Preventing Hospital-associated Venous Thromboembolism: Practical Strategies That Work

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Sept. 20, 2017
Disclosures

The presenter has no conflicts of interest to disclose.

Dr. Maynard is the author of: AHRQ DVT Prevention Guide
Abbreviations – Terms

- VTE – venous thromboembolism
- VTE-P – VTE prevention/prophylaxis
- HA VTE – hospital-associated VTE
- CDS – clinical decision support
- IPCD – intermittent pneumatic compression devices
- SCD – sequential compression devices
- GCS – graduated compression stockings
- Extended duration prophylaxis – beyond hospital stay
- LMWH – low-molecular weight heparin
- UFH – unfractionated heparin
- LDUH – low dose unfractionated heparin
- PAH – pulmonary artery hypertension
A Major Source of Mortality and Morbidity

- 350,000 to 650,000 with VTE per year
- 100,000 to > 200,000 deaths per year
- About half are hospital related
- VTE is \textit{primary} cause of fatality in half
  - More than HIV, MVAs, breast CA \textit{combined}
  - Equals 1 jumbo jet crash/day
- 10% of hospital deaths
  - Pulmonary embolism (PE) among top sources of preventable hospital-related deaths
- Huge costs and morbidity (recurrence, post-thrombotic syndrome, chronic PAH, anticoagulation)

Source: Surgeon General’s Call to Action to Prevent DVT and PE 2008 DHHS
Suboptimal VTE Prophylaxis Is Common

- ENDORSE: 70,000 cases, 358 hospitals
  - Appropriate prophylaxis: about 50%
  - 60% surgical, 40% medical
- JHM Review: 390,000 cases, 429 hospitals
  - Any dose: 78% surgical, 66% medical
  - Appropriate: 16% and 13%
- Many Others

Flip Side of Under Prophylaxis

- A 35-year-old ambulatory woman was admitted with minor burns, but more for mild alcohol withdrawal:
  - VTE prophylaxis: Enoxaparin 30 mg q 12 hours
  - $, pain, small risks of HIT, bleeding, RN time

Slide courtesy of Dr. Ian Jenkins, UCSD
QI Framework and Strategies That Work

- UC San Diego and University of California VTEP Collaborative
- Dignity Health VTEP Collaborative
- SHM/AHRQ improvement guides and Collaborative
- Experience, mentoring other hospitals via UCSD CIIS
- Johns Hopkins experience
- Systematic reviews

Practical “How-to” and More

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Suggested Citation

Strategies to Reduce HA VTE

- Centralized steering group for institution (or system) wide approach. Local teams vital. Collaborative structure
- Review and distill the evidence/best practices
- Standardize – create a VTE prevention protocol
- Embed protocol guidance into order sets, hard stops for use on admission, transfer, and post-op – provide seamless CDS
- Go beyond core measures – better measures
- Active day-to-day surveillance, in addition to monthly/quarterly: Common protocol for nurse and doctor
- Multiple mutually reinforcing interventions to reinforce protocol
- Active vs. passive interventions
- Address adherence/administration of prophylaxis
- Address other failure modes/contributing factors to HA VTE
  - Mobility, central lines, bypassing order sets, etc.
Review Evidence, identify best practice
- Guidelines
  - ATS, ACP, AAOS, ASCO, ACOG, NICE
- Regulatory
  - TJC/NQF/SCIP/CMSS
- Local standards
- Other guidance
  - Literature, meta-analyses

Define Local Best Practice Standards and Expectations
- Policies
- Protocols
 |
VTE and bleeding risk assessment
link to risk appropriate prophylaxis options

Design Multi-faceted Interventions
- Order sets
  - Embedded VTE prevention protocol
- Education
- Increase delivery of ordered prophylaxis
- Checklists
- Alerts
- Reduced use of central venous catheters
- Enhance mobility and activity
- Audit and feedback
- Care pathways

Ensure reliable delivery of best practice
- Implement, monitor, revise, and refine,
  - Engage
    - Explain why important
  - Educate
    - Share evidence, include "just in time" education
  - Execute
    - Implement intervention toolkit with standardization, good CDS, high reliability techniques
  - Evaluate
    - Regularly assess, revise and refine as needed.

