracic echocardiogram				1.552	1	0.271^
Likely/Highly likely	58 (92.1)	14 (100)	44 (89.8)			
Others*	5 (7.9)	0 (0.0)	5 (10.2)			
Refer the patient for transoesophageal echocardiogram				0.019	1	0.644^
Likely/Highly likely	4 (6.3)	1 (7.1)	3 (6.1)			
Others*	59 (93.7)	13 (92.9)	46 (93.9)			
Assess cardiac symptoms				0.290	1	0.778^
Likely/Highly likely	62 (98.4)	14 (100)	48 (98.0)			
Others*	1 (1.6)	0 (0.0)	1 (2.0)			
Auscultate the heart				N.A.	N.A.	N.A.
Likely/Highly likely	63 (100)	14 (100)	49 (100)			
Others*	0 (0.0)	0 (0.0)	0 (0.0)			
Assess the patient's stroke risk by calculating CHA2DS2-VASc score				N.A.	N.A.	N.A.
Likely/Highly likely	63 (100)	14 (100)	49 (100)			
Others*	0 (0.0)	0 (0.0)	0 (0.0)			
Refer the patient to a cardiologist				0.375	1	0.377^
Likely/Highly likely	36 (57.1)	7 (50.0)	29 (59.2)			
Others*	27 (42.9)	7 (50.0)	20 (40.8)			

Abbreviations: AF, atrial fibrillation; CHA2DS2-VASc, Congestive heart failure, Hypertension, Age ≥ 75 [doubled], Diabetes mellitus, Stroke [doubled], Vascular disease; N.A., not available.

*Others refer to ''highly unlikely'', ''unlikely'' and ''neither unlikely nor likely''.

^*p*-value of Fisher's Exact test reported as at least 1 cell had an expected count less than 5.

Barriers to Anticoagulation Prescription

Figure 1 presents the list of barriers to anticoagulating AF patients. When the two groups of physicians were asked to indicate whether having the risk for falls was a barrier to prescribing OACs to patients with AF, a statistically significant difference was identified: only 29% of the cardiologists indicated ''usually/always'' whereas 69% of the non-cardiologist physicians indicated the same. The physicians' three most common barriers to prescribing OACs were the presence of fall risk (60%), contraindications to suggested OACs (57%), and risk of adverse events (52%).

Strategies to Optimise AF Management

Figure 2 presents the nine proposed strategies to support physicians in AF management. Of the strategies, physicians have overwhelmingly rated three as ''quite useful'' and ''very useful'': having anticoagulation clinics for monitoring patients on anticoagulants (100%), pharmacists monitoring INR levels and recommending dose adjustment of warfarin (98%), and a stroke-risk calculator to quantify the risk of stroke in patients readily available in the computer (95%). Conversely, the least proportion of physicians considered it ''quite useful'' and ''very useful'' to adopt the strategy of having a centralised disease register for AF to monitor patient care and outcomes (59%).

Discussion

The results herein have shown that the cardiologists and non-cardiologist physicians had sufficient knowledge of the

Table 3 **Physician estimate of stroke risk and assessment of the benefits and risks of warfarin (n = 63).**

