Atrial fibrillation and anticoagulation in patients hospitalised for stroke in the REGIONS Care study

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ABSTRACT

AIM: To describe atrial fibrillation (AF) patient characteristics and anticoagulation patterns in stroke patients in Aotearoa.

METHODS: Reducing Ethnic and Geographic Inequities to Optimise New Zealand Stroke (REGIONS) Care study is a prospective, nationwide observational study of consecutive adult stroke patients admitted to hospital between 1 May and 31 October 2018. AF and anticoagulation prescribing, intracerebral haemorrhage (ICH) and differences by Māori ethnicity and hospital location are described.

RESULTS: Of 2,379 patients, 807 (34.3%) had a diagnosis of AF. AF patients were older than non-AF patients (mean 79.9 [SD 11] versus 72.5 [14.2], p<0.0001). AF was diagnosed before stroke in 666 patients (82.5%), of whom 442 (66.4%) were taking an anticoagulant. The most common documented reasons for non-anticoagulation were prior bleeding (20.5%), patient preference (18.1%), frailty, comorbidities/side effects (13.2%) and falls (6.8%). The ICH rate was similar for AF patients on versus not on an anticoagulant (adjusted odds ratio [aOR] 0.99, 95% confidence interval [CI] 0.55–1.80). Rates and reasons for oral anticoagulant non-prescribing were similar for Māori, non-Māori, urban and non-urban populations.

CONCLUSIONS: Although anticoagulation prescribing in AF has improved, one third of stroke patients with known AF were not taking an anticoagulant prior to admission and the majority did not appear to have an absolute contraindication offering a multidisciplinary opportunity for improvement. There were no significant differences for Māori and non-urban populations in anticoagulant prescribing.

Stroke occurs in around 9,000 people each year in Aotearoa New Zealand (Aotearoa) and is one of the most common causes of death and disability globally.[1] Atrial fibrillation (AF) increases the risk of ischemic stroke fivefold through the formation of left atrial thrombi that embolise to the brain.[2,3] Prior research has identified that Māori have greater odds of developing AF than non-Māori, with an adjusted odds ratio (aOR) of 1.91 (95% confidence interval [CI] 1.80–2.03) taking into account age, sex, socioeconomic deprivation and clinical risk factors.[4] Little is known about other differences in characteristics based on AF status in people presenting with acute stroke in Aotearoa.

Oral anticoagulants are highly effective in decreasing AF-related ischaemic stroke risk.[5] However, anticoagulants are associated with a risk of intracerebral haemorrhage (ICH) as a potentially life-threatening side effect. While this risk has reduced since the introduction of the newer direct oral anticoagulants, prescriber and patient concerns persist. This has resulted in under-prescription of anticoagulants. A United States study reported that only 20% of people known to be in AF were taking anticoagulants at the time of stroke presentation.[6] The fourth Auckland Regional Community Stroke Study (ARCOS IV) reported an anticoagulant rate of 26.5% among AF patients with stroke.[7] Another Aotearoa-based study found that among high-risk AF patients in the general population, 39.5% of people had no record of anticoagulant dispensing.[4] The primary analysis of the Reducing Ethnic and Geographic Inequities to Optimise New Zealand Stroke Care study (REGIONS Care) found a potential relationship between lower anticoagulation prescription and Māori ethnicity[8] and suboptimal access to best practice stroke care in non-urban areas in New Zealand,[9] suggesting that rural Māori may be at particularly high risk of under-treatment with anticoagulants.

In the REGIONS Care study population, we explored characteristics of patients with and without AF hospitalised for stroke, those with a pre-stroke diagnosis of AF compared to those with an AF diagnosis made at the time of stroke, AF-related anticoagulant prescribing patterns, reasons for non-prescribing and haemorrhage risk. We also

considered the potential impact of ethnicity and geography on pre-stroke prescribing and ICH risk.

Methods

REGIONS Care was a multi-part observational study designed to assess the impact of geography and ethnicity on stroke care access and outcomes. It involved nation-wide, prospectively collected patient data with a subset of patients recruited to undergo extended follow-up, linkage with health administrative data, focus groups and surveys. The full study methods have been described elsewhere,[12] and are outlined briefly below. Here, we report the results of a *post hoc* analysis focussing on AF.

