Implementation Guide to Prevention of Venous Thromboembolism (VTE)

December 2012

Cynosure Health
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Secondary Driver: Link order set to risk stratification tool.

Secondary Driver: Link order sets to recent lab values.

Secondary Driver: Use alerts but understand alert fatigue, and the roles of soft and hard stops.

Secondary Driver: Use alerts for weight based dosing for heparin.

Secondary Driver: Monitor medication administration and mitigate failures in real-time.

Secondary Driver: Use “smart pumps” to minimize dosing errors.

Change Ideas:

Suggested Process Measures

“Hardwiring” Smart Use of Technology in Improvement Plans:

Potential Barriers

Tips on How to Use the Model for Improvement:

APPENDIX I: SIMPLIFIED VTE PROPHYLAXIS 2013

References
Overview

Background:
- Venous thromboembolisms (VTE) including pulmonary emboli are the most common causes of preventable hospital death.
- The risk for developing VTE ranges from 10 - 85% (and varies based on the reason for admission).
- The rate of fatal pulmonary emboli more than doubles between the ages of 50 and 80.
- A U.S. multicenter registry study showed that the majority of hospitalized patients with risk factors for venous thromboembolism (VTE) did not receive prophylaxis.

Suggested AIMs:
- Reduce the incidence of hospital-acquired VTE by 30% by December 31, 2013.
- Increase the utilization of appropriate VTE prophylaxis in at-risk patients to 100% by December 31, 2013.

Potential Measures:

**Outcomes:**
- Reduce the incidence of hospital-acquired VTE (# of VTEs per 100 admissions) by 50% in one year.
- Reduce the incidence of hospital-acquired VTE resulting in fatality (# of deaths due to acquired VTE per 100 admissions).

**Metrics:**
- The **percentage of patients screened** on admission using a VTE risk assessment tool.
- Compliance with appropriate VTE prophylaxis (i.e. the **percentage of patients** who should have received prophylaxis, whether screened or not, **that actually received appropriate prophylaxis**).

Note: “Hospital-acquired” includes the 30-day period post discharge

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<thead>
<tr>
<th>Primary Drivers</th>
<th>Ideas to Test</th>
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<tr>
<td>Effective risk assessment</td>
<td>Adopt a VTE risk assessment screening tool that is simplified as much as possible On admission, transfer, and other change of status, assess every patient for his/her risk for VTE, using the designated VTE risk assessment screening tool</td>
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| Develop best practices for prophylaxis | Review key resources, and identify and implement best practices  
• recognize that the evidence is continuing to evolve and that recommendations may change  
• understand that professional societies may vary in their recommendations depending on their specialty  
Adopt a standardized, risk-stratified menu of choices for prophylaxis that is simplified as much as possible |
| Standardize care processes | Develop standard sets of written orders which link the results of risk assessment to the choice of prophylactic treatments  
Identify contraindications to treatments and include them in order sets  
Allow for ‘opt-out’ as clinically indicated |
| Decision support | Use protocols for dosing and monitoring |
| Involve the patient and family | Alert patients and families to the early signs and symptoms of VTE  
Give clearly written and well-explained VTE discharge instructions to patients and families  
Use the ‘read back’ method to demonstrate that patients and families have a thorough understanding of prophylactic medication administration and dosing, as well as necessary follow-up instructions regarding physician visits and/or laboratory testing. |
Making Changes:

- This intervention is in the Collaborative with Reducing Pressure Ulcers and Falls (PIVOT Collaborative). National meetings, webinars, monthly coaching calls, change packages and other tools will augment state hospital association activities. The Collaborative will leverage the IHI Model for Improvement (Plan-Do-Study-Act).

Key Resources:

- Executive Summary: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines Chest February 2012; 141:2_suppl 7S-47S.
**Driver Diagram**

AIM: Reduce the Incidence of Hospital Acquired* Venous Thromboembolic Events by 30% by 12/31/13  
*Includes events occurring within 30 days of discharge

