IMPROVING DVT PROPHYLAXIS IN HOSPITALIZED PATIENTS: A QUALITY IMPROVEMENT PROJECT

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Many hospitalized patients are at high or very high risk for developing venous thromboembolism (VTE), a condition that can manifest clinically as deep vein thrombosis (DVT) or pulmonary embolism (PE) and is associated with significant morbidity, mortality, and economic cost. VTE is the leading cause of preventable hospital deaths [1]. However, the condition is often clinically silent, and it is difficult to predict which patients will develop symptomatic thromboembolic complications.

In one study of medically ill patients admitted to a hospital who did not undergo surgery, the incidence of clinical DVT or PE was 1.59% within 90 days of admission [2]. Death occurs in 6% of DVT patients and 12% of PE patients within 1 month of diagnosis [3]. Further, VTE can lead to recurrence of events and a chronic post-thrombotic syndrome.

In 2004, the American College of Chest Physicians (ACCP) published guidelines for the use of thromboprophylaxis in hospitalized patients [4]. As rationale for their recommendations, the guideline developers cited the high prevalence of VTE in hospitalized patients, the common problem of clinically silent VTE, and the associated clinical and economic burdens of unprevented VTE. The ACCP guidelines recommend stratifying hospitalized patients into different groups based on their risk factors for VTE. All acutely ill patients with comorbidities or those who are confined to bed and have 1 or more additional risk factors should receive prophylaxis. The recommended antithrombotic agents are low-dose unfractionated heparin, low-molecular-weight heparin, fondaparinux, or adjusted-dose vitamin K antagonist, along with mechanical prophylaxis depending on the level of risk. Mechanical prophylaxis alone is used for patients at high risk of bleeding. Aspirin is not recommended as prophylaxis [4].

Significant clinical evidence supports the use of VTE prophylaxis in hospitalized patients [5,6]. Adequate prophylaxis reduces VTE by up to 50% [6,7]. Furthermore, prophylaxis for VTE has been shown to be cost-effective [8]. Finally, studies have shown little or no increase in complications of prophylaxis, such as clinically significant bleeding [4]. Yet, studies of hospitalized medically ill patients show that VTE prophylaxis is underutilized in this population [9].

This article describes a resident-led quality improvement (QI) project conducted at Southern Illinois University School of Medicine (SIU), the goal of which was to lower the incidence of DVT in hospitalized patients through improved use of adequate DVT prophylaxis in patients found to be at risk for thromboembolism. Prior to conception of the project, a high incidence of thromboembolic events had been documented in patients at one of the teaching hospitals affiliated with the SIU internal medicine residency program. The hospital had already undertaken a project to improve the rate of DVT prophylaxis, and a risk-assessment tool had been developed. However, the rate of utilization of this tool was low, and the use of pharmacologic prophylaxis was still not adequate. The goal of the resident-led project was to increase the rate of DVT risk assessment by medical staff and the use of adequate DVT prophylaxis in an effort to reduce the incidence of thromboembolic events in hospitalized patients.

Methods

Setting and Origins of Project

Memorial Medical Center (MMC) in Springfield, Illinois, is a teaching hospital that is striving to improve quality of patient care. MMC's medical director is actively implementing different projects to improve the quality of care for hospitalized patients. Involvement in a QI project is required by the SIU internal medicine residency program. The intent is to provide residents with first-hand experience in clinical practice improvement processes.

Our resident group wished to participate in a project to facilitate the improvement of health care delivery at MMC. A major portion of our clinical training is spent in the inpatient setting. We see a wide range

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of patients and treat a variety of medical illnesses in hospitalized patients. We commonly diagnose DVT in our patients and knew it was a major cause of preventable morbidity and mortality. Further, we were aware that MMC measured the number of patients with a secondary diagnosis of DVT or PE while in the hospital and that the numbers varied each month from 18 to 46 cases. The hospital has approximately 500 patients at any given time, but there is a rapid turnover within a month. Therefore, it was difficult to quantify the rate of occurrence of thromboembolic events, but the absolute numbers seemed high.