Study sample

This study involved all 28 New Zealand hospitals caring for patients with acute stroke and associated rehabilitation and community services. All adult patients admitted to hospital with a discharge diagnosis of stroke (ICD codes I61, I63, I64) between 1 May and 31 July 2018 were captured. After this date, consecutive patient recruitment continued until hospitals achieved a minimum sample size of 150 (in stroke clot retrieval centres), 100 (in other stroke centres) or until 31 October 2018, whichever occurred first. We grouped patients by self-identified ethnicity, based on Statistics New Zealand coding: New Zealand European, Māori, Pacific peoples, Asian and Other.[13]

Patients aged <18 years, and those with transient ischaemic attack (TIA) or subarachnoid haemorrhage, were excluded. For each patient, only the first admission during the study period was counted as an index event with subsequent admissions considered outcome events.

Data collection

Front-line clinical teams collected data at the time of hospital admission and during 3-month follow-up encounters and entered this into a central database. A central study team collected follow-up data at 6- and 12-months via telephone interviews, supplemented by mailed questionnaires. Baseline data included patient demographics, vascular risk factors and pre-morbid level of function, among others. For those patients identified as having a pre-stroke diagnosis of AF, anticoagulant use was recorded and where none was in use the reason for this was documented where possible. Patients prescribed but not actively taking anticoagulants at the time of presentation for reasons where this was not under the direction of a health professional were classed "not on anticoagulant" due to "patient preference".

Post-admission data included in-hospital interventions and services, investigations to determine stroke aetiology and therapies up to 3 months post-admission, follow-up appointments up to 12 months and outcome variables. Outcome variables for this *post hoc* analysis included anticoagulant prescription rate and ICH.

Data analysis

All data were analysed in Stata/IC 17.0. Patient baseline characteristics were summarised using proportions for dichotomous, means and standard deviations (SD) for continuous, and medians and interquartile ranges for non-normally distributed continuous variables. The main focus of this study was a descriptive analysis of AF patients compared with non-AF patients, anticoagulation prescribing and reasons for non-prescribing across the cohort. Sub-group analyses compared Māori with non-Māori and urban to non-urban patients. Pearson's Chi-squared and logistic regression was used for dichotomous variables and t-test for continuous variables.

Study funding and ethics

The Health Research Council of New Zealand (HRC 17/037) funded the REGIONS Care study. The study received ethics approval from the Central Region Health and Disability Ethics Committee (17CEN164).

Results

2,379 patients presented with stroke and met inclusion criteria during the study period. AF, diagnosed either pre- or post-stroke, was documented in 807/2,379 (34.3%) of patients; in 627/1,937 (32.4%) patients with ischaemic stroke and 67/285 (23.5%) with ICH. The mean (SD) age of patients with AF was higher than those without AF (79.9 [11] vs 72.5 [14.2] respectively, p<0.0001).

Compared with non-AF patients, those with AF were more likely to be of New Zealand European or Māori ethnicity, to present with anterior circulation ischaemic stroke of cardioembolic source, to experience anticoagulation-related intracerebral haemorrhage (ICH) or haemorrhagic transformation of an ischaemic stroke, to have prior stroke or ischaemic heart disease, to arrive sooner in the hospital and

to present with more severe stroke symptoms. See Table 1 for additional patient characteristics.

AF had been diagnosed prior to the stroke in 666/807 (82.5%) patients, of whom 66.4% (442/666) were not taking anticoagulants at the time of stroke. Patients with known AF but not anticoagulated pre-stroke were older, were less likely to have a diagnosis of diabetes or hypertension and were less likely to be independent than those treated with an anticoagulant. Patients diagnosed with AF at the time of stroke were younger, were less likely to have a prior stroke, TIA or ischaemic heart disease and were less likely to be living in residential care than those with known AF (Table 2).

Among those with a pre-stroke diagnosis of AF, the most commonly documented reason for not taking anticoagulants was "unknown" (66/205 [32.2%]). The most commonly known reasons for not taking an anticoagulant were prior bleeding ("ICH, GI bleed or other bleed") at 20.5% (42/205), followed by "patient preference" at 18.1% (37/205), "frailty, comorbidities, or side effects" at 13.2% (27/205), and "falls" at 6.8% (14/205). Procedure-related treatment interruption and AF duration deemed too insignificant accounted for about 3% each (Table 3).