	Physician's estimate of stroke risk		Cardiologist n = 14 n (%)				Non-Cardiology n = 49 n (%)				χ^2	df	P-value
	Cardiologist n = 14 (%)	Non-Cardiology n = 49 (%)	Benefits of anti-coagulation > risks	Benefits of anti-coagulation = risks	Risks of anti-coagulation > benefits	Unsure	Benefits of anti-coagulation > risks	Benefits of anti-coagulation = risks	Risks of anti-coagulation > benefits	Unsure			
Case 1: An otherwise healthy 65-year-old male patient diagnosed with non-valvular AF. This patient does not have diabetes or hypertension. This patient does not have a history of stroke or cardiovascular disease.													
(low-moderate risk)													
Accurate	14 (100)	49 (100)									N.A.	N.A.	N.A.
Inaccurate	0 (0.0)	0 (0.0)											
Assessment of benefits and risks of warfarin			5 (35.7)	6 (42.9)	3 (21.4)	0 (0.0)	7 (14.3)	21 (42.9)	20 (40.8)	1 (2.0)	4.032	3	0.258
Case 2: A healthy 75-year-old female patient with non-valvular AF. This patient has a history of hypertension. This patient does not have a history of diabetes. This patient does not have a history of stroke or cardiovascular disease.													
(Moderate-high risk)													
Accurate	14 (100)	48 (98.0)									0.290	1	0.590
Inaccurate	0 (0.0)	1 (2.0)											
Assessment of benefits and risks of warfarin			12 (85.7)	1 (7.1)	1 (7.1)	0 (0.0)	35 (71.4)	10 (20.4)	4 (8.2)	0 (0.0)	1.410	2	0.494

Table 4 **Physician self-reported likelihood of performing the following behaviours when reviewing a stable AF patient with stroke risk (CHA_2DS_2-VASc score ≥ 1).**

Behaviour	Physician n = 63		χ^2	df	P-value
	Cardiologist n = 14 (%)	Non-Cardiology n = 49 (%)			
Prescribe oral anticoagulation (i.e. Vitamin K antagonists or novel anticoagulants)			3.597	1	0.053^
Likely/Highly likely	13 (92.9)	33 (67.3)			
Others*	1 (7.1)	16 (32.7)			
Choose novel anticoagulants (i.e. dabigatran, rivaroxaban, apixaban, etc.) over warfarin			7.933	1	0.004^
Likely/Highly likely	13 (92.9)	25 (51.0)			
Others*	1 (7.1)	24 (49.0)			

*Others refer to ''highly unlikely'', ''unlikely'' and ''neither unlikely nor likely''.
^Level of significance was set at < 0.05.

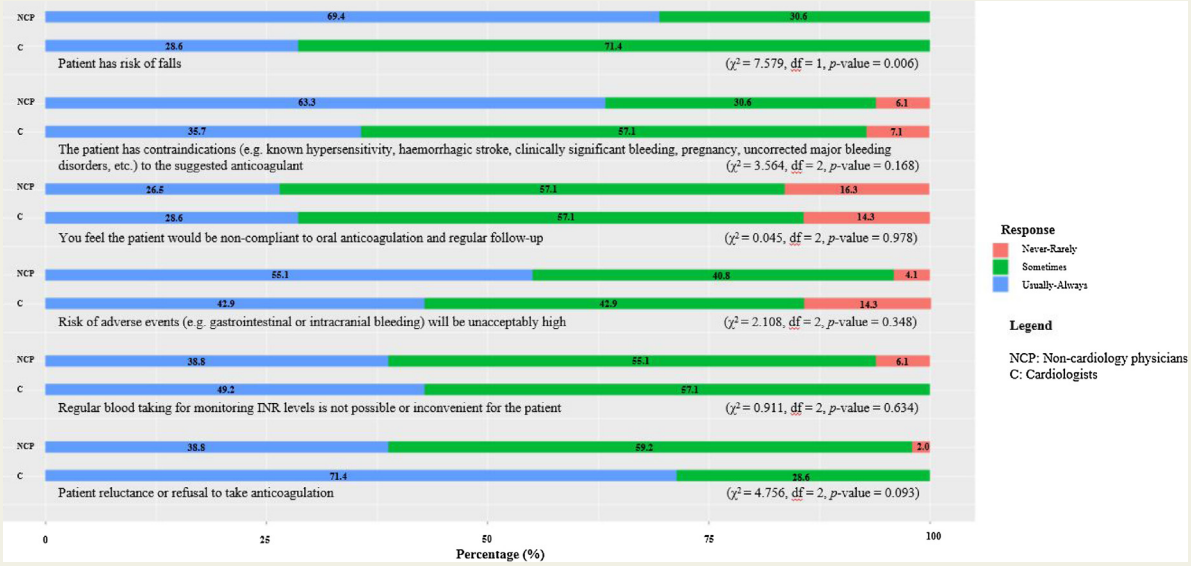

Figure 1 Strategies to optimise AF management (n = 63).

