

# Preventing stroke in people with atrial fibrillation: a cross-sectional study

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## Abstract

**Background** The annual stroke rate in atrial fibrillation is around 5 per cent with increased risk in those with hypertension, diabetes, left ventricular dysfunction and other cardiovascular risk factors. This study set out to identify the patients with atrial fibrillation and modifiable risk factors for stroke.

**Method** Analysis of practice computer data taken from eight general practices (81 811 patients) in the south of England. 944 patients with a diagnosis of atrial fibrillation, of whom 782 (82.8 per cent) were aged 65 years and over.

**Results** The age standardised prevalence of diagnosed atrial fibrillation was 1.23 per cent (1.28 per cent for men and 1.18 per cent for women). It was much more prevalent in the older population, 8.28 per cent and 6.66 per cent for males and females over 65, respectively. Cardiovascular co-morbidities were more frequent with increasing age. Blood pressure (BP) was recorded in over 95 per cent of patients with atrial fibrillation though there was scope for improving control; 25 per cent of men and 31 per cent women had a BP over 150/90. Inconsistent recording of ECG and echocardiography made it hard to identify patients with left ventricular dysfunction. Forty six per cent of men and 37 per cent of women were either being prescribed Warfarin, or had contraindications to its use; of those on Warfarin 75.9 per cent have an international normalized ratio in range. Forty four per cent were treated with aspirin. People at high risk of stroke were no more likely to be treated with Warfarin or aspirin than those at moderate risk.

**Conclusions** The rate of use of Warfarin remains low, and there is scope for better recording and management of risk factors particularly BP.

**Keywords:** atrial fibrillation, stroke, hypertension, primary health care, standards, comparative study

## Introduction

Atrial fibrillation (AF) is the commonest cardiac arrhythmia managed in primary care,<sup>1</sup> and because it is an important risk factor for stroke it has significant implications for people with the condition and for health services.<sup>2</sup> The prevalence of AF in general practice in England and Wales was estimated in 1998 at 12.1 per 1000 in men and 12.7 per 1000 in women with a reported increase in prevalence since 1994,<sup>3</sup> a similar increase has been

reported in the USA.<sup>4</sup> Its prevalence increases with age, with approximately 5 per cent of those over 65, and 10 per cent of those over 85 years.<sup>5,6</sup> The annual rate of stroke with AF is about 4.5 per cent.<sup>7</sup> There is consensus that the risk of stroke in people with AF is greater in those who also have hypertension,<sup>8</sup> diabetes, left ventricular dysfunction, or previous cerebrovascular accident and are older than 65.<sup>9,10</sup> Other risk factors which may also contribute include: smoking, obesity, existing ischaemic heart disease and hyperlipidaemia,<sup>11-13</sup> although modifying these may result in a lesser reduction in stroke risk in people with AF. However they are worth addressing as many of these people are at risk from other cardiovascular diseases as well.<sup>14</sup>

Anti-coagulation has been demonstrated to be effective in reducing the incidence of stroke in patients with AF, with aspirin providing lesser benefits.<sup>15</sup> Many believe that anti-coagulants are under-utilized, with only around a fifth of patients receiving them.<sup>9,16</sup> One reason for this is the need to regulate Warfarin therapy strictly to avoid the risk of haemorrhage. Where this cannot be achieved in this elderly population then aspirin may provide a safer option;<sup>17</sup> though opting for aspirin ahead of Warfarin remains controversial. Decision making about this issue is often complex, because many with AF are elderly with multiple medical problems and therapy.<sup>18,19</sup>

In the UK Primary Care Trusts commission care for their geographical locality. One such trust was interested to examine the quality of care of patients with AF, and whether they could be identified by computer searches across a number of practices in their locality. If this proved feasible then this would allow these

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patients to be identified, and services targeted appropriately. We therefore conducted this study to see if it was possible to identify high risk patients, with suboptimally managed AF, from searches of general practice computer records.

## Method

This study was carried out in eight general practices, with a total registered population of 81 811 (range 3559 to 14 834), in a single locality in the south of England. There are similar numbers of very elderly, over 85 years. The AF prevalence is age- and sex-standardised against the England and Wales population.<sup>20</sup>

The data were collected between May 2004 and July 2004, with written consent of the practices and approval of the local primary care trust. During this period a data collector visited each practice and collected information on demography, diagnosis, investigations, and treatment from their computer systems using the health query language MIQUEST<sup>21</sup> (Morbidity Information and Export Syntax; Box 1).

