Preventing Hospital-Acquired Venous Thromboembolism

A Guide for Effective Quality Improvement
Version 3.3

Society of Hospital Medicine

Greg Maynard MD, MSc
UCSD

Jason Stein, MD
Emory University Hospitals

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Preface: Recognizing and defining the general quality problem

Quality improvement (QI) projects should always develop from recognition of a gap between the optimal care contrasted to the care that is actually being delivered. Hospitals are complex systems. Over time each hospital accumulates its own set of care processes - some coordinated, some autonomous - which directly affect inpatient outcomes. As systems, hospitals are perfectly designed to achieve exactly what they do, so improving the output of a hospital requires change.

Not all change results in improvement, however. Recently, several systematic reviews have attempted to gauge the efficacy and effect size of the known universe of quality improvement strategies, but research in hospital care delivery has yet to elucidate a transferable strategy to deliver optimal care on a consistent basis. A review of quality improvement studies published in major journals in the U.S. found that three-quarters used simple before-after designs, often at single sites within single centers, making it challenging to attribute observed benefits to the studied intervention. The state of the science suffers from more than a lack of rigor in study design. The choices of particular interventions fundamentally lack compelling theories that would predict success. While a taxonomy for quality improvement strategies was recently derived from one of these systematic reviews, the literature still does not reflect adoption of standardized language to articulate the mechanisms underpinning performance improvement.

Until research in hospital care delivery is able to elucidate transferable strategies to deliver optimal care on a consistent basis, QI practitioners must rely heavily on experience and ingenuity. The same skills most critical for driving actual improvement in the hospital – designing, managing, and leading change successfully over time – are also commonly missing from clinician skill sets. This guide, derived primarily from principles of QI and personal experiences, is designed to help the QI practitioner lead an efficient, reliable effort to improve prevention of one of the most important problems facing hospitalized patients, hospital-acquired venous thromboembolism (HA-VTE).

Pulmonary embolism (PE) resulting from deep vein thrombosis (DVT) – collectively referred to as venous thromboembolism – is the most common preventable cause of hospital death. Fortunately, pharmacologic methods to prevent VTE are safe, effective, cost-effective, and advocated by authoritative guidelines. Yet, despite the reality that hospitalized medical and surgical patients routinely have multiple risk factors for VTE, making the risk for VTE nearly universal among inpatients, large prospective studies continue to demonstrate that these preventive methods are significantly underutilized.

The Agency for Healthcare Research and Quality calls thromboprophylaxis against VTE 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.” While individual centers have published results of successful local initiatives for improving prevalence of VTE prophylaxis, no single strategy has proven yet to be effective, sustainable, and widely applicable to other centers. One thing is certain, however. To implement effective protocols minimizing incidence of HA-VTE - while at the same time minimizing adverse outcomes - redesign is needed in both care delivery and performance tracking.
Ideas for what to change, how, and how to manage change successfully over time should come from a local improvement team, ideally a selection of established or emerging leaders with experience as frontline caregivers or complimentary insights. Members of this multidisciplinary team should have knowledge of the evidence base, local influence or insight into care delivery, or a framework for leading quality improvement. In a growing number of hospital systems, hospitalists are prime candidates to lead such teams.

**Essential elements** to reach breakthrough levels of improvement in care include:

1. **Institutional support** and prioritization for the initiative, expressed in terms of a meaningful investment in time, equipment, personnel, and informatics, and a sharing of institutional improvement experience and resources to support any project needs
2. **A multidisciplinary team or steering committee** focused on reaching VTE prophylaxis targets and reporting to key medical staff committees
3. **Reliable data collection and performance tracking**
4. **Specific goals, or aims**, which are ambitious, time-defined, and measurable
5. **A proven QI framework** to coordinate steps towards breakthrough improvement
6. **Protocols** that standardize VTE risk assessment and prophylaxis
7. **Institutional infrastructure, policies, practices, or educational programs** promoting the use of the protocol. The protocol that standardizes VTE risk assessment is so fundamental that it must not merely exist. It must be embedded in patient care. High reliability design should be used to enhance effective implementation.
How to Use this Guide

In its progress, quality improvement unfolds along several parallel fronts. Many steps in an initiative occur simultaneously and are often interdependent (Diagram 1). This guide offers a framework to help the QI practitioner achieve important milestones along the path to breakthrough levels of performance. The guide is divided into 5 sections, presenting the steps of a QI project in a logical progression.
Introduction. Essential First Steps

1. Ensure Support from the Institution

The time, energy, and expertise of a physician leader are necessary to drive improvement. But alone they will not be enough - absolutely essential is sponsorship and support from the medical center, specifically from key leaders. Such basics as revisions to order sets, data collection resources, or tweaks of health information system may require special permission, fast-track approval processes, or dedicated personnel. While most obstacles will require merely patience or ingenuity, some may be insurmountable without the influence of executive leadership.

Real support should confer the authority and resources needed for the improvement team to design and manage change. We strongly recommend that the quality improvement practitioner pauses long enough to get a commitment from the institution to back the effort.

The single most effective way to attract this support is by aligning the goals of the QI effort with the strategic goals of the organization.

Make hospital leadership aware of how an effective VTE prevention program aligns with its goals for medical care, performance reporting, customer service, and cost containment. A number of forces may fuel administrative interest in the project, including public reporting of hospital performance (e.g. The Joint Commission and National Quality Forum measures), cost savings from more efficient care, risk aversion, favorable payments for better care (e.g. Pay-for-Performance), nursing and medical staff retention (e.g. Magnet Recognition Program), related projects (Surgical Care Improvement Project), and even quality for quality’s sake. Appendix A contains “Talking Points” to garner support from administration.

In addition to using the talking points in Appendix A, simple calculations, or “back-of-the-envelope math” are useful for gross estimates of impact. Over one year, a 300-bed hospital that lacks a systematic approach to VTE prevention can expect roughly 150 cases of HA-VTE. Approximately 50-75 of those cases will be potentially preventable through missed opportunities to provide appropriate prophylaxis. Approximately 5 of those patients will die from potentially preventable PE. Each hospital-acquired DVT represents an incremental inpatient cost of $10,000, while each PE represents approximately $20,000 in additional cost.

Another quick method to estimate the impact of a VTE prevention program uses coding information as follows: run a query using all codes for DVT and PE (see Appendix B for codes of interest). These codes will represent both the HA-VTE and the cases admitted to the medical center with pre-existing DVT or PE. At least half will be HA-VTE, and if the VTE prophylaxis rate is 50%, half of those will be potentially preventable HA-VTE. Alternatively, patient may be defined as having HA-VTE when the diagnosis code is a secondary (rather than primary) diagnosis.

Both above methods can only generate a rough estimate of the impact of a VTE prevention program. A more robust and accurate approach is outlined in the section on Performance Tracking (Section 3). But these rough estimates can paint a useful picture to demonstrate the need to members of care teams and to administration.
Introduction. Essential First Steps

2. Survey previous or ongoing efforts and resources

In many ways a multidisciplinary QI team is building, flying, and navigating an aircraft that is already airborne. Therefore it pays to know exactly what resources or circumstances are already available. Experience, precedents, or skilled individuals can significantly lift an effort. Conversely, working at odds with infrastructure or strategic goals can sabotage everything.

Each of the items below could affect the approach to this improvement effort. These items can influence interventions and the performance tracking system. The QI team should find the answers to these questions.

a) What is the existing quality improvement infrastructure? What support or services are available for this project?

b) Are there any ongoing quality improvement initiatives to learn from or leverage?

c) Are there any initiatives that could influence support for a VTE prevention effort: e.g. pursuit of Magnet Recognition, Ventilator Associated Pneumonia bundle, Surgical Care Improvement Project (SCIP), interest in TJC/NQF proposed core measures

d) What performance data on VTE prevention or VTE events already exist?

e) Are there any major lessons from previous or ongoing interventions to prevent VTE?

f) How successful were previous VTE risk assessments and why? Were they integrated into order sets?

g) Are there ongoing VTE educational or awareness activities for medical staff?

h) Are hospital policies capable of enforcing provider performance of anything, e.g. medication reconciliation, vaccinations, VTE prophylaxis, etc?

i) How fragmented is care in the hospital? Are ICUs open or closed? Are patients geographically cohorted by service/specialty?

j) What are the existing practices for standardizing care transitions between settings, e.g. ER-to-floor, ICU-to-floor, OR-to-floor, direct admissions?

k) Can precedents be leveraged that have engaged patients in promoting medical staff accountability for any specific care goals?

l) In what areas of the hospital are nurses engaged in promoting medical staff accountability for any specific care goals, e.g. daily goals worksheet, participation in multidisciplinary rounds?

m) In what precedent-setting ways do clinical pharmacists already participate in care delivery, e.g. participation in multidisciplinary rounds, pharmacokinetics consults, pages to providers to adjust medication dosages for estimated GFR, etc?

n) Could the electronic health information or paging system relay clinical information to members of the care team: e.g. alerts by email, text page, fax, or CPOE?

o) Is there a precedent anywhere in the institution for feeding back individual (or service line) performance to providers?

p) Does the medical center have an electronic medical record? CPOE? Digital radiology?
Introduction. Essential First Steps

3. Clarify key stakeholders, reporting hierarchy, and approval process

Every medical center has stakeholders who should be made aware of efforts. These stakeholders are often individuals, but they can also be committees, services, training programs, hospital initiatives, or departments. The awareness, even the overt “buy-in,” of these groups will be important to boost early adoption of interventions. They may also offer legal protection for information uncovered and advance educational efforts. Early use of the proper reporting structure and approval processes is wise. Typically, these groups will include:

1. Pharmacy and Therapeutics committee
2. Nursing groups
3. Orthopedics / Surgery / Trauma leaders
4. Patient Safety committee
5. OR or Perioperative Committees
6. Chief residents and residency program directors
7. Departmental committees
Introduction. Essential First Steps

4. Assemble an effective team

Quality improvement efforts often originate from just a few thought leaders who see a gap between best practice and current practice. The VTE prevention team should quickly include:

**Team Leader:** The team leader should be a physician respected by the medical staff and ideally with some topic expertise on VTE prophylaxis and/or anticoagulation. This physician is responsible for setting the agenda, the frequency and collaborative tone of team meetings, and communicating directly with administrative and appropriate medical staff committees.

This position of influence is best held by a physician hospitalist leader, pulmonologist, hematologist, critical care physician, surgeon, or other physician leader. Though the team leader does not personally take the minutes, the team leader should edit and "own" the minutes for presentation to senior leadership. The team leader will need the commitment and contributions of other team members to move the initiative forward. The team leader and the team may need to recruit local champions based on service or hospital geography. For example, a pulmonary/critical care physician may lead efforts on VTE prophylaxis in the ICUs while a hospitalist may lead efforts on the floor/wards. Alternatively, a hospitalist or other individual may lead the entire effort. Whatever the format, a coordinated effort is required across the entire spectrum of care.

**Team QI Facilitator:** The QI facilitator, who may or may not be a physician, should be someone with QI experience. The QI facilitator plays the pivotal role of ensuring that the team functions constructively and that the project stays on track. This role requires project management skills and at times may call for ability to balance team dynamics or introduce appropriate QI tools. The QI facilitator need not have mastery of QI tools at the onset of the project, but should have a readiness to acquire new tools and a talent for moving projects forward. Mastery of the VTE literature is not important for this position. For smaller scale projects, the team QI facilitator could be the same person as a team leader, but for more ambitious projects or for projects involving buy-in from disparate physician and nursing groups, a separate facilitator is strongly recommended.

**Process Owners:** The frontline personnel involved in the process of providing VTE prophylaxis in the hospital are essential for an effective team wishing to optimize VTE prevention. Process owners should come from each service (pharmacy, nursing, etc) and geography (medical, surgical, ICU, etc).

**IT/HIS Experts:** From performance tracking to actual QI interventions, the contributions of information technology or health information system experts will be pivotal. Enlist those who can report ICD-9 code frequencies at discharge, perform data entry, can set up reports from the electronic clinical data warehouse and radiology, and who can be a liaison to medical records.

**Team Dynamics:** While meetings with the whole team are invaluable they can occasionally become impractical or impossible to schedule. Team ‘huddles,’ where a fragment of the team meets briefly to advance action items, can be very effective for overall progress. How team members interact with one another is also important. The key dynamic for an effective team is the removal of authority gradients. Since the perspective of every team member is potentially
critical, every perspective must be heard. To do that each team member must be comfortable expressing his or her viewpoint. Try to pick people who have reputations for being collaborators. It is up to leader and facilitator to enforce constructive team dynamics.

Listing the names and contact information for the VTE prevention team members, and keeping the list updated, especially electronically or online, is very useful.
Introduction. Essential First Steps

5. Set general goals and a timeline

Setting a goal is a great way to help the team stay focused and communicate with stakeholders. For clarity of purpose and to overcome initial inertia, in the early stages the team needs only to agree on general goals (e.g. reduce cases of hospital-acquired VTE).

The general goal also should be a “stretch,” one that is aggressive enough to mandate a change in design from the current process in order to achieve it (e.g. eliminate preventable cases of hospital-acquired VTE).

In addition to setting a stretch goal, at this early stage it helps also to be clear about the initial and eventual scope of the effort. Will the focus be on medical patients, surgical patients, or both? Initially it is reasonable and even advisable to “take small bites” by piloting interventions on a small scale (e.g. eliminate preventable cases of hospital-acquired VTE from medical floor 5G).

Try to be as inclusive as possible about the eventual scope. Why improve care for just a sub-set of patients? Serial testing and learning on a small scale can make even very large projects more manageable. Improvement strategies can be spread to other areas (e.g. eliminate preventable cases of hospital-acquired VTE from all medical and surgical floors and all ICUs).

Lastly, the team needs a deadline to hold itself accountable. The timeline should be ambitious but also realistic. For piloting a single improvement intervention on a single medical floor, a timeline of 12 weeks is reasonable. For spreading a series of improvement changes across an entire system, 12-18 months may be more appropriate.
Introduction. Essential First Steps

6. Use a structured framework for improvement to plan and guide progress

For team members (and as a communication aide for stakeholders), there is great value in knowing how each of the team’s activities contributes to the overall progress of the improvement effort. A coherent framework is as important to quality improvement as an understanding of aeronautics is for building an aircraft.

The team will advance the quality improvement project along several fronts simultaneously. A logical flow for a QI project, summarized below.