A similar proportion of patients with known AF who were not anti-coagulated experienced ICH compared to those with known AF who were anticoagulated: 8.5% (19/224) and 8.1% (36/442), respectively. Adjusting for age and pre-stroke independence the odds of an ICH remained similar for those with AF on versus not on anticoagulation (aOR 0.99 [0.55–1.80]; p=0.99). The rate of ICH in patients diagnosed with AF only after the stroke also had a similar ICH rate (8.5% [12/141]) to those diagnosed and anticoagulated before the stroke, suggesting that the similar rates are not explained by prescriber patient selection (Table 3). Of the 292 people with ICH in the overall study cohort, only 3.1% (9/292) were documented as AF patients in whom anticoagulation was deemed the primary cause for the bleed (Table 1).

Differences between Māori and non-Māori people with AF

There was a trend towards a higher rate of AF in Māori presenting with stroke compared to non-Māori people (39.2% [107/273] vs 33.7% [700/2,079], respectively, p=0.07). The mean (SD) age of Māori was 68.7 (13.2) compared with 81.1 (10.1) for non-Māori; p <0.0001. More Māori were taking anticoagulants prior to stroke, but this fell short of statistical significance (75.0% [66/88] vs 65.0% [376/578)], p=0.06; aOR [age, pre-stroke independence 0.57 [0.17–1.9]; 0.35]). There were no significant differences in reasons for anti-coagulation non-prescribing between Māori and non-Māori (Table 3). ICH rates in Māori patients with AF (either anticoagulated or not) were generally lower (4.6–5.3%) than in non-Māori (8.7–9.0%) and this trend persisted when adjusting for age and pre-stroke independence (aOR for Māori on anticoagulant 0.62 [0.17–2.3]; p=0.49 and aOR for all Māori with AF 0.49 [0.19–1.31]]; p=0.16) compared with non-Māori).

Regional variations

There were no significant differences noted in prescribing patterns between urban and non-urban patient cohorts (Table 4). There were numerical differences between individual districts, but case volumes for some regions were very small and need to be interpreted with caution. The urban/non-urban data are mainly included to aid with local service improvement efforts rather than to support an inter-district comparison (Appendix Table).

Discussion

In this Aotearoa-wide cohort, we found several important differences between patients admitted with stroke who do and do not carry a diagnosis of AF. The described characteristics may aid clinicians in their search for AF in patients admitted with stroke of unclear aetiology. In those who are older, of Māori or European decent, with anterior circulation ischaemic strokes, prior stroke, non-smokers, history of ischaemic heart diseases, and more severe strokes in whom the underlying cause is not immediately clear, pursuit of prolonged cardiac monitoring and/or cardiac imaging may be especially warranted. AF was more likely to be diagnosed after stroke in younger, independent patients without the typical risk factors of prior stroke, TIA or ischaemic heart disease, and wider electrocardiography screening may need to be explored.

In this study, 66.4% of patients admitted with stroke and a previously known diagnosis of AF had been treated with anticoagulants. Compared to international data, New Zealanders fare well and there is evidence of significant improvement in anticoagulant prescription rates compared to the 2015 ARCOS IV study, which reported a rate of 26.5%.[7] While this is reassuring, there remains

Table 1: Patient baseline characteristics by atrial fibrillation status.

	All	AF*	Non-AF*	p†
Number, n(%)	2379	807 (34.8)	1,509 (65.2)	-
Age, mean (SD)	75 (13.7)	79.9 (11)	72.5 (14.2)	<0.0001
Sex, female, n (%)	1,160 (48.8)	392 (48.6)	733 (48.6)	1.0
Ethnicity, n (%)				
European	1823 (76.6)	638 (79.2)	1,144 (75.8)	
Māori	273 (11.5)	107 (13.3)	149 (9.9)	<0.0001
Pacific	114 (4.8)	7 (5.0)	86 (5.7)	
Asian	115 (4.8)	6 (4.3)	90 (6.0)	
Other	54 (2.3)	12 (1.5)	40 (2.7)	
Primary diagnosis, n (%)				
Ischaemic stroke	1,937 (81.5)	696 (86.3)	1,191 (78.9)	
Haemorrhagic stroke	292 (12.3)	67 (8.3)	218 (14.5)	<0.0001
Stroke not specified	116 (4.9)	35 (4.3)	77 (5.1)	
Other/unknown	32 (1.4)	6 (1.1)	23 (1.5)	
Ischaemic stroke location, n (%)				
Anterior circulation	1,276 (68.8)	521(74.9)	763 (65.7)	<0.0001
Posterior circulation	459 (24.7)	144 (20.1)	311 (26.8)	
Other/unknown	120 (9.5)	31 (4.5)	88 (7.6)	
Ischaemic stroke cause, n (%)				
Cardioembolic—AF	627 (32.4)	575 (80.8)	68 (5.6)	
Cardioembolic—non-AF	277 (14.3)	2 (0.3)	27 (2.2)	
Carotid stenosis	96 (5)	11 (1.5)	68 (5.6)	
Vertebrobasilar stenosis	25 (1.3)	4 (0.6)	21 (1.7)	<0.0001
Small vessel	33 (1.7)	21 (3.0)	254 (20.8)	
Intracranial stenosis	30 (1.6)	6 (0.8)	26 (2.1)	
Dissection	9 (0.5)	1 (0.1)	8 (0.7)	
Other/unknown	838 (43.3)	92 (12.9)	732 (60.1)	
Haemorrhagic stroke location, n (%)				
Lobar	136 (49.1)	33 (54.1)	100 (47.4)	0.8
Deep	114 (14.2)	23 (37.7)	89 (42.2)	
Other/unknown	27 (9.7)	5 (8.2)	22 (10.4)	