The data had to be extensively cleaned and processed.

Data reliability was tested by careful examination of the denominator, the diagnostic and other clinical data due to be used in the study.<sup>22,23</sup> This involved creating a graphical representation of the age-sex profile of each practice; and also for any diseases that were to be part of the analysis. Recording levels of numerical variables (e.g. systolic BP) were examined for, and histograms plotted to observe their distribution. Recording levels were compared between practices; and if there were large discrepancies in the data or missing data then the variable concerned has been excluded from the analysis. The only exceptions are ECG data and echocardiogram data, which are specifically included as examples where data quality is poor.

Not all practice computer systems use precisely the same coding system. All these practices were either EMIS (Egton Medical Information Systems<sup>24</sup>) or Torex Premiere.<sup>25</sup> Both of these use the Read version 2 5-Byte code set. However, EMIS uses many of its own codes; and has an entirely independent drug dictionary. The EMIS drug codes are unique and do not precisely mirror the Read classification for drugs. We recoded data into classes and preparations; so that we had a simple numeric variable which for example indicates whether a patient has been prescribed Warfarin.

### Box 1 Data set collected about each person

Demographic details	MIQUEST unique ID, age and sex
Diagnostic data	Atrial fibrillation, hypertension, diabetes, coronary heart disease, TIA (Transient Ischaemic Attack) or stroke, heart failure
Cardiovascular risk factors	Blood pressure, BMI, smoking status, cholesterol level, electrolytes, ECG recording, echocardiogram results, INR
Drug treatment	Warfarin, aspirin, clopidogrel, dipyridamole, Digoxin, ACE-inhibitors

We calculated the prevalence of AF and of cardiovascular co-morbidities and risk factors by age group and sex. We analysed in 10 year bands from age 25 upwards, grouping together the population over 85 years.

We went on to examine the proportion of people with AF who had one of the following cardiovascular conditions, ischaemic heart disease, heart failure and diagnosis of hypertension and the proportion of patients with cardiovascular risk factors (blood pressure, smoking status, BMI and cholesterol levels) recorded on the practice computer. In addition we identified those with mitral valve disease and rheumatic fever, and those treated with an anti-coagulant (Warfarin) and anti-platelet therapy (aspirin).

We defined current therapy as issue of a prescription in the last 60 days; as the locality policy was to issue repeat prescriptions for 60 days therapy, though locality representatives said that they often issued Warfarin prescriptions for shorter periods.

We then formulated audit criteria (Box 2) based best practice guidance;<sup>26,27</sup> in conjunction with representatives of the practices involved. It was agreed that cardiovascular risk factors would be examined using the standards set out in the UK National Service Framework for Coronary Heart Disease<sup>28</sup> and that the 'gold standard' treatment was the current prescription of Warfarin, unless contraindicated, with an international normalized ratio (INR) target range of 2–3 for these patients. Data were analysed in SPSS Version 12.

### Box 2 Audit criteria

#### Co-morbidity

The percentage of people with AF who have cardiovascular co-morbidities recorded, including previous stroke of TIA, diabetes and heart failure

The number of people with mitral valve disease or a history of rheumatic fever

#### Blood pressure management in AF

The percentage of people with a blood pressure recorded

The percentage of people with a blood pressure above the 140/85 and 150/90 mmHg thresholds

#### Left ventricular hypertrophy

The percentage of people with an ECG or echocardiogram result

The proportion of these that indicate left ventricular hypertrophy

#### Lifestyle in people with AF

The percentage of people with a smoking habit and BMI recorded

The proportion of smokers and those with a raised BMI

#### Lipids and monitoring of electrolytes

The percentage of people who have had their cholesterol measured

The achievement of national targets (<5 mmol/l for total cholesterol)

The percentage with electrolytes recorded, and number with hypo or hyperkalaemia or impaired renal function

#### Anti-thrombus and anti-coagulant treatment

The percentage of people with concurrent cardiovascular disease who have been offered anti-platelet or anti-coagulant therapy; and the proportion where therapy is current (prescribed in the last three months)

Recording of contraindications to aspirin and Warfarin

Proportion of those currently on Warfarin with an 'in range' INR (2.0–3.0)

## Results

In total, there were 944 people with AF an overall prevalence of 11.5 per 1000 patients (Table 1) Prevalence rates increased with age, from less than 1 per 1000 in people aged under the age of 35 to 96.7 per 1000 in people aged over 75 years. The prevalence was higher in males than in females in all age categories, with an overall prevalence of 12.3 per 1000 males and 10.8 per 1000 females. 941 were aged 25 years and above, those aged below 25 years were excluded from the further analysis. The age-standardized prevalence, using the population of England and Wales, was 12.8 for males, 11.8 for females and 12.3 per 1000 overall.