A Framework for Improvement
1. Lay out the evidence / identify best practice. Determine what needs to be done for whom, and then draft a VTE protocol to standardize it.
2. Analyze care delivery. Highlight the steps in the clinical workflow where interventions will have the highest yield.
3. Create performance tracking. Set up regular data collection and charting that is reliable, inexpensive, and directly relevant to the aim.
4. Integrate the VTE protocol into the clinical workflow and then layer other QI strategies that use high reliability mechanisms
5. Perform cycles of PDSA (Plan-Do-Study-Act) to perfect #3 and #4

The diagram on the next page presents the 5 steps graphically to depict inter-relationships.
Diagram 1: Sequence and Relationship of Steps in a QI Project Aimed at Reducing Incidence of Hospital-Acquired VTE

1. Draft a VTE protocol* using best available evidence
2. Analyze care delivery
3. Set up performance tracking
4. Introduce VTE protocol, then augment with other high reliability QI strategies
5. Perfect QI strategies & performance tracking through cycles of Plan-Do-Study-Act

*VTE protocol = decision support for risk stratification + menu of appropriate prophylaxis options for each level of risk

Key Metric #1: Rate of Appropriate VTE prophylaxis
- 50%
- 40%
- 65%
- 90%
- 100%
Section 1: Lay Out the Evidence / Identify Best Practice

1. Know what the literature says about risk for VTE

The team will need to rely on at least one content expert to bring fluency with the evidence base and best practice for preventing HA-VTE. Especially relevant or authoritative are the published performance measures from the Joint Commission and guidelines from the American College of Chest of Physician’s conference on Antithrombotic and Thrombolytic Therapy. We recommend supplementing that consensus statement as needed with the reading list in the “Literature Review” section of the Society of Hospital Medicine’s VTE Quality Improvement Resource Room. At least three central realities emerge from the current VTE prevention literature, each with important implications for the team.

Reality #1: While the number and type of VTE risk factors appear to influence a patient’s overall VTE risk, there is no validated method to predict accurately or efficiently an individual patient’s risk for VTE.

Meanwhile, in the absence of prophylaxis, the risk of VTE across almost all populations of hospitalized patients is significant.

<table>
<thead>
<tr>
<th>Patient group</th>
<th>DVT incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical patients</td>
<td>10 - 26 %</td>
</tr>
<tr>
<td>Major gyne/urol/gen surgery</td>
<td>15 - 40 %</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>15 - 40 %</td>
</tr>
<tr>
<td>Stroke</td>
<td>11 - 75 %</td>
</tr>
<tr>
<td>Hip/knee surgery</td>
<td>40 - 60 %</td>
</tr>
<tr>
<td>Major trauma</td>
<td>40 - 80 %</td>
</tr>
<tr>
<td>Spinal cord injury</td>
<td>60 - 80 %</td>
</tr>
<tr>
<td>Critical care patients</td>
<td>15 - 80 %</td>
</tr>
</tbody>
</table>

The 7th ACCP Conference statement supports a group-specific approach to prophylaxis, the reasons for which are outlined below.\(^\text{10}\)

1. inability to confidently identify patients who do not require prophylaxis
2. inability to predict how risk factors combine to position an individual patient along the spectrum of thromboembolic risk
3. individualizing prophylaxis is logistically complex and likely associated with suboptimal compliance

In real terms, we favor constructing simple risk assessment models that stratify all patients into 3-4 easy to understand groups, as opposed to more complicated point scoring systems. The concept of the “VTE protocol” and suggestions for keeping it simple and effective are discussed later in Section 4.
Section 1: Lay Out the Evidence / Identify Best Practice

2. Know what the literature says about options for preventing VTE

Reality #2: Instances of clear superiority (or inferiority) do exist among prophylaxis options, but for just a few patient groups.

One of the team’s fundamental duties is to come up with a way to recommend - as well as judge - the appropriateness of one prophylaxis option over another. For this reason, the second thing to know about the VTE literature is where clear evidence exists to recommend a particular method of prophylaxis over others. The team should know that the most appropriate choice of VTE prophylaxis depends on the patient group and circumstances of the hospital stay:

- in medical patients, fondaparinux and low-molecular-weight heparins (LMWH) enoxaparin and dalteparin have efficacy comparable to TID SQ Heparin, but offer lower complication rates and other advantages potentially important to patients and nursing\textsuperscript{18-21}
- in certain higher risk patient groups (e.g. hip and knee replacement, trauma, and spinal cord injury) LMWH has demonstrated superiority over SQ Heparin\textsuperscript{10, 22-25}
- in certain patient groups, extending prophylaxis with LMWH to approximately 5 weeks is more effective than 1 week (e.g. hip replacement, surgery for cancer, and possibly medical patients with reduced mobility)\textsuperscript{10, 26}
- in certain patient groups, the adequacy of BID SQ Heparin has not been proven
- in very high risk patient groups, the addition of mechanical prophylaxis to a pharmacologic regimen may offer added benefit
- certain patient groups should not receive certain pharmacologic agents or doses, or should receive smaller doses of LMWH (e.g. creatinine clearance < 30 cc/minute)
- certain patient groups should receive pharmacologic doses in close coordination with other events (e.g. surgery, neuroaxial blockade) or with special knowledge by involved physicians (e.g. spine surgeons)

Reality #3: In the quality improvement literature no strategy has yet been described for getting the right prophylaxis to the right patient at sustainable and acceptable rates in a way that can be readily replicated by other institutions.

The typical successful strategy described in the literature profiles excellent use of special local resources, but with limited transferability. Electronic alerts have raised the prevalence of VTE prophylaxis, but in an academic setting with computerized physician order entry (CPOE), electronic decision support, and a high baseline prevalence of VTE prophylaxis.\textsuperscript{27} In another academic setting, a monthly division director-led audit-and-feedback of physician performance was combined successfully with monthly educational offerings for patients cared for by the medicine house staff.\textsuperscript{28} Replicating such strategies in non-teaching or non-CPOE settings would not be possible. More generally, because QI study designs tend not to confirm sustainability or reproducibility, the ability to articulate or judge discrete underlying mechanisms is limited.

The key point at this stage, however, is that familiarity with the evidence base positions the team to draft a “VTE protocol,” the document that becomes the foundation for the rest of the effort to prevent HA-VTE, from interventions through performance tracking.
Section 1: Lay Out the Evidence / Identify Best Practice

3. Construct the VTE protocol

It is time to construct the VTE protocol. Available time and attention must be focused on drafting and field-testing this critical ingredient. To be more efficient and more effective, we recommend reviewing and adapting the sample VTE protocols in Appendix C. Some of these protocols will suit some environments better than others. Some have been refined through generations of feedback and revisions, while others have not. Teams are encouraged to use specific features of any of these and even to paste entire sections — whatever it takes to get closer to field-testing and refining a local version of the VTE protocol.

What exactly is the VTE protocol?

The VTE protocol consists of a standardized VTE risk assessment with a linked menu of appropriate prophylaxis options, plus a method to determine contraindications to pharmacologic VTE prophylaxis.

1) **standardized VTE risk assessment** — this simply delivers decision support to the point of care; in other words, at the moment of medical decision-making, providers have what they need to stratify the patient to a specific VTE risk level

2) **linked menu of appropriate prophylaxis options** — this just allows providers to choose the right VTE prophylaxis by “backing in” to the choice from the VTE risk level derived from the standardized VTE risk assessment

3) **contraindications to pharmacologic or heparin prophylaxis** — just like the VTE risk assessment, this also simply delivers decision support to the point of care, so providers know when to choose alternative prophylaxis, i.e. if specific contraindications to anticoagulation or heparin products exist

The VTE protocol accomplishes several things at once. First, if well-integrated into all admission, transfer, or post-op orders, it prompts providers to do the right thing at the right time. Second, it gives providers the option of using, or not using, the decision support elements. Third, the VTE protocol is a definition of what the team will consider “appropriate prophylaxis” for the patients within the scope of the improvement effort. This definition will be critical when it comes time to measure baseline and new prevalence of appropriate VTE prophylaxis. It will be helpful also as an educational tool and its existence will help set expectations for care. While we recommend trying to create a VTE protocol for the majority of adult patients at the institution, both medical and surgical, ultimately the team must make its own decision about the scope of the VTE protocol. The steps to define “appropriate prophylaxis” are:

1. Create or adapt any VTE risk assessment to meet local needs (see Appendix C)
2. Choose recommended options for each level of VTE risk
3. Decide upon acceptable options for each level of VTE risk. The term “acceptable” is intentionally looser than “recommended” and will become significant when measuring whether prophylaxis is appropriate, i.e. while IV heparin may not be recommended for VTE prophylaxis, it probably should be considered an acceptable alternative when it is being used for other indications.
4. Identify absolute and relative contraindications to pharmacologic prophylaxis and settle on acceptable alternatives for these patients.
In this section, we offer specific advice in constructing a VTE protocol to meet local needs. The power of the VTE protocol will be unleashed only when it is well-integrated into the clinical workflow. That integration will be the team’s next most important objective. How the team accomplishes this will depend on institutional culture and infrastructure, such as whether the hospital uses CPOE or paper order sets.

No single VTE risk assessment has been prospectively validated as superior to others. Many factors should be taken into account when adapting one. A list of published articles focusing on VTE risk assessment appears on the last page of this section. The ideal VTE risk assessment would have the following characteristics:

1) Applicable across all patients in the scope.
   
   We recommend an approach where the team creates a single VTE protocol for all patient groups targeted by the improvement effort. For example, if the scope includes all medical and surgical patients, avoid customizing separate VTE protocols for general surgery, gyn/onc, orthopedic surgery, and medical patients. Instead try to construct a single VTE protocol that can be applied to all of them. The advantage of this approach comes from the power of standardization. A universal VTE protocol can be more readily approved and initiated; it is more likely to be recognized as definitive in its authority; it is easier to modify based on feedback; and adherence to a single VTE protocol can more readily serve as a surrogate measure for performance tracking. The predictable disadvantages are those that come from any effort that tries to apply a common solution to different groups. The challenge will be to strike a balance between limiting prophylaxis options too much (“satisfying nobody”) and allowing every option under the sun (“too busy”). There are several ways to overcome these disadvantages, but the simplest rule-of-thumb is always to allow providers the leeway of going “off protocol” when clinically appropriate.

2) Easy to access and easy to use.
   
   Simpler is better. Eventually the team may be asking providers to refer to or recall elements of the VTE protocol several times during a patient’s admission.

3) Each level of risk should be linked to evidence-based choices for prevention.
   
   Explore local factors that may play a role in selecting agents of choice for each level of VTE risk. Accounting for these local factors, the team should then move on to draft the VTE protocol. The team will be exploring not only which options are most appropriate for each level of risk, but which agents, given own local factors, should be the preferred agents for each level of risk. Relative efficacy, dosing schedules, formulary costs, and side effect profiles are all important considerations.

4) Contraindications to prophylaxis should be listed and reasonable alternatives should be encouraged.
   
   When defining contraindications to pharmacologic prophylaxis, be wary of being too liberal in defining the contraindications: many patients with “relative contraindications” develop VTE and usually end up on full dose anticoagulation anyway. Be as specific as possible when using time parameters. For example, “recent gastrointestinal hemorrhage” is not as useful as “gastrointestinal hemorrhage within one month.”
We highly recommend asking a focus group of hospitalists, residents, or anybody who frequently writes admission orders to try out early drafts of the VTE protocol. It is never too early to start listening to the end-user. Whatever is learned from focus groups should feed back immediately into a new version. Using qualitative feedback to make daily revisions for a week can bring the team very close to perfecting the usability of the VTE protocol. More detail on how to get the most out of these early pilot efforts can be found in Section 3.3 (Data Collection).

Ultimately the team should be striving for perfect integration of the VTE protocol into admission and transfer order-writing, so the importance of a simple and easy-to-use model can not be overstated. Even if the VTE protocol is supremely easy to use, it will be ineffective if patients bypass the protocol. In later sections, we outline a number of approaches to prevent this, and many other methods to enhance the reliability of the VTE protocol.
How UCSD (a 300-Bed Referral Center) Handled Common VTE Protocol Questions:

**Should IPC be a first line “appropriate” choice for patients at moderate risk of VTE?**
At UCSD, we originally wanted to keep IPC as an option for patients at moderate risk for VTE (in spite of a lack of solid evidence in the literature for medical patients). Our audits revealed about 55% compliance with IPC, however, and we then adapted the approach of the ACCP Consensus conference, which relegates IPC to patients with contraindications for pharmacologic prophylaxis but also as a secondary method to enhance the effectiveness of pharmacologic prophylaxis.

**Which patients need IPC in addition to pharmacologic prophylaxis?**
At UCSD, we decided the very high risk MUST have it, while other patients COULD have it.

**Which patients should have Heparin 5000 units q 12 hours as an option vs Heparin 5000 units q 8 hours?**
We initially had 4 levels of VTE risk. We allowed Heparin 5000 units q 12 h as a choice for patients at moderate VTE risk (which described many of our medical ward patients), but advocated the higher frequency 5000 units q 8 h for high risk patients (which typified our sicker medical and critical care patients).

Eventually we collapsed our moderate and high-risk categories into a single category because:
- poor compliance with IPC eliminated that as a viable first line method.
- many of our patients on heparin 5000 units q 12 h were still developing VTE
- it would greatly simplify our risk assessment tool and order sets if we eliminated it as an option for all patients unless they were 50 kg or less.
Other teams may very logically make alternative choices based on local factors.

**Should we offer UFH 7,500 q 12 h as an option?**
At first glance this is an attractive choice, as it retains q 12 h dosing and pharmacodynamically should deliver the same protection as offered by the clinical trial proven UFH 5000 q 8 h regimens. Unfortunately, we found that our pharmacy or nurses had to draw up 7500 unit doses on special order, while the 5000 unit doses came pre-packaged from the distributor. Your situation may vary, but for us the 7500-unit dose carried too many labor, cost, and potential safety issues.
Should LMWH or UFH be our recommended choice for VTE prophylaxis in moderate to high-risk patients?

This is a difficult decision for many institutions. The team should make a decision that is best for patients and nurses, while still being fiscally responsible.