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<th>Primary Drivers</th>
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<th>Change Ideas</th>
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<tr>
<td>Effective Risk</td>
<td>• Adopt effective and reliable risk assessments to determine patient risks for</td>
<td>• Simplify screening results by grouping patients in low, medium and high-risk categories that dictate</td>
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| Stratification        | VTE and bleeding                                                                 | specific treatment options  
|                       | • Develop mechanisms to ensure risk screening for all admitted patients          | Screen patients upon admission, transfer to a new level of care, and when there is a change in their  |
|                       |                                                                                 | condition                                                                                               |
| Standardized Care     | • Create a system for incorporating regular updates from the medical literature, | • Use key resources as a starting point  
| Process               | recognizing that the evidence continues to evolve and may drive revisions in     | • Develop and implement standardized order sets which link level of risk to appropriate prophylaxis  |
|                       | policies, and that professional society recommendations may vary across specialties. | • Analyze the use of order sets to learn from the data and revise the process  
|                       | • Develop, Adopt, and Apply best practices to all patients                      | • Create a nurse/physical therapy-directed progressive mobility protocol  
|                       | • Develop standard order sets and protocols                                     |                                                                                                       |
|                       | • Allow “opt-out” methodology where clinically appropriate                      |                                                                                                       |
|                       | • Develop and implement ambulation protocols                                    |                                                                                                       |
| Decision Support      | • Monitor timeliness of anti-coagulant administration practices                 | • Understand the current practice status: use sampling strategies to perform real-time audits in various  |
|                       | • Use flowsheets that accompany the patient along transitions of care           | units from paper or EMR records  
|                       | • Have pharmacists round concurrently with physicians                          | • Use validated tools to assess current clinical staff knowledge about the risks of anticoagulants  |
|                       | • Use pharmacists to assist with identification of alternatives when contraind | • Pilot pharmacist participation on rounds in the ICU or the post-op orthopedics unit  
<p>|                       | ications to one medication protocol exist                                        | • Make pharmacists available to all clinical staff by telephone or EMR                                |</p>
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<tr>
<td>Prevention of Failure</td>
<td>• Have pharmacists perform independent double-checks of all VTE prophylaxis orders</td>
<td>• If using paper records, have nursing staff fax all documented risk assessments and medication contraindications along with the VTE prophylaxis orders to the pharmacy for review</td>
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<td>• If using electronic records, allow pharmacists to access risk assessments and order sets.</td>
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<td>• Communicate each patient’s VTE risk and prescribed prophylaxis to the entire health care team, including consulting physicians and nurses</td>
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<td>• If using electronic records, create hard stops for admitting and transferring physicians to address VTE risks and prophylaxis.</td>
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<td>Identification and Mitigation of Failure</td>
<td>• Educate patients and families regarding risks and symptoms of VTE, and risks of bleeding and other complications of prophylaxis</td>
<td>• Allow pharmacists via approved protocols to adjust unfractionated heparin and warfarin based on current lab values</td>
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<td>• Utilize front line clinicians as ‘first responders” to address over/under coagulation as per approved protocols</td>
<td>• Allow nursing to hold heparin or administer Vitamin K via approved protocols based on most recent lab values</td>
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<tr>
<td>Smart Use of Technology</td>
<td>• Link order set to risk stratification tool results</td>
<td>• Capture accurate weights on all patients on prophylaxis</td>
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<td>• Link order set to recent lab test values</td>
<td>• Send patient weight with VTE prophylaxis orders to the pharmacy for review</td>
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<td>• Use alerts, but understand the roles of soft and hard stops and the impact of alert fatigue</td>
<td>• Use the proper level of alerts with stops and forcing functions. Provide acknowledgement and drop-down opt-out lists for drug interactions and allergies</td>
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<td>• Use alerts to implement weight-based dosing for heparin</td>
<td>• Use EMR real-time reports to monitor electronic alerts when dosing occurs outside a specified window</td>
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<td>• In real-time, monitor and mitigate delays in medication administration timing</td>
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<td></td>
<td>• Use “smart pumps” to minimize dosing errors</td>
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Footnotes:
3 Geerts, WH et al, CHEST June 2008 vol. 133 no. 6 suppl 381S-453S. Retrieved at http://chestjournal.chestpubs.org/content/133/6_suppl/381S.full
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12 Hsiao et al, Nurses’ knowledge of high-alert medications: instrument development and validation, Journal of Advanced Nursing 66(1), 177-190.
Prevention of Venous Thromboembolism (VTE)

Venous thromboses are clots that develop in deep and superficial veins, frequently in the lower extremities in individuals whose mobility is limited due to illness, trauma, or surgery. Patients with venous thromboses can experience blockage of the affected blood vessel and local circulation, along with symptoms such as pain and swelling of the surrounding tissue or limb. An embolus occurs if part of or all of the clot breaks away from a deep vein and travels through the venous system to the heart and lungs, leading to acute morbidity or mortality. A VTE, which can include a pulmonary embolus (PE) secondary to a deep vein thrombosis (DVT), is one of the most common preventable causes of hospital death.1,2,3

