


Impact of a Computerized Antithrombotic Risk Assessment Tool on the Prescription of Thromboprophylaxis in Atrial Fibrillation: Hospital Setting

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Abstract

The computerized antithrombotic risk assessment tool (CARAT) is an online decision-support algorithm that facilitates a systematic review of a patient's stroke risk, bleeding risk, and pertinent medication safety considerations, to generate an individualized treatment recommendation. The CARAT was prospectively applied across 2 hospitals in the greater Sydney area. Its impact on antithrombotics utilization for thromboprophylaxis in patients with nonvalvular atrial fibrillation was evaluated. Factors influencing prescribers' treatment selection were identified. The CARAT recommended a change in baseline therapy for 51.8% of patients. Among anticoagulant-eligible patients (ie, where the risk of stroke outweighed the risk of bleeding) using "nil therapy" or antiplatelet therapy at baseline, the CARAT recommended an upgrade to warfarin in 60 (30.8%) patients. For those in whom the bleeding risk outweighed the stroke risk, the CARAT recommended a downgrade from warfarin to safer alternatives (eg, aspirin) in 37 (19%) patients. Among the "most eligible" (ie, high stroke risk, low bleeding risk, no contraindications; $n = 75$), the CARAT recommended warfarin for all cases. Discharge therapy observed a marginal increase in anticoagulation prescription in eligible patients ($n = 116$; 57.8% vs 64.7%, $P = .35$) compared to baseline. Predictors of warfarin use (vs antiplatelets) included congestive cardiac failure, diabetes mellitus, and polypharmacy. The CARAT was able to optimize the selection of therapy, increasing anticoagulant use among eligible patients. With the increasing complexity of decision-making, such tools may be useful adjuncts in therapy selection in atrial fibrillation. Future studies should explore the utility of such tools in selecting therapies from within an expanded treatment armamentarium comprising the non-vitamin K antagonist oral anticoagulants.

Keywords

atrial fibrillation, antithrombotic therapy, thromboprophylaxis, anticoagulants, stroke, warfarin

Introduction

Decision-making around the selection of antithrombotic therapies for stroke prevention in patients with atrial fibrillation (AF) is relatively complex, underpinning the suboptimal use of anticoagulants (particularly warfarin) in the target elderly population.¹⁻⁶ Prescribers are understandably concerned about the potential for bleeding, especially in older patients,^{7,8} given that multiple comorbidities, polypharmacy, frailty, risk of falls, and cognitive impairment may all contribute to adverse drug events.^{9,10} Therefore, the assessment of the risk versus benefit of therapy is not straightforward^{11,12} and has more recently been further challenged by the availability of additional treatment options (ie, non-vitamin K antagonist oral anticoagulants—NOACs), none of which are risk free.

There is a need to support clinicians in their decision-making to help canvas the range of treatment options and to

ensure a robust assessment of the risk versus benefit of therapy in an individual patient. Decision-support tools represent one such strategy, and the computerized antithrombotic risk assessment tool (CARAT) is one example.¹³ Derived from

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hospital-based risk assessment algorithms,¹⁴ the CARAT facilitates a systematic review of the patient's stroke and bleeding risk factors, as well as pertinent medication safety considerations, and subsequently generates a treatment recommendation. As a prototype, the tool has received positive feedback from clinicians regarding its applicability in practice, particularly in helping to differentiate among treatment options while also emphasizing the need to consider anticoagulant therapy as first-line treatment.^{13,15} At the time of this study, the NOACs were not widely available, and as such the tested version of this tool considered warfarin as the first-line treatment option, and indeed—to a large extent—this still reflects current practice in Australia; following the recent introduction of the new agents, the practice is largely to continue existing patients on warfarin and consider the introduction of NOACs in newly diagnosed patients.¹⁶ However, this will likely change over time, adding to the complexity of treatment selection.

In view of the need to support decision-making in practice, the aim of this study was to evaluate the impact of the CARAT on the utilization of antithrombotic therapy in patients with AF. Specifically, the objectives were to determine the proportion of patients prescribed antithrombotic therapy at baseline (pre-CARAT) and at discharge (post-CARAT), compare the treatment recommendations generated by CARAT with the antithrombotic therapies actually prescribed by clinicians (post-CARAT), and identify the factors influencing prescribers' choice of therapy.

