Proactive Prophylaxis: Multidisciplinary Prevention of Pulmonary Embolism and Deep Vein Thrombosis

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Application Development: Alert Technology
Marilyn D. Paterno
Information Systems, Partners Health Care

Objectives

1. Describe how the alerting system works and what it needs in order to succeed.
2. Describe the specific process we developed to use the BWH alerting system for Proactive Prophylaxis Prevention of PE and DVT.

Abstract

The Brigham Integrated Computing System (BICS) is built on a common database structure that allows all of the data in its systems to be shared. Admitting records, demographic information, vital signs, lab results, surgery notes, and computerized order entry (CPOE) are all available to each other. This allows a great deal of interoperability to take place, and provides a fertile ground for robust clinical decision support systems to be built and implemented.

For more than 10 years, BICS has had two significant applications available in addition to the ones mentioned above. First, there is a paired Coverage List and Sign-Out application. Coverage List is a role-based system that assigns each House Officer to a role, and each role to a patient, allowing the computer to know at any given time who is responsible for "covering" the patient. Its companion, Sign-Out, allows the physicians to move their patients to coverage by another role as part of the process by which they share information on patient care and plan overnight.[1]

The second application is known as the "Event Engine", or Clinical Alerting System. In the Event Engine, rules are built using blocks of logic, with options available to determine how and whom to notify of an important event. It allows the physician to select from one or more action items, each of which can be handled by the system from the alert screen. Customizations that it provides include the opportunity to randomize alerting by patient or physician, limit it to patients admitted to certain services, and to receive late-arriving information that might change the nature of the alert. Notification can be by pager, email, changes to the pod (unit) census monitor, and/or sign-on. When sign-on is selected, the alerts are presented to the physician at the time he or she signs in to BICS. Selecting to page automatically selects sign-on in addition.[2]

Taken together, the available data and systems included all the components necessary for using electronic means to improve the quality of care for patients at risk for deep vein thrombosis or venous thromboembolism. The process that we created for this study follows the following steps:

1. A background job runs at 3:00 a.m. each day, gathering data on every patient in the hospital. Scores are applied to each set of data collected, and added up to create a DVT Risk Score. For all patients whose score deems them to be at risk, the verifying data are stored together and prepared to be sent through an inference engine for evaluation.
2. At 8:30 a.m., when sign-out procedures are likely to be completed, the data stored are sent by another background process to a processing queue that is called by the Event Engine Dispatch program.
3. Each set of data is evaluated for three conditions:
    a. Is the score > 3?
    b. Does the patient currently have any anti-embolism orders, such as for TED stockings or pneumatic compression boots?
    c. Is the patient being given any anticoagulant drugs?
4. For a rule to be true, the answer to a. must be “Yes”, and for b. and c. must be “No”.
5. When a rule is true for a patient, an audit record is created, and flags are set that will cause the alert screen to come up when the assigned physician next signs on to BICS.

An alert will be presented for the same patient in the same admission only once. To ensure that this will include patients with long-term stays in the hospital, we defined an “Episode of Care” of one year. The system detects the date of the initial alert, compares the date, and if less than a year has passed, does not notify the covering doctor.

When we reviewed the data from the initial study, it seemed reasonable to provide some method of escalation that would lead to an increase in acknowledgement rates, and therefore to the ordering of preventive prophylaxis to a greater number of patients who are at risk. The method we chose is to wait for 24 hours after an alert was sent, and if it has not been acknowledged by then, to page the attending physician for the patient. This escalation path has been added to the enhancements for part two of the study.

The specific data used to determine risk score are as follows:

1. Age. Patient over age 70 = 1 point.
2. Obesity. Patient with BMI > 20 = 1 point.
3. Surgery/Immobility. Patient having had major surgery in the past 7 days, *or* patient having orders for bed rest = 2 points. Orders for immobility are not sought if surgery occurred.
4. Hormone Therapy. Patient having orders for hormone therapy = 1 point.

5. Cancer. Patient with a diagnosis of cancer of any type = 3 points.
6. VTE History. Patient with a history of pulmonary embolism, venous thromboembolism, or deep vein thrombosis = 3 points.
7. Hypercoagulable state. Patients determined to be in a hypercoagulable state = 3 points.

The alert process that we devised is robust and dependable, and we are able to extract useful data to help prevent DVT. Our ability to put it into place with relative ease is due in large measure to the existing integrated systems that are in place at Brigham and Women's Hospital. We have designed it to be modular, in order to allow for changes to be made with as much flexibility and ease as possible.

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[1] Hiltz FL;Teich JM;. *Coverage List: a provider-patient database supporting advanced hospital information services*. *Proc Annu Symp Comput Appl Med Care* 1994; 809-813.

[2] Kuperman GJ;Teich JM;Bates DW;Hiltz FL;Hurley JM;Lee RY;Paterno MD;. *Detecting alerts, notifying the physician, and offering action items: a comprehensive alerting system*. *Proc AMIA Annu Fall Symp* 1996; 704-708.