The risk for VTE is nearly universal among inpatients, Fortunately, pharmacologic and mechanical methods to prevent VTE are safe, cost-effective, and supported by evidence-based research.4 Yet, despite the reality that hospitalized medical and surgical patients routinely have multiple risk factors for VTE, large prospective studies continue to demonstrate that these preventive methods are significantly underutilized.5,6,7,8,9,10

The Agency for Healthcare Research and Quality calls thromboprophylaxis against VTE (prevention of clots and emboli) the “number one” patient safety practice. The American Public Health Association has stated that the “disconnect between evidence and execution as it relates to DVT prevention amounts to a public health crisis.”11

The American College of Chest Physicians (ACCP) and the American Academy of Orthopaedic Surgeons (AAOS) have identified the following best practices for thromboprophylaxis:

- In medical patients, low-molecular-weight heparins (LMWH) enoxaparin and dalteparin have efficacy comparable to sub-cutaneous heparin when administered three times daily (SQ Heparin), but offer lower complication rates and other potential advantages for patients.12,13,14,15
- For certain higher-risk patient groups (e.g. patients post hip and knee replacement, trauma, and spinal cord injury) low-molecular-weight heparins, in some studies, have demonstrated superiority over subcutaneous heparin and fondaparinux.4,16,17,18,19,20
- Controversy does exist regarding thromboprophylaxis for hip and knee replacement patients. The ACCP prefers LMWH16 while the AAOS states that there is not enough evidence to recommend one form of pharmacologic prophylaxis over another.21
- In certain patient groups (e.g. patients post hip replacements or surgery for cancer, as well as some non-surgical patients with reduced mobility), extending LMWH prophylaxis for approximately 4-5 weeks may be more effective than providing only 1 week of treatment. However, the AAOS states that there is not enough evidence to recommend such an extension routinely, and that such extensions should be individualized.4,21,22,23,24
- In very high-risk patient groups, the adequacy of twice daily subcutaneous heparin has not been proven.4
- In very high-risk patient groups, the addition of mechanical prophylaxis to a pharmacologic regimen may offer added benefit. The AAOS recommends this
combination therapy in hip or knee replacement patients who have a history of prior VTE. 4,21

- Certain patient groups (such as the elderly or patients with impaired liver or kidney function, e.g. creatinine clearance < 30 cc/minute) should not receive certain pharmacologic agents or doses, or should receive smaller doses of LMWH 4
- Certain patient groups should receive pharmacologic doses in close coordination and timing with other critical events such as surgery.

Updated guidelines can often be found by visiting the National Guideline Clearinghouse at [www.guideline.gov](http://www.guideline.gov). 25

The clear messages from the literature are:

1. VTE is common among both medical and surgical hospitalized patients. 10
2. 50% or more of VTEs are preventable. 10
3. 10% of VTE events are associated with fatal pulmonary emboli, among the most common preventable causes of hospital death. 10
4. Complex assessment models for VTE risk are logistically difficult to incorporate into workflows and therefore typically associated with suboptimal utilization of prophylaxis. 4,10,16
5. Additionally, complex assessment models cannot confidently identify patients who do not require prophylaxis or predict how risk factors combine to position a specific patient along the spectrum of VTE risk. 4,10,16

Therefore, simple risk assessment models that stratify patients into several risk groups are favored over more complicated individual point-scoring systems. 10

**Suggested AIMs**

- Reduce the incidence of hospital-acquired VTE by 30% by 12/31/2013.
- Increase the utilization of appropriate VTE prophylaxis in at-risk patients to 100% by 12/31/2013.

**Effective Risk Stratification**

Effective risk stratification allows for the development of standardized processes that can drive more effective prophylaxis. Employing simple risk stratification makes this process easier to accomplish and more likely to be reliably applied in the busy hospital setting. Although easier to implement, this risk-grouping approach does not reduce the effectiveness of the selected therapeutic alternatives for individual patients.

**Secondary Driver: Adopt a risk-assessment screening system**

A screening tool should address the risks of VTE and the risk of bleeding for each patient.

Adopt a risk-assessment screening tool that is easy to complete and embed it into the workflow. More complex tools demand extra work and create reliability and sustainability challenges, while offering limited advantages in determining a therapeutic approach.
Secondary Driver: Risk screen all patients admitted.
Develop a VTE risk-screening tool and determine when and by whom it will be completed. As VTE morbidity and mortality is high, all admitted patients should be screened.