Table 1 (continued): Patient baseline characteristics by atrial fibrillation status.

	All	AF	Non-AF	p
Haemorrhagic stroke cause, n (%)				
Hypertensive	147 (53.3)	23 (36.5)	119 (57.5)	
Anticoagulation	13 (4.7)	9 (14.3)	4 (1.9)	
Haemorrhagic transformation	36 (13)	17 (27.0)	19 (9.2)	<0.001
Amyloid Angiopathy	15 (5.4)	3 (4.8)	8 (3.7)	
Underlying SOL/AVM/aneurysm	6 (2.2)	0 (0)	6 (2.9)	
Other	10 (3.7)	10 (15.9)	40 (19.3)	
Unknown	49 (17.8)	3 (4.8)	6 (2.9)	
Risk factors, n (%)				
Prior stroke	515 (21.9)	211 (26.1)	287 (19.0)	0.0001
Prior TIA	303 (12.9)	104 (12.9)	192 (12.7)	0.89
Carotid stenosis	180 (7.8)	56 (6.9)	119 (7.9)	0.39
Hypertension	1,695 (71.7)	596 (73.9)	1,057 (70)	0.048
Diabetes	571 (24.2)	175 (21.7)	379 (25.1)	0.07
Dyslipidaemia	998 (42.6)	310 (38.4)	661 (43.8)	0.01
Atrial fibrillation	807 (34.3)	807 (100)	0 (0)	-
Smoker	287 (12.2)	52 (6.4)	227 (15)	<0.0001
Ischaemic heart disease	575 (24.5)	270 (33.5)	295 (19.5)	<0.0001
Rheumatic heart disease	40 (1.7)	23 (2.9)	17 (1.1)	0.056
Family history of stroke	161 (6.9)	41 (5.1)	116 (7.7)	0.018
Pre-stroke situation, n (%)				
Pre-stroke independent (mRS<3)	2,040 (86.7)	678 (83.8)	1,322 (87.6)	
Employed	465 (19.7)	82 (10.2)	374 (25)	0.01
Living situation	681 (28.7)	274 (34)	392 (26)	<0.0001
Home alone	1,491 (62.8)	448 (55.5)	1,003 (66.5)	<0.0001
Home with others	178 (7.5)	78 (9.7)	96 (6.4)	
Residential care	26 (1.1)	7 (0.9)	18 (1.2)	
Other				
ED arrival <4 hours n (%)	1,020 (43.8)	376 (47.5)	615 (41.6)	0.007
ED arrival <24 hours n (%)	1,784 (76.8)	626 (79.4)	1,111 (75.5)	0.03
Level of disability on arrival n (%)				
GCS verbal <5	858 (36.1)	368 (45.7)	465 (30.8)	<0.0001
Requires assistance to walk	1,332 (56.2)	508 (63.2)	787 (52.2)	<0.0001
Upper limbs MRC <3/5	871 (36.7)	342 (42.5)	506 (33.6)	<0.0001

*64 missing values for AF status.
†Compares patients with versus without AF diagnosed at any time—either pre- or post-stroke SOL = space-occupying lesion; AVM = arteriovenous malformation; for other abbreviations see Table 2.

Table 2: Patient baseline characteristics by timing of atrial fibrillation diagnosis and anticoagulant treatment.