A high proportion of patients had a concurrent cardiovascular diagnoses (Table 2). Ischaemic heart disease (IHD) was much more prevalent in men than women (31.6 per cent compared with 23.7 per cent); diabetes was more common in men (14.5

per cent compared with 11.6 per cent); stroke, heart failure and hypertension had smaller or no sex differences.

Cardiovascular risk factor recording was variable (Table 3). Nearly everybody (98 per cent) had a blood pressure recording and just under 90 per cent a smoking record. BMI, cholesterol and LDL-cholesterol were recorded more in men. LDL was measured in less than half of men (43.1 per cent) and under a third of women (30.8 per cent).

Although the mean systolic and diastolic blood pressures, cholesterol and LDL cholesterol are below the target set for blood pressure control in national guidance<sup>28</sup> (Table 4), this inevitably leaves a considerable proportion above.

Fifty seven per cent have a blood pressure at or above the 140/85 threshold (i.e. either systolic is  $\geq 140$  or diastolic  $\geq 85$ ) of whom 28 per cent above 150/90 (Table 5). Approximately 10 per cent of men and women have cholesterol and LDL above recommended treatment thresholds; though these figures should be treated with caution because of the high percentage of patients who have not had a cholesterol or LDL measure. A total of 24.5 per cent are recorded as current or ex-smokers. Almost exactly twice as many men are smokers as women. Perhaps reflecting the relatively affluent area of Surrey these practices are located in, 63 per cent are recorded as having never smoked. Just over a quarter of people with AF have a BMI over 28. Only 9.5 per cent of people with AF are recorded as having an ECG, and only 4.5 per cent an echocardiogram. There is not sufficient data to make valid comments about left ventricular hypertrophy.

Anti-coagulant and anti-platelet therapy are prescribed differently to men and women. Warfarin is prescribed to more men than women (42.6 per cent, compared with 35.2 per cent).

**Table 1** Prevalence of AF recording

Age	Gender		Total
	Female	Male	
0–24	0.00% (0)	0.03% (3)	0.01% (3)
25–34	0.02% (1)	0.05% (3)	0.03% (4)
35–44	0.07% (5)	0.17% (13)	0.12% (18)
45–54	0.15% (8)	0.37% (22)	0.27% (30)
55–64	0.58% (25)	1.78% (82)	1.19% (107)
65–74	2.31% (69)	5.36% (152)	3.80% (221)
75–84	7.52% (182)	9.70% (167)	8.43% (349)
85+	12.46% (148)	13.56% (64)	12.77% (212)
Overall	1.08% (438)	1.23% (506)	1.15% (944)

**Table 2** Percentage of patients with concurrent cardiovascular diagnoses in people with atrial fibrillation and percentage with one or more concurrent diagnoses

Age group	Concurrent cardiovascular diagnoses					No of concurrent diagnoses			
	IHD	CVA & TIA	HF	DM	HT	1	2	3	4
Men									
25–34	0	0	0	0	0	0	0	0	0
35–44	7.7	7.7	0	7.7	15.4	38.5	0	0	0
45–54	13.6	4.5	9.1	4.5	31.8	40.9	4.5	4.5	0
55–64	22.0	11.0	7.3	9.8	32.9	26.8	13.4	9.8	0
65–74	32.9	18.4	15.8	18.4	51.3	37.5	23.0	15.1	2.0
75–84	34.1	20.4	19.8	16.8	52.1	41.3	26.9	12.0	3.0
85+	46.9	21.9	42.2	10.9	46.9	32.8	28.1	20.3	4.7
All ages	31.6	17.3	18.3	14.5	45.9	36.4	21.9	12.9	2.2
Women									
25–34	0	0	0	0	0	0	0	0	0
35–44	0	0	0	0	0	0	0	0	0
45–54	0	12.5	0	12.5	50.0	37.5	0	12.5	0
55–64	16.0	8.0	4.0	12.0	32.0	40.0	16.0	0	0
65–74	15.9	24.6	7.2	15.9	50.7	34.8	24.6	10.1	0
75–84	27.5	16.5	15.9	13.2	48.9	36.8	22.5	10.4	2.2
85+	26.4	20.3	30.4	8.1	49.3	37.2	27.0	8.1	4.7
All ages	23.7	18.3	18.3	11.6	47.7	36.3	23.3	8.9	2.5

IHD, ischaemic heart disease; HF, heart failure; DM, diabetes mellitus; HT, hypertension; CVA & TIA, cerebrovascular accident or transient ischaemic attack.