Secondary Driver: Repeat risk screening for patients with a change of condition.
Reevaluating the risks of VTE and the appropriateness of therapy is critical as a patient’s condition changes. For example, patients may have had contraindications for anti-coagulation because of planned surgery or certain types of injury. As they recover or move to a less intensive level of care, anticoagulant therapy may no longer be contraindicated and may even be beneficial. Conversely, patients whose status worsens might require a readjustment of their thromboprophylaxis orders. A post-operative case with complications may benefit from the addition of mechanical as well as pharmacological thromboprophylaxis to the treatment plan.

Change Ideas:
- Screen upon admission, upon transfer to a different level of care, and on a change of condition.
- Link VTE risk screening to another mandatory process such as medication reconciliation.
- Select a tool that segments patients into risk groups and recommends associated treatment options.

Suggested Process Measures
- The percentage of patients who receive screening upon admission
- The percentage of patients who receive screening upon transfer
- The percentage of patients who develop VTE and are not on prophylaxis

“Hardwiring” Effective Risk Stratification in Improvement Plans:
To avoid underestimating the risk of VTE in hospitalized patients, screening should be tied to a mandatory trigger such as admission orders, transfer orders, or medication reconciliation. Examples include:
- Developing a policy to require screening at specified intervals for units using paper records
- Creating a “soft stop” in an electronic medical record
- Adding independent reassessment by hospital pharmacist of any patient screened as low risk or who does not receive VTE prophylaxis orders within a designated period of time.

Determining who performs the risk-stratification (physician, nurse, or pharmacist), and how the results of risk assessment are communicated to the healthcare team, can promote staff adherence to the policy.

Standardized Care Processes
Standardized tools and processes ensure that every patient is evaluated and treated appropriately. To ensure regular and routine use, these tools may be linked to triggers such as admission, transfer, or surgery.
Secondary Drivers: Create a system to provide regular updates from the medical literature.
Designate a subcommittee of the medical staff such as the Pharmacy & Theraupetics Committee to oversee periodic review of medical literature as regards VTE prevention and treatment, including the identification and dissemination of updated protocols for thromboprophylaxis.

Secondary Driver: Develop standard VTE order sets and protocols.
“Standard work” assures that patients get the agreed upon standard of care by default, unless a patient is known to have a condition that would dictate alternate care. Order sets are one approach that can produce standard work and improve standardization by providing prompts for ordering providers. However, order sets offer a limited set of choices that may need to be adapted for patients in special circumstances.

Secondary Driver: Allow “opt-out” methodology where clinically appropriate.
Reliability theory has demonstrated that an “opt-out” approach, wherein a physician must act to remove a specific portion of an order set and justify those actions, can, in certain circumstances, lead to better outcomes. Analysis of “opt-out” orders and justified changes can:
1. show where there may be a need to improve a standard process;
2. lead to opportunities to educate clinicians as to best practices, and
3. underscore that certain uncommon or complex conditions may require clinician interventions that go beyond “standard work”.

Secondary Driver: Develop ambulation protocols
Reduced mobility is a risk factor for the development of VTE. Institute a process that assesses a patient’s mobility and generates recommendations for safe mobilization and interventions such as physical therapy, as appropriate. Nurse-driven mobility protocols have been shown to be effective in reducing immobility-related complications and hospital lengths-of-stay. 26, 27

Change Ideas:
• Start with key literature references that summarize current best practices.
  ○ Remember that evidence is evolving and that recommendations may change as new data are collected.
  ○ Recommendations from academic associations and specialty professional societies may also vary and evolve. 10, 16, 21, 28, 29
• Use the ISMP newsletters and national references to stay abreast of the literature; assign specific staff the responsibility to monitor and update the teams.
• Develop standardized order sets. See Appendix I for an example. Risks assessed should be linked with appropriate prophylaxis standards in the order sets.
• List the most common reasons for an ‘opt-out’ on the order sheet so that physicians can document justifications for subsequent analysis.
• Analyze opt-out justifications on a regular basis to help improve order sets, as well as to inform users of a standard process.
• Create a progressive mobility protocol directed by nursing or physical therapy. 30
Suggested Process Measures

- The percentage of patients who are classified in moderate or high risk groups and have VTE prophylaxis ordered.
- The percentage of patients who receive the correct form of VTE prophylaxis.

“Hardwiring” Standardized Care Processes in Improvement Plans:
If orders are provided on paper, create one form on a single page that serves as both a risk assessment form and a prophylaxis order form. The risk assessment should drive the prophylaxis orders. If orders are delivered electronically, design the system so that the risk assessment must be completed first and can then drive the appropriate prophylaxis. The order form should also list the most common alternate therapies and their justifications, allowing physicians to document the reasons for their decisions on the order form. These data can be collected and aggregated to promote individual and institutional learning.