assessment of stroke in AF patients. Most of them (75–100%) were aware of the necessary risk assessment when reviewing a patient newly diagnosed with AF. Furthermore, nearly all of them (98–100%) were also able to give an accurate assessment of stroke risk in the given case scenarios. Despite this, the non-cardiologist physicians were less likely than the cardiologists to prescribe OACs for AF patients at risk of stroke. This highlights that, while knowledge about stroke prevention in AF patients is widely known, there remain barriers to translating this into actual practice among some physicians.

The optimisation of AF management necessitates the physicians' awareness of, and adherence to, treatment guidelines. As previously mentioned, there is growing evidence that AF patients benefit from OACs even when only one stroke-risk factor is present (i.e. CHA_2DS_2-VASc score 2 in females, CHA_2DS_2-VASc score 1 in males) [6,8,10]. Against this background, the patient in Case 1 with a CHA_2DS_2-VASc score of 1 would benefit from OACs. However, only 36% of cardiologists and 14% of non-cardiologist physicians opined that the benefits of warfarin would outweigh its risks (Table 3). Similarly, when asked to report their likelihood of prescribing either VKAs or NOACs for a patient with CHA_2DS_2-VASc score of 1, 27% of the physicians (7% cardiologists and 33% non-cardiologist physicians) were unlikely to do so (Table 4). The patient in Case 2 with a CHA_2DS_2-VASc score of 5 would evidently benefit from oral anticoagulation. Yet, 25% of the physicians (14% cardiologists and 29% non-cardiologist physicians) opined that the benefits of warfarin would not outweigh its risks. Collectively, these findings demonstrate the possibility that the physicians were aware of the recommended guidelines but were uncomfortable with making

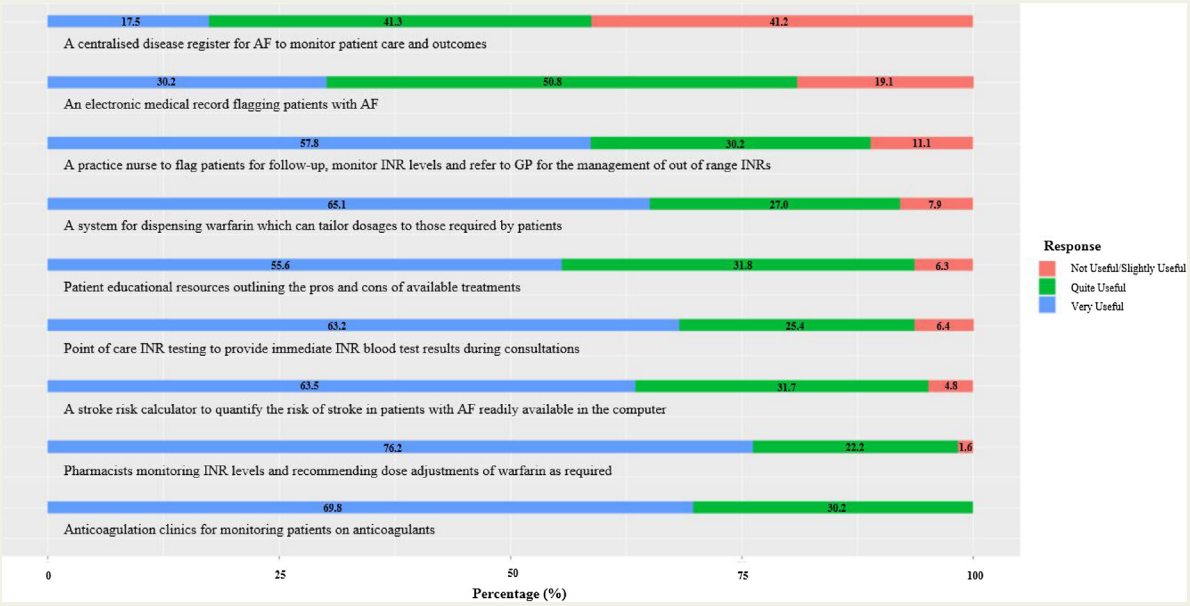

Figure 2 Barriers to prescribing anticoagulation (n = 63).

decisions which carried risks and so returned to their accustomed practices which were usually guided by their own clinical experience [24,29].

