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Coordinated anticoagulation management in a rural setting

Background
Oral anticoagulation management is difficult in rural settings because of reduced patient access to pathology testing and medical management. Previous research reports the effectiveness of coordinated anticoagulation management incorporating education, point of care international normalised ratio (INR) testing, patient self care models, protocols and use of specially trained personnel. This article presents findings on the assessment of a Victorian rural program using a modified anticoagulation clinic and other strategies to improve anticoagulation management.

Methods
This program assessed multiple strategies including comprehensive patient education, protocols and point of care INR testing. These were implemented in a rural hospital and rural general practices. Specific measures for evaluation were time in the therapeutic INR range and complication rate.

Results
Time in the therapeutic INR range was 69% for the standard range (2.0–3.0) and 81% using an expanded range (1.8–3.0). The anticoagulation related complication rate was 0.03 per patient year (95% CI: 0.01, 0.06). International normalised ratio testing every 14 days resulted in 78% of time spent in therapeutic range.

Discussion
The strategies employed in the study increased time spent in therapeutic range and reduced anticoagulation related complications.

The standard measure of anticoagulation control in patients taking warfarin is the international normalised ratio (INR), the ratio of a patient's prothrombin time and a standardised prothrombin time. Warfarin has a narrow therapeutic range, and patients require regular INR testing to prevent haemorrhage or thromboembolic events. In the 1992 Australian Health Care Study, 10.7% of adverse drug events were anticoagulation related, at an estimated annual cost of $100 million for hospital management alone.[1,2]

Models for warfarin management include individual general practitioner care and anticoagulation clinics. Anticoagulation clinics report lower adverse event rates, increased time within therapeutic range and improved patient satisfaction compared with individual GP care,[3–5] outcomes closer to those achieved in large randomised control studies.[6,7] Coordinated anticoagulation care can provide patients with scheduling and tracking, accessible INR testing, support and ongoing education, fewer adverse events, reduced use of hospital services and associated costs.[4,6–8]

Management of anticoagulation therapy is more difficult in rural areas as coordination is problematic due to isolation and the distances involved in accessing pathology laboratories and specialised staff.[9]

Methods

The study was conducted in the sparsely populated (1.5 persons per km^2) Wimmera region of Victoria, 350 km from Melbourne; 22.7% of its residents are aged over 60 years. Wimmera Base Hospital in Horsham is the region's main referral centre.

Interventions

The program incorporated an anticoagulation clinic, point of care INR testing in remote centres, development of anticoagulation dosing protocols for GP use, and a comprehensive patient education program over 3 years.

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The anticoagulation clinic

The clinic comprised a specially trained nurse, a part time pharmacist for 2 years and part-time dietician for 1 year at Wimmera Base Hospital. A patient education program was delivered to patients in an initial, 1 hour one-on-one session. The three personnel who delivered the program provided verbal and written information on warfarin management in relation to health, lifestyle, diet and medication.[10–17]

In 2004 the clinic expanded to four other Wimmera towns. Patients were offered the education program as well as point of care INR testing using the Roche Coaguchek-S monitor. Results were recorded in patients' anticoagulation records and forwarded to the patient's doctor. Horsham patients had standard laboratory INR testing throughout the study. Warfarin dosing for all study patients was managed by the patient's GP.

Clinical decision support tools for the program

Protocols and nomograms based on internationally recognised standards[10,13,18,19] were developed by a team consisting of a physician, three GPs, a chief hospital pharmacist, chief pathologist and an anticoagulation nurse. The protocols included guidelines on warfarin dosing, frequency of INR testing and management of high INRs (>4.1), and a patient reminder system to promote regular INR testing.

The interface between hospital care and discharge home – with or without support services (eg. Hospital in the Home, District Nursing Service) was a consistent source of problems in controlling coagulation after patients commenced warfarin. Patients with abnormal INR results (<1.5, >4.1) were followed up by clinic staff to investigate the reason for the abnormal results and to ensure there was contact between patient and managing doctor so that the warfarin dose could be altered if necessary.

Patient recruitment and data collection

Patients taking or commencing warfarin were referred by GPs, hospital staff, Hospital in the Home or District Nursing Services, or were self referred in response to brochures at the pathology service and advertising posters at the hospital and practices. Enrolment was voluntary and patients gave informed consent. A minimum of 3 months INR data was required for data analysis; patients with thromboembolic events were excluded from analysis if they had been taking warfarin for fewer than 3 months. Participants' INR results were provided by the local pathology service. Data were collected between 2002–2004 or until a patient ceased warfarin use.

Data analysis

Variables analysed included time in therapeutic range, impact of regular and more frequent INR testing, and complication rate. Continuous measures are presented as medians and 25–75th percentiles. The Wilcoxon rank-sum test (for continuous variables) and Chi-square test (for proportions) were used for comparisons between groups. A p value < 0.05 was considered statistically significant.

The time in days a subject spent in each range – 'very low', 'low', 'on target', 'high' and 'very high' – (*Table 1*) was calculated by the linear interpolation method.[22–23] The percentage of time in each range was compared using Wilcoxon rank-sum as the test of significance. Differences in percentage of time in the 'very low' range were thought to relate to risk of embolism, and to risk of bleeding in the 'very high' range.

Results

Participant demographics

Two hundred and twenty-seven patients were enrolled over the 3 years of the study. Median age was 72 years, with 25% over 78 years. Forty-eight percent were women; 42% were overweight and 26% obese; 8% currently smoked and 72% consumed alcohol. The most common indication for anticoagulation was atrial fibrillation (55%); other reasons were valve replacement (10%), pulmonary embolus (10%) and deep vein thrombosis (15%). The median number of comorbidities was five, and median number of medications was eight. Twenty-one percent of patients were taking a concomitant antiplatelet medication.