Patients and Method

Study Design

A prospective cohort study was conducted across 2 hospitals in the wider Sydney area (1 large metropolitan hospital and 1 regional hospital in New South Wales, Australia), over a period of 12 months, prior to the listing of the first NOAC in pharmaceutical benefits scheme (PBS; between 2011 and 2013) for thromboprophylaxis in AF.¹⁷ Essentially, the treatment regimens of hospital inpatients were reviewed before applying the CARAT to generate patient-specific treatment recommendations; the recommendations were presented to the treating clinicians for consideration during their decision-making. The review of therapy, application of CARAT, and liaison with clinicians was undertaken by a designated project pharmacist at each hospital. The final antithrombotic treatment decisions (at discharge) were recorded to identify any changes in therapy. Approval for the conduct of the study was obtained from the respective institutions' human research and ethics committees.

Patient Recruitment

Patients with AF were identified through screening of admissions to the target hospital wards (ie, cardiology, aged care, and stroke units). Patients were recruited if they fulfilled the following criteria: diagnosed with nonvalvular AF (new-onset or pre-existing), aged ≥ 18 years, able to communicate in English

(or had a carer who was able to do so on their behalf), and able to provide written consent to participate in the study.

Baseline Data Collection (Pre-CARAT)

A purpose-designed data collection form was used to extract relevant patient information to populate the CARAT tool, including the patient's medical history, stroke and bleeding risk factors, medication regimen including antithrombotic therapy, functional and/or cognitive impairments, medication management issues, and current social situation (Table 1). These data were extracted from the medical notes and medication charts; where specific information or further clarification was needed, the patient/carers was interviewed at the bedside. All collected data were used to populate the CARAT tool to generate an individualized treatment recommendation. The baseline antithrombotic therapy was also documented at this stage.

Application of CARAT (Intervention Phase)

The CARAT is a custom-designed online decision-support tool^{13,14} that recommends antithrombotic therapy based on patients' estimated risk (bleeding) versus benefit (stroke prevention) assessment, potential contraindications (medication safety issues), and evidence-based guidelines.¹⁸⁻²¹ At the first level, the stroke risk assessment is based on the validated CHADS₂ score¹⁸ and CHA₂DS₂-VASc score,¹⁹ and the bleeding risk is estimated using the HEMORR₂HAGES score²¹ and HAS-BLED score²⁰; both stratification schemes categorize patients as being at low, intermediate, or high risk.

The patients' level of risk (for both stroke and bleeding) was ascertained by calculating the number of points accrued using the available risk assessment tools as follows:

- CHADS₂ stroke risk: 0 point = low risk, 1 point = intermediate risk, and ≥ 2 points = high risk¹⁸
- CHA₂DS₂-VASc stroke risk: 0 point = low risk, 1 point = intermediate risk, and ≥ 2 points = high risk²²
- HAS-BLED bleeding risk: 0 = Low risk; 1-2 = Intermediate risk; and ≥ 3 = High risk²⁰
- HEMORR₂HAGES bleeding risk: 0 to 1 = low risk, 2 to 3 = intermediate risk, and ≥ 4 = high risk²¹

Both sets of scoring tools were applied to all patients; where a discrepancy between the scores was observed, the highest level of risk was recorded for that patient regardless of the tool used (using the most conservative approach). Patients were considered eligible for anticoagulation if their stroke risk was equal to, or more than, the bleeding risk. Likewise, if the risk of bleeding was higher than the risk of stroke, the patients were considered to be ineligible for oral anticoagulants by the tool; alternative therapies (ie, antiplatelets) or specialist review was recommended instead. Patients who were at intermediate or high risk of stroke and at low risk of bleeding were determined by the CARAT to be eligible for anticoagulation with warfarin therapy. At the