To make an informed decision, take into account:
1. Pharmacy cost
2. Cost of administration (q 8 hours vs q day.)
3. Patient satisfaction / Nursing satisfaction
4. Lower incidence of HIT with LMWH
5. Danger of using LMWH as default (will you forget to use UFH in patients with renal insufficiency, or do you have a reminder process that works in these situations?)
6. Roughly equivalent performance (some would argue a slight edge exists for LMWH, especially in the critically ill patients)

At UCSD we found the following:

<table>
<thead>
<tr>
<th></th>
<th>Pharmacy cost</th>
<th>Admin time / cost</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMWH q day</td>
<td>$16</td>
<td>10 min / $5.33</td>
<td>$21.33</td>
</tr>
<tr>
<td>UFH q 8 h</td>
<td>$1</td>
<td>30 min / $16.00</td>
<td>$17.00</td>
</tr>
</tbody>
</table>

Pharmacy costs above are based on actual pharmacy purchase costs at UCSD (not retail cost to customer). Admin time / cost are based on GRASP methodology estimates of nursing time to administer UFH q 8h vs LMWH q day: estimated as 10 minutes per injection, multiplied by the going average RN rate ($32/hour). Note, that this does not mean the institution really reaps the savings of 20 minutes nursing time per day, but rather it represents an opportunity cost, i.e. the nurse is freed up for 20 minutes for other responsibilities.

While there was only a $4.33 difference in cost per patient day between these two options, and the q day dosing of LMWH is attractive to patients and nurses, we decided to allow for either UFH 5000 q 8 h or Enoxaparin 40 mg / day as first options for patients at intermediate VTE risk. We thought it was important to retain an UFH choice in patients with end stage renal disease, and had no valid reason to exclude it as an option in the intermediate VTE risk population. Other teams should make these decisions based on the local environment.
How Emory Hospitals Handled a Few Common VTE Protocol Questions:
(Emory University Hospital is a 550-bed referral center and Emory Crawford Long Hospital is a 550-bed community teaching hospital)

**Should LMWH or UFH be our recommended choice for VTE prophylaxis in moderate to high-risk patients?**

At Emory, because the literature demonstrates superiority of LMWH over UFH in a relatively small sub-set of patient populations (i.e. spinal cord injury, acute ischemic stroke, trauma, hip and knee arthroplasty, and bowel surgery for cancer patients) we decided to design a simple VTE protocol that could be applied to the majority of patients for whom efficacy is comparable. We also found this made it much easier to risk stratify and recommend prophylaxis options for these patients. Since only a small percentage of our inpatients could be considered low risk, almost all our inpatients without contraindications to pharmacologic prophylaxis should be receiving either UFH or LMWH.

For the several patient groups in whom LMWH has demonstrated superiority, we decided it wouldn't be hard to customize VTE protocols. Similarly, the provider groups for patients where pharmacologic prophylaxis is contraindicated appreciated that we could also customize their VTE protocols to make it easy to order mechanical prophylaxis and hard to order pharmacologic prophylaxis.

**Which patients need mechanical in addition to pharmacologic prophylaxis?**

At Emory, because of the very large risk group “intermediate-to-high” we decided that mechanical prophylaxis should not be part of our recommendations for routine prophylaxis. But we did include mechanical prophylaxis as an additive option for patients with more risk factors, as well as for patients with relative or absolute contraindications to pharmacologic prophylaxis. In our orthopedic VTE protocol we presented the combination of mechanical and pharmacologic prophylaxis as the recommended option.

**Which patients should have Heparin 5000 units q 12 hours as an option versus Heparin 5000 units q 8 hours?**

At Emory we found that a portion of our inappropriate prophylaxis derived from the choice of BID Heparin in patients younger than 75, a group in whom BID Heparin is not convincingly better than placebo. So while we wanted to reduce the frequency of BID Heparin in those patients, we did decide to preserve it as an option for patients older than 75. To discourage inappropriate use of BID Heparin we indented it from the margin of the order sheet and added the qualifier “inadequate except for patients older than 75.”
Suggested Reading for VTE Protocol Development
These Articles Focus on VTE Risk Factors or VTE Risk Assessment


Section 2: Analyze Care Delivery

1. Qualitative analysis: diagram care delivery to identify failure modes

What the team learns from drawing and discussing a map of the current process can be frankly surprising. The team may identify wasted or duplicated efforts, lack of consensus on the current process, hidden complexities, and opportunities to streamline or simplify.

The figure below diagrams the steps in care delivery for preventing hospital-acquired VTE. As a starting point for discussion, the team could try to estimate how often each step occurs. For those steps that occur less than 100% of the time, have the team list those things that can and do go wrong in the current system. This simple qualitative analysis may reveal steps in the current process that are so obviously unreliable or faulty that they become the natural focus of interventions. Make an attempt at this point to prioritize these “failure modes.” Examples of actual failure modes on the next page may be helpful to review or discuss.

Figure 2-1: Care Delivery for Preventing Hospital-Acquired VTE

Conceptual Flow Diagram of Care Delivery for Providing VTE Prophylaxis: A number of inter-related steps combine to determine whether a patient, at any given moment, is receiving appropriate VTE prophylaxis.

- Clinical Support Services = Nursing, Pharmacy, etc
- HA-VTE = Hospital Acquired VTE
Actual Failure Modes (from UCSD and Emory):

- VTE risk assessment not routine or standard
- Bleeding risk assessment not routine or standard
- Most “appropriate” prophylaxis option for each level of risk not conveniently available for provider
- Differing opinions or lack of awareness of how at-risk some medical or surgical patients are
- Differing opinions on what is “appropriate” even among our experts
- Protocols: Ortho has > 4, Surgery has > 4, Medicine has 0, they don’t all agree.
- Noncompliance with mechanical prophylaxis (mechanical prophylaxis often on the floor, in the window sill, not in the room, or not delivered to room when patient admitted at night or over weekend)
- Unnecessary immobility: excessive sedation, unnecessary restraints, central lines, catheters, IV fluids, or O2 therapy
- VTE and bleeding risk can and do change, but no reassessment is routine or standard
- Platelet monitoring is haphazard when heparin ordered
- Over use of non-retrievable IVC filters
- Transfers out of ICUs may drop VTE prophylaxis
- Prophylaxis stopped at discharge even when risk continues in some patients after discharge.
- Peri – procedure and post-trauma: widely different impressions of when it is safe to start anticoagulation
Section 2: Analyze Care Delivery

2. Quantitative analysis: analyze care delivery to identify the rate-limiting steps

Ultimately patients and providers care most about final clinical outcomes, like whether or not a patient has developed a hospital-acquired DVT or PE. Our chances to reduce the likelihood of hospital-acquired VTE begin the moment the patient is admitted and actually recur every day. To help the team focus its time on the most high yield interventions, it is extremely helpful to identify the most frequent sources of missed chances to prevent HA-VTE. Through the eyes of a perfectionist, these missed chances can be thought of as “rate-limiting steps.” To someone who is merely an optimist, they may be thought of as “high leverage points” for improvement.

Empirical analysis of each step below is very useful. We highly recommend the following brief audit exercise. Go to 20-30 random charts on the pilot unit. Tally up the prevalence of appropriate prophylaxis (as judged by the team’s new gold standard, the VTE protocol). Next, look at the charts of the patients who were not on appropriate prophylaxis. If mechanical prophylaxis alone has been ordered, look also at the patient to determine if mechanical prophylaxis is being worn. This should take no more than 2-3 hours, especially with a chart audit form like the one on the following page. Once the chart audit is complete make a simple tally sheet of the type and number of failures; or alternatively annotate the diagram as below.

Figure 2-2: Care Delivery for Preventing Hospital-Acquired VTE

- Patient admitted to hospital
  - Provider orders VTE prophylaxis at admission
    - Clinical Support Services deliver appropriate VTE prophylaxis...
      - Change in patient’s VTE risk level, contraindications, or site/unit of care
        - Is the patient on appropriate VTE prophylaxis here?
          - No VTE at discharge
  - Care Delivery: Prevention of HA-VTE
    - Provider performs VTE risk assessment
      - Provider links patient’s VTE risk level to menu of appropriate VTE
      - Clinical Support Services assess patient

§ Mechanical prophylaxis not delivered to room or not on patient
Figure 2-2: Care Delivery for Preventing Hospital-Acquired VTE. In this hospital, a sample of 25 charts showed that two-thirds of failures to order appropriate VTE prophylaxis occurred at the time of admission and are attributable either to provider ordering or medical decision-making (35% ordered nothing for VTE prophylaxis, another 30% ordered something that the VTE team considered inappropriate). One in 5 failures was due to failures to re-assess VTE risk later in the hospital stay. One in 8 failures was due to problems with delivering or wearing sequential compression devices.

With quantitative information like this the improvement team can make rational choices when deciding which steps in care delivery to re-design and which steps to measure. For VTE prevention in the hospital above, a key moment occurs when physicians write admission orders. At this moment at least two different types of failure modes appear to contribute significantly to a poor overall baseline prevalence of appropriate VTE prophylaxis.
Hospital Date Audited: __/__/__
(HDA) DD/MM/YY

Date of Admission Orders: __/__/__
DD/MM/YY 24 hr clock

Hospital __________________________ Patient MR# __________
Nursing Unit _________________________ Age __________
Admitting Physician ____________________ Weight __________ kg / lbs
Responsible Physician ____________________ Creatinine __________

VTE RISK LEVEL (for HDA: auditor uses decision support on reverse)
01 low risk 03 very high risk
02 intermediate-to-high risk

ADMISSION ORDER SET W/ VTE RISK ASSESSMENT USED
11 no
12 yes

PROPHYLAXIS ORDERED WITHIN 1ST 24 HRS OF ADMISSION
21 none
22 mechanical
23 pharmacologic
24 both mechanical and pharmacologic

ACTIVE PROPHYLAXIS ORDER ON HOSPITAL DATE AUDITED
31 none and none ordered at any point
32 none but an earlier prophylaxis order was discontinued & not restarted
33 pharmacologic
34 non-pharmacologic
35 both non-pharmacologic and pharmacologic

NON-PHARMACOLOGIC ORDER
41 none 43 graduated compression stockings or TED hose
42 ambulation 44 sequential compression devices

PHARMACOLOGIC ORDER
51 none
52 Enoxaparin 40 mg SQ daily 56 Heparin 7,500 units SQ q 12 hrs
53 Enoxaparin 30 mg SQ BID 57 IV Heparin with PTT > 45
54 Heparin 5,000 units SQ q8 hours 58 Fondaparinux 2.5-7.5mg SQ daily
55 Heparin 5,000 units SQ q 12 hours 59 Wafarin alone with INR > 2

CONTRAINDICATIONS TO PHARMACOLOGIC PROPHYLAXIS
61 none (documented or apparent to auditor)
62 relative (documented or apparent to auditor; auditor, please circle any on reverse)
63 absolute (documented or apparent to auditor; auditor, please circle any on reverse)

PROPHYLAXIS IS APPROPRIATE (per assessment of auditor)
--as of Hospital Date Audited; use VTE risk level above + protocol on reverse of this form--
01 No 03 Unsure 02 Yes
### VTE Risk Stratification

<table>
<thead>
<tr>
<th>Low Risk</th>
<th>Intermediate – to – High Risk</th>
<th>Very High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0 risk factors (or expected LOS ≤ 2 days), plus patient ambulatory, or • Minor Surgery (same day or &lt; 45 minutes OR time)</td>
<td>Any VTE risk factor below.</td>
<td>• Acute ischemic stroke • Acute spinal cord injury • Multiple major trauma • Abdominal or pelvic surgery for cancer • Orthopedic patients: elective hip or knee arthroplasty; hip, pelvic, or severe leg fracture</td>
</tr>
</tbody>
</table>

#### VTE Risk Factors

<table>
<thead>
<tr>
<th>Patient Circumstances</th>
<th>Medical or Surgical Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 40 years</td>
<td>Myocardial Infarction (&lt; 3 months)</td>
</tr>
<tr>
<td>Hospitalization for surgery or acute illness</td>
<td>CHF (NYHA Class III or IV)</td>
</tr>
<tr>
<td>Obesity (BMI &gt; 30)</td>
<td>Venous stasis/ varicose veins</td>
</tr>
<tr>
<td>Immobility (confined to bed or chair)</td>
<td>Lung disease (acute or chronic)</td>
</tr>
<tr>
<td>Previous ischemic stroke w/paresis</td>
<td>Dehydration, severe (&gt;10% weight)</td>
</tr>
<tr>
<td>Central venous catheter</td>
<td>Nephrotic syndrome</td>
</tr>
<tr>
<td>History of DVT or PE</td>
<td>Inflammatory bowel disease</td>
</tr>
<tr>
<td>Family history DVT or PE (1° deg relative)</td>
<td>Sepsis</td>
</tr>
<tr>
<td>Recent major surgery (≤ 3 months)</td>
<td>Rheumatologic disease (active)</td>
</tr>
</tbody>
</table>

#### Evidence

Prevention of venous thromboembolism: the 7th ACCP Conference on Antithrombotic and Thrombolytic Therapy. Chest. 2004 Sep;126 (3 Suppl):338S-400S.

### Contraindications To Pharmacologic VTE Prophylaxis

<table>
<thead>
<tr>
<th>Absolute</th>
<th>Relative</th>
<th>Within</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spine surgery</td>
<td>Intracranial hemorrhage</td>
<td>1 year</td>
</tr>
<tr>
<td>Active hemorrhage</td>
<td>GI hemorrhage</td>
<td>1 month</td>
</tr>
<tr>
<td>Hemorrhage from severe trauma to head or spinal cord (&lt; 1 month)</td>
<td>GU hemorrhage</td>
<td>1 month</td>
</tr>
<tr>
<td></td>
<td>Craniotherapy</td>
<td>2 weeks</td>
</tr>
<tr>
<td></td>
<td>Intraocular surgery</td>
<td>2 weeks</td>
</tr>
<tr>
<td></td>
<td>Epidural catheter insertion</td>
<td>12 hours</td>
</tr>
<tr>
<td></td>
<td>Epidural catheter removal</td>
<td>4 hours</td>
</tr>
<tr>
<td></td>
<td>Post-operative bleeding concerns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Active intracranial lesions/neoplasm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypertensive urgency/emergency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thrombocytopenia (&lt;50K) or falling platelet count</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coagulopathy (INR &gt; 2, or PT &gt; 18)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>End stage liver disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>

---

### Consider as Appropriate Prophylaxis Options (for each VTE risk level):

- **Very High Risk**: Enoxaparin 40 mg SQ q 24, Enoxaparin 30 mg SQ BID, Fondaparinux 2.5 mg SQ q24, Warfarin with INR > 2, or any therapeutic anticoagulation
- **Intermediate-to-High Risk**: Enoxaparin 40 mg SQ q 24, Heparin 5,000 units SQ q8, Heparin 7,500 units SQ q 12, or Heparin 5,000 units SQ q 12 (if age > 75 yrs), Fondaparinux 2.5 - 7.5 mg SQ q24, or any therapeutic anticoagulation
- **Low Risk (or Contraindications to Anticoagulation)**: documented ambulation q shift, Graduated Compression Stockings or TED hose, or Pneumatic/Bilateral Sequential Compression Devices

---

This Form Completed By: ______________ on: ___ / ____ / ____

End Chart Abstract Form – Stop Here – Thank you.
Section 3: Performance Tracking (selecting and reporting metrics)

1. Key metric #1: prevalence of appropriate VTE prophylaxis

After reading Section 2, the diagram below should be familiar. Though we used it earlier to understand care delivery, we use it now to measure care delivery.