Time in therapeutic range

The median proportion of time spent in the therapeutic range was 68.6% using the standard range (2.0–3.0) and 80.8% using the expanded range (1.8–3.0) (*Table 2*).[22,23]

Table 1. Therapeutic ranges and INR ranges based on indication for anticoagulation

Therapeutic range	Subjects without valves	Subjects with valves
	INR	INR
Very low	0–1.4	0–2.0
Low	1.5–1.9	2.0–2.4
On target	2.0–3.0*	2.5–3.5
High	3.1–3.5	3.6–4.0
Very high	3.6+	4.0+

* Standard therapeutic range (an expanded therapeutic range for nonvalve anticoagulation of 1.8–3.0 was also considered during analysis)

Complication rate

Eight patients had complications (a rate of 0.03 per patient year [95% CI: 0.01, 0.06]), specifically haematuria (two), gastrointestinal haemorrhage (two), epistaxis (three) and stroke (one).

Impact of regular and more frequent INR testing

At one remote site, INRs were tested every 14 days resulting in a median proportion of time in therapeutic range (under the standard classification) of 78.2% versus 62.5% (p=0.0004) at Horsham (*Table 3*).

Patients with 'very low' or 'very high' INRs had valve replacements, more comorbidities or prolonged treatment with warfarin (*Table 4*).

Discussion

It is possible to achieve gains in INR management using a coordinated approach. By combining individual GP care with an anticoagulation support service, we were able maintain patients in the therapeutic range for most of the time, with a very low complication rate.

Limitations

This study was limited by many factors, primarily the method of patient recruitment. Most patients were self referred, so those taking warfarin for many years or whose INRs were stable may have chosen not to enrol. Patients were often referred by their clinicians because their INRs were intractably unstable. Healthy younger patients with thromboembolic events were excluded from analysis because their period of warfarinisation was less than 3 months. Another limitation was the varying degree to which GPs adopted the anticoagulation protocols. Individual GP preferences regarding INR management are also likely to have affected the results.

Strengths

Our study demonstrates gains in anticoagulation management using a coordinated approach. Qualitative data was also collected; evaluation questionnaires and focus groups completed by patients were held in the first and last 6 months of the project. Although this data has not been subjected to formal qualitative analysis, patients consistently praised the program, with many commenting that they felt more comfortable taking warfarin after undertaking the education.

Table 2. Percentage of time spent in defined INR ranges after enrolment into the study (n=227)*

Median %	Standard INR range (2.0-3.0)	Expanded INR range (1.8-3.0)
Very low	0.5	0.5
Low	20.2	6.8
On target	68.6	80.8
High	3.6	3.6
Very high	0	0

* Median follow up per patient = 420 days, total follow up for entire group = 283 years

Table 3. Comparison of INRs and percentage of time spent in defined ranges at one remote site and at Horsham

		Remote site (n=17)	Main site (n=109)	*p* value
Median follow up per patient		364	461	0.56
Median %	Very low	0	0.3	0.35
	Low	10.8	23.7	0.05
	On target	78.2	62.5	0.0004
	High	5.2	4.6	0.64
	Very high	0	0.6	0.19
Total follow up days for group		6924	49 011	

Outcomes

Quality of anticoagulation control was principally measured by time spent in the therapeutic INR range and the patient complication rate. Time in the standard therapeutic range was 69%, and 81% in the expanded range. Patients spent more time in the therapeutic range than patients in other studies which used individual GP care models (33–64%) and anticoagulation service models (59–86%).[3,5,6,8,10] The complication rate of 0.03 per patient year also compared favourably with those previously reported (1.4–7.3 per patient year of therapy),[4,6,7,10] however differences in methodology prevent direct comparison.

Frequency of INR testing

The researchers also hypothesised that increased time in therapeutic range would lead to fewer INR tests being performed. However, median length of time for the next INR test after two consecutive tests in therapeutic range was 21 days. At one remote site where testing was conducted fortnightly, 78% of time was spent in the target range, supporting previous research findings that better control occurs with more, rather than less frequent testing.[10,13]

Implications for general practice

- A comprehensive patient education program delivered in combination with a support service for both patients and clinicians can improve anticoagulation management.
- Multiple, coordinated approaches to anticoagulation management are likely to be more successful than single strategy models.
- Point of care INR testing was generally well accepted in this study.

Conflict of interest: Roche Diagnostics Australia supplied the Coaguchek-S INR monitors and test strips, but had no role in data collection or manuscript preparation.

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Table 4. Comparison of patients with very low (<1.5) and very high (>4.1) INR values versus those without any extreme values

		Very low (n=12)	No extreme INR (n=174)	Very high (n=41)	*p* value
Median age		70.5	71.5	74.0	0.23
Median period of anticoagulation before enrolment (months)		1.6	6.4	5.0	0.08
Median number of comorbidities		5.5	5.0	6.0	0.03
Median number of medications		7.5	7.0	9.0	0.08
Gender (% male)		66.7	50.6	53.7	0.54
Valve replacement (%)		0	6.9	31.7	<0.0001
Antiplatelet medication (%)		16.7	19.6	26.7	0.97
Median period of follow up (months)		551	373	609	0.002
Time spend in defined INR ranges (median %)	Very low	7.2	0	2.1	0.0001
	Low	33.9	19.4	18.1	0.03
	On target	53.7	71.6	59.2	0.0002
	High	2.2	2.6	7.7	0.0001
	Very high	0.9	0	5.0	0.0001

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