Table 1. Patient Characteristics and Clinical History.^{a,b}

Characteristics (N = 195)	Number of Patients (% of Total Patients)
Age (≥ 75 years)	133 (62.8)
Gender (N = 195)	
Male	94 (46.6)
Female	101 (51.8)
Type of AF (N = 195)	
New onset	24 (12.3)
Paroxysmal	48 (24.6)
Persistent	82 (42.1)
Not known	41 (21)
Clinical history (N = 195)	
Congestive cardiac failure	68 (34.9)
Diabetes mellitus	32 (16.4)
Hypertension	140 (71.8)
Uncontrolled hypertension	23 (11.8)
History of stroke	39 (20)
History of transient ischemic attack	27 (13.8)
History of bleeding	29 (14.9)
Malignancy	40 (20.5)
Hepatic–renal disease	24 (12.3)
Alcohol abuse	7 (3.6)
Low platelet count	14 (7.2)
Anemia	35 (17.9)
Dementia	17 (8.7)
Excessive fall risk	71 (36.4)
Using polypharmacy (>4 medications)	160 (82.1)
Using medications with major drug interactions with warfarin	8 (4.1)
Allergic to warfarin	7 (3.6)
Allergic to warfarin and aspirin	1 (0.5)
Allergic to aspirin	8 (4.1)
Allergic to aspirin and clopidogrel	1 (0.5)
Estimated stroke risk ^c (N = 195)	
High	148 (75.9)
Intermediate	39 (20)
Low	8 (4.1)
Estimated bleeding risk ^c (N = 195)	
High	11 (5.6)
Intermediate	56 (28.7)
Low	128 (65.6)

Abbreviations: AF, atrial fibrillation; CARAT, computerized antithrombotic risk assessment tool; SBP, systolic blood pressure.

^aThese data were used to populate the CARAT tool.

^bUncontrolled hypertension defined as systolic blood pressure (SBP) >160 mm Hg.²³

^cStroke risk based on CHADS₂ score and bleeding risk based on HEMORR₂HAGES score.

second level of assessment, the CARAT considered any medication safety issues that may act as contraindications to the use of therapy; these included medical, functional, cognitive, social, and iatrogenic factors such as drug allergies, clinically significant (major) drug interactions, medication nonadherence, and medication management support difficulties.¹⁴ When these factors were present and were considered to be nonmodifiable, they were regarded as contraindications to therapy. Patients who were deemed to be most eligible for anticoagulant therapy were those assessed to have a high

stroke risk, low bleeding risk, and without any contraindications to therapy. Once the tool was populated with the patient's data, the risks were assessed and then a treatment recommendation (for warfarin, aspirin, other, or nil therapy) was generated. The CARAT recommends nil therapy only in 2 particular scenarios: (1) when patients are assessed to have low risk of stroke with a high risk of bleeding or (2) when both anticoagulant therapy and antiplatelet therapy are contraindicated (most likely due to a specific history of bleeding events).

In this study, utilizing the patient data extracted at baseline, the project pharmacist populated the tool to generate an individualized assessment and treatment recommendation, which was documented (printed and attached to the patient's medication chart) and presented to the treating medical team for consideration. The project pharmacist liaised directly with the medical teams (eg, on the ward, during rounds, or case conferences) to ascertain their final treatment decisions and the reasons for their choice. The antithrombotic therapy prescribed to each patient on discharge was subsequently recorded, noting any changes (compared to baseline).

Patient Follow-Up

Patients, who consented to follow-up, were contacted by the project pharmacist approximately 12 months after discharge from the hospital. In a brief telephone interview, guided by a semi-structured questionnaire (open- and closed-ended questions), the project pharmacist confirmed the patient's antithrombotic therapy post-discharge to identify any subsequent changes to treatment.

Data Analysis

The Statistical Package for the Social Sciences (SPSS 21.0) software was used for data analysis. Descriptive statistics were used to characterize the patients and to describe the utilization of therapy. The χ^2 test was applied to determine the relationship between categorical variables. Cohen κ was applied to calculate inter-rater agreement between clinicians' choice and CARAT recommendation. Multivariate logistic regression (Forward Wald) identified factors affecting prescribers' preferences for antithrombotic therapy. *P* values of $\leq .05$ were considered statistically significant in all analyses.

Results

Of the 205 patients who participated in the study, 10 were excluded from the analysis due to incomplete data. On average, the remaining 195 (51.8% females) patients had 2.97 ± 1.56 coexisting chronic conditions. Eight patients were on medications that reportedly had minor–moderate interactions with warfarin (paracetamol, prednisolone, amiodarone; Table 1).

Table 2. Indications for the Use of Combination Antithrombotic Therapy.