An important reason for development of a thromboembolic event is inadequate prophylaxis, and a random review of charts by hospital staff had shown that prophylaxis was overlooked in many cases. Many patients who were given prophylaxis received only mechanical prophylaxis despite the absence of contraindications for pharmacologic prophylaxis. We felt assessment for risk of thromboembolism should be a routine part of the initial assessment and should be as basic as ordering a diet for the patient. Our goal was not to have all patients on anticoagulants for DVT prophylaxis but to have 100% of physicians assessing their patients for appropriateness of prophylaxis.

A hospital-wide project was already in place to improve appropriate and adequate use of DVT prophylaxis, and a DVT risk-assessment form based on the 2004 ACCP guidelines had been developed (**Figure 1**). This tool was intended as a guide to help physicians categorize patients according to their level of risk and initiate thromboprophylaxis appropriately. The form was placed in the front page of each patient chart. Subsequently, reminder stickers were placed in charts as well as in the nursing units.

At the time of our resident-led project, the MMC hospital medical director was conducting a pilot study in 1 of the hospital units using another intervention. The intervention involved educating the nursing supervisor who in turn trained all the nurses to ask physicians about DVT prophylaxis while receiving admission orders over the telephone.

Interventions

Our group joined the hospital-wide project about 2 months after its initiation, and our involvement spanned 16 weeks (**Table**). As a first step, we performed random chart reviews to identify those patients for whom DVT risk assessment was not done despite the presence of the standard assessment form. We then introduced 2 interventions to serve as further reminders to physicians regarding the importance of DVT risk assessment and prophylaxis. The interventions were discussed with and approved by the MMC medical director. The first of these was a reminder letter signed by the medical director and addressed to the physicians who we had found on our random chart review were not using required prophylaxis. We then placed the reminder letter in front of the charts of new patients admitted by those physicians.

As our next intervention, we included a reminder on the standard admission form used in the emergency department (ED) at MMC. This form contains basic questions (name of the admitting physician, admitting diagnosis, unit of admission). We added a check box for DVT prophylaxis. The physician was required to check off 1 of the prophylactic drugs listed or to indicate that prophylaxis was not required. Thus, DVT risk assessment was included along with other basic information, decreasing likelihood of its omission while writing admission orders.

Outcome Measurements

Our primary outcome was the rate of physician use of the DVT risk-assessment tool. A secondary outcome was the rate of use of adequate DVT prophylaxis (versus any prophylaxis).

Data Collection

A data collection form was developed by our team, which included: patient demographic information, reason for admission, unit of admission, whether or not a resident was involved in patient care, whether or not DVT risk assessment was done, whether prophylaxis was adequate when ordered, and whether there was any contraindication to prophylaxis.

Data were collected by prospective chart review and entered into a central database. Charts were pulled for all patients who were hospitalized for at least 48 hours in any of the following hospital units: 2E-Med (medical unit), 2E-Onc (oncology unit), 2B (surgical unit), 2G (medical and surgical unit), 4G (neurology unit), 5B (renal and dialysis unit), 6B (cardiac unit), 6G (cardiac unit), and 3B (rehabilitation unit). Patients hospitalized in the pediatric, psychiatric, orthopedic, obstetric, or intensive care unit were excluded from the study. In the orthopedic and intensive care units, the rate of physician use of DVT prophylaxis was already close to our goal of 100%. Pediatric, psychiatric, and obstetric units were excluded because the risk factors for DVT and the overall DVT incidence were low.

