

# BMJ Open Quality Reducing inappropriately suspended VTE prophylaxis through a multidisciplinary shared learning programme and electronic prompting

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## ABSTRACT

**Background** Venous thromboembolism (VTE) is a major cause of preventable hospital death, accounting for up to 10% of inpatient mortality. National guidelines recommend that all patients should be regularly assessed for VTE risk, and prescribed mechanical and pharmacological prophylaxis accordingly. While previous studies have focused on improving prescription uptake on admission, there has been relatively little emphasis on the inappropriate suspension of prophylaxis during inpatient stay.

**Objective** The purpose of this project was to identify the reasons and scale of inappropriate suspension of pharmacological VTE prophylaxis for medical inpatients. We subsequently planned to introduce a number of interventions in order to reduce inappropriate suspension.

**Methods** An initial audit of all medical inpatients was carried out to establish the number with inappropriately suspended pharmacological prophylaxis. We then designed a series of educational meetings and electronic prompting interventions to alert prescribers to these errors, followed by re-audit to assess their efficacy.

**Results** The number of patients with inappropriately suspended VTE prophylaxis was significantly reduced following introduction of our intervention strategy.

**Conclusions** Combined education and electronic email prompts are an effective way of alerting practitioners to reduce inappropriate suspension of VTE prophylaxis. With ongoing teaching and integration of prescribing software alerts, this reduction in VTE prescribing errors could be sustained.

## PROBLEM

Venous thromboembolism (VTE) is a potentially life-threatening complication of protracted hospital stay. Approximately 10% of all hospital deaths are caused by VTE, amounting to over 25 000 deaths per year in 2005 according to the UK Department of Health.<sup>1 2</sup>

National guidelines state that all patients should be risk assessed for VTE on admission, following consultant review or if their clinical condition changes.<sup>3</sup> Judicious prescribing of pharmacological prophylaxis must be monitored throughout inpatient stay, and

suspended if the risk of prophylaxis outweighs its benefit. However, this requires active surveillance in order to ensure timely recommencement once the risk has dissipated.

Following a number of serious incidents involving withdrawal of VTE prophylaxis at this acute trust, an audit was carried out in winter 2017 to investigate the proportion of medical inpatients who had their VTE prophylaxis suspended inappropriately and the perceived clinical contraindications. The perceived contraindications were reviewed against the trust's guideline for VTE prophylaxis and reviewed at the thrombosis committee, led by the haematologist.

## BACKGROUND

VTE describes the formation of blood clots within the venous system, which can subsequently dislodge and travel to other areas of the body. A potentially life-threatening sequelae is pulmonary embolus—occlusion part of the arterial supply to the lung. The risk of thrombus formation is described by Virchow's triad—blood stasis, hypercoagulability and endothelial injury—each of which can be augmented during hospital admission.<sup>4</sup>

There has been considerable effort to prevent VTE cases in hospital, predominantly through prescribing of mechanical and pharmacological prophylaxis.<sup>3</sup> The most widely used method is low molecular weight heparin (LMWH)—a subcutaneous one time per day injection that does not require routing haematological monitoring. Its mechanism of action involves potentiating antithrombin—a protease inhibitor which impedes the function of factor Xa in the clotting pathway.<sup>5</sup>

Each patient admitted should be risk assessed for VTE and bleeding concordantly before pharmacological prophylaxis is administered. While different trusts use their own

scoring criteria, they are based on national guidelines produced by the department of health.<sup>3</sup>

Several initiatives have been employed to try and increase VTE risk assessment and prescribing uptake for hospital inpatients on admission, including patient education,<sup>6</sup> visual prescribing aids,<sup>7 8</sup> electronic prompts<sup>9 10</sup> and real time audit/feedback<sup>11</sup> (for extensive review, see Lau and Haut<sup>12</sup>). However, there has been relatively little focus on the monitoring of VTE prophylaxis after admission. Of particular concern is the cohort of patients that have their LMWH periodically suspended due to bleeding risk, but this risk is not reviewed again in a timely manner resulting in thromboembolic risk. While some of the aforementioned methods may help to reduce this problem, to our knowledge there is no study which evaluates their efficacy in this regard.

The Whittington Hospital is a district general hospital located in the north of London, serving a local population of approximately 500 000. It has a total of 360 beds and eight medical wards, receiving referrals from both primary care and accident and emergency.<sup>13</sup> Local guidelines and VTE risk assessments tools are provided within the trust, based on national guidelines published by the department of health. Each medical clerking is documented in a booklet, which gives visual prompts to carry out VTE risk assessment and record it electronically. This prompt is replicated on both the paper drug charts and post-take clerking sheets, and email alerts are sent to members of staff when the electronic assessment has not been completed. However, there is currently no system for alerting staff to patients who have their pharmacological prophylaxis inappropriately suspended.