	Known AF before stroke			**New AF diagnosis at time of stroke**	
Number, n/N (%)	**666/807 (82.5)**			**141/807 (17.5)**	
	Known AF on anticoagulant	**Known AF not on anticoagulant**	**p***		**p†**
	442/666 (66.3)	**224/666 (33.6)**			
Age, mean (SD)	79.4 (11.1)	82.6 (10.4)	<0.0001	77 (10.8)	<0.0001
Sex, male, n (%)	206 (46.6)	116 (51.8)	0.20	70 (49.7)	0.27
Urban, n (%)	191 (43.2)	87 (38.8)	0.28	51 (36.2)	0.22
Ethnicity, n (%)					
European	350 (79.2)	182 (81.3)	0.09	106 (75.2)	0.49
Māori	66 (14.9)	22 (9.8)		19 (13.5)	
Pacific	14 (3.2)	7 (3.1)		7 (5.0)	
Asian	9 (2.0)	7 (3.1)		6 (4.3)	
Other	3 (0.7)	6 (2.7)		3 (2.8)	
Primary diagnosis, n (%)					
Ischaemic stroke	373 (84.4)	199 (88.8)	0.12	124 (87.9)	0.51
Haemorrhagic stroke	36 (8.1)	19 (8.5)		12 (8.5)	
Other/unknown	33 (7.5)	6 (2.7)		5 (3.6)	
Risk factors, n (%)					
Prior stroke or TIA	179 (45.0)	88 (39.3)	0.17	28 (19.9)	<0.001
Hypertension	337 (76.2)	154 (68.8)	0.041	105 (74.5)	0.84
Diabetes	112 (25.3)	34 (15.2)	0.003	29 (20.6)	0.73
Dyslipidaemia	177 (40.0)	74 (33.0)	0.08	59 (41.8)	0.36
Current smoker	28 (6.3)	9 (4.0)	0.22	15 (10.6)	0.03
Ischaemic heart disease	170 (38.5)	70 (31.3)	0.07	30 (21.3)	<0.001
Rheumatic heart disease	18 (4.1)	3 (1.3)	0.05	2 (1.4)	0.27

Table 2 (continued): Patient baseline characteristics by timing of atrial fibrillation diagnosis and anticoagulant treatment.

Pre-stroke situation, n (%)					
Independent (mRS<3)	381 (86.2)	162 (72.3)	<0.0001	125 (88.6)	0.04
Employed	50 (11.3)	15 (6.7)	0.06	17 (12.2)	0.39
Living situation	142 (32.1)	80 (35.7)	0.09	52 (34)	0.02
Home alone	257 (58.1)	109 (48.7)		82 (58.2)	
Home with others	41 (9.2)	33 (14.7)		4 (2.8)	
Residential care	2 (0.5)	2 (0.9)		3 (2.1)	
Other					
Level of disability on arrival n (%)					
GCS verbal <5	187 (42.4)	110 (49.3)	0.34	368 (47.7)	0.55
Requires assistance to walk	274 (62.3)	142 (63.7)	0.72	92 (63.2)	0.88
Upper limbs MRC <3/5	186 (42.2)	92 (41.3)	0.82	64 (45.4)	0.42

*Compares patients diagnosed with AF pre-stroke on anticoagulant versus not on anticoagulant.
†Compares all patients diagnosed with AF pre-stroke to those newly diagnosed at time of stroke.
TIA = transient ischaemic attack; mRS = modified Rankin score (0–6); GCS = Glasgow coma scale (0–15); MRC = Medical Research Council motor strength scale (0–5).

Table 3: Oral anticoagulation in stroke patients with atrial fibrillation for all patients and for Māori and by non-urban hospitals.