Specifically, we’ll now look at this diagram to select metrics – meaningful and measurable steps the team can use to track performance over time. In most instances the most telling metric is the **prevalence of appropriate prophylaxis**. Not only does it have the most causal relationship to the main clinical endpoint, hospital-acquired VTE, but it is also a sensitive indicator of how well the various care delivery steps come together.

**Figure 3-1: Outcomes Chain for Preventing Hospital-Acquired VTE**

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**Figure 3-1: Outcomes Chain for Hospital-Acquired VTE.** Whether a patient develops a preventable hospital-acquired DVT or PE depends heavily on recent, appropriate VTE prophylaxis. While one key metric to track is the intermediate outcome “appropriate VTE prophylaxis,” the more proximal steps in the care delivery pathway are where care re-design will likely occur, e.g. your VTE protocol. The other key metric to track is the prevalence of hospital-acquired DVT or PE.
Using the prevalence of appropriate VTE prophylaxis as one of the team's 2 key metrics also offers something that can be measured regularly and reliably. Set up daily, weekly, or monthly data collection for this metric (see Section 3-3). This data flow offers a reliable way to track performance of the changed care delivery system. What makes the clinical endpoint of HA-VTE unsuitable as a lone metric for performance tracking is that events are too infrequent and often sub-clinical or delayed in onset for timely, useful feedback.

It should now be clear how the VTE protocol serves not just as the main ingredient for the improvement intervention, but also for the measurement system that can track performance.
Section 3: Performance Tracking (selecting and reporting metrics)

2. Key metric #2: incidence of Hospital-Acquired VTE

Ultimately what the team cares most about is how well the steps of care delivery come together to prevent hospital-acquired VTE, the main clinical endpoint, or outcome. Clearly, the incidence of hospital-acquired VTE must be one of the team’s key metrics.

A common definition for “hospital-acquired DVT or PE” would be a clot first discovered during the course of hospitalization, or discovered within 30 days of a prior hospitalization. There are various methods for trying to capture this metric in a useful way, each with its own advantages in terms of accuracy and efficiency.

Methods for Defining Hospital-Acquired VTE

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method 1 (Minimum)</td>
<td>Track total # DVT and PE diagnosis codes in your medical center.*</td>
</tr>
<tr>
<td>Method 2 (Better)</td>
<td>Method 1, then pull charts post-discharge and retrospectively determine if hospital or community acquired.</td>
</tr>
<tr>
<td>Method 3 (Better yet)</td>
<td>Method 2, then retrospectively determine if hospital-acquired VTE were on appropriate prophylaxis when VTE developed.</td>
</tr>
<tr>
<td>Method 4 (Best)</td>
<td>Prospectively capture new cases of DVT or PE as they occur by setting up reporting system with radiology or vascular departments.</td>
</tr>
</tbody>
</table>

*Then divide by 2 to estimate the fraction that is hospital-acquired. The literature suggests that approximately half of all cases of DVT and PE diagnosed in the hospital are hospital-acquired. Alternately, use all VTE codes listed as a secondary diagnosis as a surrogate for hospital-acquired VTE.

The first method is very simple and can be done with no effort. The diagnosis codes for DVT and PE appear in Appendix B.

The “Better yet” option introduces the concept that the team can actually get more from a chart review than just a classification of “hospital-acquired” versus “community-acquired.” The VTE can now also be classified as “hospital-acquired while on appropriate prophylaxis” versus “hospital-acquired while not on appropriate prophylaxis.” With this method the team can plot the incidence of “preventable HA-VTE,” a subset of all HA-VTE events that communicates the most about the entire VTE prevention effort. This option would also allow surveillance for other factors that led to the formation of a hospital-acquired clot. For example, was the patient sedated or restrained? Did the patient have a central line associated clot, and if so, was the line really needed at the time the clot formed? Given the time and resources, the team could do a mini-root cause analysis to generate other potential strategies to prevent hospital-acquired VTE.

The “Best” option has all of the advantages listed above, but with the additional advantages that chart review is much easier when the patient is still in the hospital. The chart review can also be more efficient with the capability to query a digital imaging system to screen all pertinent imaging studies on a regular basis. In the 350 bed facility at UCSD a nurse or nurse practitioner screens all pertinent studies from the prior day, identifies all new hospital-acquired clots, and completes a thorough chart review on all new hospital-acquired VTE. The whole process takes less than an hour on each weekday. It can be done very efficiently by using automated search criteria if the radiology department uses a suitable digital imaging system. The team should try...
to create a flow of data that pulls up all pertinent diagnostic studies, complete with their reports, at the click of a button.

Depending on the limitations of the radiology information system, the team may come up with another method that is more useful and expedient.

Once the team has defined “hospital-acquired VTE” and figured out how to find the cases, it has another decision. Simply track the raw number of hospital-acquired VTE, or control for the number of patients or patient-days? Controlling for patient days at risk for VTE does add a little more work, but would reduce some of the “noise” in the data by controlling for the probability that more hospital-acquired VTE occur with higher hospital occupancy. At UCSD, for example, each month we calculate the total number of patient days for adult inpatients in the hospital > 48 hours and use that as the denominator. We use the total number of hospital-acquired VTE events as the numerator. This helped us generate a specific aim, outlined in the next section.

Another option to consider if the team has the capacity to look at all newly diagnosed events of DVT and PE in the medical center: tracking the number of days between hospital-acquired VTE events or potentially preventable hospital-acquired VTE events, allows the team to plot “days between events.” Each event becomes a point on the x-axis, while the number between events appears on the y-axis.

Now it is time for the team to decide, given the resources at the hospital, how to measure the incidence of hospital-acquired VTE.
Section 3: Performance Tracking (selecting and reporting metrics)

3. Data collection

While data collection can be costly in terms of time and money, the focus should remain on improvement rather than measurement. To track performance regularly and to advance PDSA cycles the team needs just enough data to know whether changes are leading to improvement. A sampling strategy that uses 20 randomly selected patient charts per month can be statistically appropriate as well as relatively quick and easy. To make the time commitment more manageable, 5 charts could be audited each week with the results rolled up into monthly reports. The team should designate an individual or two to collect, collate, plot, and manage the data. Many improvement projects falter or die simply because data collection is inadequate.

The team should also choose between sampling active inpatients or recent discharges. The former approach may offer several real-time advantages. Providers can be alerted to prophylaxis oversights, which might create moments to improve care as well as educate. In addition, by sampling active inpatients, insights into process barriers and valid reasons to amend the new process may emerge more readily. Self-coding and scan-able forms can lessen the burden of data entry.

Available data collection resources may dictate methods and definitions in any given medical center. Whatever method is chosen, consistency and usefulness are critical. It is usually helpful to pilot the metric definitions and steps in data collection to learn and solve stumbling blocks. In much the same way the team performs cycles of PDSA for care delivery improvements, it should go through several cycles of PDSA to perfect performance tracking system.

For example, to refine the VTE protocol and develop it as a valid audit tool, the team can apply the VTE protocol to audit 10-20 patients, using 3 independent reviewers. Did the reviewers arrive at the same risk level? Did they agree on absence or presence of contraindications to pharmacologic prophylaxis? Did they share the same conclusion about whether the patient was receiving adequate prophylaxis?

There are several issues that sequential pilots of the audit tool should help resolve.

*How much time is acceptable in peri-operative or trauma settings for a patient not to be on pharmacologic prophylaxis?* Appendix C can suggest some parameters.

*What are the acceptable VTE prophylaxis options versus preferred options for each level of VTE risk?* Realize that when auditing, there will be VTE prophylaxis options that make sense to consider as “adequate” even though they are not listed as “recommended” in the VTE protocol. For example, the auditor may accept UFH 7500 SQ q12 as acceptable prophylaxis in the moderate VTE risk patient, even if it is not listed as an option on the VTE protocol because of the lack of pre-packaged syringes or clinical trials supporting that regimen.

*What patients will be included in the sampling?* Depending on the scope of the initiative, it may make sense to exclude:

- Obstetric patients
- Psychiatry or behavioral health unit patients
- Patients hospitalized < 24 or 48 hours
Younger patient populations

Which data collection strategy should the team use for performance tracking?
The team could look at a representative sample of patients at baseline, and then repeat with a representative sample after introducing the VTE protocol. This “before- after” approach is simple, but the data can be misleading. We have found that day-to-day variation in prevalence of VTE prophylaxis can be as wide as 35%. Such a wide range of variation indicates multiple sampling events are necessary to ensure accurate conclusions. Rather than using just several data points before an intervention, we recommend using at least 20 data points before an intervention and as many as necessary after the intervention to determine the new steady-state prevalence of prophylaxis. Results can be tracked and trended in run charts.

There are several common sampling strategies:

- **Convenience sampling** – patients are selected by reviewers because they are available on the ward, but otherwise there is no particular selection process. Convenience samples categorized by ward or service would be a common model.
- **Random sampling** – all patients in a representative population are subject to selection. At UCSD we use this model. All patients over 18 and in house for > 24 hours are assigned a number, and an Excel random number generator (a free plug-in application) produces a list of 10 patients subject for review that day. The data collector goes to the first random patient generated for the audit. This has the advantage of giving an accurate picture of the demographics and VTE risk in the institution. The main disadvantage is the potential that some small but important patient group will only be subject to a few audits.
- **Stratified random sampling** – patients from several important patient groups are randomly sampled (e.g. medical versus surgical versus orthopedic, or critical care versus non-critical care). The advantage of this method is the ability to target patient groups at higher risk for VTE, or with other criteria important to the VTE prevention effort.

Before piloting and finalizing an audit tool, it will be important to pilot and finalize the VTE protocol. Feedback from the VTE protocol pilot could change the audit form.
Section 3: Performance Tracking (selecting and reporting metrics)

4. Data reporting using run charts

At every team meeting, specific aims should be reviewed and progress towards these aims should be presented to the group. The best way to do this is with a graph. Especially when presenting performance within the institution’s reporting structure, graphical formats will be more effective than denser tabular format.

There are two ways the team can graph improvement data to follow trends over time: the run chart and the statistical process control (SPC) chart. While SPC charts offer advantages, run charts are easier to make and usually adequate.

Run charts simply plot performance data over time. Compared to tables of data, run charts offer a quicker picture of how an intervention is working relative to a baseline. Run charts should be annotated along the x-axis where new interventions or events occur. This little addition can make it easier to see the effects of different stages of an intervention – or to subtract the effect of known secular trends. For run charts, ubiquitous software (Excel® or any of several free online run chart applications) is available and no statistical expertise is needed.

For QI projects, monthly plots are usually adequate, although when testing new or revised improvement strategies via PDSA, weekly plots may be desirable in order to see effects sooner.
The table and run chart below represent identical data from UCSD. Clearly, the run chart makes it easier to appreciate the dramatic trends in performance over time.

<table>
<thead>
<tr>
<th>Patients w/ Preventable VTE</th>
<th>Pt Days</th>
<th>Case per 1k pt days</th>
<th>% appropriate prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-05</td>
<td>6</td>
<td>5198</td>
<td>1.2</td>
</tr>
<tr>
<td>Feb-05</td>
<td>3</td>
<td>4652</td>
<td>0.6</td>
</tr>
<tr>
<td>Mar-05</td>
<td>4</td>
<td>5583</td>
<td>0.7</td>
</tr>
<tr>
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<td>5205</td>
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</tr>
</tbody>
</table>
Section 3: Performance Tracking (selecting and reporting metrics)

5. Transform general goals into a metric-specific aim statement

Earlier, under Essential First Steps, the team set a purposefully ambitious general goal. Doing so gave a broad sense of the breakthrough success the team wanted to achieve.

In Sections 3 we defined key metrics. With these metrics the team can now commit itself to accomplishing something specific. We highly recommend that you formalize that commitment in an aim statement.

Good aim statements articulate a stretch goal that is specific, measurable, time limited, and applicable to a particular population of patients.

The figure in Section 3-1 shows an intermediate outcome (sometimes also called a “process measure”) and a clinical endpoint. Using the following examples, the team should now write an aim statement for the chosen metrics.

**Intermediate Outcome:** 95% of patients admitted to medical units 5G and 6G will be on [appropriate VTE prophylaxis](#) as defined by our protocol by October 31, 2009.

**Clinical Endpoint:** Reduce the rate of hospital-acquired VTE from the baseline of 1.2 events per 1000 patient days by half to 0.6 per 1000 patient days by October 31, 2009.
Section 3: Performance Tracking (selecting and reporting metrics)

6. Balancing Measures

The team now has an aim statement for two key performance metrics and is ready to plan changes to the system. But both patients and hospitals are complex systems. What if the improvement changes lead to unintended consequences for either patients or the hospital? How will the team know?

Consider monitoring potential areas of concern to detect any detrimental effects of improvement changes. These additional metrics are called "balancing measures."

For example, as balancing measures the team may decide to track the incidence of heparin induced thrombocytopenia, or bleeding episodes, or the cost of using more pharmacologic prophylaxis.
Section 4. Layer Interventions

We recommend that a systematic effort to improve VTE prophylaxis prevalence starts with a single, specific intervention – a VTE protocol. Once the VTE protocol is in place, the team can layer additional interventions to leverage it (e.g. educational efforts, audit-and-feedback of performance, etc).

This first layer is so fundamental that your team should consider the VTE protocol the prerequisite, enabling layer for any subsequent interventions.

1. The VTE Protocol

Your team may come up with a dozen interventions to optimize prevalence of appropriate VTE prophylaxis. One intervention every team should implement first is a very well integrated VTE protocol.

Why a protocol?

The key concept is routine. Doing a complex activity the same way each time is the best way to make sure that nothing is left out. In the hospital, protocols serve that purpose. They standardize and structure care delivered by a group of providers.

Why is routine important? Across a population of patients, one of the most common sources of sub-optimal care arises from provider inconsistency. For variety of reasons providers inevitably vary care inappropriately, whether compared to each other or compared to themselves. In fact, a graph that depicts improved system performance over time almost always shows a progressive narrowing of the range of performance. In a powerful way, protocols have the capacity to improve care by specifically reducing this unnecessary variation in performance, from medical decision-making to ordering.