This quality improvement project aimed to assess the reasons for inappropriate suspension of VTE prophylaxis for medical inpatients. We implemented a number of strategies to reduce this error, and evaluate their combined efficacy. Our primary outcome was total number of patients with inappropriate suspension of VTE prophylaxis. Secondary outcomes included rationale and average length of inappropriate suspension.

## MEASUREMENT

Formal power calculation was restricted by the lack of data on frequency of inappropriate VTE suspension or potential impact of interventions. An initial pilot audit was therefore conducted of all medical inpatients over a 7-day period. This identified 20 patients with withheld VTE prophylaxis, with 20% having a period of inappropriate suspension. In order to more reliably capture the rationale and frequency of suspension, data collection was set at 4-week period. Baseline data was therefore collected through an audit of all medical inpatients in the month of November 2017.

The Whittington Hospital uses an electronic prescribing system which was able to send a daily email alert identifying patients who had their pharmacological VTE prophylaxis suspended. For each patient, the rationale

and duration of suspension was recorded, along with the ward the patient was located. Individual case notes, blood results and imaging reports were then reviewed in order to establish which patients had any inappropriate periods of suspension. Responsible clinicians on the ward were subsequently notified.

Following initial review of the results, it became apparent there were several frequent causes of inappropriate suspension of VTE prophylaxis. They were categorised as:

- ▶ Delay in restarting prophylaxis following clinical procedure which carried risk of bleeding.
- ▶ Delay in resumption following CT head ruling out bleed post-fall.
- ▶ Suspended following a suspected haemorrhage, but not restarted once risk dissipated.
- ▶ Suspended due to biochemical abnormalities (raised international normalized ratio [INR] or low platelets), however, delay in restarting once these had normalised.
- ▶ Other.

These themes were subsequently used in the re-audit to assess the efficacy of intervention in different areas.

## DESIGN

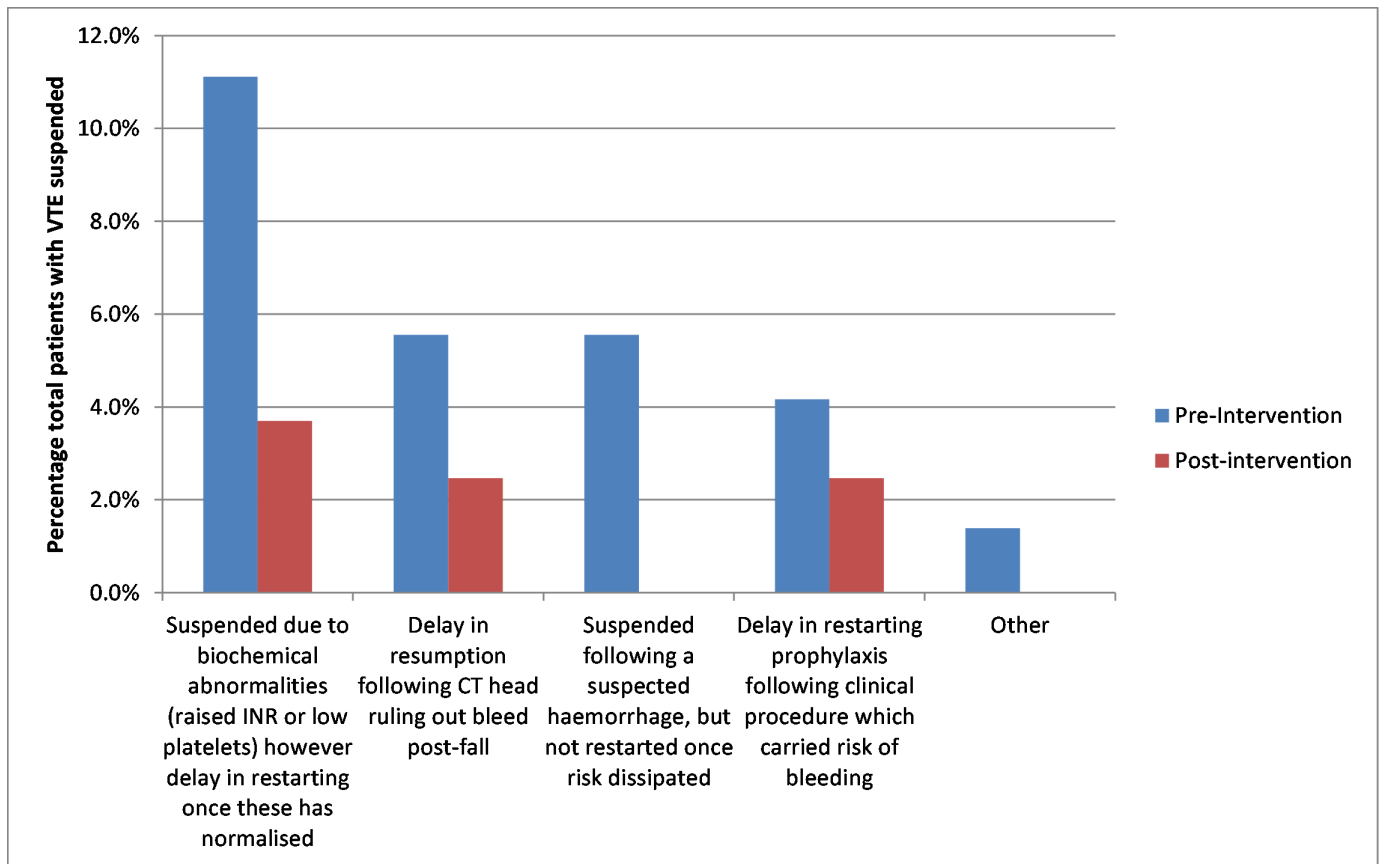
Review of the baseline audit showed that a total of 72 patients had their pharmacological VTE prophylaxis suspended during admission. Over a quarter (28%) had a period of inappropriate suspension (average duration 3.1 days, range 1–10 days). The most common reason for this was delay in restarting prophylaxis once biochemical abnormalities had normalised (40%). This was followed by prophylaxis not being restarted after a CT head ruled out intracerebral bleed post fall (20%), following clinical suspicion of bleeding (20%), following a clinical procedure with increased bleeding risk (15%) and other (5%) (see figure 1).