**Table 3** Percentage of patients with atrial fibrillation who have cardiovascular risk factors recorded

Age group	Blood pressure	Smoking status	BMI	Cholesterol	LDL
Men					
25–34	66.7	100.0	33.3	33.3	33.3
35–44	84.6	69.2	69.2	46.2	23.1
45–54	100.0	90.9	81.8	40.9	18.2
55–64	98.8	90.2	91.5	78.0	47.6
65–74	100.0	90.8	86.2	78.9	53.9
75–84	99.4	91.6	88.6	71.9	40.1
85+	95.3	89.1	84.4	57.8	32.8
All ages	98.4	90.3	86.7	71.0	43.1
Women					
25–34	100.0	100.0	100.0	0	0
35–44	100.0	100.0	100.0	40.0	40.0
45–54	100.0	100.0	87.5	62.5	37.5
55–64	100.0	96.0	96.0	84.0	36.0
65–74	100.0	91.3	84.1	68.1	47.8
75–84	97.8	88.5	89.6	64.8	34.6
85+	94.6	79.7	66.9	36.5	16.9
All ages	97.3%	86.8%	81.5%	56.4%	30.8%

BMI, body mass index (kg/m<sup>2</sup>); LDL, low density lipoprotein cholesterol.

**Table 4** Management of cardiovascular risk factors in patients with atrial fibrillation

	Mean	SD	SE	Min	Max	Median
Men						
Systolic	135.8	17.1	0.8	80.0	190.0	135.0
Diastolic	77.9	9.8	0.4	50.0	106.0	80.0
BMI	26.8	4.3	0.2	17.2	47.2	26.4
Cholesterol	4.8	0.9	0.0	2.5	9.0	4.8
LDL	2.8	0.8	0.1	1.3	5.5	2.8
Women						
Systolic	138.5	18.3	0.9	90.0	220.0	139.5
Diastolic	77.6	9.3	0.5	50.0	110.0	80.0
BMI	26.2	5.2	0.3	15.2	44.5	25.2
Cholesterol	5.2	1.1	0.1	2.7	8.2	5.1
LDL	2.8	0.8	0.1	1.3	4.8	2.7

SD, standard deviation; SE, standard error of the mean; Min, minimum; Max, maximum.

The peak age for using Warfarin is between 65 and 74 years (Table 6) Aspirin is currently prescribed less in men than women (28.2 and 34.5 per cent, respectively.) Aspirin prescribing increases as people with AF get older. It is used most in the very elderly of both sexes. Men have more contraindications to Warfarin and aspirin recorded than women.

453 of the 503 men (85.9 per cent) and 351 of 438 (80.1 per cent) of women diagnosed as having AF are receiving Warfarin or aspirin or have these drugs contraindicated. The calculation takes into account that 5 men and 6 women have contraindications to both Warfarin and aspirin, and that nine additional men and two women have a code that suggests they have been advised to purchase their own aspirin 'OTC' (over-the-counter direct from the pharmacist).

**Table 5** Percentage with risk factors above intervention thresholds

Blood pressure	Men		Women		Total	
	<i>n</i>	%	<i>n</i>	%	<i>N</i>	%
140–149 or 85–89	149	30%	120	27%	269	29%
≥150 or ≤90	128	25%	136	31%	264	28%
Total cholesterol						
≥5 mmol/l	64	12.7%	42	9.6%	106	11.3%
LDL-cholesterol						
≥3 mmol/l	47	9.3%	16	3.7%	63	6.7%
Smoking						
Current smoker	58	11.5%	24	5.5%	82	8.7%
Ex-smoker	104	20.7%	45	10.3%	149	15.8%
BMI						
BMI >28	60	11.9%	33	7.5%	93	9.9%
BMI >30	88	17.5%	74	16.9%	162	17.2%

Control of the level of anti-coagulants is measured using INR with a target range of 2–3. The mean INR for men was 2.46, and for females 2.43. There was no difference in control of INR across the age groups or between genders. The range was from 1.0 to 5.8. Approximately a quarter (24.1 per cent) of those with an INR measure had an out of range result. A total of 11.3 per cent of men and 9.9 per cent of women had an INR over 3; and, 14.1 per cent of men and 12.5 per cent of women had an INR under 2.