Spread and Sustain

Analyze Care Delivery
Survey Previous/Ongoing Efforts
- Environment, baseline, failure modes, barriers to implementation

Continue analysis of care delivery
- Local barriers, impact of interventions

Track Metrics

Key Metrics:
- Prevalence of appropriate VTE Prophylaxis
- Incidence of Hospital-Associated VTE

Establish Foundation:
- Institutional Support and Centralized, Empowered VTE Prevention Steering Team
The Essential First Intervention

1) A standardized VTE risk assessment, linked to...
2) A menu of appropriate prophylaxis options, plus...
3) A list of contraindications to pharmacologic VTE prophylaxis

Challenges:

*Make it easy to use (“automatic”)*

*Make sure it captures almost all patients*

*Trade-off between guidance and ease of use/efficiency*
# 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* (&quot;State of Nature&quot;)</td>
<td>40%</td>
</tr>
<tr>
<td>2</td>
<td>Decision support exists but not linked to order writing, or prompts within orders but no decision support</td>
<td>50%</td>
</tr>
<tr>
<td>3</td>
<td><strong>Protocol well-integrated</strong> (into orders at point-of-care)</td>
<td>65-85%</td>
</tr>
<tr>
<td>4</td>
<td>Protocol enhanced (by other QI / high reliability strategies)</td>
<td>90%</td>
</tr>
<tr>
<td>5</td>
<td><strong>Oversights identified and addressed in real time</strong></td>
<td>95+%</td>
</tr>
</tbody>
</table>
Characteristics of the Hypothetical Ideal Protocol:

Trade-offs and prioritization of characteristics often needed

- Accurately detects all patients at risk for DVT
- Reliably **excludes** patients who would be unlikely to develop DVT, minimizing inappropriate over-prophylaxis in those of lower risk
- Provides actionable recommendations for permutations of VTE and bleeding risk
- Simple to use in routine clinical practice
- Identifies patients that should have a combination of mechanical and anticoagulant prophylaxis
- Lends itself to automation or dynamic ongoing re-evaluations
- Integration results in convincing decreases in hospital-associated VTE without any increase in bleeding
Protocol

- Local standards of best practice
- Written out
- Algorithmic decision trees can be useful
- Include operational definitions
- Must have enough detail to be measurable and make judgments re: *Is this case meeting our standard of care?*

Examples requiring operational definitions:
- High INR
- Low platelet counts
- Impaired mobility
- “Low risk”
Prompt – Not a Protocol – No CDS Offered

DVT Prophylaxis Orders

- Anti-thromboembolism stockings
- Sequential compression devices
- UFH 5000 units SubQ q 12 hours
- UFH 5000 units SubQ q 8 hours
- LMWH (Enoxaparin) 40 mg SubQ q day
- LMWH (Enoxaparin) 30 mg SubQ q 12 hours
- No Prophylaxis, Ambulate
Over 20 Different VTE Risk Assessment Models

- No consensus on what is best in clinical practice
- Individualized point-based scoring (quantitative) models
  - Generally more rigorously validated in determining risk, but not in clinical practice
- Grouping or “bucket” models
  - Generally not as well validated in predicting risk, but easier to implement, more published/unpublished success stories in reducing HA VTE
  - Examples:
    - NICE/NHS guidelines, Australia / New Zealand working group model
    - Classic “3 bucket” model
    - Updated “3 bucket” grouping model

- Examples:
  - Caprini
  - Padua
  - Improve
Caprini Model

- Validated in predicting risk
- Can be difficult to use reliably
- Only 1 published success in clinical practice published after 30 years of use
- Works best in centers with advanced CDS to make it easier/more automated

### Each Risk Factor Represents 1 Point
- Age 41-60 years
- Swollen legs (current)
- Varicose veins
- Obesity (BMI >25)
- History of inflammatory bowel disease
- Minor surgery planned
- Sepsis (<1 month)
- Abnormal pulmonary function (COPD)
- Serious lung disease including pneumonia (<1 month)
- Oral contraceptives or hormone replacement therapy
- Pregnancy or postpartum (<1 month)
- History of unexplained stillbirth, recurrent spontaneous abortion (≥3), premature birth with toxemia or growth-restricted infant
- Other risk factors

### Each Risk Factor Represents 2 Points
- Age 61-74 years
- Arthroscopic surgery
- Major surgery (>45 minutes)
- Malignancy (present or previous)
- Laparoscopic surgery (>45 minutes)
- Patient confined to bed (>72 hours)
- Immobilizing plaster cast (<1 month)