Having identified the reasons of inappropriate suspension, a multidisciplinary task group was organised to develop strategies for improvement. This included acute and general medical team, haematology team, e-prescribing pharmacists and prescribers. Strategies developed were implemented over a 4-month period from December 2017 to March 2018, and evaluated following re-audit.

## STRATEGY

In order to address VTE prophylaxis issues during admission, the stakeholders including medical team, haematology team, e-prescribing pharmacists and prescribers were involved to facilitate a sustained change. The interventions were accessible to all medical teams in the hospital, and they received regular updates/alerts which were actively monitored.

Previous work has demonstrated that education can be a powerful tool promoting VTE prophylaxis uptake.<sup>6</sup> We



**Figure 1** Percentage of patients with inappropriate VTE suspension pre-intervention and post-intervention by category. VTE, venous thromboembolism.

built on this approach, targeting the healthcare staff most actively involved in prophylaxis VTE prescribing.

- ▶ Formalised teaching sessions with junior doctors to demonstrate the results of the initial audit, with particular focus on the perceived reasons for inappropriate suspension of VTE prophylaxis (online supplementary appendix 1). In addition, we demonstrated how to access hospital guidelines for VTE prophylaxis, as well as a brief explanation of how they should be implemented. We also took this opportunity to hold an open discussion with junior doctors regarding VTE prophylaxis prescribing, and remind them of the importance of daily medication review.
- ▶ Lectures with hospitals pharmacists to highlight the need for regular review of suspended medications, and the importance of liaising with medical team. In addition, results of the initial audit were emailed to all hospital pharmacists, as well as summarised versions of the guidelines on contraindications to VTE prophylaxis prescribing (online supplementary appendix 2). Verbal and written feedback from these sessions was obtained to help guide further intervention strategies. Several junior doctors raised concern that hospital guidelines were ambiguous with regard to prescribing VTE prophylaxis in liver dysfunction. In response, the guidelines were reviewed to provide clearer instruction with regard to biochemical abnormalities, including advice

on when to consult with the haematology team. Junior doctors and hospital pharmacists were informed of the update by email.

Semi-quantitative feedback from these sessions obtained from electronic feedback forms was positive (rated 4.5 out of 5 for usefulness—70% response rate) (online supplementary appendix 3).

As an adjunct to these educational sessions, we also wanted to implement an electronic prompting system to alert staff when VTE prophylaxis was suspended. Our initial intention was for this to be integrated into the electronic prescribing system, through a different colour background for suspended medications. However, due to software limitations, this was not possible. We also obtained feedback from our junior doctor teaching sessions that pop-up prompts on the prescribing software were frustrating and often ignored, and therefore relatively ineffective as an alerting system for prescribers.

We therefore implemented an email alert system, which identified patients from the system who had their VTE prophylaxis suspended. This was initially trialled with a junior doctor, who reviewed patient prescription notes to verify the system. They identified that the alerts were unable to accurately quantify the length of suspension, nor whether the suspension was currently active. Part of this error was due to the dates used for calculation in the software. The first date of VTE suspension was always

selected as the starting point for calculation, even if there were multiple periods of suspension and resumption during that admission. Furthermore, the system was unable to detect whether electronic suspension actually corresponded to withheld VTE prophylaxis. This was partly because some patients were prescribed alternative medication (eg, lower dose or different regimen), and also due to suspension requests being withdrawn prior to medication rounds (eg, following multidisciplinary team review).