The best protocols preserve our ability to customize care for special patient situations or circumstances. In contrast to variation arising from provider behavior, variation from the protocol that arises due to special patient situations is always acceptable. The protocol should make that clear.

It may be useful to returning to the VTE protocol and its components: the VTE protocol consists of a standardized VTE risk assessment with a linked menu of appropriate prophylaxis options, plus a method to determine contraindications to pharmacologic VTE prophylaxis.

1) standardized VTE risk assessment – delivers decision support to the point of care so that, at the moment of medical decision-making, providers have what they need to stratify the patient to a specific VTE risk level
2) linked menu of appropriate prophylaxis options – assists providers with making the best choice for VTE prophylaxis
3) contraindications to pharmacologic or heparin prophylaxis – delivers decision support to the point of care so that, at the moment of medical decision-making, providers know when to choose alternative prophylaxis
One of the great determinants of success will be whether the team can make use of the VTE protocol so easy and automatic that all patients coming into the hospital at any time from any place will be ‘funneled’ through it.

Transitions of Care: Extending the Range of the VTE Protocol

For selected inpatients, such as those with major orthopedic procedures there are high level ACCP recommendations to extend the VTE prophylaxis beyond the duration of the hospitalization. The evidence-base may eventually identify other populations that may benefit from extended prophylaxis. We recommend that the team address this issue, and incorporate guidance on extended duration of VTE prophylaxis into the discharge process.

Examples of VTE protocols appear in Appendix C.
Section 4. Layer Interventions

2. Key principles for effective QI interventions

The VTE protocol sounds simple, but the devil can be in the details. A protocol, and any subsequent layers of QI interventions, will usually fail unless the team pays attention to these details. A review of some principles for effective interventions is in order:

**Principle #1. Keep it simple for the end user.**
Inevitably there will be trade-offs between the depth of detail to give providers and the simplicity of the forms and processes they are asked to accept. Almost always, simpler is better. Minimize calculations the end user has to make, or automate that process for them. Limit prophylaxis options to as few as possible for each VTE risk category.

**Principle #2. Do not interrupt workflow.**
It is safe to assume the care-giving team will have multiple demands competing for attention and time. Involve frontline workers to make sure the VTE protocol is easy to use. Without input from the front-line, implementation will not go smoothly. Focus-group feedback is invaluable and easy to do. Check-box orders are much easier to use than free text and can encourage acceptance of a new form. If the team cannot nest a VTE risk assessment within admission, post-operative, or transfer order sets, a stand-alone VTE risk assessment sheet should be stapled to the order set – and the order set must be easy to find wherever and whenever it is needed. End users are unlikely to go out of their way to download or locate a VTE risk assessment form. It must be re-stocked regularly. Clinicians should want to use your order sets if you design them properly. In general, if your VTE protocol interrupts workflow it will be rejected.

**Principle #3. Design reliability into the process.**
Especially in the complicated health care setting, do not expect humans to be perfect. Part of the team’s job is to engineer higher reliability into the process of protecting patients from hospital-acquired VTE. If the VTE protocol relies solely on the following traditional methods, the team will be disappointed with the results:

- Order sets
- Personal check lists
- Working harder next time
- Feedback of performance
- Awareness and training

All of the above methods are helpful and some are even necessary, but they are not sufficient alone to achieve breakthrough improvement. The team must design interventions that use at least one of the following high reliability strategies.
High Reliability Strategies

- Desired action is the **default** action (not doing the desired action requires opting out)
- Desired action is **prompted** by a reminder or a decision aide
- Desired actions is **standardized** into a process (take advantage of work habits or patterns of behavior so that deviation feels weird)
- Desired action is **scheduled** to occur at known intervals
- Responsibilities for desired action are **redundant**

If designed well, the VTE protocol will be an intervention that invokes several of these high reliability strategies. If it is nested into existing order sets it can serve as a reminder to **prompt** ordering of prophylaxis. If admission, post-op, or transfer order sets are themselves easy to use, always stocked, and easy to find where providers need them, the VTE protocol can be **standardized** into the process of writing most admission orders. If a clerk or pharmacist is empowered to halt processing of an order set that has no prophylaxis selected, the responsibility for ensuring VTE prophylaxis can be made **redundant**. If a member of the care team performs regular review of patient medication administration records, responsibility for finding prophylaxis “outliers” can be **scheduled** and also made **redundant**. All of the above strategies would increase the reliability that patients receive VTE prophylaxis appropriately.

**Principle #4. Pilot interventions on a small scale before attempting wider implementation.**

No plan survives its first contact with reality. Inevitably there will be glitches with a first pass at anything new. So why not learn faster by failing faster? Piloting on a small scale creates opportunities to iron out glitches before implementing more broadly. Small-scale pilots can be as simple as a 5-minute focus group where 5 physicians give feedback on several versions of the protocol. The next pilot could consist of trying out the protocol on one patient with one physician and one nurse.

**Principle #5. Monitor use of the protocol.**

Rolling out the protocol is really only a beginning. The team must have a plan that ensures the VTE protocol is part of the completed admission orders for every patient who enters the medical center.

When providers do not use the protocol or deviate from it, reasons might derive from logistics, patients, providers, and other variables. The team should anticipate variations from the protocol, but should capture those instances, learn from them, and react by taking steps to reduce them. Why is the order set not used in some areas? Can we integrate it into other heavily used order sets? Which types of admissions are inadvertently bypassing our protocol? Which patients just don’t fit with our protocol - can we change it so that it fits more patients and situations? Which providers would benefit from focused educational efforts? Are we stocking and re-stocking the protocol in all the key areas in the hospital? While no protocol will
fit every patient, the idea is to squeeze needless variability out of medical decision-making and ordering.

Remember, though, it is quite important to preserve the freedom of provider’s to vary from the protocol due to medical necessity. There will always be a need for providers to tailor care to meet the needs of individual patients, or to accommodate special circumstances.
Section 4. Layer Interventions

3. Beyond the VTE Protocol: Using a “Hierarchy of Reliability”

Consider the following “hierarchy of reliability” when planning and executing the VTE prevention initiative. By using this guide and a little ingenuity, a serious institutional effort should be able to achieve the impressive performance gains of Level 4. Successful Level 5 reliability, as we have demonstrated in pilots at our institutions, is within reach of many institutions with electronic medication administration records.

**Hierarchy of Reliability**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Predicted Prophylaxis rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No protocol (“State of Nature”)</td>
<td>40%</td>
</tr>
<tr>
<td>2</td>
<td>Decision support exists but not linked to order writing; or prompts exist within orders but no decision support at-hand</td>
<td>50%</td>
</tr>
<tr>
<td>3</td>
<td>Protocol well-integrated into orders at point-of-care</td>
<td>65-85%</td>
</tr>
<tr>
<td>4</td>
<td>Protocol enhanced (by other QI and high reliability strategies)</td>
<td>90%</td>
</tr>
<tr>
<td>5</td>
<td>Oversights identified and addressed in real time</td>
<td>95+%</td>
</tr>
</tbody>
</table>

**Level 1: State of Nature**

In the “unimproved” modern hospital patients receive care that depends solely on the knowledge, skills, and memory of their physicians. There is no standardized assessment for VTE risk and there are no reminders within the real-time flow of care delivery to prompt physicians to order VTE prophylaxis. In this “state of nature,” expect approximately 40% of patients to be on appropriate VTE prophylaxis at any given moment.

**Level 2: Average**

Many hospitals that have tried to improve VTE prophylaxis find themselves at Level 2, with only partially effective components of a VTE protocol:

i. A *standardized VTE risk assessment* to guide choice of VTE prophylaxis, but it is not well integrated into admission and transfer order sets (e.g. the VTE protocol exists only as a stand-alone form or pocket card), or

ii. A *prompt* to order VTE prophylaxis is nested within admission and transfer order sets, but no VTE risk assessment exists to guide choice of VTE prophylaxis

**Level 3: VTE Protocol**

Level 3 is the entry point for most serious QI efforts – a complete VTE protocol. All 3 elements of a complete VTE protocol are combined within a paper order set or CPOE. The more effective
VTE protocols also have a visual link from the level of VTE risk to the options for appropriate prophylaxis; this visual link enables providers to make a rapid, accurate decision and action to order appropriate prophylaxis.

In a Level 3 VTE prevention program not only are providers prompted to order VTE prophylaxis when completing admission or transfer orders, they also have a standardized VTE risk assessment immediately available to support medical decision-making. Level 3 makes it possible for providers to have what they need, when and where they need it, to make an appropriate prophylaxis choice. Expect 65-85% of patients to be on appropriate VTE prophylaxis with the Level 3 VTE protocol.

Remember that providers should always retain the freedom to deviate from the protocol when meeting the needs of a given patient. The protocol, with successive refinements, eventually should drive management choices in the great majority of patients.

**Level 4: Layers of QI Strategies that Leverage the VTE Protocol**

All of the conditions of Level 3 exist, but the use of the VTE protocol at admission and transfer is enhanced by additional QI strategies. Level 4 uses high reliability mechanisms to make it a rare event for a patient to enter the hospital without going through your VTE protocol.

Also at Level 4, any variations from the protocol or adverse effects while on the protocol are studied in depth. The protocol and its integration are continually refined and its use continually increased based on these events, using the collective intelligence, experience, and investigation of the institution.

Use the table “Armamentarium of QI Strategies” as a source of additional Level 4 ideas. Most of these other strategies leverage the existence of a VTE protocol well-integrated in the workflow. Providers, nurses, pharmacists, even patients can refer back to the VTE protocol for clarity, confidence, or advocacy. Remember, *any additional, layered interventions should include at least one high reliability mechanism in the design.* Expect 80-90% of patients to be on appropriate VTE prophylaxis with Level 4, an extremely impressive level of performance that would place the medical center among better performers.

**Level 5: Oversights “Identified-and-Mitigated”**

Level 5 represents a profound leap in quality. Here the team improves care by a whole order of magnitude, a rare achievement in health care. All of the conditions of Level 4 exist, plus there is now a strategy to identify and address the prophylaxis oversights that inevitably occur. Back at Level 4, at least one in 10 patients still fail to receive appropriate prophylaxis. Will the team be satisfied with that considerable gain? It depends on whether the team is merely pursuing excellence (relative to “industry standards”), or actually pursuing perfection. Instances will always occur where VTE prophylaxis is not ordered on admission or transfer, or not replaced with alternatives when contraindications arise, or not resumed when suspected contraindications fail to materialize, or not administered properly when ordered (i.e. mechanical prophylaxis). Strategies that “identify-and-mitigate” these oversights are critical for sustaining prophylaxis prevalence over 90%. Level 5 may be impractical or unsustainable without an electronic medication record and reporting mechanism.

A mature Level 5 will also judge the efficacy of mitigation itself and its own failures will be immediately remedied. Failure modes of mitigation would be systematically catalogued,
analyzed, and then eliminated. Achieving this level of reliability across an entire hospital would represent a pioneering effort in VTE prevention. Level 5 solutions transferable to other institutions would represent something transformative for hospital care.

**Armamentarium of QI Strategies**

<table>
<thead>
<tr>
<th>QI Strategy Category</th>
<th>Specific Ideas for VTE Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provider education</td>
<td>• Didactic sessions on VTE prevention (e.g. noon conference, grand rounds, etc)</td>
</tr>
<tr>
<td></td>
<td>• Distributed educational materials (e.g. pocket cards with VTE risk factors, etc)</td>
</tr>
<tr>
<td>Provider reminder systems</td>
<td>• Prompts nested within paper admission/transfer/post-op order sets supported by VTE risk assessment as decision support (VTE protocol)</td>
</tr>
<tr>
<td></td>
<td>• Prompts using CPOE with risk assessment as decision support (VTE protocol)</td>
</tr>
<tr>
<td></td>
<td>• Stickers on charts or posters in order-writing areas</td>
</tr>
<tr>
<td>Facilitated relay of clinical data to providers</td>
<td>• Alerts to physicians by means other than medical record, e.g., page, electronic alert, phone call, email to provider regarding VTE prophylaxis oversights.</td>
</tr>
<tr>
<td>Audit and feedback of performance to providers</td>
<td>• Feedback of VTE prophylaxis performance to individual providers or groups of providers (with or without benchmarking to top performers)</td>
</tr>
<tr>
<td>Patient education</td>
<td>• Discrete disclosure to patients of increased risk for VTE (e.g. pamphlets, physician or nurse teaching of patient or caregiver, closed circuit TV program in patient rooms, etc.)</td>
</tr>
<tr>
<td>Organizational or operational change</td>
<td>• Administrative support personnel dedicated to ensure constant stocking of VTE protocol order set in needed areas</td>
</tr>
<tr>
<td></td>
<td>• Clinical support personnel dedicated to ensure and document that mechanical prophylaxis is worn by patients</td>
</tr>
<tr>
<td></td>
<td>• Hospital-wide (or unit-specific) teams or individuals with regular responsibility to ensure each patient is receiving appropriate VTE prophylaxis (e.g. physician, nurse, pharmacist, etc), a.k.a. &quot;VTE Hit Squad&quot;</td>
</tr>
<tr>
<td>Incentives, regulation, and policy</td>
<td>Provider-Directed:</td>
</tr>
<tr>
<td></td>
<td>• Honor recognition of highest performers each month or quarter</td>
</tr>
<tr>
<td></td>
<td>• Financial incentives based on achievement of VTE prophylaxis performance goals</td>
</tr>
<tr>
<td></td>
<td>• Punitive actions for failures to meet minimum performance (suspension of privileges, stockade in town square, etc.)</td>
</tr>
<tr>
<td></td>
<td>Health System-Directed:</td>
</tr>
<tr>
<td></td>
<td>• Enforced policy mandating use of VTE protocol (e.g. “hard stops” in processing of admission/transfer/post-op orders that fail to prescribe VTE prophylaxis)</td>
</tr>
</tbody>
</table>

Section 5. Continue to Improve

1. Learning in the clinical setting: Plan-Do-Study-Act

Reality does have a way of exposing the weaknesses of even the best plans. Especially in a complex environment like a hospital there will always be unforeseen glitches when trying something new. So start small and scale quickly by using rapid cycles of action-oriented learning. A great way to do this is by using the popular Plan-Do-Study-Act model.

Start by planning (Plan) the intervention, and then test (Do) it. In the next step (Study), team members should observe the test first-hand, paying close attention to competing demands and physical space. Listen to individuals involved in the test to hear what worked and what did not. Ask for alternative ideas and discuss them on the spot. The idea, of course, is to understand what could or should be done differently from how the team originally planned it. In the last step (Act), revise the plan and try it again.

