

# Service improvement system to enhance the safety of patients admitted on long-term warfarin

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## Abstract

It is common for hospital inpatients on warfarin to suffer from fluctuations in their INR (international normalised ratio). Raised INRs are potentially very dangerous and may result in acute life-threatening haemorrhages. Conversely, low INRs may increase the risk for the development of venous thromboembolism. Having observed many deranged INRs among hospital inpatients, we decided to focus our project on identifying the contributing factors to deranged INRs and ways to address this problem. We analysed the warfarin prescriptions on all drug charts and surveyed the junior doctor staff. Our results revealed poor knowledge and confidence levels on warfarin prescribing among junior doctor staff. This is likely to be reflected in the poor completion rate of warfarin prescriptions. We instituted practical changes to resolve the issue: most importantly, a change to the warfarin administration time from 6 pm to 2 pm, supported by a poster campaign to increase awareness of the problem. The objective of these changes was to reduce prescribing errors by reducing warfarin prescriptions out-of-hours, by the on-call doctors. We repeated the audit cycle twice. Although our interventions were successfully introduced as shown in our second audit cycle, the changes that were implemented were not sustained as shown in the third audit cycle. We identified a need for annual intervention to educate new junior doctor staff to ensure that the positive outcomes achieved are maintained in the long term.

## Problem

Dosing warfarin is a daily challenge and deranged international normalised ratios (INRs) are a frequent occurrence in hospital patients. This is likely due to a combination of acute illness, interactions with other medications, changes in diet and exercise, and inadequate prescribing knowledge. Errors in prescribing leading to deranged INRs can have serious clinical implications and put patients at risk of life-threatening haemorrhages or thrombosis. In the UK warfarin is traditionally administered at 6 pm, and for hospital inpatients this means that warfarin is inevitably prescribed by an out-of-hours junior doctor. We sought to identify common problems relating to the prescription and administration of warfarin at our district general hospital and implement a service improvement system to enhance the safety of patients admitted on warfarin.

## Background

Warfarin is the most prescribed oral anticoagulant in the UK (1). Many of the patients admitted to hospital are on long term warfarin, and we often observe fluctuations in their INR during their hospital stay. Our project focuses on ways to improve warfarin prescribing among junior doctors, one of the areas which we believe is having an impact on the incidence of deranged INRs observed.

## Baseline Measurement

We conducted a hospital-wide snapshot audit and analysed all inpatient warfarin prescriptions during a 1 week period, excluding patients on labour, paediatric, and dialysis wards. We analysed the warfarin prescriptions through the review of the 10 components in

the oral anticoagulant section on the drug chart, to assess if they were completed correctly. They included: indication, target INR, duration, date started, name, route, time, signature, bleep, and prescription date. We also surveyed the junior doctor staff through the use of questionnaires. We focused on three main areas: level of knowledge on prescribing warfarin; knowledge of local hospital policies and guidelines with regard to warfarin prescribing; and the proportion of warfarin prescriptions completed out-of-hours when on-call. In addition, we collected laboratory data to evaluate the total number of raised INRs above 5 over a 1 week period for all inpatients. We excluded patients from the accident and emergency department, those from the anticoagulant clinic, and those admitted from the community with a raised INR. The cut-off value of 5 was used because this is the value for which the risk of bleeding is deemed high enough by the latest edition of the British Committee for Standards in Haematology, such that explicit guidance is issued (either withholding warfarin for 1-2 doses in INRs 5-8, or administering oral vitamin K in INRs >8 in non-bleeding patients) (2).

Our results showed that doctors had a low level of knowledge and little confidence in prescribing warfarin. This led to components of the warfarin prescription on the drug chart being left blank and others completed by pharmacists. In addition, a considerable proportion of warfarin prescriptions was made out-of-hours because warfarin is usually administered at 6 pm. There were also no hospital clinical guidelines to advise doctors on prescribing the correct maintenance dose of warfarin, taking into account the patient's INR.

## Design

Our findings were presented at the hospital's Patient Safety Board's

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meeting, and our proposed interventions were approved by senior hospital management and physician representatives.

First, the warfarin administration time was changed to 2 pm to enable the patient's regular day team to prescribe the warfarin instead of the on-call doctor. This was authorised by our pharmacy department and all nursing, medical, and pharmacy staff were made aware of the change. Secondly, we updated the hospital warfarin prescribing guidelines in cooperation with one of the haematology consultants. Thirdly, we increased junior doctor awareness through a poster campaign.

Our project was conducted between March and November 2013 with the cycle being repeated twice following the implementation of our interventions. Our third cycle was completed in November 2013, to assess whether the changeover of new junior doctor staff in August 2013 would adversely affect the positive outcomes that had been achieved initially.

### Strategy

Cycle 1 relates to our results obtained in March 2013. Out of a total of 240 hospital inpatients, we analysed the warfarin prescriptions of 14 patients (23 patients had no drug chart available for analysis). Our results revealed that, on average, 74% of the components on the warfarin prescription were completed by doctors, 8% by pharmacists, and 18% were left blank. The survey of junior doctors revealed they were often called to prescribe warfarin when on-call (mean 3 per shift) and there was a lack of guidance and education about warfarin prescribing. Laboratory data revealed 20 cases of raised INRs above 5 over a 1 week period in adult inpatients.

