An audit of compliance with warfarin prescribing guidance

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Objectives To determine whether or not inpatients newly started on warfarin at Glan Clwyd Hospital, Denbighshire, had been initiated according to audit standards based on local anticoagulation guidance.

Methods Audit standards based on local anticoagulation guidance were developed. All medical and surgical patients starting warfarin treatment were prospectively identified. Compliance with the audit standards was audited retrospectively via the patients’ medical notes. The data captured were: indication for warfarin; baseline international normalised ratio (INR) results; and adherence to local guidance relating to frequency of INR testing and dosing.

Results 122 patients were included in the audit, with a mean age of 74 years. The indication for warfarin was stated for 96% of the patients. Of the group under 70 years of age and with a baseline INR <1.4, 10 out of 27 (37%) complied with the audit standards and the proportion of patients with a therapeutic INR on discharge was 90% in the group that complied and 87% in the group that did not. Of the patients ≥70 years of age or with an INR ≥1.4, only 33 out of 95 (35%) were initiated according to the audit standards and a therapeutic INR was achieved on discharge in 68% of the group that complied and 70% in the group that did not.

Conclusion This audit shows that there is considerable room for improvement in correctly following the anticoagulant guidelines for initiating warfarin therapy.

Warfarin is the most frequently prescribed anticoagulant in the UK and is indicated for stroke prophylaxis in patients with atrial fibrillation (AF), treatment of thromboembolism, use in certain cardiac diseases, and for patients with mechanical heart valves. Warfarin use in the elderly has increased dramatically in recent years due to evidence demonstrating reduction of ischaemic stroke in AF.

At Glan Clwyd Hospital, Denbighshire, the junior medical staff generally undertake the prescribing of warfarin for acute inpatients, as is common across the UK. Following discharge from hospital, subsequent monitoring of international normalised ratio (INR) and warfarin dose adjustment is often undertaken by a patient’s GP. The British National Formulary recommends that a baseline INR should be recorded before warfarin is started. It also recommends starting elderly patients at a lower dose. An audit carried out at Glan Clwyd Hospital in 2007 showed that 13 out of 33 patients (40%) had a baseline INR ≥1.4 before starting warfarin. There is no published guidance on how to initiate warfarin in patients who have elevated baseline INR.

The “Safer patients initiative” in 2005 highlighted the importance of developing local guidance on the prescribing of warfarin. Following recommendations from the National Patient Safety Agency, local anticoagulation initiation guidance (ie, for days 1–4 of treatment) was updated to take into account both patient age and baseline INR (see Figure 1, p2). Younger patients (<70 years of age) with a baseline INR <1.4 receive dosing according to the Fennerty regimen, which requires daily INR monitoring for four consecutive days; the warfarin dose for each day is selected based on the INR result. Patients with a baseline INR ≥1.4 or elderly patients (≥70 years of age) receive the regimen recommended by Siguret and...
A data capture form was designed to record all the relevant information required based on the audit standards. The audit was carried out for five months, from February to June 2008. All medical and surgical patients newly started on warfarin were identified prospectively by pharmacy staff. Medical records were then reviewed retrospectively and therefore ethics approval was not required. All data were collected by the auditor (RO). Patients discharged before day 4 were excluded.

**Results**

A total of 134 patients were initiated on warfarin treatment but 12 were discharged before day 4 so were excluded. The age range of the 122 patients included in the audit was 36 to 101 years with a mean age of 74 years. Patients over 70 years of age accounted for 78% of the group (95 patients) and 28% of eligible patients had a baseline INR $\geq 1.4$ with liver enzymes within the normal range (34 patients).

The main indications for warfarin were AF (55%) and thromboembolism (39%). See Box 1 (p3) for a summary of the results.

In the group of patients <70 years of age with an INR $< 1.4$, 10 out of 27 (37%) had daily INR monitoring and appropriate doses according to local guidance for four consecutive days. Therefore, 17 patients were not initiated according to the audit standards — either because their INR was not measured daily (only 47 out the possible 68 INR results were recorded) or because the doses prescribed were not in keeping with the guidance. Nevertheless, the number of patients achieving therapeutic INR was similar in the group that followed the guidance (90%) and the group that did not (87%). The frequency of over-anticoagulation was similar in the groups (20% versus 18%). See Box 2 (p4) for a summary of compliance with the audit standards.

In the group containing elderly patients and patients with a baseline INR $\geq 1.4$, dosing according to local guidance was given to 33 out 95 patients (35%). A therapeutic INR was achieved on discharge in 68% (21/31) of the group in which the guidance was followed and 70% (40/57) of the group in which the guidance was not included in the audit standards.