Nonetheless, the system correctly identified each patient who had had their VTE prophylaxis suspended (current or past), and were therefore rolled out to all hospital pharmacists to review in concert with the medical team.

## RESULTS

Primary and secondary outcomes were evaluated through re-audit of all medical inpatients during the month of May 2018. The same email alert system was used to identify patients with prophylaxis suspended. During this period, the occupancy rates were comparable (medical wards >90% capacity).

A total of 81 inpatients had their VTE prophylaxis suspended during this period. Seven (9%) of these patients had their prophylaxis suspended for an inappropriate period of time (average length 3.4 days, range 1–6 days). The delay in resuming prophylaxis most commonly occurred following resolution of biochemical abnormalities (three patients—43%), followed by CT head excluding cerebral bleed and after clinical procedure with potential bleeding risk (two patients each category—29% each). There were no patients in other categories.

A  $\chi^2$  test was used to assess for statistically significant between the pre-intervention and post-intervention groups using *Quanspy* software.<sup>14</sup>

With respect to the initial audit in December 2017, there was a significant reduction in the proportion of patients who had their VTE prophylaxis suspended inappropriately ( $p < 0.001$ ). Length of delay and distribution of reasons for delay were roughly comparable (see [figure 1](#)).

## LESSONS AND LIMITATIONS

Audit cycles are limited by random variations in outcome measures that can obscure results. In addition, VTE prophylaxis suspension rates may be affected by seasonal variations in prescribing. Although occupancy rates were similar between both periods, this could potentially have confounded causal association between our intervention and outcomes.

A further limitation of our study was that it was not blinded, potentially introducing observer bias. However, this is relatively limited, since hospital guidelines provide a rigorous basis for assessing the appropriateness of prescribing.

External validity of this study is also limited to medical inpatients. We chose not to include surgical patients as VTE prescribing is complicated by preoperative and postoperative considerations that are less clearly defined by guidelines. Furthermore, our audit was conducted at a district general hospital with intervention targeted at junior doctors and pharmacists. Applicability to other hospitals may be limited by fewer collective educational meetings, differences in VTE guidelines as well as lack of electronic prescribing systems.

Finally, our results did not permit isolated assessment of the efficacy for interventions, since re-audit following each strategy roll-out would have been impractical due to time constraints (4 weeks for each cycle). Nevertheless, we intend for both the educational sessions and electronic prompting to be continued in parallel since they complement each other through sustained training and regular prompting—both of which have been shown to increase VTE prescribing uptake.<sup>12</sup>

An interesting observation from this project was the general aversion to electronic prompts in prescribing software (verbal feedback from junior doctors). Of particular frustration was the inability to stop the prompt's from recurrently showing each time the software was opened. Ironically this may have the opposite effect intended—some junior doctors mentioned that they clicked on the close button without fully reading the messages. Our email alert system avoided this issue through uninterrupted use of prescribing software. However, if software prompts could be tailored to specific instances of medication suspension, without restricting utility, they may be practical for VTE prescribing alerts.

## CONCLUSION

In this study, we have highlighted the problem of inappropriate VTE prophylaxis suspension and proposed reasons for why there is delay in resumption. Moreover, we have demonstrated that a combined educational and electronic prompting strategy to be effective at reducing the number of cases of inappropriate suspension. This reduced all categories of erroneously withheld prophylaxis, although the average duration remained similar.

A major limitation of quality improvement interventions is their diminishing temporal influence—the improvement evaporation effect. This is particularly relevant in regard to educational strategies used in this project, most notably due to rotation of the junior doctor cohorts and subsequent learning loss.<sup>15</sup> We recognise that the results of this study are only sustained with continued educational input and prompting. As a result, we intend for the audit results and lessons to be presented at formalised teaching sessions for the incoming groups, along with re-audit by new junior doctors. Moreover, the project has been uploaded onto the hospital quality improvement electronic platform, facilitating knowledge sharing and future adoption.<sup>16</sup>

Sustainability also requires institutional involvement.<sup>17</sup> Much of the success from this project has been due to the multidisciplinary team engagement, particularly general medical doctors, haematology team, pharmacists and a trust executive board who are motivated in improving this important aspect of patient safety. The hospital prescribing infrastructure will also play a key role in providing a platform for maintaining awareness and driving new improvement.

Nevertheless, it is difficult to predict the impact of improvement decay on the interventions in this project, and future strategies may need to be designed. Potential developments include the use of prompting systems within electronic prescribing and integration of software to alert when biochemical results no longer warrant suspension. Further refinement of our electronic email alerts to distinguish current and past medication suspension would also facilitate prescription review. Most importantly however, continued education emphasising the role of the clinician in reviewing VTE prophylaxis on a regular basis is essential to ensure judicious prescribing.

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