### Each Risk Factor Represents 3 Points
- Age 75 years or older
- History of DVT/PE
- Positive Prothrombin 20210A
- Positive Factor V Leiden
- Positive Lupus anticoagulant
- Elevated serum homocysteine
- Heparin-induced thrombocytopenia (HIT)
- Elevated anticardiolipin antibodies
- Other congenital or acquired thrombophilia
- If yes: Type

*most frequently missed risk factor

### Total Risk Factor Score:

### Caprini Score | Risk | VTE Incidence | Recommended Prophylaxis
---|---|---|---
0 - 2 | very low - low | < 1.5%<sup>1</sup> | Early ambulation, IPC |
3 - 4 | moderate | 3%<sup>2</sup> | LMWH; UFH; or IPC. If high bleeding risk, IPC until bleeding risk diminishes |
5 - 8 | high | 6%<sup>2</sup> | LMWH + IPC; or UFH + IPC. If high bleeding risk, IPC until bleeding risk diminishes |
> 8 | very high | 6.5 - 18.3% | LMWH + IPC; or UFH + IPC. If high bleeding risk, IPC until bleeding risk diminishes. Consider extended duration prophylaxis |

<sup>1</sup> Abdominal or pelvic surgery for cancer should receive extended VTE prophylaxis with LMWH x 30 days.<sup>3</sup>

IPC = intermittent pneumatic compression
LMWH = low molecular weight heparin
UFH = unfractionated heparin

**- Classic “3 bucket” model derived from AT8**

<table>
<thead>
<tr>
<th><strong>Low Risk</strong>: Minor surgery in mobile patients. Medical patients who are fully mobile. Observation patients with expected hospital stay &lt; 48 hours.</th>
<th>No prophylaxis, reassess periodically, ambulate.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moderate Risk</strong>: Most general, thoracic, open gynecologic or urologic surgery patients. Medical patients, impaired mobility from baseline or acutely ill.</td>
<td>UFH or LMWH prophylaxis*</td>
</tr>
<tr>
<td><strong>High Risk</strong>: Hip or knee arthroplasty, hip fracture surgery. multiple major trauma, spinal cord injury or major spinal surgery, Abdominal-pelvic surgery for cancer.</td>
<td>IPCD <strong>AND</strong> LMWH or other anticoagulant*</td>
</tr>
</tbody>
</table>

*For those at moderate or high risk and contraindications to anticoagulation, use IPCD.*
Updated Model – More c/w AT9 Guidelines

Updated “3 bucket” model, now in use at authors’ site (UC San Diego)

<table>
<thead>
<tr>
<th>Low Risk:</th>
<th>Observation status, expected LOS &lt; 48 hours. Minor ambulatory surgery unless multiple strong risk factors. Medical patients ambulatory in hall and not Moderate or High Risk. Ambulatory cancer patients admitted for short chemotherapy infusion.</th>
<th>No prophylaxis, reassess periodically, ambulate.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate Risk (Most general medical / surgical patients):</td>
<td>Most general, thoracic, open gynecologic or urologic surgery patients. Active cancer or past VTE / known thrombophilia in medical patient with LOS &gt; 48 hours. Medical patient with decrease in usual ambulation AND VTE risk factors (MI, Stroke, CHF, PNA, active inflammation / infection, dehydration, age &gt; 65)</td>
<td>UFH or LMWH prophylaxis*</td>
</tr>
<tr>
<td>High Risk:</td>
<td>Hip or knee arthroplasty, hip fracture surgery, multiple major trauma, spinal cord injury or major neurosurgery, abdominal-pelvic surgery for cancer</td>
<td>IPCD AND LMWH or other anticoagulant*</td>
</tr>
</tbody>
</table>

*For those at moderate or high VTE risk and contraindications to anticoagulation, use IPCD alone until bleeding risk subsides.
Percent of Randomly Sampled Inpatients with Adequate VTE Prophylaxis