Decision-Support
Decision-support can be divided into passive versus active. “Passive” decision-support occurs when clinicians are offered resources they can query regarding a specific patient condition or medication. Passive support is voluntary and not forced, and has not been shown to effectively change clinician practices enough to improve overall patient safety.

“Active” decision-support occurs when a prompt is given to the caregiver suggesting a best practice based on both research evidence and system knowledge about the individual patient (including the risk assessment). An electronic medical record (EMR) can use logic algorithms in real-time to analyze a patient’s clinical information, and notify clinicians of provider-approved recommended treatments. For paper records, a risk stratification tool can be linked to a pre-approved order set on the same page. “Active” decision-support has been shown to improve clinical practices and patient care.

Of course, such recommendations may not incorporate all of the significant patient factors and should only serve as guides for physicians as they use their clinical judgment.

Secondary Drivers: Use flow sheets that follow the patient through care transitions.
Medication administration flow sheets for anticoagulants should follow the patient from unit to unit with transfers. Lack of continuity of information during a handoff can result in errors with transitions of care.

Secondary Driver: Have a pharmacist available as part of the care team.
When clinical pharmacists are available on units and able to round as part of the care team, the team is more likely to utilize the pharmacist’s knowledge and expertise, improving medication-related decision-making and reducing errors. To optimize clinical pharmacist resources, target areas in the hospital where medication orders are frequent and complex, and where errors are more common.
Secondary Driver: Use pharmacists to identify alternatives when contraindications exist.
When a patient has a contraindication to standard therapy, decision-making can become challenging. Consulting a clinical pharmacist can provide guidance regarding other prophylaxis formulations and regimens available.

Change Ideas:
- Assess the current status of VTE prophylaxis and events for hospital units: use sampling strategies to perform paper or EMR audits for all units.
- Use validated tools to assess the current knowledge of clinical staff regarding the risks of VTE and anticoagulant therapies.31,32
- Pilot pharmacist participation on rounds in the ICU or the post-op orthopedics unit.
- Have pharmacists available for consultation with all clinical staff via telephone or electronic device.

Suggested Process Measures
- The number of consultation requests that the clinical pharmacist receives.
- The number of prophylactic anticoagulant orders that were modified as a result of pharmacist consultation.

“Hardwiring” Decision Support in Improvement Plans:
Add the pharmacists’ phone or pager number to the “opt-out” section of the order set.

Prevention of Failure
According to principles of reliability theory, processes to prevent failure, supported by processes to promptly identify and mitigate failure, provide the best mechanisms to provide reliable, effective and safe care. The following are some strategies and change ideas that been successful in this regard.

Secondary Driver: Independent double-checks of all VTE prophylaxis orders
Independent double-checks recognize “human factors”; i.e. that humans are not perfect and make mistakes. Assuming that clinicians never make mistakes leads to predictable error. Having one clinician double-check the work of another, (e.g. a pharmacist reviewing a physician’s VTE prophylaxis orders), helps to insure that order errors (drug, dose, frequency, and route) do not occur.

Change Ideas:
- If using paper records, have nursing staff fax the VTE prophylaxis orders along with all risk assessments and documentation of medication contraindications to the pharmacy for review. If using electronic records, provide access to medication orders and risk assessments to the pharmacists.
- Ask pharmacists to double check the appropriateness, correctness, and completeness of the VTE orders as guided by evidence-based medical staff policy.
- Communicate each patient’s VTE risk and prophylaxis recommendations and/or orders to the entire health care team including consulting physicians, nurses, and physical
therapists (e.g. designate a location where all members of the healthcare team have access).

- Create process “stops” at admission and transfer that require the appropriate clinician to acknowledge and address VTE risk and prophylaxis.

**Suggested Process Measures**

- The percentage of “opt-out” orders that are sent to the pharmacist.
- The percentage of patients with VTE prophylaxis orders that are changed at transfer to a different unit or level of care.
- The percentage of moderate or high risk patients without VTE prophylaxis orders.

**“Hardwiring” Prevention of Failure in Improvement Plans:**
Create process “stops” in workflows that:

- require pharmacy review of VTE prophylaxis orders, and
- clinician review of risk and VTE prophylaxis orders when a patient is admitted or transferred to a different level of care.

**Identification and Mitigation of Failure**
It is very difficult to design a system that prevents failure at all times. Early identification and mitigation of failure when it does occur is critical for the promotion of process reliability.