Finally, we looked at high risk<sup>26,27</sup> groups to see if more intensive treatment is being targeted at those most at risk. Warfarin and aspirin were prescribed in similar proportions to patients in the very high, high and moderate risk categories, with less prescribed to those at low risk. Men were prescribed more Warfarin than women, in all three of the highest risk categories. Hypertension, diabetes and heart failure were more prevalent in the high risk group; more so than in the very high risk group (people who had suffered a previous stroke or TIA.) These diseases were much less prevalent in those at moderate or low risk. A similar trend was seen in mean blood pressure. Smoking was most prevalent in the low risk group (Table 7)

## Discussion

### Principal findings

The study demonstrated that the use of Warfarin remains low, despite all the evidence of benefit, and guidelines produced for its use. Where Warfarin is used it is not targeted at those in the highest risk categories; though overall four out of five patients with AF are treated with Warfarin or aspirin or have contraindication to these therapies.

The study showed the feasibility of using computer searches can be used to identify patients with AF; group them according to level or risk; and, identify those who are suboptimally managed. Practice computer data was excellent in some areas and variable in others. Nearly all patients with a diagnosis of AF

**Table 6** Prescribing and contraindications to Warfarin and aspirin

	Prescribed Warfarin ( <i>n</i> )	Percentage prescribed Warfarin	Warfarin contraindicated ( <i>n</i> )	Percentage prescribed or contraindicated Warfarin
Male				
35–44	1	7.7	0	7.7
45–54	7	31.8	1	36.4
55–64	32	39.0	2	41.5
65–74	85	55.9	8	61.2
75–84	72	43.1	4	45.5
85+	16	25.0	1	26.6
Total	213	42.6	16	45.8
Female				
45–54	2	25.0	0	25.0
55–64	8	32.0	0	32.0
65–74	31	44.9	2	47.8
75–84	71	39.0	3	40.7
85+	40	27.0	4	29.7
Total	152	35.2	9	37.3
Male				
	Prescribed aspirin ( <i>n</i> )	Percentage prescribed aspirin	Aspirin contraindicated ( <i>n</i> )	Percentage prescribed or contraindicated aspirin
35–44	2	12.5	1	18.8
45–54	1	4.5	0	4.5
55–64	21	25.6	12	40.2
65–74	33	21.7	27	39.5
75–84	54	32.3	29	49.7
85+	31	48.4	8	60.9
Total	142	28.2	77	43.5
Female				
45–54	1	12.5	1	25.0
55–64	5	20.0	1	24.0
65–74	19	27.5	7	37.7
75–84	60	33.0	24	46.2
85+	64	43.2	12	51.4
Total	149	34.5	45	44.9

have a record of their blood pressure, smoking habit and BMI; four out of five have had Warfarin or aspirin prescribed where it was not contraindicated. However, in others there is considerable scope for improvement in practice computer data; particularly the recording of ECG of echocardiograph evidence of left ventricular hypertrophy.

We defined the prevalence of AF and how it differs between the sexes. In men it is at least double that in woman in every ten year age band up to age 75; after this age prevalence in women approximates to that in the male population. The overall prevalence in males and females is similar because there are many more women than men alive over age 75. Concurrent cardiovascular disease is much more common with advancing age.

### Implications for practice

The existence of compelling evidence about the benefits of Warfarin is not translated into practice. The existence of evidence-based guidance alone is not enough to change practice.<sup>18</sup> The reasons why female appear to be prescribed aspirin less often and Warfarin more often need to be explored. Substantial numbers

would benefit from improved blood pressure control, and possibly improved monitoring and management of hyperlipidaemia. Warfarin could be better targeted at those at greatest risk of stroke.

### Limitations of the study

The study is based on routinely collected data, there was no additional input provided to promote data quality of consistency of recording between practices.

We did not search the whole general practice record. Only structured, often referred to as 'Read coded' data, were used in the study. Narrative or 'free text' records, including text scanned into the computer system from hospital letters was not included. Similarly data still contained within any written records were not included.

There was inter-practice variation in data recording, and where levels of recording were lower than could be reasonably expected or there was marked variation between practices, those data were not included.