	All	Māori	Non-Māori	P-value	Urban	Non-Urban	P-value
Overall AF prevalence*	807/2,352 (34.9)	107/273 (39.2)	700/2,079 (33.7)	0.07	478/1,420 (33.7)	329/932 (35.3)	0.42
Known AF on anticoagulant	442/666 (66.3)	66/88 (75.0)	376/578 (65.0)	0.06	251/388 (64.7)	191/278 (68.7)	0.28
New AF diagnosis at time of stroke (not on anticoagulant at time of stroke)	141/807 (17.5)	19/107 (17.8)	122/700 (17.4)	0.92	90/478 (18.8)	51/329 (15.5)	0.23
Known AF but not on anticoagulant	224/666 (33.6)	22/88 (25.0)	202/578 (34.9)	0.07	137/388 (35.3)	87/278 (31.3)	0.28
Reason for no anticoagulation							
Falls	14/205 (6.8)	2/20 (10)	12/185 (6.5)	0.56	9/123 (7.3)	5/82 (6.1)	0.74
ICH, GI bleed, other bleed	42/205 (20.5)	3/20 (15)	39/185 (21.1)	0.52	26/123 (21.1)	16/82 (19.5)	0.78
Frailty, comorbidities, side effects	27/205 (13.2)	1/20 (5)	26/185 (14.1)	0.25	12/123 (9.8)	15/82 (18.3)	0.79
Pre-/peri-procedure	7/205 (3.4)	1/20 (5)	6/185 (3.2)	0.67	6/123 (4.9)	1/82 (1.2)	0.15
Patient preference/non-compliant	37/205 (18.1)	5/20 (25)	32/185 (17.3)	0.40	22/123 (17.0)	15/82 (18.3)	0.81
Stopped for procedure and never restarted	7/205 (3.4)	1/20 (5)	6/185 (3.2)	0.67	3/123 (2.4)	4/82 (4.9)	0.33
AF duration felt not significant	5/205 (2.4)	0/20 (0)	5/185 (2.7)	0.46	4/123 (3.3)	1/82 (1.2)	0.34
Unknown	66/205 (32.2)	7/20 (35)	59/185 (31.9)	0.78	41/123 (33.3)	25/82 (20.5)	0.05

Data are number of patients (% of group)
*Missing values/unknown: n=63
#Missing values=19

room for improvement as several of the stated reasons for non-prescription are potentially inappropriate. While prior bleeding—the most commonly documented reason for non-prescription—may be an appropriate rationale for withholding medication, it often is appropriate to restart an anticoagulant post bleeding, and specialist determination of the risks and benefits of anticoagulation should be sought. Frailty and falls are debated contraindications for anticoagulation. Concerns around frailty are not unique, with a study from Singapore identifying "fall risk" as the most common reason (38.3%) for the non-prescription of anticoagulants.[10] However, it has been reported that a patient has to fall 295 times a year before the risks of anticoagulants outweigh their benefits.[11] Failure to reinitiate anticoagulation after a procedure is inappropriate and should be addressed. The large number of undocumented reasons for withholding anticoagulation also suggests the need for further patient education and/or practitioner prioritisation. Where there is clinician uncertainty around prescribing anticoagulants, specialist input should be available. One option is to take advantage of online tools such as the recently launched BPAC AF decision support tool.[12]

Our ethnic comparison identified that Māori compared to non-Māori AF patients with stroke are younger, a finding previously reported.[8] The reasons for this are unclear but may relate to different risk factors including diabetes, rheumatic and other heart disease, and sleep apnoea.[8,13] The lower mean age of AF diagnosis in Indigenous peoples is also a trend seen in other countries. Australian Aboriginal and Torres Strait Islander patients with diagnosed AF were younger than non-Indigenous Australians aged 54.8 vs 69.3 years.[14] There is a similar pattern among Indigenous peoples of Canada, who have a mean age of stroke of under 65 years.[15] The finding that Māori presenting with stroke had a similar rate of undiagnosed AF and a trend towards a higher rate of anticoagulation stands in contrast to prior work,[8] and suggests recent improvements in care and health equity. Of further reassurance is that we did not find a significant difference in anticoagulant prescribing rates between urban and non-urban treatment settings. However, some variation by hospital was observed and further follow-up by individual stroke services is encouraged.

One finding that is noteworthy is the 20% "patient preference" in favour of non-anticoagulation, and this reason was numerically more common among Māori patients. This is not unique to New Zealand. In a cohort from the United States, "patient/family declined" (22%)[16] anticoagulation, with similar findings in other studies.[17,18] The decision for a patient to decline anticoagulation suggests ongoing concern about side effects, including bleeding complications. Health practitioners play a very important role and if they are apprehensive or do not feel confident about risks and benefits, specialist involvement in this conversation may be beneficial.