Novel anticoagulants (i.e. dabigatran, rivaroxaban, apixaban, and edoxaban) are now the favoured options for anticoagulating AF patients in most international guidelines as they have fewer drug-drug and drug-food interactions than VKA (i.e. warfarin) [7,30]. NOACs are known for their predictable pharmacokinetics which allows for fixed dosing, thereby not requiring regular monitoring of the patient's anticoagulation status [31]. In addition, NOACs are associated with lower risks of bleeding [15]. Especially in Asians with AF, NOACs have been recommended to be the anticoagulant of choice for stroke prevention [14]. Understandably, the cardiologists in this study were observed to be more informed about the benefits of NOACs than their non-cardiologist counterparts, and so were significantly more likely to choose NOACs over warfarin ($\chi^2 = 7.933$, $p < 0.05$). Anxiety often accompanies the lack of knowledge, when a novel alternative is considered [32]. This may explain the consequent reluctance amongst the non-cardiologist physicians in favouring NOACs over warfarin.

When considering barriers to prescribing OACs for AF patients with stroke risk, compared to the non-cardiologist physicians, the cardiologists appeared less conservative and more confident. The risk of falls in the patient would not be a definitive reason to deter cardiologists from prescribing OACs. Instead, the patient's reluctance or refusal to take OACs is the most definitive reason that deters cardiologists from prescribing OACs. This was congruous to previous studies reporting the cardiologists' perception towards OAC prescription and patient's compliance with anticoagulation treatment [33,34]. It could possibly be because cardiologists were more aware of the available treatments and measures to anticoagulate patients with the risk of falls. Additionally, cardiologists might be better at assessing and minimising the risk of bleeding associated with anticoagulation.

The physicians' three most common barriers to prescribing OACs (fall risk, contraindications to OAC, and risk of adverse events) were consistent with the study [24] from which the survey instrument was adapted. These barriers were congruent with the manner in which they rated the usefulness of the proposed strategies to optimise AF management. They felt that the two most useful strategies were having anticoagulant clinics for monitoring patients on OACs (100%), and pharmacists to monitor patients' anticoagulation status and recommend OACs' dose adjustments (98%). The adverse risks associated with OACs can be prevented with careful and timely monitoring of the patient's anticoagulation status, and collaborating with pharmacists who have the best expertise in drug dosing [35]. In fact, the 2016 ESC guidelines recommend and support multidisciplinary collaboration in the care of AF patients, which is part of the integrated management of AF care [6].

The integrated management of AF, based on the Chronic Care Model [36], is patient-centric. The integrated management of care amalgamates important elements of patient care and promotes multidisciplinary collaboration [37]. Through a multidisciplinary collaborative approach to care, an efficient skill mix of physicians, nurses, pharmacists, and other allied health professionals will be involved in the care of the patients with AF. There is strong evidence present to establish the positive impact of the integrated management of care. In the AF population, such a model of care was found to reduce mortality and hospital readmission, and improve quality of life, AF knowledge and cost-effectiveness [38–42].

A unique component of the integrated management of AF care is the use of technological tools to provide clinical decision support, and it was demonstrated to improve health care providers' adherence to recommended AF management guidelines [43]. With the clear treatment protocol incorporated into the decision support tool, physicians might feel more inclined to adhere to the recommended guidelines and prescribe OACs when indicated. It is, hence, reasonable to hypothesise that by undertaking the integrated management of AF, the physicians' likelihood of prescribing OACs for AF patients with higher risks of experiencing OAC adverse effects will increase. Besides, such a model of care promotes empowerment for patient self-management, thereby, optimising AF management [6].