- Baseline
- Consensus building
- Order Set Implementation & Adjustment
- Real time ID & intervention
<table>
<thead>
<tr>
<th>Year</th>
<th>Patients at Risk</th>
<th>Cases w/ any VTE</th>
<th>Risk for HA VTE</th>
<th>Odds Ratio</th>
<th>(95% CI)</th>
<th>Cases with PE</th>
<th>Risk for PE</th>
<th>Odds Ratio</th>
<th>(95% CI)</th>
<th>Cases with DVT (and no PE)</th>
<th>Risk for DVT</th>
<th>Odds Ratio</th>
<th>(95% CI)</th>
<th>Cases w/ Preventable VTE</th>
<th>Risk for Preventable VTE</th>
<th>Odds Ratio</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>9,720</td>
<td>131</td>
<td>1 in 76</td>
<td>1.0</td>
<td></td>
<td></td>
<td>1 in 463</td>
<td>1.0</td>
<td></td>
<td>110</td>
<td>1 in 88</td>
<td>1.0</td>
<td></td>
<td>44</td>
<td>1 in 221</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>9,923</td>
<td>138</td>
<td>1 in 73</td>
<td>1.03</td>
<td>(0.81, 1.32)</td>
<td>22</td>
<td>1 in 451</td>
<td>1.02</td>
<td>(0.54, 1.96)</td>
<td>116</td>
<td>1 in 85</td>
<td>1.03</td>
<td>(0.79, 1.96)</td>
<td>21</td>
<td>1 in 473</td>
<td>0.47#</td>
<td>(0.26, 0.80)</td>
</tr>
<tr>
<td>2007</td>
<td>11,207</td>
<td>92</td>
<td>1 in 122</td>
<td>0.61#</td>
<td>(0.46, 0.80)</td>
<td>15</td>
<td>1 in 747</td>
<td>0.62</td>
<td>(0.30, 1.26)</td>
<td>77</td>
<td>1 in 146</td>
<td>0.61*</td>
<td>(0.45, 0.82)</td>
<td>7</td>
<td>1 in 1,601</td>
<td>0.14*</td>
<td>(0.05, 0.31)</td>
</tr>
</tbody>
</table>

# p < 0.01 *p < 0.001

Effective Implementation/CDS Principles

1. Keep it simple for the end user
   a. Some adjustments can be made behind the scenes (pharmacy adjustment of dose or peri-op timing, for example)
   b. Minimize calculations/clicks, automate process for them
   c. Streamline options, offer only preferred choices

2. Don’t interrupt the workflow
   a. Integrate risk assessment in admit/transfer/post-op processes
   b. Keep VTE risk assessment, bleeding risk assessment, and ordering of risk-appropriate prophylaxis together as a unified process

3. Design reliability into the process
   a. **Forcing functions**/hard stop for VTEP
   b. Present preferred risk-appropriate prophylaxis as the default option once risk level chosen
   c. **Scheduling** and redundant checks for highest risk patients
   d. **Standardization** for services/groups of patients (discourage over-customization at provider level)

continued...
Effective Implementation/CDS Principles, continued

4. Pilot interventions on a small scale
   a. Engage medical staff groups, look for barriers and special needs
   b. Use case histories or real patient scenarios to simulate use of the order set

5. Monitor use of the protocol. Build measurement and monitoring into order set and documentation tools
   a. Capture VTE risk, declaration of contraindications, what is ordered
   b. Ambulation, IPCD adherence
   c. Audits – order sets being used? Completed properly?
   d. Learn for variation from protocol
Strategies for VTE Prevention
Beyond order sets

- A good protocol-driven order set is well integrated
- Assessing administration/adherence
  - (not just orders)
- Alert systems
  - Electronic alerts (E-alerts)
  - Human alerts
- Raising situational awareness (e.g., checklists)
- Audit and feedback
- Measure-vention
- Increase activity
- Optimize central lines
- Focus on extended duration for select populations
Challenges with Mechanical Prophylaxis

- **Ordering**
  - M.D. over-ordering, including for low-risk patients
  - Clinical decision support needs (IF high risk and no contraindication) then SCDs and LMWH

- **Compliance**
  - Comfort, fall risks, convenience, priorities
  - Bulky devices and tethering vs. battery powered
  - Nurse driven protocol?

- **Documentation**
  - Adherence: priorities; challenges (what’s adequate? documentation of use at that moment?)
  - Timing: fallouts when not documented instantly, even when (+) test was protocoled surveillance
What is a blood clot?
- Clumps of thickened blood that blocks blood flow
- Blood clots most often form in your legs, arms, and groin but could move to your lungs, heart or brain
- Blood clots can be dangerous and deadly

To prevent a blood clot from happening during your hospital stay, your doctor may ask you to take a medication or wear a leg device.