DVT PROPHYLAXIS RISK ASSESSMENT AND ORDER

RISK FACTOR ASSESSMENT

AGE:		MEDICAL:		HYPERCOAGULABLE STATE:	
41–60 years	(1)	Hip, pelvis, or leg fracture	(4)	Protein C or S deficiency	(3)
61–75 years	(2)	Elective major lower extremity arthroplasty	(4)	Factory V Leiden mutation	(3)
> 75 years	(3)	Ischemic stroke	(3)	Antithrombin III deficiency	(3)
IMMOBILITY:		Paralysis	(3)	Lupus anticoagulant	(3)
Bed confinement anticipated > 48 hours	(1)	Infection (severe/sepsis)	(3)	Homocysteinemia	(3)
Coma	(2)	Cancer	(3)	Hyperviscosity syndrome	(3)
SURGERY:		COPD/respiratory distress	(2)	Antiphospholipid antibodies	(3)
General anesthesia > 2 hours duration	(1)	Nephrotic syndrome	(2)	Plasminogen or plasminogen activator deficiency	(3)
		Central venous catheter	(2)	Prothrombin gene mutation 20210 A	(3)
		Heart failure	(2)		
		Varicose veins	(2)	**Previous DVT or PE**	(3)
		Obesity (> 20% IBW)	(2)	**Family history of thrombosis**	(3)
		Inflammatory bowel disease	(1)		
		Pregnancy/postpartum < 1 month	(1)	**Total Score** ⇨ ☐	
		Estrogen use (oral contraceptives, HRT)	(1)		

PRE-SURGICAL (Generally not applicable to outpatient procedures)

- ❑ Enoxaparin (Lovenox) 40 mg subcu administer in Holding [Total Risk Score 2 or more]
- ❑ Heparin 5000 Units subcu administer in Holding [Total Risk Score 2 or more]
- ❑ Pneumatic compression (PAS) apply before surgery [may be in addition to above]

MEDICAL AND POST-OP

LOW RISK (score of 1 or less)	MODERATE RISK (score of 2 or 3)	HIGH RISK (score of 4 or more)
❑ No prophylaxis indicated	❑ Heparin 5000 Units subcu every 12 hr ***OR*** ❑ Enoxaparin (Lovenox) 40 mg subcu daily ***OR*** ❑ Arixtra 2.5 mg subcu daily	❑ Heparin 5000 Units subcu every 8 hr ***OR*** ❑ Enoxaparin (Lovenox) 40 mg subcu daily ***OR*** ❑ Arixtra 2.5 mg subcu daily

Start date: Time:

❑ **MECHANICAL (PAS Boots)**

Pneumatic compression device: consider in 1) patients meeting criteria for Moderate or High Risk in addition to drug therapy

OR

2) patients in whom anticoagulation with drug therapy is contraindicated

CONTRAINDICATION to drug prophylaxis (check reason[s] below)

❑ Active or suspected bleeding ❑ Severe head or spinal cord trauma ❑ Covered under order set or care map

❑ Other: _____

NOTES

- **Fondaparinux sodium (Arixtra) is safe and effective in individuals who have been shown to have heparin-induced thrombocytopenia.**
- **Enoxaparin (Lovenox) with creatinine clearance < 30 ml/min: reduce dose to 30 mg every 24 hr.**
- **Enoxaparin (Lovenox) is not used with epidural/spinal catheter or spinal puncture.**
- **This is a reminder and a general guide. Physicians must use their judgment in addressing the needs of individual patients.**

_____ _____ _____

Physician signature Date Time

Figure 1. DVT prophylaxis risk-assessment form developed for use at Memorial Medical Center in Springfield, Illinois. COPD = chronic obstructive pulmonary disease; DVT = deep vein thrombosis; HRT = hormone replacement therapy; IBW = ideal body weight; PE = pulmonary embolism; subcu = subcutaneous.

Table. Timeline of Resident Component of the DVT Prophylaxis Quality Improvement Project

Date	Resident Activity/Intervention
11 Dec 2005–18 Jan 2006	Preintervention chart review
18 Jan 2006	Initiate reminder letter (first intervention)
26 Feb 2006	Inclusion of letter in ED admission form (second intervention)
23 Mar 2006	End of data collection
18 Jan 2006–23 Mar 2006	Postintervention chart review

DVT = deep vein thrombosis; ED = emergency department.