**Secondary Driver: Educate patients and families**
Education of patients and families regarding the risk of VTE, anti-coagulant-induced bleeding, and other complications, can both prevent and mitigate failures when they occur. The patient or family member may be the first to become aware of the signs of a complication of anti-coagulation, side effects of mechanical prophylaxis, or signs and symptoms of VTE, and can share these observations with the healthcare team in a timely manner. Creating an environment in which the patient or family feels comfortable asking questions and raising issues to clinicians promotes good communication and patient safety.

**Secondary Driver: Utilize protocols for anti-coagulation.**
One of the causes of delay in treating over- or under-anti-coagulation is the necessity of locating and consulting with the ordering physician. Allowing nurses or pharmacists to respond to an emergency and stop anti-coagulation, give reversal agents, or adjust dosages as per a pre-approved protocol can reduce delays and risks for patients.

**Change Ideas:**

- Allow nursing staff to hold heparin administration or administer Vitamin K based on designated acute lab test values via pre-approved protocols.
- Allow pharmacists to adjust unfractionated heparin and warfarin dosage based on current lab values via pre-approved protocols.
- Involve patients and families in the design of patient education materials that enhance communication with clinical staff and patient safety.
**Suggested Process Measures**

- The **number of out-of-range lab values in one week** for patients receiving prophylactic anticoagulation
- The **number of patients who are able to verbalize the warning signs** of treatment complications and the **next steps** for clinical staff notification.

**“Hardwiring” Identification and Mitigation of Failure in Improvement Plans:**
Create and approve medical staff policies that allow pharmacists and nurses, in pre-approved situations, to stop or adjust coagulation doses based on the most recent lab values without first contacting the treating physician. Develop a “closed-loop” system to address critical lab values that identifies all the steps necessary to rectify the concern and ensure it is managed appropriately. Periodically audit the process to ensure it is functioning as a closed-loop.

**Smart Use of Technology**
Technology, used smartly, can drive improvement. Technology must be designed and implemented to be aligned with human approaches to thinking and workflow, and to eliminate or mitigate common causes of human error.

**Secondary Driver: Link order set to risk stratification tool.**
This is perfectly suitable for the smart use of technology. When the clinician completes risk stratification, the technology automatically leads the clinician to the recommended choices of orders for that risk stratification.

**Secondary Driver: Link order sets to recent lab values.**
As pre-approved in medical staff policies and procedures, laboratory results can prompt clinicians to alter anti-coagulation therapy. For example, a medical staff policy can be developed that allows a nurse or pharmacist to alter an anti-coagulant dose if a specific lab test result is outside of accepted range.

**Secondary Driver: Use alerts but understand alert fatigue, and the roles of soft and hard stops.**
Alerts can be very useful, but if overused when not necessary, they are likely to be ignored, i.e. “alert fatigue.” “Soft stops” are alerts or pop-ups that encourage providers to consider recommendations, reminders, triggers, or information in their decision-making process, but do not require a specific action. “Hard stops” halt the process, and require a specific action to resume process function.

**Secondary Driver: Use alerts for weight based dosing for heparin.**
Some protocols require the calculation of heparin dosing by weight. Weight-based dosing can be safer and more effective, particularly in populations with widely-varying BMIs. An electronic record can easily assist with calculating the recommended dose by using the entered patient weight. The pharmacist can also double-check the dose via an integrated EMR system.
**Secondary Driver: Monitor medication administration and mitigate failures in real-time.**
Electronic monitoring of medication administration allows charge nurses and pharmacists to run real-time reports regarding delayed administration of medications. Delayed administration or missed doses of an anticoagulant could have significant negative consequences for the patient. Catching and mitigating these delays in real-time can improve the efficacy of prophylaxis. In addition, analyzing the data may lead to insights that promote improvements in the systems of medication delivery that will decrease the incidence of delays.

**Secondary Driver: Use “smart pumps” to minimize dosing errors.**
Smart pumps can alert clinicians to potentially unsafe drug therapy prior to drug administration. The smart pump is designed to fuse traditional infusion-pump technology with pre-determined clinical guidelines and IV drug administration protocols. If program choices entered are outside a designated range, the pump sounds an alarm, indicating a “soft stop” or “hard stop” warning. A soft stop allows the infusion to continue without the need for dosing choices to be reentered. With a hard stop, the choices must be reprogrammed to comply with the pre-approved dosing guidelines.