Combination Antithrombotic Therapy Prescribed at Discharge (N = 195)	Indication/s Cited in the Patients' Medical Notes	Number of Patients (%)
Aspirin + clopidogrel	Post-CABG, coronary artery stent, ischemic heart disease	6 (3)
Aspirin + dipyridamole	Transient ischemic attack	4 (2)
Warfarin + clopidogrel	Post-CABG, coronary artery stent	2 (1)
Warfarin + aspirin	Post-CABG	4 (2)
Warfarin + dipyridamole	Not specified	1 (1)
Aspirin + enoxaparin	Bridging therapy	1 (1)

Abbreviation: CABG, coronary artery bypass graft.

Baseline Utilization of Therapy

Overall, 87.7% of patients were using some type of antithrombotic therapy at baseline (pre-CARAT application). Warfarin was the most frequently prescribed therapy in 53.3% of patients (44.1% on warfarin alone and the remaining 9.2% using combination therapy involving an antiplatelet agent; Tables 2 and 3). Among patients eligible for warfarin (ie, risk of stroke outweighed bleeding risk; $n = 116$), an anticoagulant was used only in 57.8% of patients. At baseline, patients with a low risk of stroke ($n = 8$) were more frequently prescribed nil therapy compared to patients with a high risk of stroke ($n = 146$, 25.0% vs 10.9%, $P < .01$; Table 3).

Among the 75 (38.4%) patients deemed to be most eligible for anticoagulant therapy (ie, high risk of stroke, low bleeding risk, no contraindications to therapy), only two-thirds (66.6%) of patients received warfarin, while the remaining 33.3% were not anticoagulated (22.7% of these patients were on aspirin and the remaining 10.7% were on nil therapy; Table 3).

Computerized Antithrombotic Risk Assessment Tool Recommended Therapy

The CARAT recommended antithrombotic therapy in all 195 patients, with warfarin the most commonly recommended option (59.4% patients); no patient was recommended nil therapy (Table 3). In only 5 cases did the CARAT recommend "other therapy" (ie, clopidogrel) because 4 patients were allergic to aspirin and 1 patient was allergic to both warfarin and aspirin. Among those deemed to be most eligible for warfarin therapy ($n = 75$), the CARAT expectedly recommended warfarin in all patients (Table 3).

Baseline Versus CARAT Recommended Therapy

The CARAT recommended a change in baseline therapy for 101 (51.8%) patients, with 60 (30.8%) considered upgrades in therapy (ie, change to a more effective therapy; Table 4). Among these upgrades, 49 patients were deemed to be at high

risk of stroke and were recommended an upgrade to warfarin. In contrast, 37 (19%) patients were recommended "downgrades" because their risk of bleeding outweighed their stroke risk. The net effect of the upgrades and downgrades in therapy was an overall increase (from baseline) in the potential use of any antithrombotic therapy (87.7% vs 100%, $P < .01$) and in the potential use of warfarin therapy specifically (53.3% vs 59.4%, $P = .02$; Table 3). Among those patients with a low risk of bleeding ($n = 118$), the net effect of CARAT recommendations was also a significant increase in the potential use of antithrombotic therapy (88.1% vs 100%, $P < .01$; Table 3). Among those assessed as being most eligible for anticoagulation ($n = 75$), CARAT recommended an upgrade to therapy in all cases with an overall increase (from baseline) in the potential use of any antithrombotic therapy (89.3% vs 100%, $P = .01$), as well as an increase in the use of warfarin (66.6% vs 100%, $P < .01$).

Discharge Therapy (Post-CARAT)

At discharge, there was an overall increase in the prescription (actual use) of antithrombotic therapy, compared to baseline (87.7% vs 93.8%, $P = .05$). The proportion of patients prescribed CARAT-recommended therapy increased significantly compared to that at baseline (48.2% vs 57.9%, $P < .01$). Among the patients deemed to be eligible for anticoagulant therapy (ie, in whom the risk of stroke was outweighed by the risk of bleeding) as per CARAT ($n = 116$), there was a slight increase in anticoagulant therapy prescription during discharge, compared to that observed at baseline (57.8% vs 64.7%, $P = .35$).

Among those deemed to be most eligible for anticoagulation ($n = 75$), there was a marginal (nonsignificant) increase in the actual use of warfarin (73.3% at discharge vs 66.6% at baseline, $P = .47$) (Table 3). More than one-quarter (26.7%) of the most eligible patients were not prescribed anticoagulant therapy at discharge: 20% of these patients were discharged on aspirin, while the remaining 6.7% were discharged on nil therapy (Table 3).