Our finding of similar ICH rates in anticoagulated and non-anticoagulated patients, diagnosed either pre- or post-stroke, should offer reassurance to both patients and prescribers around anticoagulation safety, especially with novel direct anticoagulants that carry a substantively similar bleeding risk to antiplatelets.[19] There may be additional barriers to accepting anticoagulation treatment in disadvantaged populations who may be distrustful or apprehensive based on prior or even recent experiences with health providers. Health providers may also be ill equipped to conduct effective conversations with patients of different cultural backgrounds and unconscious bias may play a role. Extra work may be required to address this potential treatment gap.

This study has several strengths and limitations. Strengths include the overall large sample size, the nation-wide dataset with complete hospitalised case ascertainment and high data quality. Additionally, our study reports multiple factors including general anticoagulation rates, prescribing patterns and differences by ethnicity and geography. Limitations include the *post hoc* design, observational nature and smaller sample size of those with AF in ethnic sub-groups, precluding any analysis beyond Māori and NZ Europeans. Even for Māori, the sample size may be too small to conclusively exclude potentially important differences. Therefore, the ethnicity data should be interpreted with caution. In addition, we did not have data on congestive heart failure and thus could not calculate relevant AF stroke risk scores, nor did we have information on type of direct oral anticoagulant or time in the therapeutic range.

In summary, patient characteristics of those presenting with stroke with or without underlying AF differ and can help guide post-stroke work-up. Anticoagulation rates in the setting of AF, while improved, still fall short of what should

be achievable, and we report several reasons that may not justify withholding this highly effective therapy. The low risk of ICH in the setting of modern anticoagulants is further emphasised by our finding of numerically lower rates of ICH in AF patients on anticoagulation compared to those without. Future work should focus on individual service audits to identify local treatment gaps, patient and practitioner focus groups to identify concerns and barriers and further studies exploring how justified non-prescribing is in each case. Finally, where prescribers experience uncertainty they should consult specialists, available guidelines or electronic decision support.

COMPETING INTERESTS
Authors have nothing to disclose.

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REFERENCES
1. Feigin VL, Krishnamurthi R, Barker-Collo S, et al. Measuring stroke and transient ischemic attack burden in New Zealand: Protocol for the fifth Auckland Regional Community Stroke Study (ARCOS V). Int J Stroke. 2020;15(5):573-83. doi: 10.1177/1747493019884528.
2. Best JG, Bell R, Haque M, Chandratheva A, Werring DJ. Atrial fibrillation and stroke: a practical guide. Pract Neurol. 2019;19(3):208-24. doi: 10.1136/practneurol-2018-002089.
3. Yuan Z, Bowlin S, Einstadter D, et al. Atrial fibrillation as a risk factor for stroke: a retrospective cohort study of hospitalized Medicare beneficiaries. Am J Public Health. 1998;88(3):395-400. doi: 10.2105/ajph.88.3.395.
4. Tomlin AM, Lloyd HS, Tilyard MW. Atrial fibrillation in New Zealand primary care: Prevalence, risk factors for stroke and the management of thromboembolic risk. Eur J Prev Cardiol. 2017;24(3):311-9. doi: 10.1177/2047487316674830.
5. 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(7):492-501. doi: 10.7326/0003-4819-131-7-199910050-00003.
6. Yiin GSC, Li L, Bejot Y, Rothwell PM. Time Trends in Atrial Fibrillation-Associated Stroke and Premorbid Anticoagulation. Stroke. 2018;50(1):STROKEAHA118022249. doi: 10.1161/STROKEAHA.118.022249.
7. Feigin VL, Krishnamurthi RV, Barker-Collo S, et al. 30-Year Trends in Stroke Rates and Outcome in Auckland, New Zealand (1981-2012): A Multi-Ethnic Population-Based Series of Studies. PLoS One. 2015;10(8):e0134609. doi: 10.1371/journal.pone.0134609.
8. Thompson SG, Barber PA, Gommans JH, et al. The impact of ethnicity on stroke care access and patient outcomes: a New Zealand nationwide observational study. Lancet Reg Health West Pac. 2022;20:100358. doi: 10.1016/j.lanwpc.2021.100358.
9. Ranta A, Thompson S, Harwood MLN, et al. Reducing Ethnic and Geographic Inequities to Optimise New Zealand Stroke Care (REGIONS Care): Protocol for a Nationwide Observational Study. JMIR Res Protoc. 2021;10(1):e25374. doi: 10.2196/25374.
10. Lew SJ, Lim JK. Stroke prevention in elderly patients with atrial fibrillation. Singapore Med J. 2002;43(4):198-201.
11. Man-Son-Hing M, Nichol G, Lau A, Laupacis A. Choosing antithrombotic therapy for elderly patients with atrial fibrillation who are at risk for falls. Arch Intern Med. 1999;159(7):677-85. doi: 10.1001/archinte.159.7.677.
12. BPAC.Inc. Stroke Prevention in Atrial Fibrillation using AF Electronic Decision Support Tool [Internet]. [cited 023 Jul 13]]. Available from: https://bpac.org.nz/b-safe/.
13. Noubiap JJ, Nyaga UF, Ndoadoumgue AL, et al. Meta-Analysis of the Incidence, Prevalence, and Correlates of Atrial Fibrillation in Rheumatic Heart Disease. Glob Heart. 2020;15(1):38. doi: 10.5334/gh.807.
14. Katzenellenbogen JM, Teng TH, Lopez D, et al. Initial hospitalisation for atrial fibrillation in Aboriginal and non-Aboriginal populations in Western Australia. Heart. 2015;101(9):712-9. doi: 10.1136/heartjnl-2014-306678.
15. Katzenellenbogen JM, Woods JA, Teng TH, Thompson SC. Atrial fibrillation in the Indigenous populations of Australia, Canada, New Zealand, and the United States: a systematic scoping review.