This study is not without limitations. Firstly, a wide margin of error (10%) was used in the sample-size calculation, implying a 10% likelihood that the results from this study would differ from the actual physician population [28]. Nonetheless, the median level of agreement in the likelihood of performing tasks related to stroke assessment was 96.1%, a finding that is much higher than the previously projected value (70%) based on the literature [24]. Hence, the margin of error would have been less than the projected 10% in this study. Secondly, the physicians' real-life clinical decisions may not be accurately reflected through their response to the hypothetical patients in the case scenarios. The factors considered during their clinical decision could not be examined comprehensively in this study. Thirdly, the apparent skewness of the breakdown between cardiologists (n = 14) and non-cardiologists (n = 49) which may have introduced sampling error, reducing the generalisability of the study's results. Finally, considering that a survey design was used, there are possibly other hitherto unidentified barriers and facilitators to the optimisation of AF management.

Conclusion

While knowledge about stroke prevention in AF patients is well-understood amongst physicians in Singapore, existing barriers to anticoagulation may impede the translation of knowledge into practice in the management of AF patients. The implementation of collaboration with pharmacists and of closer monitoring of AF patients on anticoagulation through an integrated management approach can plausibly bridge the knowledge to practice gap, and improve physicians' adherence to stroke preventive measures.

Funding

None.

Conflict of Interest

There were no conflicts of interests for any of the authors.

Acknowledgements

We would like to thank Adj Asst Prof Jack Tan, President of the Singapore Cardiac Society (SCS), for granting us access to recruit the physicians in the SCS. We would also like to thank Dr. Melina Gattellari and team for granting us permission to modify and use their survey tool for the purpose of this study.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.hlc.2018.02.024.

References

[1] Srivastava A, Hudson M, Hamoud I, Cavalcante J, Pai C, Kaatz S. Examining warfarin underutilization rates in patients with atrial fibrillation: detailed chart review essential to capture contraindications to warfarin therapy. Thromb J 2008;6(1):1–6.
[2] Eagle KA, Cannom DS, Garcia DA. Management of atrial fibrillation: translating clinical trial data into clinical practice. Am J Med 2011;124(1):4–14.
[3] Chien KL, Su TC, Hsu HC, Chang WT, Chen PC, Chen MF, et al. Atrial fibrillation prevalence, incidence and risk of stroke and all-cause death among. Chin Int J Cardiol 2010;139(2):173–80.
[4] Ryder KM, Benjamin EJ. Epidemiology and significance of atrial fibrillation. Am J Cardiol 1999;84(9a):131–8.
[5] Tomita H, Hagii J, Metoki N, Saito S, Shiroto H, Hitomi H, et al. Impact of sex difference on severity and functional outcome in patients with cardioembolic stroke. J Stroke Cerebrovasc Dis 2015;24(11):2613–8.
[6] Kirchhof P, Benussi S, Kotecha D, Ahlsson A, Atar D, Casadei B, et al. 2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS. Europace 2016;18(11):1609–78.
[7] Chiang CE, Okumura K, Zhang S, Chao TF, Siu CW, Lim TW, et al. 2017 consensus of the Asia Pacific Heart Rhythm Society on stroke prevention in atrial fibrillation. J Arrhythm 2017;33(4):345–67.
[8] Lip GY, Skjøth F, Rasmussen LH, Larsen TB. Oral anticoagulation, aspirin, or no therapy in patients with nonvalvular AF with 0 or 1 stroke risk factor based on the CHA2DS2-VASc score. J Am Coll Cardiol 2015;65(14):1385–94.
[9] Fauchier L, Lecoq C, Clementy N, Bernard A, Angoulvant D, Ivanes F, et al. Oral anticoagulation and the risk of stroke or death in patients with atrial fibrillation and one additional stroke risk factor: the Loire Valley Atrial Fibrillation Project. Chest 2018;149(4):960–8.
[10] Chao TF, Liu CJ, Wang KL, Lin YJ, Chang SL, Lo LW, et al. Should atrial fibrillation patients with 1 additional risk factor of the CHA2DS2-VASc score (beyond sex) receive oral anticoagulation? J Am Coll Cardiol 2015;65(7):635–42.
[11] Joundi RA, Cipriano LE, Sposato LA, G. Saposnik and Stroke Outcomes Research Working Group, Ischemic stroke risk in patients with atrial fibrillation and CHA2DS2-VASc score of 1: systematic review and meta-analysis. Stroke 2016;47(5):1364–7.
[12] National Clinical Guideline Centre (UK). Atrial fibrillation: the management of atrial fibrillation National Clinical Guideline Centre. National Institute for Health and Clinical Excellence: Guidance. London: National Institute for Health and Care Excellence (UK); 2014.
[13] Hart RG, Benavente O, McBride R, Pearce LA. Antithrombotic therapy to prevent stroke in patients with atrial fibrillation: a meta-analysis. Ann Intern Med 1999;131:492–501.
[14] Lip GY, Wang KL, Chiang CE. Non-vitamin K antagonist oral anticoagulants (NOACs) for stroke prevention in Asian patients with atrial fibrillation: time for a reappraisal. Int J Cardiol 2015;180:246–54.
[15] Xiong Q, Lau YC, Senoo K, Lane DA, Hong K, Lip GY. Non-vitamin K antagonist oral anticoagulants (NOACs) in patients with concomitant