Factors Influencing Selection of Antithrombotic Therapy

Following multivariate analysis (logistic regression, stepwise Forward Wald), congestive cardiac failure (adjusted odds ratio [OR] = 3.748, 95% confidence interval [CI] = 1.79-7.84, $P < .001$), polypharmacy (≥ 4 medications) (adjusted OR = 2.433, 95% CI = 1.06-5.56, $P = .035$), and diabetes mellitus (adjusted OR = 2.812, 95% CI = 1.07-7.33, $P = .034$) were significant predictors of the likelihood of a patient receiving warfarin in preference to antiplatelet therapy at discharge (Cox and Snell $R^2 = .15$, Nagelkerke $R^2 = .10$, 67.8% correctly predicted).

Prescribers' Reasons for Therapy Selected

Among the 81 patients who were prescribed (at discharge) a therapy different to that recommended by CARAT, a specific reason was provided by the prescriber in 34 cases. In 25 of these cases, CARAT had recommended warfarin therapy;

Table 3. Distribution of Antithrombotic Therapy According to Patients' Stroke and Bleeding Risk^a.

Stage of Study	Risk (Per Scoring Tool ^b)	Warfarin (± Antiplatelet)	Aspirin (± Other Antiplatelet)	Clopidogrel	Nil Therapy	Total Number of Patients (% of Total)
Part A: Distribution of Antithrombotic Therapy According to Stroke Risk						(N = 195)
Baseline therapy	Low	2 (1)	4 (2.1)	0 (0)	2 (1)	8 (4.1)
	Intermediate	22 (11.2)	12 (6.1)	1 (0.5)	6 (3.1)	41 (21)
	High	80 (41)	42 (21.5)	8 (4.1)	16 (8.2)	146 (74.9)
	Total	104 (53.3)	58 (29.7)	9 (4.6)	24 (12.3)	195 (100)
CARAT recommendation	Low	0 (0)	8 (4.1)	0 (0)	0 (0)	8 (4.1)
	Intermediate	4 (2.1)	35 (17.9)	2 (1)	0 (0)	41 (21)
	High	112 (57.4)	32 (16.4)	2 (1)	0 (0)	146 (74.9)
	Total	116 (59.4)	75 (38.4)	4 (2)	0 (0)	195 (100)
Discharge therapy	Low	0 (0)	7 (3.6)	0 (0)	1 (0.5)	8 (4.1)
	Intermediate	21 (10.8)	18 (9.2)	1 (0.5)	1 (0.5)	41 (21)
	High	86 (44.1)	43 (22.1)	7 (3.6)	10 (5.1)	146 (74.9)
	Total	107 (54.8)	68 (34.8)	8 (4.1)	12 (6.1)	195 (100)
Part B: Distribution of Antithrombotic Therapy According to Bleeding Risk						(N = 195)
Baseline therapy	Low	71 (36.4)	29 (14.8)	4 (2.1)	14 (7.1)	118 (60.5)
	Intermediate	27 (13.8)	27 (13.8)	4 (2.1)	6 (3)	64 (32.8)
	High	6 (3)	2 (1)	1 (0.5)	4 (2.1)	13 (6.6)
	Total	104 (53.3)	58 (29.7)	9 (4.6)	24 (12.3)	195 (100)
CARAT recommendation	Low	79 (40.5)	38 (19.4)	1 (0.5)	0 (0)	118 (60.5)
	Intermediate	35 (17.9)	26 (13.3)	3 (1.5)	0 (0)	64 (32.8)
	High	2 (1)	11 (5.6)	0 (0)	0 (0)	13 (6.6)
	Total	116 (59.4)	75 (38.4)	4 (2)	0 (0)	195 (100)
Discharge therapy	Low	73 (37.4)	35 (17.9)	4 (2.1)	6 (3)	118 (60.5)
	Intermediate	28 (14.3)	29 (14.8)	3 (1.5)	4 (2.1)	64 (32.8)
	High	6 (3)	4 (2.1)	1 (0.5)	2 (1)	13 (6.6)
	Total	107 (54.8)	68 (34.8)	8 (4.1)	12 (6.1)	195 (100)
Part C: Distribution of Antithrombotic Therapy Among the Most Eligible Patients ^c						(N = 75)
Baseline therapy	The most eligible patients ^c	50 (25.6%)/(66.6%)	17 (8.7%)/(22.7%)	0 (0%)	8 (4.1%)/(10.7%)	75 (38.4%)/(100%)
CARAT recommendation		75 (38.4%)/(100%)	0 (0%)	0 (0%)	0 (0%)	75 (38.4%)/(100%)
Discharge therapy		55 (28.2%)/(73.3%)	15 (7.6%)/(20%)	0 (0%)	5 (2.5%)/(6.7%)	75 (38.4%)/(100%)