The table below highlights the advantages of PDSA as well as principles for doing it well.

<table>
<thead>
<tr>
<th>Advantages of PDSA</th>
<th>Principles for Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allows for valuable modifications to improve effectiveness or preserve productivity</td>
<td>Start new changes on the smallest possible scale, e.g. one patient, one nurse, one doctor</td>
</tr>
<tr>
<td>Allows “failures” to come to light without undermining performance and momentum</td>
<td>Run just as many PDSA cycles as necessary to gain confidence in a change, then spread incrementally</td>
</tr>
<tr>
<td>Identifies areas of resistance that might undermine spread to other units</td>
<td>Spread incrementally to more patients, then more nurses, then doctors, and finally units</td>
</tr>
<tr>
<td>Allows costs and side effects of the change to be assessed</td>
<td>Balance changes within overall system to ensure other processes not adversely stressed</td>
</tr>
<tr>
<td>Increases certainty that change will result in improvement</td>
<td>Pay special attention to preserving productivity and workflow</td>
</tr>
<tr>
<td>Allows for detailed documentation of improvement</td>
<td></td>
</tr>
</tbody>
</table>

Whoever observes and studies the test should record lessons and suggested alternatives. These should be shared at the next multidisciplinary team meeting. The Institute of Healthcare Improvement (IHI) has a pre-printed PDSA Worksheet to download: http://www.ihi.org/IHI/Topics/Improvement/ImprovementMethods/Tools/Plan-Do-Study-Act%20(PDSA)%20Worksheet
Section 5. Continuing to Improve

2. Spreading improvement to other units

Spreading successful improvements to other areas of the hospital requires that the new process refined in the pilot get woven into the wider fabric of every day clinical work.

The IHI published a brief but very useful White Paper, “A Framework for Spread.” We highly recommend this resource, but summarize the field-tested themes here:

- Committed organizational leadership is crucial
- Begin planning for spread as early as possible
- Be specific in the aims of spread (who, what, where, when)
- Leverage existing infrastructure and identify infrastructure gaps
- Execute the spread plan but learn and revise as you go

Just as for the pilot, let the key principles for layering effective QI interventions (Section 4-2) guide your efforts to spread the improvement.
References

Appendix A: Talking Points to Attract Administration Support for Venous Thromboembolism Prevention Programs

Hospitalized patients are at high risk for venous thromboembolism (VTE).

• Over two million Americans suffer from VTE each year, with over half of all patients developing their VTE in the hospital or in the thirty days post hospitalization. In a large registry trial capturing over 5,451 patients at 183 sites over a six-month period, 50% (2,726) developed their VTE during hospitalization.
• Most hospitalized patients have at least one risk factor for VTE.
• Every year, 23 million people undergo surgery in the United States, of which a significant number are considered high or highest risk for development of VTE.
• Without the benefit of VTE prophylaxis, the incidence of proximal deep venous thrombosis (DVT) and clinical pulmonary embolism (PE) in the majority of surgical patients is unacceptably high. Up to 20% of surgical patients in the highest risk category - for example those undergoing hip or knee arthroplasty, or hip fracture surgery develop proximal deep venous thrombosis (DVT). Proximal DVT is the most dangerous and frequently leads to PE without anticoagulation prophylaxis.
• The medical patient is also at high risk; in a typical hospital it is estimated that less than 5% of medical patients could be considered at low risk by most VTE risk stratification methods.
• Medical patients probably account for more than half of all hospital-acquired VTE events. In the DVT Free registry study, half the inpatients who suffered from VTE were non-surgical and had no surgical procedures in the preceding 3 months.
• Without prophylaxis the range of DVT risk is between 10-26% in general medical patients, 17-34% in patients with myocardial infarction, 20-40% in patients with congestive heart failure, 11-75% in patients with stroke, and 25-42% in general medical intensive care patients.
• A 400 bed hospital with an average prevalence of VTE prophylaxis can expect that 200 patients will suffer from hospital-acquired VTE each year, around half of which are potentially preventable (estimates derived from DVT Free Registry and as yet unpublished UCSD experience).

Venous thromboembolism leads to substantial inpatient costs, morbidity, and mortality

• 1 in 10 of the > 2 million Americans developing DVT goes on to die from pulmonary embolism (PE).
• These 200,000 patient deaths represent more annual deaths than those from breast cancer, AIDS, and traffic accidents combined.
• Many of these VTE deaths contribute to hospital mortality.
• Pulmonary embolism is the most common preventable cause of death in the hospital; an estimated 10% of inpatient deaths are secondary to PE. Patients who survive the initial diagnosis of PE face a mortality rate of 17.5% at 90 days.
• Not only do patients with VTE suffer a 30% cumulative risk for recurrence, they are also at risk for the potentially disabling post-thrombotic syndrome.
• While many VTE are clinically silent, symptoms of hospital-acquired VTE often require ongoing therapy and represent a significant morbidity.
• The incremental length of stay and costs of treating a case of a preventable VTE event are substantial. AHRQ HCUP estimates of incremental inpatient cost is $10,000 per DVT and $20,000 per PE.
Effective, safe, and cost effective measures to prevent hospital-acquired VTE exist.

- Pharmacologic prophylaxis reduces the incidence of asymptomatic and symptomatic DVT and PE by 50-65%.
- Prevention of DVT also prevents PE and fatalities from PE.
- Cost effectiveness of VTE prophylaxis has been repeatedly demonstrated.
- The chief concern of prophylaxis is bleeding, but bleeding risk secondary to pharmacologic prophylaxis is a rare event, based on abundant data from meta-analyses and placebo controlled randomized controlled trials.
- Overwhelming evidence reveals that pharmacologic VTE prophylaxis not only prevents adverse patient outcomes, it is also cost effective.

Gap between current practice and optimal practice is very large.

The high prevalence of hospital-acquired VTE is largely due to the under-utilization of simple, cost effective prophylactic measures. Of the 2,726 patients who had their DVT diagnosed while hospitalized in the DVT Free registry, only 1,147 (42%) received prophylaxis within the 30 days before diagnosis.

Several prominent organization acknowledge the magnitude of this “implementation gap” the AHRQ report, Making Healthcare Safer, cited the provision of appropriate VTE prophylaxis as the paramount effective strategy to improve patient safety.

Leapfrog:
PE is “the most common preventable cause of hospital death in the United States”

Agency for Healthcare Research and Quality (AHRQ):
Thromboprophylaxis is the number 1 patient safety practice to prioritize among the nearly 70 practices reviewed.

American Public Health Association (APHA):
“The disconnect between evidence and execution as it relates to DVT prevention amounts to a public health crisis.”

The current reality in American hospitals is thus arrestingly sub-standard, especially considering what could be accomplished with simple, safe, and effective prophylaxis for the at-risk inpatient.

Incorporate local data if you have it, re: prevalence of adequate VTE prophylaxis, number of different order sets, and anecdotes.

VTE Prevention is increasingly incorporated into public reporting, guidelines, regulatory agency, and national quality initiative priorities.

- TJC is currently piloting measures of VTE prophylaxis, incidence of hospital-acquired VTE, and VTE diagnosis / treatment.
- Surgical Care Improvement Project (SCIP)
- Leapfrog
- AHRQ
Reliably preventing VTE in the hospital is inherently complex (more education alone won’t get the job done)

- VTE risk and bleeding risks vary within patient populations.
- The risk of VTE and the risk of bleeding may change for an individual patient several times as they progress through their hospital stay.
- Medication changes, weight, age, renal function, and recent or impending invasive interventions may all influence decisions about the best VTE prevention options.
- Transitions across care providers and locations leads to multiple opportunities for breakdown in the delivery of optimal VTE prophylaxis.
- Thoughtful, evidence-based protocols, multidisciplinary system changes, and comprehensive educational efforts are required to achieve optimal VTE prophylaxis in the complex hospital setting.

What is needed to close the gap – essential elements for effective and safe prevention of VTE in the hospital

Educational and awareness efforts alone have proven inadequate in increasing appropriate use of VTE prophylaxis. Similarly, order sets and critical pathways not supported by a healthy quality improvement framework are unlikely to succeed. Process re-design and continuous attention must include two essential elements:

1) performance of a VTE risk assessment for every patient on admission and regularly throughout hospitalization
2) selection of appropriate prophylaxis by linking the VTE risk to a corresponding menu of proven options

VTE prevention programs can be cost effective

- Achieving optimal prevention of hospital-acquired VTE requires incremental monitoring, educational efforts, systems change, and coordination of the services of many hospital divisions, all of which may incur incremental costs.
- This incremental expense can be cost effective in a variety of settings.
- Costs of VTE prevention initiatives can demonstrate a good ROI via:
  - Improved LOS, readmission rates, morbidity, and mortality.
  - Improved documentation of patient acuity and related payment for acuity.
  - Income generated via incremental physician and allied health professional billing.
- We would like to explore ways to build in and demonstrate ROI with the hospital administration.

A roadmap is in place

- Extensive guidance is available from the literature and consensus conferences.
- The Society of Hospital Medicine has produced a comprehensive guide to effective implementation of VTE prevention programs, utilizing a proven performance improvement framework, first-hand experience, and the collective wisdom from several institutions addressing VTE prevention. The guide includes practical information on:
  - Organizing and managing a multidisciplinary steering committee, reporting into the medical center administration.
  - Practical methods to assess institutional performance in VTE prophylaxis and identifying and tracking patients with hospital-acquired VTE.
  - Constructing an institutional VTE risk assessment model, and integrating it into work flow and order sets.
  - Methods to bolster chances of success by integration of high reliability design features and attention to effective implementation techniques
Summary – Push for support

- Hospital-acquired VTE is an important entity. Effective, safe, and evidence-based measures to prevent hospital-acquired VTE are currently underutilized at our medical center, resulting in needless mortality and morbidity.
- We have personnel who are ready to aggressively address this and have a number of great guides to help us achieve our goals.
- Administrative support for an empowered multidisciplinary steering committee is needed.
- Institutional prioritization and the will to standardize and improve systems in the face of substantial cultural and complex barriers is an absolute necessity to achieve breakthrough levels of improvement.
- Improved data collection and reporting, incremental monitoring, creation of metrics, and improved documentation are necessary.
- More specifically, what we need:

  Depending on how advanced or ambitious the effort, it may be important to lay out a business plan, including specific aim, timeline, personnel, FTE support, and other resources required.
Appendix B: Discharge Codes for DVT and PE (updated March 2007)

453.40  DVT LE NOS
453.41  DVT prox LE
453.42  DVT distal LE
453.8   DVT NEC
415.11  iatrogenic PE
415.19  other PE

Complementary codes of 997.2 and 999.2 qualify the above codes and may also be very helpful.
Appendix C: Sample VTE Protocols

VTE Protocol Specs: **Adult inpatients**
Format: Paper Scope: new patients admitted Pages: 1 Content/Use: this form evolved into a standing order for LMWH triggered when nurses identified risk factors during the admission intake assessment Formulary: two LMWHs (Dalteparin and Enoxaparin)

---

**MED/SURG SERVICES**

**VENOUS THROMBOEMBOLIC (VTE) PROPHYLAXIS ORDERS (ADULT)**

**ORDER NUMBER:** MS-27.0  **LAST REVIEWED/REVISED:** PILOT 11/03

**DATE OF ORIGIN:** 08/03  **APPROVED:**

---

**DATE/TIME:**

**Height/Weight:**

**DIAGNOSIS:**

**ALLERGIES:**

---

**Risk Factors:**
- Any **two or more** is an indication for VTE prophylaxis
  - **Age** over 40 years
  - **Obesity**
  - **ICU admission**
  - **Presence of a central venous line**
  - **Prolonged immobility, more than 24 hours**
  - **Past history of Chronic Lung Disease or an inflammatory disorder**
  - **Admitted with or a history of heart failure, pneumonia or serious infection, vancosine veins, nephrotic syndrome, sickle cell disease, pregnancy or estrogen use**

**"High" Risk Factors:**
- Any **One** is an indication for VTE prophylaxis
  - Major trauma (abdomen, pelvis, hip or leg)
  - Ischemic (non hemorrhagic) stroke or paralysis
  - Malignancy
  - Any prior history of deep vein thrombosis or pulmonary embolism

---

**Anticoagulant prophylaxis exclusion criteria:**
- Significant renal insufficiency (affects low molecular weight heparin only!)
- Uncontrolled hypertension
- Presence or history of heparin induced thrombocytopenia
- Recent intraocular or intracranial surgery
- Spinal tap or epidural anesthesia within the previous 24 hours
- Any active bleeding
- Coagulopathy or thrombocytopenia
- Current treatment with anticoagulants
- Hypersensitivity to unfractionated heparin or low molecular weight heparin

**LAB:** CBC with diff every 2 days while on Heparin or LMWH (Low Molecular Weight Heparin)

**TREATMENTS:** (please check appropriate boxes for patient)
For patients with three or more risk factors or any two risk factors with one risk factor being stroke/paralysis, cancer, major surgery, trauma, or prior VTE, consider using Enoxaparin every 12 hours or the higher dose of Dalteparin.

