

GUIDELINE DRIVEN CLINICAL DECISION SUPPORT TO IMPROVE VENOUS THROMBOEMBOLISM RISK ASSESMENT AND PHARMACOLOGIC PROPHYLAXIS AT A UNIVERSITY TEACHING HOSPITAL.

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ABSTRACT

Background: Venous thromboembolism (VTE) remains a significant cause of morbidity and sudden mortality in hospitalized patients, occurring in approximately 2% of general medical patients while hospitalized¹, yet numerous studies outline the underutilization of VTE prophylaxis²⁻⁴ despite clear guidelines for its use^{5,6}. We developed and implemented a clinical decision support (CDS) system using a commercially available electronic medical record (EMR) to promote risk assessment by house officers, increase pharmacologic prophylaxis, and decrease VTE events

Methods: Our hospital administration formed a QI team to review the literature and develop guidelines for VTE prophylaxis. The panel developed goals which included improvement in risk assessment and prophylaxis. An automated CDS intervention was designed utilizing a commercially available CDS system and EMR (Discern Expert⁷⁻¹⁰ and Millennium[®], Cerner Corporation).

Results: During a 2-week post-implementation assessment we found that 87% of admitted adult patients had a documented risk assessment performed by a physician or advanced practice nurse within 8 hours of admission, the goal of our guideline. A 5-month pre- and post-implementation comparison demonstrated an increase in the percentage of patients who received pharmacologic prophylaxis at some time during their admission, from 27.6% to 36.5% (P<0.001), a 9% absolute improvement.

Conclusion: The implemented CDS system promoted prompt risk assessment by house officers and improved rates of pharmacologic prophylaxis.

BACKGROUND AND SIGNIFICANCE

➔ **Clinical Decision Support:** CDS systems leverage clinical data gathered in an EMR into useful knowledge to assist clinicians in clinical decision-making. Computerized physician order entry (CPOE) in conjunction with CDS has the potential to improve a variety of quality and safety measures.

➔ **Using CDS for increasing pharmacologic prophylaxis of VTE:** Within the last few years, new efforts have focused on using the benefits of EMR's with CDS to create alerts notifying medical providers of the need for VTE prophylaxis. Several studies have used CDS to issue alerts advising physicians to adjust prophylaxis according to patient risk factors^{11,12}. In a study done on post-surgical patients, the CDS reminded clinicians to use prophylaxis, increasing the rate of mechanical prophylaxis, but not pharmacologic prophylaxis¹¹. In a more recent study, the CDS assessed risk and alerted clinicians of high risk patients who were not receiving prophylaxis. This study showed an increase in the use of both mechanical and pharmacologic prophylaxis as well as a decrease in VTE events¹².

➔ **The novelty of our CDS system:** Neither of the two prior CDS systems mentioned used a physician-completed assessment to aid in teaching/reinforcing guidelines to physicians. Since the risk data is generally provided by the clinicians, the system does not necessarily require a data rich EMR. This allows assessment of patients without a prior history of care at our institution which would be required for full computerized risk assessment. In addition, our system employs a common commercially available EMR and CDS system, making it more rapidly reproducible by other hospitals.

Figure 2

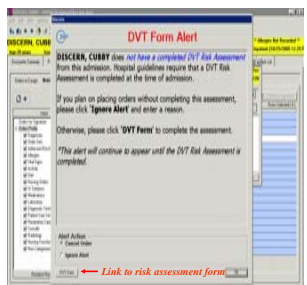


FIGURE 2: Alert displayed to MD's when placing an order less than 8 hours from admission on a patient without completed risk assessment.

Figure 3

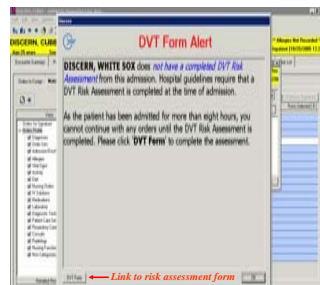


FIGURE 3: Alert displayed to MD's when placing an order greater than 8 hours from admission on a patient without completed risk assessment.

Figure 1



FIGURE 1: VTE risk assessment form.

METHODS

➔ **Guideline Development:** The VTE prophylaxis guidelines were developed by a multidisciplinary committee with input from our Information Services department with the intent to produce guidelines that could be facilitated by use of CPOE and CDS.

➔ **Risk Assessment Form Development:** The risk assessment form (see Figure 1) was designed for rapid completion. The form adapts as responses are entered, prompting for additional information only when needed based on answers supplied in the prior question set. It is not necessary to answer every question on the form for it to be signed as complete as long as the answers presented define the risk. For instance, once contraindication is checked, the other questions are not useful and the form can be signed.

➔ **Clinical Decision Support Development:** Completion of the form is promoted by a reminder to physicians for the first 8 hours after admission (See Figure 2). After 8 hours, the reminders mandate completion of the form (see Figure 3). The alerts have hyperlinks to the form to facilitate completion. Nurses and pharmacists are exempt from the prompts.