Abbreviation: CARAT, computerized antithrombotic risk assessment tool.

^aItalic values signify total number of patients which is considered as 75.

^bStroke risk based on CHADS₂ score; bleeding risk based on HEMORR₂HAGES score.

^cMost eligible candidates are defined as those at HIGH risk of bleeding, LOW risk of hemorrhage, and without any medication safety considerations (nil contraindications).

clinicians' reasons for not prescribing warfarin in 17 of these cases were perceived excessive falls risk (6 cases), dementia (4 patients), history of bleeding (4 cases), patients to be referred for palliative care (2 cases), and patient and carer reluctant to be on warfarin (1 case). In the other 8 patients, who were deemed to be the most eligible candidates for anticoagulation, the documented reasons for not prescribing warfarin therapy were patient and carer reluctant to use warfarin (5 cases) and concerns about nonadherence (3 cases).

In 6 patients, CARAT had recommended antiplatelet therapy (rather than anticoagulation) because of a high risk of bleeding. However, these patients were all prescribed warfarin at discharge, with clinicians citing the following reasons: history of previous stroke (1 patient), concomitant deep vein thrombosis (1 patient), concurrent renal embolism (1 patient), reluctance to change current therapy since 2 patients had been using warfarin for "years," and 1 patient wished to continue warfarin therapy. While for remaining 3 patients who were not

prescribed aspirin therapy as recommended by CARAT but were discharged on nil therapy instead, clinicians cited the following reasons: history of gastrointestinal bleeding (2 patients) and anemia (1 patient). Overall, the level of agreement between CARAT and clinicians' choice of therapy was relatively low ($\kappa = .193$).

Patient Follow-Up Post-discharge

Among the 56 patients who consented to, and were available for, follow-up, 36 patients were discharged on the therapy recommended by CARAT and the majority (85%) were maintained on this until the point of follow-up (32 patients on warfarin, 3 on aspirin, and 1 on clopidogrel). In another 5 patients, the therapy had changed postdischarge due to "bleeding in the brain" (1 patient on aspirin), "not happy with the therapy" (1 patient on clopidogrel), "therapy too complicated" (2 patients on warfarin who reported that the international

Table 4. Changes in Antithrombotic Therapy Pre- and Post-intervention.^a

Change in Therapy, Number of Patients (% Within Group)	Baseline (N = 101)	Discharge (N = 82)	P Value
Upgrade in therapy^b			
Nil therapy to warfarin	13 (6.6)	7 (3.5)	.02 ^b
Aspirin/clopidogrel to warfarin	36 (18.4)	34 (17.4)	
Nil to aspirin/clopidogrel	11 (5.6)	5 (2.5)	
Total	60 (30.8)	46 (23.5)	
Downgrade in therapy^c			
Warfarin to aspirin	37 (19)	32 (16.4)	.29
Total	37 (19)	32 (16.4)	
Sidestepping^d			
Aspirin to clopidogrel	2 (1)	2 (1)	.5
Clopidogrel to aspirin	2 (1)	2 (1)	
Total	4 (2)	4 (2)	

^aN = 195.^bPatients requiring a change from less effective to more effective stroke prevention therapy (eg, from nil therapy to anticoagulant or antiplatelet therapy or from antiplatelet therapy to anticoagulant therapy).^cPatients requiring change to less effective, albeit safer, therapy (eg, from anticoagulant to antiplatelet or from antiplatelet or anticoagulant to nil therapy).^dPatients requiring change within the same class of treatment (eg, changing from one anticoagulant to another anticoagulant or from one antiplatelet to another antiplatelet).

normalized ratio [INR] was often out of range, requiring frequent dose adjustments), and 1 patient experienced a transient ischemic attack requiring a change of antithrombotic therapy (the patient was on warfarin at the time of hospital discharge).