1. ☐ Intermittent Sequential Pneumatic Compression Device (SCD) bilateral for the leg/calf

**PHARMACY:** (please check appropriate boxes for patient)
2. ☐ Heparin 5000 units subcutaneously every eight hours
3. ☐ Enoxaparin (Lovenox) injection 40 milligrams subcutaneously daily or
   - ☐ Enoxaparin (Lovenox) injection 30 milligrams subcutaneously every 12 hours
4. ☐ Dalteparin (Fragmin) injection 2500 units subcutaneously daily or
   - ☐ Dalteparin (Fragmin) injection 5000 units subcutaneously daily
5. ☐ No VTE Prophylaxis at this time

**Physician**

Signature: ___________________________  date: __________  Pager: ___________________________
VTE Protocol Specs: Adult inpatients
Format: Paper Scope: new patients admitted Pages: 1 Content/Use: this risk assessment supports decision making for any admission orders

### VTE PROPHYLAXIS ASSESSMENT

<table>
<thead>
<tr>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
<th>Very High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outpatient surgery</td>
<td>No &quot;risk factors&quot; and general moderate/major surgery in patient age 40 to 60 years old</td>
<td>General moderate/major surgery in patient age over 60 and no other risk factors</td>
<td>Elective major lower extremity orthopedic (hip or knee)</td>
</tr>
<tr>
<td>No &quot;risk factors&quot; and minor surgery in patient age less than 40 years old</td>
<td>No &quot;risk factors&quot; and major gynecological surgery for benign disease</td>
<td>Major gynecological surgery for malignant disease</td>
<td>Non-elective hip, pelvic or other lower extremity orthopedic procedure</td>
</tr>
<tr>
<td>No &quot;risk factors&quot; vascular surgery</td>
<td>No &quot;risk factors&quot; and extensive open GU procedures</td>
<td>Risk factors and general moderate/major surgery in patient age greater than 60</td>
<td>Acute spinal cord injury with paraplegia</td>
</tr>
<tr>
<td>No &quot;risk factors&quot;, minor laparoscopic procedure</td>
<td>Risk factors and minor general surgery</td>
<td>Risk factors and vascular surgery</td>
<td>Multiple major trauma</td>
</tr>
<tr>
<td>0-1 &quot;risk factors&quot; and independent ambulatory medical patient</td>
<td>Risk factors and laparoscopic procedures</td>
<td>Risk factors and major gynecological surgery for benign disease</td>
<td></td>
</tr>
<tr>
<td>Medical patients with risk factors but not high risk medical conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>High risk medical conditions: Ischemic CVA with limited mobility</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Central venous catheter with 2 or more risk factors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ICU admission with 2 or more risk factors</td>
<td></td>
</tr>
</tbody>
</table>

### RECOMMENDED PROPHYLAXIS

<table>
<thead>
<tr>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
<th>Very High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early ambulation</td>
<td>Intermittent pneumatic compression devices AND OR</td>
<td>Intermittent pneumatic compression devices AND</td>
<td>Intermittent pneumatic compression devices AND OR</td>
</tr>
<tr>
<td>Range of motion exercises</td>
<td>Enoxaparin 40 mg SC daily OR</td>
<td>Enoxaparin 40 mg SC daily OR</td>
<td>Enoxaparin 30 mg SC q12 hours OR</td>
</tr>
<tr>
<td>Heparin 5,000 units SC q 4 hours OR</td>
<td>Heparin 5,000 units SC q 8 hours OR</td>
<td>Heparin 7,500 units SC q12 hours OR</td>
<td>Warfarin INR 2-3</td>
</tr>
<tr>
<td>Heparin 500 units SC q 12 hours OR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heparin 7,500 units SC q 12 hours OR</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### RISK FACTORS

- Age over 65
- Prior history of VTE
- Decompensated CHF
- Bed rest/impaired mobility
- Central line
- Estrogen or other hormonal therapy
- Myeloproliferative disease
- Known thrombophilia
- Active malignancy
- Obesity
- Pregnancy/post partum
- Inflammatory bowel disease
- Active or chronic lung disease
- Active rheumatological disease
- Nephrotic syndrome
- Sickle cell disease
- Tobacco use
- Dehydration
- Varicose veins or venous stasis

### RELATIVE OR ABSOLUTE CONTRAINDICATION TO PHARMACOLOGIC PROPHYLAXIS

- Lumbar puncture or epidural anesthesia within 24 hours
- Active bleeding
- Coagulopathy (INR greater than 1.5) or thrombocytopenia (platelet count less than 60,000)
- Significant renal insufficiency
- (Creatinine clearance less than 30 – do not use LMWH or fondaparinux)
- Hypertensive urgency, emergency or crisis
- Presence or history of HIT (heparin induced thrombocytopenia)
- Recent intracranial or intracranial surgery or lesions

RE-ASSESS DAILY!!!
VTE Protocol Specs: Adult inpatients
Format: Paper Scope: new patients admitted Pages: 1 Content/Use: this is a stand-alone VTE risk assessment to be used when providers write admission orders

ADULT DVT PROPHYLAXIS
PHYSICIAN ORDER SHEET
ALLERGIES (FOOD AND/OR DRUG): [ ] NKA

HEIGHT: [ ] WEIGHT: [ ]

Risk Factors for Deep Vein Thrombosis / Pulmonary Embolism (DVT/PE) (Check risk factors)

<table>
<thead>
<tr>
<th>Major</th>
<th>Minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior DVT or PE</td>
<td>Age 40-60 yrs</td>
</tr>
<tr>
<td>Malignancy</td>
<td>Heart Failure, Compensated</td>
</tr>
<tr>
<td>Age greater than 60 yrs</td>
<td>Obesity (BMI greater than or equal to 30)</td>
</tr>
<tr>
<td>Hypercoagulable state, inherited or acquired</td>
<td>Inflammatory bowel disease</td>
</tr>
<tr>
<td>Central venous access</td>
<td>Trauma/Burns</td>
</tr>
<tr>
<td>Nonhemorrhagic Stroke</td>
<td>Smoking</td>
</tr>
<tr>
<td>Prolonged Immobility (greater than 72 hrs), or Paralysis</td>
<td>Minor Surgery</td>
</tr>
<tr>
<td>Major Surgery</td>
<td>Pregnancy or less than 1 month postpartum</td>
</tr>
<tr>
<td>Immobilizing Lower Extremity Cast</td>
<td>Oral Contraceptive, Hormone Replacement Therapy use</td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td>Estrogen Receptor Modulators (i.e Tamoxifen, Raloxifene)</td>
</tr>
<tr>
<td>Heart Failure (Decompensated)</td>
<td>Varicose veins</td>
</tr>
<tr>
<td>Sepsis or Severe Infection</td>
<td></td>
</tr>
</tbody>
</table>

Contraindications for Anticoagulation Therapy
- Hx-Heptamin Induced Thrombocytopenia
- Severe hypotension (uncontrolled)
- Head or spinal trauma (w/ hemorrhage)
- Hemorrhagic CVA
- Dissecting or cerebral aneurysm
- Hemorrhagic brain hemorrhage
- PT or aPTT greater than 1.5 x control
- Severe thrombocytopenia (plate count below 100,000)
- Active, uncontrolled bleeding
- Recent TURP (within 6 weeks)
- Active peptic ulcer disease
- Bacterial endocarditis
- Threatened abortion
- Previous spinal decompression surgery (within 10 days)
- Eye or brain surgery (within 48 hours)

Use of epidural requires clearance by anesthesiology

DVT Prophylaxis for Medical and Surgical Patients
Review risk factors/Contraindications prior to ordering appropriate prophylaxis

<table>
<thead>
<tr>
<th>Patient Category</th>
<th>Risk Factors (RF)</th>
<th>Risk</th>
<th>Prophylaxis Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor procedure and less than 40 yrs and no additional RF</td>
<td>Low</td>
<td>Early ambulation – Prophylaxis Not Indicated</td>
<td></td>
</tr>
<tr>
<td>Medical inpatient with no major or minor RF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-major procedure (less than 45 min) and 40-60 yrs or additional RF</td>
<td>Moderate</td>
<td>Heparin 5000 units subcut every 12 hours</td>
<td></td>
</tr>
<tr>
<td>Major surgery (greater than 45 min) and less than 40 yrs without additional RF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-major surgery greater than 60 yrs or additional RF</td>
<td>High</td>
<td>Heparin 5000 units subcut every 8 hours</td>
<td></td>
</tr>
<tr>
<td>Major surgery (greater than 45 min) greater than 40 yrs or additional RF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical inpatient with any risk factor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knee Replacement Surgery</td>
<td>High</td>
<td>Enoxaparin (Lovenox) 30mg subcut Q12h</td>
<td></td>
</tr>
<tr>
<td>Trauma (Major or Lower Extremity) (warfarin not indicated)</td>
<td></td>
<td>Warfarin (Coumadin) orally per MD order</td>
<td></td>
</tr>
<tr>
<td>Hip Replacement Surgery</td>
<td>High</td>
<td>Enoxaparin (Lovenox) 40mg subcut daily</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Warfarin (Coumadin) orally per MD order</td>
<td></td>
</tr>
<tr>
<td>Combine with pharmacologic methods in high risk surgical patients and multiple RF</td>
<td>High</td>
<td>Intermittent pneumatic compression device</td>
<td></td>
</tr>
<tr>
<td>Contraindications to anticoagulation therapy</td>
<td></td>
<td>Graduated Compression Stockings</td>
<td></td>
</tr>
<tr>
<td>Check CBC with platelet count on day 2 of heparin or enoxaparin and every third day thereafter. Notify MD if platelet counts falls 50% or more from baseline.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date/Time	Prescriber Signature	Print Name


Society of Hospital Medicine
VTE Protocol Specs: Adult medical inpatients

Format: Paper Scope: new patients admitted to general medicine service Pages: 1 Content/Use: one of several pre-printed order sets used by providers who write admission orders; at times competes with disease-specific admission order sets Formulary: whenever LMWH is ordered, pharmacy makes automatic substitutions with SQ Heparin

Date/Time: ____________________________________ Sent to Pharmacy ________________

Diagnosis/Chief Complaint: ____________________________________________________________

Billing Status: ________________________________

- Attending physician: ___________________ TEAM (if PICS)
- Courtesy list Dr. ________________________ _____________ ☐ Do not call
- Condition: _________________________________________________________________
- Code Status: ______________________________

☐ No known allergies  ☐ Allergies: ________________________________

VTE prophylaxis options:

<table>
<thead>
<tr>
<th>Option</th>
<th>VTE Risk Factor Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Heparin 5000 units subcutaneously q6h</td>
<td>★ History of DVT/PE</td>
</tr>
<tr>
<td>☐ Sequential/compression stocking</td>
<td>★ Ischemic stroke, trauma,</td>
</tr>
<tr>
<td></td>
<td>hemorrhage, or paralysis</td>
</tr>
<tr>
<td>Other:</td>
<td>★ Malignancy</td>
</tr>
<tr>
<td></td>
<td>★ Hypercoagulable state</td>
</tr>
<tr>
<td></td>
<td>★ Age &gt; 40 years</td>
</tr>
<tr>
<td></td>
<td>★ Indwelling central venous</td>
</tr>
<tr>
<td></td>
<td>line</td>
</tr>
<tr>
<td></td>
<td>★ Cerebrovascular disease</td>
</tr>
<tr>
<td></td>
<td>★ History of chronic lung</td>
</tr>
<tr>
<td></td>
<td>disease or inflammatory</td>
</tr>
<tr>
<td></td>
<td>disorder</td>
</tr>
<tr>
<td></td>
<td>★ Admission with (or history of): heart failure, pneumonia, serious infection, varicose veins, nephrotic syndrome, sickle cell disease, recent major surgery, prostatic, or estrogen use</td>
</tr>
</tbody>
</table>

Pharmacy / IV's:

- Initiate Insulin Subcutaneous Orders Order Set (MD to indicate insulin type of intensity of regimen): ____________
- Initiate IV order set for: ____________
- Acetaminophen (Tylenol) 650 mg PO/PR q6h pm pain or temperature >101°F (not to exceed 4 grams per 24 hours)
- Promethazine (Phenergan) 6.25 – 25 mg IM/IV/PO/PR q6h pm nausea/vomiting
- Ondansetron (Zofran) 4 mg PO/IV q6h pm nausea/vomiting
- Milk of Magnesia (MOM) 15 ml PO q6h pm constipation
- MagnesiumAluminum (Maalox) 30 ml PO q6h pm indigestion
- Guafencisin (Robitussin) 10 ml PO q6h pm expectoration
- Zolpidem (Ambien) 5 mg po hs pm insomnia, for patients ≥ 65 years of age only
- Zolpidem (Ambien) 5-10 mg po hs pm insomnia, for patients < 65 years of age only
- Other medication hs pm sleep:
- Nitroglycerin 0.4 mg SL q5min pm chest pain. If no relief after 3 doses, get STAT ECG and notify MD.

IV fluid: @________ml/hr
- Normal saline flush scheduled and pm for pm adapter as per policy
- Additional medications:

Phone/Verbal

<table>
<thead>
<tr>
<th>Phone/Verbal</th>
<th>MD</th>
<th>RN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order entered by:</td>
<td>Time</td>
<td>Non Rx Orders verified by:</td>
</tr>
<tr>
<td>patient label/ addressograph</td>
<td>60</td>
<td>Society of Hospital Medicine</td>
</tr>
</tbody>
</table>
VTE Protocol Specs: **Adult inpatients**

**Format:** Paper  
**Scope:** newly admitted patients  
**Pages:** 1  
**Content/Use:** provider adds up risk factors to get a total score and then uses the score to choose from a menu of recommended prophylaxis options

---

**DATE:**

**TIME:**

**ALLERGIES:**

---

**RECOMMENDED REGIMENS FOR PROPHYLAXIS BASED ON RISK FACTOR ASSESSMENT**

1. **Assign risk score:** __________ (see reverse side for risk assessment criteria)

2. **Patient has contraindication to pharmacologic prophylaxis** (circle one):  **Y** or **N**  
   (See reverse side for list of relative and absolute contraindications)

3. **Order for thromboprophylaxis** (**✓** in box activates order)  
   **NOTE:** Do not use these guidelines if the patient is receiving therapeutic anticoagulation.

<table>
<thead>
<tr>
<th>NON-PHARMACOLOGIC</th>
<th>PHARMACOLOGIC (Send order to Pharmacy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Ambulation Only</td>
<td>SCD (Knee High)</td>
</tr>
<tr>
<td>Risk Factor Score</td>
<td>5,000 Units SQ Q12H</td>
</tr>
</tbody>
</table>

**Contraindication to drug therapy**

- Low (0)
- Moderate (1-2)
- High (3-4)
- Very High (≥5)

4. **Order for laboratory**  
   (**✓** in box activates order)  
   □ CBC with platelets every other day  
   □ Daily INR if Warfarin is used  
   □ Other laboratory order (describe): ________________

---

**SPECIAL CONSIDERATIONS:**

- Renal impairment: Use low molecular weight heparins with caution in patients with Scr > 2 or CrCl < 30 mL/min. Use of fondaparinux is contraindicated in patients with a CrCl < 30 mL/min.
- Patients < 50 kg: consider dose adjustments for pharmacologic prophylaxis in patients with a weight of < 50 kg.  
- Fondaparinux should not be used in patients < 50 kg.  
- Obesity: Appropriate dosing for obese patients is not well established. Consider CHAS consult.

---

Signature ___________________________ M.D. # __________ Time ______ Date ______ Pager __________

**FLAG CHART** Checked by ___________________________ R.N. Time ______ Date ______
**VTE Protocol Specs:** Adult inpatients (reverse side of form on previous page)

**Format:** Paper
**Scope:** newly admitted patients
**Pages:** 2

**Content/Use:** provider adds up risk factors to get a total score and then uses the score to choose from a menu of recommended prophylaxis options.