**Method**

Audit standards were drawn from the anticoagulation guidance and were as follows:

- All patients should have their target INR range and indication for warfarin documented
- All patients <70 years of age and with a baseline INR $< 1.4$ should have daily INR monitored and correct dosage selected according to the guidance from days 1 to 4
- All patients $\geq 70$ years of age or with a baseline INR $\geq 1.4$ should have daily dosage according to guidance from days 1 to 4
- All patients aged $\geq 70$ years of age or with a baseline INR $\geq 1.4$ should have their INR checked on day 4 and dose adjusted accordingly (although the guidance stipulates the need to monitor INR daily, this does not affect the dose of warfarin, which should remain fixed at 4mg daily for three days; INR monitoring on days 1–3 was therefore not included in the audit standards)

**Figure 1: Warfarin initiation guidance used at Glan Clwyd Hospital**

![Warfarin initiation guidance](Image)
not followed. It is notable that in the group where the guidance was not followed an INR >6 occurred in 10% of patients (n=6).

**Discussion**

The group of patients studied was, largely, an elderly population (78% of patients starting warfarin treatment were over the age of 70 years and their mean age was 80 years), which is in line with the demographics of central-north Wales. This investigation, along with a previous audit, showed that a substantial number of acutely ill patients had a baseline INR ≥1.4 at the time of starting warfarin. These patients did not have any obvious liver disease. This high incidence of elevated baseline INR values has not been previously reported and merits further investigation.

The anticoagulation guidance was developed to reflect our population and local observations because the most readily available reference source, the BNF, gives no specific guidance other than stating that a lower dose of warfarin should be prescribed in these circumstances.

Despite the guidance, only 43 out of 122 patients (35%) had their INR monitored and warfarin dosed according to local guidance from days 1 to 4. This result is not dissimilar to that of other audits performed in UK hospitals, which have shown that recommended regimens were followed correctly for 27% of patients (11/41) and 39% of patients (16/41). The average length of hospital stay from warfarin initiation to discharge was 6.9 days. Siguret and colleagues found that the mean time needed to achieve a therapeutic INR was 6.7 days and that the predicted dose on day 4 was the actual maintenance dose in 72% of the patients. In the younger group 60% were in the therapeutic range on day 4 and 90% on discharge. This latter finding is comparable to Fennerty and colleagues’ findings.

No serious adverse events were reported in this audit; however, 15 of the 122 patients (12%) had at least one INR result >4. In the younger group, the number of patients with an INR >4 was similar in those for whom the audit standards were met and those for whom they were not (20% versus 18%, respectively). For the older patient group, 6% of patients in whom the audit standards were met had at least one INR result >4, compared with 13% in those for whom the audit standards were not met. The age range of the elderly cohort not treated according to guidance was 75 to 101 years with a mean age of 85 years. This is of concern because incidence of intracranial haemorrhage due to warfarin increases substantially in patients over the age of 80 years with an INR >4.13,12

Junior medical staff received education on warfarin prescribing but its effectiveness was not formally evaluated in this audit. There is evidence to show that providing feedback to staff can lead to some improvement in prescribing but education and feedback requires formal evaluation with respect to warfarin prescribing. In order to improve inpatient anticoagulation, further studies need to be undertaken to address issues around educating the junior medical staff about warfarin prescribing (eg, whether or not undertaking the BMJ learning module before beginning their ward duties leads to improvement in subsequent prescribing).

Recently, the British Pharmacological Society has recommended that junior medical staff follow 10 principles to improve safe and effective use of medicines. This message has to be promoted to all staff involved in prescribing and one means of delivering this could be by having a clinical pharmacist teacher-practitioner involved in tutoring medical staff.

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Age &lt;70 years and INR &lt;1.4</th>
<th>Age ≥70 years or INR ≥1.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>27</td>
<td>58</td>
</tr>
<tr>
<td>Therapeutic INR on day 4</td>
<td>6 (60%)</td>
<td>8 (47%)</td>
</tr>
<tr>
<td>Over target INR on day 4</td>
<td>2 (20%)</td>
<td>2 (12%)</td>
</tr>
<tr>
<td>Therapeutic INR on discharge</td>
<td>9 (90%)</td>
<td>13/15* (87%)</td>
</tr>
<tr>
<td>Expected number of INR results (days 1–4)</td>
<td>40</td>
<td>68</td>
</tr>
<tr>
<td>Actual number of INR results (days 1–4)</td>
<td>40</td>
<td>47</td>
</tr>
<tr>
<td>INR &gt;4</td>
<td>2 (20%)</td>
<td>3 (18%)</td>
</tr>
<tr>
<td>INR &gt;6</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Not all patients had their INR recorded.
An alternative to junior medical staff prescribing warfarin would be for other healthcare professionals to undertake its management. Several studies support this concept.16-18

Conclusion
Local anticoagulation guidance was updated to reflect both the local elderly population and NPSA recommendations for patients starting warfarin treatment. This guidance was followed in only a third of the patients newly started on warfarin treatment. Irrespective of guidance, therapeutic INR on discharge was achieved in 90% of the younger patient group and in 70% in the elderly group. However, some patients had elevated INR values possibly because of poor compliance with the guidance.

Based on the findings of this audit, this anticoagulant guidance should be revised, in terms of the number of INR tests required, and then the updated guidance reaudited in a larger group of patients.

References