Cycle 2 relates to our results obtained in July 2013, following the implementation of our interventions in May 2013. We analysed 22 warfarin prescriptions out of a total of 240 hospital inpatients. Results revealed the successful transition of warfarin administration time to 2 pm, with 100% of warfarin prescriptions being prescribed for 2 pm. This correlated with a reduction in the number of out-of-hours warfarin prescriptions by on-call junior doctors (mean <1 per shift). Furthermore, warfarin prescription by doctors improved from an average of 74% to 78%, although using a chi-squared analysis, this was not a statistically significant change ( $p>0.5$ ). However, in both cycle 1 and cycle 2 there were significant outliers within the data itself; in particular, "Start date" and "Duration" were persistently poorly completed by doctors in both audit cycles, out of keeping with the remainder of the chart. If these components are removed and the results re-analysed, then an improvement from 73.1% to 90.3% is seen, which represents a significant improvement ( $p<0.05$ ). There was also a reduction in the number of raised INRs above 5, with 11 cases over a 1 week period.

Cycle 3 relates to our results obtained in November 2013, following the changeover of junior doctor staff. We analysed 20 warfarin prescriptions out of a total of 253 hospital inpatients (30 patients had no drug chart available for analysis). Results revealed a statistically significant ( $p<0.05$ ) decline both in terms of the proportion of components of the warfarin prescription completed by doctors (from 78% to 62%, with now 16% being completed by

pharmacists), and with regard to the warfarin administration time with only 70% being administered at 2 pm. These results correlated with an increase in the number of raised INRs above 5 over a 1 week period from 11 to 15 cases. Figure 1 illustrates the average completion rates of the warfarin prescriptions for each audit cycle.

In each cycle, it was noted that a number of drug charts were not available for review during data gathering. This was due to the drug charts not being on the ward, often in the pharmacy. Given the incidence of warfarin prescription being 7.6% on average across the cycles, this would correlate with between 1-2 additional warfarin prescriptions being unavailable for analysis within each audit cycle.

### Results

The results of our analyses show that simple actions can be taken to implement change. However, more work is needed to ensure that these changes remain in place in the long term.

The warfarin prescription is not completed adequately by doctors, and in all three cycles the components which were most often missed included start date, and duration. This information is easily found in the patient's yellow book, which, in the UK, is used to monitor warfarin dosage and INR fluctuations in the community. We have concluded that by changing the prescribing time to 2 pm, this ensures that the patient's own team takes ownership for prescribing and obtaining current information from the patient's yellow book. It also allows for the common situation when the patient's blood tests are omitted from the morning phlebotomy round. If this is noted at 2 pm there is still time to take a sample of the patient's blood, check the INR, and prescribe warfarin accordingly, before the patient's own team go off duty. The timing change repatriates the responsibility of warfarin prescribing to the patient's own team of doctors. The components which are most frequently correctly completed include name, route, time, and signature.

We have successfully introduced changes to increase the safety of patients admitted on long term warfarin. Our results, however, show the need for an annual "refresher" course for new junior doctors to ensure we maintain the positive changes that were introduced.

See supplementary file: ds2982.pptx - "diagram for presentation warfarin prescribing"

### Lessons and Limitations

We have identified several limitations in our project, which may have partly contributed to the poor outcomes observed in audit cycle 3. Although we updated the hospital clinical guidelines on prescribing warfarin following our first audit cycle, the guidelines are not easily searchable on the intranet for use as a reference guide. This is caused by the search facility selecting documents other than clinical guidelines, meaning the new guidance was not easily found. In addition, the e-learning module that we developed and planned to introduce following the first audit cycle was not delivered before our second or third audit cycles. Those planned changes will now be implemented and we hope they will help to ensure that our initial

actions will be sustained.

There was also the potential to have missed between 1-2 additional warfarin prescriptions per audit cycle, if the average incidence of warfarin prescriptions were applied to the drug charts not available. Given the relatively low number of warfarin prescriptions within each cycle, this could have an impact on the overall results seen. However, given the high turnover and movements on/off wards, it was not felt to be practical to review these missing charts at other times, owing to the risk of potentially re-analysing the same chart more than once (because to maintain anonymity, charts were assigned to bed number only, not patient details).

Our actions were made possible by our Trust's early phlebotomy service which allows INR results to be made available in time for the 2 pm warfarin prescription. Lack of this service in other trusts could hinder the roll-out of this project.

## Conclusion

Overall, our results show that improvement is possible with simple, low cost measures. However, the changes that were introduced require regular reinforcement to ensure they remain effective in the long term. For this reason we propose annual education courses in the form of a compulsory prescribing e-learning module for all new junior doctor staff joining the Trust.

## References

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## Declaration of interests

Nothing to declare

## Acknowledgements

None