---

### Deep Vein Thrombosis Risk Factor Assessment

Check all pertinent thromboembolism risk factors (RFs)

<table>
<thead>
<tr>
<th>RFs with value of 1 point</th>
<th>RFs with value of 2 points</th>
<th>RFs with value of 3 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Age 41-60 years</td>
<td>- Age 61-70 years</td>
<td>- Age over 70 years</td>
</tr>
<tr>
<td>- Prior history of postoperative DVT</td>
<td>- Prior to unprovoked/idiopathic DVT</td>
<td>- Prior history of PE</td>
</tr>
<tr>
<td>- Family history of DVT or PE</td>
<td>- Major surgery</td>
<td>- Inherited thrombophilia *</td>
</tr>
<tr>
<td>- Leg swelling, ulcers, stasis, varicose veins</td>
<td>- Malignancy</td>
<td>- Acquired thrombophilia *</td>
</tr>
<tr>
<td>- MI/CHF</td>
<td>- Multiple trauma</td>
<td></td>
</tr>
<tr>
<td>- Stroke with paralysis</td>
<td>- Spinal cord injury with paralysis</td>
<td></td>
</tr>
<tr>
<td>- Inflammatory bowel disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Central line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Bed confinement / immobilization &gt; 12 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- General anestheseia time &gt; 2 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Pregnancy, or postpartum &lt; 1 month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Obesity (&gt;20% over IBW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Hyperviscosity syndromes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Estrogen therapy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL RISK FACTOR SCORE =**

- Low: 0
- Moderate: 1-2
- High: 3-4
- Very High: >4

*Thrombophilia includes Factor V Leiden, and prothrombin variant mutations; anticoagulant antibody syndrome; antithrombin, protein C or protein S deficiency; hyperhomocysteinemia; myeloproliferative disorders.*

**Abbreviations**

- **LDUH**: low dose unfractionated heparin
- **LMWH**: low molecular weight heparin
- **SCD**: sequential compression device

<table>
<thead>
<tr>
<th>Low Risk (0 RFs)</th>
<th>Moderate Risk (1-2 RFs)</th>
<th>High Risk (3-4 RFs)</th>
<th>Very High Risk (&gt;4 RFs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early ambulation</td>
<td>LDUH (5,000 Units) q 8-12 h or LMWH or SCD</td>
<td>LDUH (5,000 Units) q 8 h or LMWH or SCD</td>
<td>LMWH or Warfarin, INR 2-3</td>
</tr>
</tbody>
</table>

### Contraindications to Pharmacologic Prophylaxis

<table>
<thead>
<tr>
<th>Relative</th>
<th>Absolute</th>
</tr>
</thead>
<tbody>
<tr>
<td>- History of cerebral hemorrhage</td>
<td>- Active hemorrhage</td>
</tr>
<tr>
<td>- Cranotomy within 2 weeks</td>
<td>- Heparin or warfarin use in patients with heparin-induced thrombocytopenia</td>
</tr>
<tr>
<td>- GI, GU hemorrhage within the last 5 months</td>
<td>- Warfarin use in the first trimester of pregnancy</td>
</tr>
<tr>
<td>- Thrombocytopenia</td>
<td>- Severe trauma to head, spinal cord or extremities with hemorrhage within the last 4 weeks</td>
</tr>
<tr>
<td>- Coagulopathy (PT &gt;16 sec)</td>
<td>- Epidural/intravascular spinal catheter – placement or removal</td>
</tr>
<tr>
<td>- Active intracranial lesions/neoplasms/monitoring devices</td>
<td></td>
</tr>
<tr>
<td>- Proiferative retinopathy</td>
<td></td>
</tr>
<tr>
<td>- Vascular access/bloody sites inaccessible to hemostatic control</td>
<td></td>
</tr>
</tbody>
</table>

### Recommendations for the Use of Antithrombotic Prophylaxis in Patients with Epidural Catheters

**For patients receiving low-dose SQ unfractionated heparin (5,000 units Q12h):**

- Wait 4-6 hours after a prophylactic dose of unfractionated heparin before placing or removing a catheter.
- Initiate unfractionated heparin thromboprophylaxis 1-2 hours after placing or removing a catheter.
- Concurrent use of epidural or spinal catheter and SQ low-dose unfractionated heparin is not contraindicated.

**For patients receiving prophylactic-dose Low Molecular Weight Heparin:**

- Wait 24 hours after a prophylactic dose of low molecular weight heparin before placing a catheter or performing a neuraxial block.
- Wait 12-24 hours after a prophylactic dose of low molecular weight heparin before removing a catheter.
- Initiate low molecular weight heparin thromboprophylaxis 2-4 hours after removal of the catheter.
- Initiate low molecular weight heparin thromboprophylaxis 24 hours after a “single shot” spinal procedure.
- Concurrent use of an epidural catheter and low molecular weight heparin thromboprophylaxis needs to be approved by the pain service.

**For patients receiving fondaparinux:**

- Extreme caution is warranted given the sustained antithrombotic effect, early postoperative dosing, and "irreversibility."
- Until further clinical experience is available, an alternate method of prophylaxis should be utilized.

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Adult Venous Thromboembolism Prophylaxis Order
**VTE Protocol Specs:** Adult inpatients admitted, transferred between units, or post-op  
**Institution:** Emory Hospitals  
**Format:** Paper  
**Scope:** every non-orthopedic patient admitted or transferred to any service from any area including post-op  
**Pages:** 1st of two pages.  
**Content/Use:** any service has the freedom to staple this as another page in pre-printed order sets, but is foremost encouraged to copy/paste the check box options into revisions of existing order sets while pasting the risk stratification/decision support on the back  
**Formulary:** one LMWH (Enoxaparin

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**EMORY HOSPITALS**  
**Standardized VTE Risk Assessment**

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### DATE: ____/____/____  
### TIME: ________________

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**VENOUS THROMBOEMBOLISM (VTE) PROPHYLAXIS and Risk Stratification:**  
--For decision support, see tables on reverse: “VTE Risk Stratification” and “Contraindications to Pharmacologic VTE Prophylaxis”—

<table>
<thead>
<tr>
<th>Medical &amp; Surgical (Non-Orthopedic) patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Enoxaparin (Lovenox) 40 mg SQ q 24 hr, or</td>
</tr>
</tbody>
</table>
| □ Enoxaparin (Lovenox) 30mg SQ q 24 hr (CrCl < 30) | Intermediate – to – High Risk  
| □ Heparin 5000 units SQ q 8 hr, or |  
| □ Heparin 5000 units SQ q 12 hr (inadequate except for age > 75 yrs) | Low Risk  
| □ Ambulate q shift |  

**Special Situations**  
**Contraindication(s) to Pharmacologic VTE Prophylaxis** (or as supplement to anticoagulation for higher risk patients)  
□ Graduated Compression Stockings, or  
□ Pneumatic / Sequential Compression Devices

**Contraindication to Heparin-Based Pharmacologic VTE Prophylaxis**  
□ Fondaparinux 2.5mg SQ q24 hr

**Alternative prophylaxis**  
□ Patient already on therapeutic anticoagulation  
□ No order for VTE prophylaxis requires reason here: _________________________________

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Physician Signature: __________________________ Contact Number: ________________
### VTE Risk Factors

**Medical or Surgical Conditions**

<table>
<thead>
<tr>
<th>Category</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardiac</strong></td>
<td>Myocardial Infarction (&lt; 3 months)</td>
</tr>
<tr>
<td><strong>Respiratory</strong></td>
<td>Left-sided PLE, pleural effusion, or tension pneumothorax</td>
</tr>
<tr>
<td><strong>CNS</strong></td>
<td>Brain tumor, neurosurgical procedure, or spinal cord compression</td>
</tr>
<tr>
<td><strong>GI</strong></td>
<td>Acute bleeding (bleeding at ≥ C7)</td>
</tr>
<tr>
<td><strong>GU</strong></td>
<td>Active intrarenal hemorrhage, severe urinary tract hemorrhage</td>
</tr>
<tr>
<td><strong>Endo</strong></td>
<td>Active endometrial hemorrhage, or uterine hemorrhage</td>
</tr>
<tr>
<td><strong>Hematology</strong></td>
<td>Malignancy, or active anticoagulant state (HIT, HIT-like syndrome)</td>
</tr>
<tr>
<td><strong>Orthopedic</strong></td>
<td>Fractured hip, pelvis, femur, or leg</td>
</tr>
<tr>
<td><strong>Rheum</strong></td>
<td>Active inflammatory bowel disease, spondyloarthropathy, or rheumatologic</td>
</tr>
<tr>
<td><strong>Sepsis</strong></td>
<td>End-stage liver disease, or unknown cause</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Active bleeding (bleeding at ≥ C7)</td>
</tr>
</tbody>
</table>

**Patient Circumstances**

- Age > 40 years
- History of VTE or PE
- History of DVT or PE
- History of VTE or PE (1st degree relative)
- Active hemorrhage
- Acute trauma (≤ 1 month)
- Central venous catheter
- Active anticoagulant state (HIT, HIT-like syndrome)
- Myeloproliferative disorder
- Rheumatologic disease (active)
- Elective hip or knee arthroplasty
- Active bleeding (bleeding at ≥ C7)
- Multiple risk factors

**Evidence**

Prevention of venous thromboembolism: the 7th ACCP Conference on Antithrombotic and Thrombolytic Therapy. Chest. 2004 Sep;126 (3 Suppl):338S-400S.

### Contraindications

**Absolute**

- Spinal surgery
- Active hemorrhage
- Active bleeding (bleeding at ≥ C7)
- Active anticoagulant state (HIT, HIT-like syndrome)
- Myeloproliferative disorder
- Rheumatologic disease (active)
- Elective hip or knee arthroplasty
- Active bleeding (bleeding at ≥ C7)

**Relative**

- Intracranial hemorrhage
- GI hemorrhage
- GU hemorrhage
- Craniotomy
- Intraocular surgery
- Epidural catheter insertion
- Epidural catheter removal
- Active intracranial lesions/neoplasm
- Hypertensive urgency/emergency
- Thrombocytopenia (platelet < 50k, or falling platelet count)
- Coagulopathy (INR > 2, or PT > 18)
- End-stage liver disease
- Other: ___________________
### Venous Thromboembolism (VTE) Risk in the Hospitalized Inpatient

<table>
<thead>
<tr>
<th>LOW</th>
<th>MODERATE</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Ambulatory patient without additional VTE Risk Factors</td>
<td>- All other patients Most patients! (not in LOW or HIGH category)</td>
<td>- Elective major lower extremity arthroplasty</td>
</tr>
<tr>
<td>- Ambulatory patient with expected LOS &lt;= 2 days, or same day/minor surgery Only a few patients!</td>
<td></td>
<td>- Hip, pelvic, or severe lower extremity fractures</td>
</tr>
</tbody>
</table>

#### Ambulation and Education
- LMWH or UFH 5000 units q 8h
- LMWH or Arixtra or Coumadin, AND IPC

### Pharmacologic Prophylaxis Options: Choose ONE:

- Enoxaparin 30 mg subcutaneous q 12 hours (HIGH risk, knee replacement)
- Enoxaparin 40 mg subcutaneous q 24 hours (both MODERATE and HIGH risk patients, except knee replacement)
- UFH 5000 units subcutaneous q 8 h (MODERATE risk only)
- UFH 5000 units subcutaneous q 12 h. (for MODERATE risk patients < 50 kg or > 75 years of age)
- Fondaparinux 2.5 mg subcutaneous q 24 hours (alternate in selected HIGH risk patients)
- Coumadin _____ mg po daily, target INR 2-3 (alternate in selected HIGH risk patients)
- NO pharmacologic prophylaxis, patient has a contraindication to pharmacologic prophylaxis or is on therapeutic anticoagulation (please check contraindication(s) on reverse.)
- NO pharmacologic prophylaxis, patient has NO VTE risk factors listed on reverse and meets LOW risk criteria above.

### Mechanical Prophylaxis:

- Venodynes (IPC) (Default adjunct in HIGH risk patients, or if contraindications to anticoagulation)
- Graduated compression stockings
- NO mechanical VTE prophylaxis

**VTE Risk Factors and Contraindications listed on reverse**

Physician Signature: __________________________ Contact Number: __________________

Date and Time: ___________________
### Venous Thromboembolism Risk Factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Prior history of VTE</th>
<th>Acute or chronic lung disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 50 years</td>
<td>Impaired mobility</td>
<td></td>
</tr>
<tr>
<td>Myeloproliferative disorder</td>
<td>Inflammatory bowel disease</td>
<td>Obesity</td>
</tr>
<tr>
<td>Dehydration</td>
<td>Active rheumatic disease</td>
<td>Known thrombophilic state</td>
</tr>
<tr>
<td>CHF</td>
<td>Sickle cell disease</td>
<td>Varicose veins /chronic stasis</td>
</tr>
<tr>
<td>Active malignancy</td>
<td>Estrogen based contraceptives</td>
<td>Recent post-partum w/ immobility</td>
</tr>
<tr>
<td>Hormonal replacement</td>
<td>Central venous catheter</td>
<td>Nephrotic syndrome</td>
</tr>
<tr>
<td>Moderate to Major surgery</td>
<td></td>
<td>Myocardial infarction</td>
</tr>
</tbody>
</table>

### Contraindications or other Conditions to Consider with Pharmacologic VTE Prophylaxis

<table>
<thead>
<tr>
<th><strong>ABSOLUTE</strong></th>
<th><strong>RELATIVE</strong></th>
<th><strong>OTHER CONDITION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Active hemorrhage</td>
<td>Intracranial hemorrhage within last year</td>
<td>Immune mediated HIT</td>
</tr>
<tr>
<td>Severe trauma to head or spinal cord with hemorrhage in the last 4 weeks</td>
<td>Craniotomy within 2 weeks</td>
<td>Epidural analgesia with spinal catheter (current or planned)</td>
</tr>
<tr>
<td>Other ____________________________</td>
<td>Intraocular surgery within 2 weeks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GI, GU hemorrhage within the last month</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thrombocytopenia (&lt;50K) or coagulopathy (PT &gt; 18 seconds)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>End stage liver disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Active intracranial lesions/neoplasms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypertensive urgency / emergency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Post-operative bleeding concerns*</td>
<td></td>
</tr>
</tbody>
</table>

*Scheduled return to OR within the next 24 hours  *Major Ortho: 24 hours leeway
*Spinal cord or Ortho Spine: 7 days leeway  *General Surgery, s/p transplant, s/p Trauma admission: 48 hours leeway