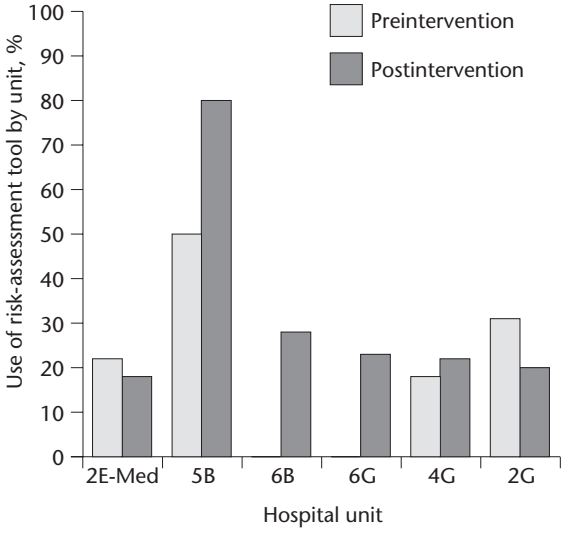

Figure 2. Use of the DVT prophylaxis risk-assessment tool by hospital unit. DVT = deep vein thrombosis; 2E-Med = medical unit; 5B = renal and dialysis unit; 6B and 6G = cardiac units; 4G = neurology unit; 2G = medical and surgical unit.

Results

Our portion of the QI project was completed at the end of 16 weeks. A total of 169 patient charts were reviewed (approximately 10 charts per week). Of these, 96 involved patients admitted prior to our interventions, and 73 involved patients admitted postintervention. Data were analyzed for only 6 of the 9 hospital units due to lack of postintervention data in 3 units. One of those not included in the analysis, 2E-Onc (oncology unit), was the unit in which the medical director had introduced a parallel intervention involving nursing education. The other 2 units, 2B (surgical) and 3B (rehabilitation), had a high rate

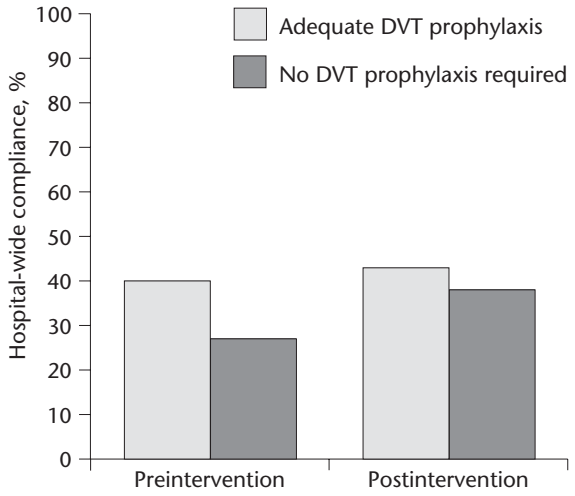

Figure 3. Hospital-wide compliance in prescribing adequate DVT prophylaxis. DVT = deep vein thrombosis.

of adequate pharmacologic prophylaxis preintervention and therefore were also dropped from our postintervention analysis.

For the primary outcome, we found that hospital-wide use of the DVT risk-assessment tool increased from 20.8% preintervention to 33.3% postintervention. A subgroup analysis by hospital unit, however, showed decreased use of the tool in some units (**Figure 2**). For the secondary outcome, we found that hospital-wide physician compliance in prescribing adequate pharmacologic prophylaxis improved slightly, from 39.6% preintervention to 41.7% postintervention (**Figure 3**). A subgroup analysis for each unit demonstrated wide variation in results, with some units showing a decrease in the number of patients who received adequate pharmacologic prophylaxis (**Figure 4**). The number of patients who should not have received prophylaxis, either because of contraindication or because there was no indication for it, are also shown in Figure 3 and Figure 4. The necessity for prophylaxis was determined by the admitting physician or by reviewer assessment using the DVT risk-assessment tool.