atrial fibrillation and heart failure: a systemic review and meta-analysis of randomized trials. Eur J Heart Fail 2015;17(11):1192–200.
[16] Connolly SJ, Ezekowitz MD, Yusuf S, Eikelboom J, Oldgren J, Parekh A, et al. Dabigatran versus warfarin in patients with atrial fibrillation. N Engl J Med 2009;361(12):1139–51.
[17] Patel MR, Mahaffey KW, Garg J, Pan G, Singer DE, Hacke W, et al. Rivaroxaban versus warfarin in nonvalvular atrial fibrillation. N Engl J Med 2011;365(10):883–91.
[18] Camm AJ. The RE-LY study: Randomized Evaluation of Long-term anticoagulant therapY: dabigatran vs. warfarin. Euro Heart J 2009;30 (21):2554–5.
[19] Ogilvie IM, Newton N, Welner SA, Cowell W, Lip GY. Underuse of oral anticoagulants in atrial fibrillation: a systematic review. Am J Med 2010;123(7):638–45.
[20] Murray S, Lazure P, Pullen C, Maltais P, Dorian P. Atrial fibrillation care: challenges in clinical practice and educational needs assessment. Can J Cardiol 2011;27(1):98–104.
[21] Singapore Department of Statistics Population trends; 2016, Available from: http://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/population_and_population_structure/population2016.pdf.
[22] Ministry of Health Health manpower; 2016, Available from: https://www.moh.gov.sg/content/moh_web/home/statistics/Health_Facts_Singapore/Health_Manpower.html.
[23] The Singapore Cardiac Society; 2017, Available from: http://www.singaporecardiac.org/index.php.
[24] Gattellari M, Worthington JM, Zwar NA, Middleton S. The management of non-valvular atrial fibrillation (NVAF) in Australian general practice: bridging the evidence-practice gap. A national, representative postal survey. BMC Fam Pract 2008;9(62). Available from: https://bmcfampract.biomedcentral.com/articles/10.1186/1471-2296-9-62.
[25] Albers GW, Dalen JE, Laupacis A, Manning WJ, Petersen P, Singer DE. Antithrombotic therapy in atrial fibrillation. Chest 2001;119(1 Suppl):194s–206s.
[26] Gage BF, Waterman AD, Shannon W, Boechler M, Rich MW, Radford MJ. Validation of clinical classification schemes for predicting stroke: results from the National Registry of Atrial Fibrillation. JAMA 2001;285 (22):2864–70.
[27] Lynn MR. Determination and quantification of content validity. Nurs Res 1986;35(6):382–6.
[28] Scheaffer RL. Elementary survey sampling, 7th, Intl ed. Pacific Grove, Califonia: Brooks/Cole Cengage Learning; 2012.
[29] Arendts G, Krishnaraj M, Paull G, Rees D. Management of atrial fibrillation in the acute setting: findings from an Australasian survey. Heart Lung Circ 2010;19(7):423–7.
[30] Chiang CE, Wu TJ, Ueng KC, Chao TF, Chang KC, Wang CC, et al. 2016 Guidelines of the Taiwan Heart Rhythm Society and the Taiwan Society of Cardiology for the management of atrial fibrillation. J Formos Med Assoc 2016;115(11):893–952.