**Change Ideas:**
- Capture accurate weights for all patients on prophylaxis for use by the ordering clinician.
- The pharmacist should receive the patient weight with the VTE prophylaxis orders.
- Use alerts with forcing functions and stops at the proper level and frequency.
- Provide an acknowledgement and drop-down opt-out list for drug interactions, contraindications, and allergies.
- Use EMR real-time reports to send electronic alerts when dosing occurs outside specified guidelines.

**Suggested Process Measures**
- The percentage of patients stratified to moderate or high-risk groups that receive appropriate prophylaxis orders by weight.

**“Hardwiring” Smart Use of Technology in Improvement Plans:**
Hardwiring clinical processes into electronic systems promotes safety and reduces the ability of staff to ignore or work-around necessary measures. However, implemented alerts should be designed to be relevant and helpful to the clinician so as not to be ignored. Overuse of alerts may condition clinicians to ignore warnings and other types of intelligent electronic support provided.

**Potential Barriers**
- Recognize that the use of “smart” technology will be a change of practice for some physicians. Physicians may also resist pharmacist input regarding anti-coagulation. However, clinicians have traditionally underestimated VTE risk. They may be unaware of the expertise and knowledge pharmacists have in the area of VTE prophylaxis that can aid in clinical decision-making. It may be necessary for individuals or groups from the medical staff to receive education and coaching which outlines the benefits of these new approaches for providers and patients. Enlisting respected physician champions who
have successfully used these new technologies and processes as mentors can help transition more hesitant clinicians towards acceptance.

- Some physicians may be uncomfortable with having pharmacists review orders. Physician and pharmacist education, supported by approved medical staff policies that outline the pharmacists’ scope of practice and their communications with ordering physicians, can help to overcome these barriers.
- Clinicians may resist a process stop that requires reassessment of VTE risk when a patient is transferred to a different level of care. Reporting of data and experiences in which stops resulted in treatment changes that reduced VTE risk and improved patient outcomes can be helpful.
- Use “smart” technology intelligently. Some clinicians may resist adoption of technology because the process is too complicated and burdensome—make their work easier, not harder. For example, outline the common contraindications (as supported by current evidence) for a specific VTE protocol/order set and provide this information clearly on the ordering page to assist the clinician in decision-making.
- These improvements will be new territory not only for physicians, but also for many nurses and pharmacists. Nurses and pharmacists may be concerned about making a mistake or about not having adequate training to implement the new policies. They may also fear that the medical staff will not be receptive or cooperative. Education of all parties about the risks of delayed intervention vs. the efficacy of immediate intervention will help mitigate these concerns. Framing nurses’ and pharmacists’ roles as “first-line responders” could ease physicians’ acceptance.

**Use administrative leadership and sponsorship to help remove or mitigate barriers:**

- Implementing changes in practices to reduce VTEs will demand advocacy from all the units involved via effective physician, pharmacy and nursing leaders and champions. Their efforts can overcome perceptions that such changes are burdensome, punitive, or dangerous.
- An executive sponsor from senior management, who recognizes the value of preventing VTE and its complications to patients and to the organization, can help brainstorm and implement solutions to promote stakeholder acceptance and remove barriers, as well as provide resources and education across the organization that underscore the benefits of these new processes.

**Change not just the practice, but the culture:**

- Changing the culture will likely be necessary, especially for physicians, who will be asked to trade their traditional individualized approach to risk assessment and prophylaxis for a team-based standardized approach. They may be loath to relinquish control and worried about negative consequences for their practice and their patients. Providing education about the proven benefits of standard processes can reassure hesitant physicians that these changes will benefit their patients.
- Order sets may make some physicians uncomfortable. Most physicians learn best from peers and will often value their peers’ recommendations over “expert advice.” Physician
champions and early adopters can provide a positive peer influence that can inspire other physicians to embrace new procedures.

- Some physicians are not used to consulting with pharmacists regarding patient treatment decisions, and may not be aware of the breadth and depth of their training and expertise. Beginning the change process with a receptive local unit for a small test of change can demonstrate the value of pharmacy consultations. Successful trials can then be disseminated to other units across the organization.

**Tips on How to Use the Model for Improvement:**

- Tips for identifying barriers to timely anti-coagulant administration:
  - Design and conduct a very quick assessment of the last 20 doses of anticoagulants on VTE patients.

- Tips on mitigation of error:
  - Examine data or reports about the length of time it takes to contact a treating physician to get orders changed if lab results are out of range, and the patient safety consequences of these delays.