Once completed, the assessed risk is displayed on a clinician results flow sheet. This assessment could be opened to obtain the recommended prophylaxis strategy (see Figure 4).

Each evening the CDS compares the risk assessment and pharmacologic treatment of each adult in the hospital. In addition, the system reviews objective discrete data in the EMR to evaluate if patients have more risk than in the assessment. Alerts are printed at the nursing station of each patient and sent to clinician's electronic mailbox under the following circumstances;

- The risk assessment form had not been completed within 8 hours
- The treatment did not match the risk
- The risk was assessed to be higher than described in the form.
- A contraindication based on a spinal tap was present greater than 24 hours and needs to be re-assessed.

➔ **Trial Design and Statistical Analysis:** A control cohort was developed which included all adult admissions contained within the 150 days prior to CDS implementation. This was compared to admissions contained within the 150 days after CDS implementation. Comparisons of proportions of medication use between the control and post-implementation groups were compared using a Chi Square statistic. Comparisons of group characteristics were done using a Chi Square statistic or t-test. Statistical significance was set at P<0.05

RESULTS

➔ There were minimal complaints from house officers and the system was well accepted by faculty.

➔ The risk assessment was completed in 87% of adult non-obstetrical patients within 8 hours (see Graph 1)

➔ The characteristics in the historical control and post-implementation cohorts are shown in Table 1. There was no significant difference in the age or gender distributions in the cohorts.

➔ Compared to the control group, the use of prophylactic anticoagulation increased from 27.6% to 36.5% (P<0.001), a 9% absolute improvement. This improvement was entirely due to the increase in the use of sub-cutaneous heparin (see Table 2).

➔ Analysis of changes in prophylactic anticoagulation use over time suggest a rapid and sustained improvement after CDS implementation (see graph 2).

Figure 4

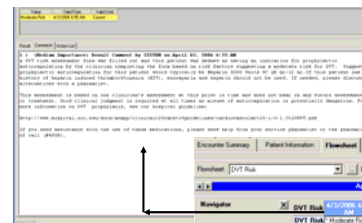


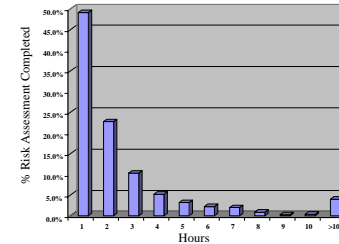
FIGURE 4: Display of risk assessment in clinical flow sheet with blow-up of information displayed if the assessment is right clicked.

Table 1

	PRE Intervention	POST Intervention	P
Number of Patients	5,505	4,598	
Number of Days	150 days	150 days	
Age	46.4 +/-18.3 years	47.1 +/-18.5 years	NS
% Female	64.9%	64.8%	NS

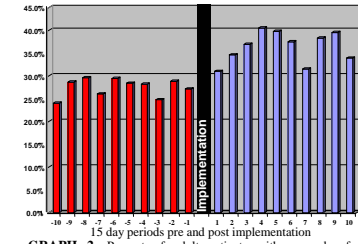
TABLE 1: Description of the pre and post implementation cohorts

GRAPH 1



GRAPH 1: The percentage of admitted patients with a risk assessment completed as a function of hours after admission.

GRAPH 2



GRAPH 2: Percent of adult patients with an order for pharmacologic VTE prophylaxis versus 15 day time periods prior to and after CDS implementation.

TABLE 2

Anticoagulant	% given therapy		P
	PRE	POST	
Heparin Sub-Cutaneous	24.69%	33.73%	<0.0001
Fondaparinux	0.16%	0.20%	NS
Warfarin for TKA or THA	0.25%	0.24%	NS
Enoxaparin	2.94%	2.65%	NS
Total prophylactic anticoagulation	27.6%	36.5%	<0.0001

TABLE 2: Comparison of the pre- and post-implementation use of prophylactic anticoagulation by medication and in total.

CONCLUSIONS

➔ An automated clinical decision support (CDS) system was developed and implemented to improve compliance with hospital guidelines on appropriate prophylaxis for venous thromboembolism which included clinician risk assessment, an approach which can both educate house staff and improve prophylaxis rates.

➔ The CDS system achieved 87% compliance in meeting our guideline goal of a risk assessment within 8 hours of admission.

➔ CDS implementation increased the percentage of adult patients who received pharmacologic prophylaxis at some time during their admission, from 27.6% to 36.5% (P<0.001), a 9% absolute improvement. The number needed to treat (NNT) for the system was 11 admissions per 1 additional patient receiving prophylaxis.

➔ The improvement in pharmacologic prophylaxis was entirely due to increased use of sub-cutaneous heparin, with no change in the use of other prophylactic medications.

➔ The temporal relationship in Graph 2 suggests that the change was rapid and sustained over 150 days.

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