BMC Cardiovasc Disord. 2015;15(1):87. doi: 10.1186/s12872-015-0081-6.
16. Ashburner JM, Atlas SJ, Khurshid S, et al. Electronic physician notifications to improve guideline-based anticoagulation in atrial fibrillation: a randomized controlled trial. J Gen Intern Med. 2018;33(12):2070-7. doi: 10.1007/s11606-018-4612-6.
17. Gumbinger C, Holstein T, Stock C, et al. Reasons underlying non-adherence to and discontinuation of anticoagulation in secondary stroke prevention among patients with atrial fibrillation. Eur Neurol. 2015;73(3-4):184-91. doi: 10.1159/000371574.
18. Arnsten JH, Gelfand JM, Singer DE. Determinants of compliance with anticoagulation: A case-control study. Am J Med. 1997;103(1):11-7. doi: 10.1016/s0002-9343(97)90048-6.
19. Sagris D, Leventis I, Georgiopoulos G, et al. Bleeding risk comparison between direct oral anticoagulants at doses approved for atrial fibrillation and aspirin: systematic review, meta-analysis and meta-regression. Eur J Intern Med. 2020;79:31-6. doi: 10.1016/j.ejim.2020.05.001.

Appendix

Appendix Table 1: Atrial fibrillation (AF) and oral anticoagulant use (OAC) by district.

DHB of domicile	No AF	Known AF on OAC	Known AF not on OAC	AF Dx post-stroke	Unknown	Total	% AF	% known AF not on OAC/all stroke	% known AF not on OAC/known AF
Northland	58	12	15	12	0	97	40%	15%	56%
Waitematā	157	27	22	14	0	220	29%	10%	45%
Auckland	77	21	5	2	0	105	27%	5%	19%
Counties Manukau	117	53	8	10	1	189	38%	4%	13%
Waikato	117	42	13	8	9	189	38%	7%	24%
Lakes	62	16	11	9	5	103	40%	11%	41%
Bay of Plenty	108	37	20	13	0	178	39%	11%	35%
Tairāwhiti	18	12	0	3	2	35	49%	0%	0%
Taranaki	57	17	18	4	1	97	41%	19%	51%
Hawke's Bay	57	33	3	2	0	95	40%	3%	8%
MidCentral	67	16	7	5	8	103	35%	7%	50%
Whanganui	50	7	7	4	2	70	29%	10%	30%
Capital and Coast	93	17	13	18	1	142	35%	9%	43%
Hutt	71	7	11	3	0	92	23%	12%	52%
Wairarapa	27	14	1	0	1	43	37%	2%	7%
Nelson Marlborough	35	10	7	0	0	52	33%	13%	41%
West Coast	15	5	4	1	2	27	44%	15%	44%

Appendix Table 1 (continued): Atrial fibrillation (AF) and oral anticoagulant use (OAC) by district.

Canterbury	162	52	39	22	3	278	42%	14%	43%
South Canterbury	25	11	3	2	0	41	39%	7%	21%
Southern	124	33	16	8	1	182	32%	9%	33%
Overseas	12	0	1	1	0	14	14%	7%	50%
Total	1,509	442	224	141	36	2,352	36%	10%	27%