We relied on clinician entered codes that Warfarin was contraindicated, or that there was an adverse reaction; rather than

**Table 7** Management of patients by degree of risk

	Number of cases (n)	% of people with AF	% prescribed Warfarin	% prescribed Aspirin	% hypertensive	% diabetic	% Heart Failure	Mean systolic BP mmHg	% smokers
<b>Males</b>									
Level of risk									
Very high:	87	17.3	51.7	31.0	55.2	10.3	20.7	137.0	32.2
- Previous ischaemic stroke or TIA									
High:	202	40.2	43.1	30.2	75.2	26.7	34.2	137.5	30.7
- Age over 65 and one other risk factor, from: Hypertension, diabetes, heart failure, left ventricular dysfunction									
Moderate:	141	28.0	42.6	30.5	22.0	7.1	3.5	135.9	32.6
- Age over 65, with no other risk factors, or Age under 65, with other risk factors									
Low:	73	14.5	28.8	15.1	0.0	0.0	0.0	129.2	35.6
- Age under 65, with no other risk factors									
Total / overall rates	503	100	42.3	28.2	45.9	14.5	18.3	Mean systolic BP mmHg	32.2
<b>Females</b>									
Level of risk									
Very high:	80	18.3	32.5	41.25	58.8	12.5	22.5	138.2	23.8
- Previous ischaemic stroke or TIA									
High:	191	43.6	33.5	37.17	79.1	19.9	31.9	138.7	13.6
- Age over 65 and one other risk factor, from: Hypertension, diabetes, heart failure, left ventricular dysfunction									
Moderate:	145	33.1	40.0	29.66	7.6	2.1	0.7	136.9	13.8
- Age over 65, with no other risk factors, or Age under 65, with other risk factors									
Low:	22	5.0	18.2	9.09	0.0	0.0	0.0	128.4	18.2
- Age under 65, with no other risk factors									
Total / overall rates	438	100	34.7	34.02	47.7	11.6	18.3	128.4	15.8

following the example of Carroll and Majeed<sup>6</sup> and actively searching for data that identified that a contraindication was present.

It was not possible to separate those patients who have paroxysmal AF, from those with persistent; nor was there consistent data recorded about cardioversion or carotid endarterectomy.

We acknowledged within our method that there are subtle variations between the different computer manufacturers' coding of data, and that we had to arbitrarily define what represented 'current' therapy.

### Comparison with the literature

The age standardized prevalence of AF: 7.36 per cent in the over 65s, and 12.3 per cent in the over 85s (crude rates are 6 and 12 per cent) is higher than the 5 and 10 per cent reported elsewhere.<sup>5,6</sup> Though similar to that reported in 1998.<sup>3</sup> The area from which the data in this study is collected is one of relatively high social class, something known to be associated with lower levels of cardiac morbidity.<sup>29,30</sup> This data might indicate that the prevalence of AF is continuing to rise.<sup>3,4</sup>

This data shows much higher rates of anticoagulant use in routine clinical practice than in previous studies. It is roughly double the level (22 per cent) found by Deplanque et al.,<sup>16</sup> and that (21 per cent) found by Wheeldon et al.,<sup>31</sup> and Sudlow et al.<sup>32</sup> (23 per cent). Practice based, near patient anti-coagulant monitoring may contribute towards more patients to be treated with Warfarin.<sup>33</sup> The difference between male and female treatment rates might be that men are started on Warfarin in secondary care when treated for their heart disease or other cardiovascular morbidity at a younger age.

People with AF would benefit from further reduction in blood pressure:<sup>8</sup>

'...each 10 mmHg lower systolic BP is associated with a decrease in risk of stroke of approximately one third in subjects aged 60 to 79 years. The association is continuous down to levels of at least 115/75 mmHg. ...'

### Call for further research

Examination of the complete medical record, computerized and written, would allow the validity of these findings to be checked; there are well established methods to do this.<sup>34,35</sup>

The reasons for inter-practice variability in data need to be better understood; although reported for more than 10 years<sup>36</sup> they persist in many clinical areas.<sup>37,38</sup>

We need to know what type of intervention is likely to be successful in changing the behaviour of clinicians and ensure best practice is implemented. This might include use of: education,<sup>37</sup> telemedicine,<sup>39</sup> near patient testing,<sup>33</sup> financial incentives or other approach to improve the quality of care.

### Conclusions

Usage of Warfarin remains low despite the existence of evidence and guidance for its use; though the practices involved in this

study are achieving higher levels of anti-coagulant monitoring than previously reported. Use of Warfarin does not appear to be targeted at those at highest risk. Priorities for practices and localities should be: improved uptake of Warfarin for people with AF of high and very high risk of stroke; and, improved management of blood pressure. Automated searches of computer data have allowed suboptimally managed patients with AF to be identified; so that they can benefit from improved quality of care.

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