Two additional subgroup analyses were performed for the secondary outcome. In the first, patients were divided into those with medical and those with surgical admissions, and the adequacy of prophylaxis was calculated for each group. This analysis revealed that 62% of medical patients and 73% of surgical patients received adequate prophylaxis. The second analysis was done to determine whether resident physician involvement in patient care was associated with

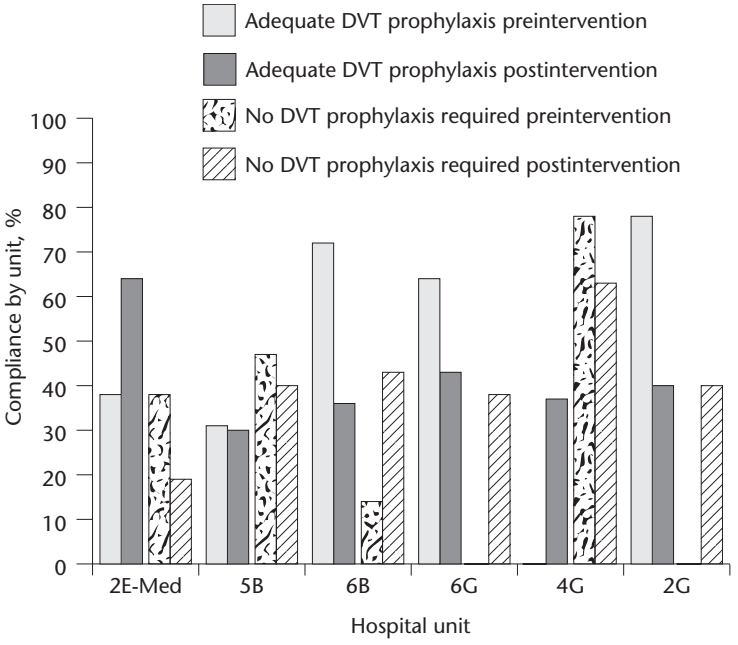

Figure 4. Compliance in prescribing adequate DVT prophylaxis by hospital unit. DVT = deep vein thrombosis; 2E-Med = medical unit; 5B = renal and dialysis unit; 6B and 6G = cardiac units; 4G = neurology unit; 2G = medical-surgical unit.

improved prophylaxis. Prior to the intervention, 50% of patients cared for by resident physicians received adequate prophylaxis; this number rose to 66% postintervention.

Discussion

The results of our study were not statistically significant. Overall, there was an increase in physician use of the DVT risk-assessment tool after our interventions. However, the number of patients receiving adequate prophylaxis only marginally increased and in some units actually declined. An associated finding in these units was an increase in the number of patients with a contraindication to pharmacologic prophylaxis. The reason for this increase is not clear. Although presumably a chance occurrence, it could explain the apparent decline in the number of patients who received adequate pharmacologic prophylaxis.

Improvement in DVT prophylaxis was greater when resident physicians were involved in patient care. One reason for this could be that residents are more adaptable to new interventions. Although residents did not receive any separate education from us, the fact that a resident-driven DVT prophylaxis project was in place could have made them more inclined to use the risk-assessment tool. This finding could also be related to the fact that all residents were supervised by attending physicians in an educational setting.

A greater number of patients with surgical admissions received adequate prophylaxis as compared with medically ill patients. This result was what we expected based on previous trends. In fact, the reason the orthopedic surgical unit was initially excluded from the study was that it had already attained a high rate of compliance. We similarly found a high rate of adequate prophylaxis in the general surgical unit and, thus, dropped this unit from the postintervention data analysis.

Our goal was to improve the use of the risk-assessment tool that was introduced as part of the hospital-wide initiative to lower the rate of DVT in hospitalized patients. We were surprised that our 2 additional interventions did not significantly impact physician behavior. However, there was a positive trend in that more physicians used the risk-assessment tool after our interventions, although the numbers were small. Physicians demonstrated some increased awareness but still seemed reluctant to place patients on DVT prophylaxis. There could be several reasons for this. Inclusion of a reminder in the ED standard admission form might have been effective but would not have made a difference for patients who were directly admitted from clinical settings. Despite multiple reminders to physicians, it was still possible to ignore the risk-assessment tool. Even when physicians used the tool, adherence to guidelines was not complete, perhaps because of fear of bleeding complications. Better physician education as to risks versus benefits of DVT prophylaxis may be helpful.