[31] De Caterina R, Husted S, Wallentin L, Andreotti F, Arnesen H, Bachmann F, et al. New oral anticoagulants in atrial fibrillation and acute coronary syndromes: ESC Working Group on Thrombosis-Task Force on Anticoagulants in Heart Disease position paper. J Am Coll Cardiol 2012;59(16):1413–25.
[32] Kirley K, Rao G, Bauer V, Masi DC. The role of NOACs in atrial fibrillation management: a qualitative study. J Atr Fibrillation 2016;9 (1):1416.
[33] Lip GY, Zarifis J, Watson RD, Beevers DG. Physician variation in the management of patients with atrial fibrillation. Heart 1996;75 (2):200–5.
[34] Bush D, Tayback M. Anticoagulation for nonvalvular atrial fibrillation: effects of type of practice on physicians' self-reported behavior. Am J Med 1998;104(2):148–51.
[35] Barnes GD, Nallamothu BK, Sales AE, Froehlich JB. Reimagining anticoagulation clinics in the era of direct oral anticoagulants. Circ Cardiovasc Qual Outcomes 2016;9(2):182–5.
[36] Wagner EH. Chronic disease management: what will it take to improve care for chronic illness? Eff Clin Pract 1998;1(1):2–4.
[37] Hendriks JML, Crijns HJGM, Vrijhoef HJM. Integrated chronic care management for patients with atrial fibrillation: a rationale for redesigning atrial fibrillation care. J Atr Fibrillation 2015;7(5):45–50.
[38] Hendriks J, Tomini F, van Asselt T, Crijns H, Vrijhoef H. Cost-effectiveness of a specialized atrial fibrillation clinic vs. usual care in patients with atrial fibrillation. Europace 2013;15(18):1128–35.
[39] Carter L, Gardner M, Magee K, Fearon A, Morgulis I, Doucette S, et al. An integrated management approach to atrial fibrillation. J Am Heart Assoc 2016;5(1):1–10.
[40] Hendriks JM, de Wit R, Crijns HJ, Vrijhoef HJ, Prins MH, Pisters R, et al. Nurse-led care vs. usual care for patients with atrial fibrillation: results of a randomized trial of integrated chronic care vs. routine clinical care in ambulatory patients with atrial fibrillation. Eur Heart J 2012;33 (21):2692–9.
[41] Stewart S, Ball J, Horowitz JD, Marwick TH, Mahadevan G, Wong C, et al. Standard versus atrial fibrillation-specific management strategy (SAFETY) to reduce recurrent admission and prolong survival: pragmatic, multicentre, randomised controlled trial. Lancet 2015;385 (9970):775–84.
[42] Hendriks JM, Vrijhoef HJ, Crijns HJ, Brunner-La Rocca HP. The effect of a nurse-led integrated chronic care approach on quality of life in patients with atrial fibrillation. Europace 2014;16(4):491–9.
[43] Hendriks JM, Nieuwlaat R, Vrijhoef HJ, de Wit R, Crijns HJ, Tieleman RG. Improving guideline adherence in the treatment of atrial fibrillation by implementing an integrated chronic care program. Neth Heart J 2010;18(10):471–7.