For the 28 patients discharged on a therapy not recommended by CARAT, all remained on that therapy at the time of follow-up. Of the 8 patients on warfarin, 2 patients expressed that they found INR monitoring complicated. Among the 19 patients on aspirin, 1 complained about “stomach upsets” from the therapy.

Discussion

Overall, in this study, a decision support tool (CARAT) was able to facilitate a comprehensive assessment of individual patients according to their stroke and bleeding risks, and relevant medication safety issues, to generate treatment recommendations. The net effects of this are that the overall use of antithrombotics increased. Recent studies have reported that antithrombotic therapy is not always utilized in accordance with the individualized stroke risk–benefit assessment for a patient.^{24,25} In this study, a comprehensive decision-making support tool was able to optimize the use of therapy in eligible “at-risk” patients, especially anticoagulation. International studies have shown that basing treatment selection on risk–benefit assessment and guidelines successfully increases the use of anticoagulants in at-risk patients.^{26,27} However, in our study, the tool additionally included an assessment of medication safety considerations, improving the overall utilization of antithrombotics.

However, not all patients were discharged on tool-recommended therapy, as reported in other studies.²⁶

Prescribers sometimes disagreed with CARAT due to isolated risk factors, such as perceived risk of falls, history of bleeding,²⁸ even though these were already factored into the tool’s risk–benefit assessment. This perhaps reflects clinicians’ reluctance to prescribe antithrombotics to some patients, leading them to focus on specific issues. Although the recent availability of the NOACs may help overcome certain barriers to anticoagulation, they are not without risk, such that individualized risk assessment remains an important component of decision-making. Thus, there is a need for clinicians to holistically assess individual patients when prescribing antithrombotic therapy, especially, the need to account patient preferences and likely adherence as reflected in clinicians’ feedback.

On follow-up, discharge therapy was retained in most without any major problems. Some patients, however, were challenged by the need for regular INR monitoring; in such cases, NOACs may offer advantages. Indeed, the practical difficulties of warfarin therapy (eg, time and inconvenience involved in attending the anticoagulation clinics, inconvenience when travelling, and challenges in educating patients about INR testing) contribute to patients’ dissatisfaction.²⁹ This study also identified clinicians’ perceptions about patients’ nonadherence as a deterrent to warfarin use.³⁰ However, in regard to NOACs, the absence of therapeutic monitoring to identify medication non-adherence is also of concern for clinicians.³¹ This study, akin to other studies,^{14,27} highlights the need for the patient and family involvement in shared decision-making, factoring individual perspectives that may underpin adherence to therapy.

In considering the findings of this study, the limitations must be acknowledged. First, this study was conducted in the local Australian hospital setting and the results might not be generalizable to other health settings. Second, the NOACs were not available under the PBS at the time of the study; hence, they were not considered as core treatment options in CARAT. However, the decision-making around treatment selection (warfarin vs NOACs) is still based on individualized risk versus benefit assessments involving similar risk factors, alongside relevant medication safety issues (including those specific to NOACs). Finally, only a limited number of patients gave their consent for the follow-up.

Overall, this tool has assisted prescribers in the rational selection of antithrombotic therapy in at-risk patients with AF. Anticoagulants appear to be a viable option for most patients even when the risk–benefit assessment is considered. A proportion of eligible patients are potentially undertreated, despite the risk–benefit assessment. A CARAT was able to optimize the selection of therapy in patients with AF, increasing the proportion of patients receiving an anticoagulant and reducing the proportion receiving no thromboprophylaxis at all. Given the increasing complexity of decision-making in the clinical context, such a tool may be a useful adjunct in selecting appropriate therapies for patients with AF. Although the recommendations generated by CARAT were based on validated stroke risk and bleeding risk assessment scores, as well as evidence-based clinical guidelines,¹⁸⁻²¹ future studies need to explore the utility of such a tool in selecting therapies

from within an expanded treatment armamentarium comprising the NOACs. Furthermore, future studies need to validate this tool with regard to the prediction of clinical outcomes (ie, stroke and bleeding events) to confirm the full benefits of CARAT following the optimization of stroke prevention among at-risk patients.

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Declaration of Conflicting Interests

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