However, we suspected that in the majority of cases, physicians still failed to consider DVT prophylaxis and to therefore assess patient risk. This theory is somewhat supported by the subsequent progress

made in the hospital-wide project, which was continued after our portion was completed. Because there was significant improvement in DVT prophylaxis on the oncology unit, where the parallel intervention involving nursing education was introduced, the medical director provided direct education to nursing staff on all units. The job of the nursing staff was to remind the physician if DVT risk assessment had not been done. Also, the director reminded physicians in his monthly newsletter. The hospital continued to measure the medical staff's rate of compliance with adequate DVT prophylaxis. According to hospital data, at the end of the next 20 weeks, 3 of the 8 units were at 100% compliance and had reached this level by week 4. These results suggest that a combination of direct nursing and physician education may be a more effective method to improve awareness of the need for DVT risk assessment and compliance with adequate prophylaxis. Perhaps another reason for the improvement in the hospital data was that there had been enough time for our 2 interventions to take effect.

Our study has several limitations. First, our project involved 2 interventions done sequentially but within a short duration of time. There was not enough time between our interventions to accurately measure the effect of each. Also, we finished our project 4 weeks after our last intervention, and therefore there may not have been enough time to measure the effect of this intervention. The final numbers for our hospital are very encouraging and may suggest that a combination of all the interventions was the reason for the ultimate improvement in compliance.

Although we did a random chart review with some representation from all units, the number of charts reviewed before and after the intervention was not equal. The time period of data collection was also different before and after the intervention. Patient charts were reviewed from only a 5-week period preintervention compared with a period of 10 weeks postintervention.

Lessons Learned

This project was an exciting learning opportunity and our team's first experience as active participants in a QI project. It gave us an opportunity to work with the hospital medical director as well as other administrators. In the process, we realized that hospital-wide initiatives are not easy to implement. Introducing any new paper or electronic order form necessitates approval by the medical director, hospital administrators, and sometimes the board of directors. Even our relatively simple intervention of introducing DVT prophylaxis in the ED admission sheet took several weeks to take effect. Initially, we had doubts as to the advisability of taking on a hospital-wide project. It seemed as though our involvement would not have any impact. But, we learned that our interventions, however small or insignificant, had some utility. We were able to provide input into the hospital-wide project as to what might or might not have been effective, and this project is beginning to be successful. Importantly, we gained insight into the functioning of a hospital system and came to realize that many pitfalls in health care delivery are at least partly based in systems issues. Many factors must be taken into account before changes are made in a system.

In addition to learning about doing research, this project has taught us about leadership and teamwork. Working as part of a team was not always easy. A group of us had to work in a relatively short period of time to complete the project. But, we felt we were successful and benefited from the experience. Our group is now involved in another inpatient QI project, and the lessons learned our first experience in a hospital-wide project are being applied. For our current project, we would like to focus on 1 issue and use a single intervention to better measure its effect on the outcome. We know that at the outset we should have an outline of the time frame for our interventions and take steps necessary for implementation of any interventions prior to initiating the project.

Participating in this project also improved our awareness of the need for adequate DVT prophylaxis in hospitalized patients at risk for thromboembolism. Our group is now cognizant of the factors related to prescribing anticoagulants for prevention of thromboembolic complications, and we have conceived ideas for future methods to improve DVT prophylaxis. One of these is to insert a query regarding DVT prophylaxis in an electronic form. This could be incorporated in such a way that it was a required item on an admission checklist. Physicians would then need to address this item before they could move on to the next in the order sheet. Studies examining use of electronic alerts have shown that these prompts improved rates of DVT prophylaxis [10,11]. Also, we believe that further efforts to increase awareness and education about DVT prophylaxis are warranted. If the hospital-wide data collected after completion of our project are any indication, direct education appears to be effective. Perhaps patient education is the next step. Our hospital uses information stickers in nursing units and

bulletin boards to remind patients to ask for adequate pain management and infection prevention. Similarly, we could produce patient information fliers stating the importance of DVT prophylaxis and educating patients to ask physicians if they need prophylaxis.

Finally, we are also more aware of preventive measures in the hospital, whether related to thromboprophylaxis or not. We presented our project at a meeting that was open to all physicians and other personnel working at MMC. At the very least, it was yet another reminder to all of them of their role in reducing hospital-related morbidity and mortality.

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