- Tips for developing and implementing risk stratification and VTE prophylaxis order sets:
  - Ask one or two of the physicians on the improvement committee to trial these processes during their next three admissions.
  - Begin the trials in one unit.
  - Reconvene and debrief after the small trials and identify modifications needed in the process. Repeat the trial if needed.
  - Order sets: Design a small pilot on a unit where the lead physicians and nurses are open to testing this innovation.
    - Try the new procedures with a few patients.
    - Consider implementing nursing or pharmacy intervention at first only with critical values well beyond the expected lab result range. For example, allow nurses or pharmacists to stop warfarin when the INR >6.0.
    - Once the team achieves success and confidence in implementing these procedures, the INR at which nurses and pharmacists would be authorized to act can be lowered.
APPENDIX I: SIMPLIFIED VTE PROPHYLAXIS 2013

Principles:

- Sensible prophylaxis is effective in moderate-risk and high-risk patients.
- Bleeding concerns tend to be overestimated.
- Every hospital should develop a formal strategy that addresses the prevention of VTEs.
- VTE prophylaxis protocols must become a routine part of the patient care culture.
- ‘Simple’ is effective:
  - If an intervention isn’t simple, opportunities will be missed, and errors will be more likely to occur.
  - When prophylactic methods are equivalent, choose the method that simplifies the overall approach.
  - Remember that clinically acceptable alternatives exist.

The following is an example of a Simplified Evidence Based Recommendation: (normal bleeding risk)

<table>
<thead>
<tr>
<th>VTE Risk: Low</th>
<th>Medical: fully mobile, brief admission</th>
<th>No specific prophylaxis</th>
<th>Early mobilization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surgical: procedure &lt;45 minutes,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>mobile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VTE Risk: Moderate</th>
<th>Medical: bed rest, sick</th>
<th>LMWH (Grade 1A)</th>
<th>Start post-op</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surgical: major general, urologic or gynecologic procedures</td>
<td>Continue until discharge</td>
<td></td>
</tr>
</tbody>
</table>

| VTE Risk: High | Medical: major orthopedics | LMWH
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Major trauma</td>
<td>Continue for up to 35 days (Grade 2B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>THR, TKR: Start 12 hours pre-op (Grade 1B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HFS: Start &gt;4 hours pre-op if surgery delayed</td>
</tr>
</tbody>
</table>
LDUH is also Grade 1A\textsuperscript{16}

Addition of mechanical prophylaxis to LMWH in patients at high risk for VTE may be beneficial (Grade 2C)\textsuperscript{16}

The AAOS states there is not enough evidence to distinguish among pharmacologic prophylaxis options.\textsuperscript{21}

The ACCP states that fondaparinux and LDUH are now Grade 2B.\textsuperscript{16} The AAOS states there is not enough evidence to distinguish between pharmacologic prophylaxis options.\textsuperscript{21}

**Recommendations: high bleeding risk:**

<table>
<thead>
<tr>
<th>Active bleeding</th>
<th>Use mechanical prophylaxis, preferably IPC (Grade 2C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Known major bleeding disorder</td>
<td>Re-evaluate and add LMWH when bleeding risk subsides. (Grade 2C)</td>
</tr>
<tr>
<td>Platelet count &lt;50,000</td>
<td></td>
</tr>
<tr>
<td>Intracranial bleeding in prior five days</td>
<td></td>
</tr>
<tr>
<td>All neurological and spinal surgeries</td>
<td></td>
</tr>
<tr>
<td>Heparin induced thrombocytopenia</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

- Inferior vena cava filters are not indicated for VTE prophylaxis and will increase DVT risk.
- Routine calf ultrasound surveillance for DVT not indicated.
- IPCs are generally preferred to GCSs but may be tolerated less well, be more costly, and result in lower adherence by patients and staff. Calf length is preferred and results in better compliance and fewer infections.

**Abbreviations used:**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCS</td>
<td>Graduated compression stockings</td>
</tr>
<tr>
<td>HFS</td>
<td>Hip fracture surgery</td>
</tr>
<tr>
<td>IPC</td>
<td>Intermittent pneumatic compression</td>
</tr>
<tr>
<td>LDUH</td>
<td>Low density unfractionated heparin</td>
</tr>
<tr>
<td>LMWH</td>
<td>Low molecular weight heparin</td>
</tr>
<tr>
<td>THR</td>
<td>Total hip replacement</td>
</tr>
<tr>
<td>TKR</td>
<td>Total knee replacement</td>
</tr>
<tr>
<td>VTE</td>
<td>Venous thromboembolic events</td>
</tr>
</tbody>
</table>
References

31 Hsaio et al, Nurses’ knowledge of high-alert medications: instrument development and validation, Journal of Advanced Nursing 66(1), 177-190.