If your doctor asks you to take a medication....
- The medication is a blood thinner
- This medication is a small injection into fatty tissue just below the skin
- It may be given more than once a day
- You will likely not need the medication once you leave the hospital

If your doctor asks you to wear a leg device...
- Sleeves will be placed on your legs that will squeeze your legs off and on during the day
- This light squeeze will increase the flow of blood in your legs to prevent clots from forming
- These sleeves should be removed before you are out of bed and walking because they can cause you to trip and fall
- Be sure you to ask for the sleeves to be put back on when you are back in bed

*If you are able to walk, this may decrease your risk. Please ask your nurse for help before getting out of bed.*
TJC and SCIP Measures

- Relatively low bar
- Do not drive rapid cycle QI
- Looks only at set points in hospitalization
  - Does not address patients who “fall off” protocol
- TJC measures: any prophylaxis = adequate prophylaxis
- Go beyond core measures to achieve better results
  - Judge adequacy of prophylaxis by adherence to your protocol
  - HA VTE = readmitted cases with new VTE + those not present on admission
  - Monitor for lapses in care on a day-to-day basis
Outcomes Measure for HA VTE and Preventable VTE

- Real-time capture using imaging system, and concurrent review of cases to see if they are HA or community acquired, preventable/not preventable. Not practical for most, but may be gold standard
- Improved methodology using administrative data
  - Captures readmitted patients as well as those with POA = No
  - Captures UE DVT, but tracks them separately
  - Higher bar for ‘preventable’
  - Audits to validate coding
- Administrative coding caveats
MEASURE-VENTION

Daily measurement drives concurrent intervention \textit{(i.e., same as Level 5 in Hierarchy)}

Identify suboptimal prophylaxis \textbf{in real time}

- Ongoing assessment
- Use for real-time intervention
# Anticoagulation

- **20** on anticoagulation
- **4** on mechanical prophylaxis with lab contraindication
- **3** on Nothing
- **1** mechanical

## Table: Anticoagulation Orders

<table>
<thead>
<tr>
<th>BED LABEL</th>
<th>Service</th>
<th>VTE Risk Category</th>
<th>Medication</th>
<th>Dose</th>
<th>SCD</th>
<th>Lab Contra</th>
<th>Orders state contra</th>
<th>Orders state LOW VTE Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>2250A</td>
<td>Medicine Thornton</td>
<td>LOW</td>
<td>warfarin (COUMADIN) tablet 3 mg</td>
<td>3 mg EVERY EVENING Oral</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>2250B</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>enoxaparin (LOVENOX) injection 30 mg</td>
<td>30 mg DAILY Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2251</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>heparin injection 5,000 Units</td>
<td>5000 Units EVERY 12 HOURS Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2252</td>
<td>Cardiothoracic Surgery</td>
<td>MODERATE/HIGH</td>
<td>No Anticoag Med</td>
<td>No Anticoag Dose</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2253</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>enoxaparin (LOVENOX) injection 40 mg</td>
<td>40 mg DAILY Subcutaneous</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2254</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>heparin injection 5,000 Units</td>
<td>5000 Units EVERY 8 HOURS Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2255</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>heparin injection 5,000 Units</td>
<td>5000 Units EVERY 12 HOURS Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2256A</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>enoxaparin (LOVENOX) injection 40 mg</td>
<td>40 mg DAILY Subcutaneous</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2256B</td>
<td>Pulmonary Vascular Medicine</td>
<td>MODERATE/HIGH</td>
<td>enoxaparin (LOVENOX) injection 50 mg</td>
<td>50 mg EVERY 12 HOURS Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2257A</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>enoxaparin (LOVENOX) injection 40 mg</td>
<td>40 mg DAILY Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2257B</td>
<td>Gynecology</td>
<td>MODERATE/HIGH</td>
<td>No Anticoag Med</td>
<td>No Anticoag Dose</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2258</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>enoxaparin (LOVENOX) injection 30 mg</td>
<td>30 mg DAILY Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>2259</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>No Anticoag Med</td>
<td>No Anticoag Dose</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2260</td>
<td>Pulmonary/Critical Care</td>
<td>LOW</td>
<td>No Anticoag Med</td>
<td>No Anticoag Dose</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2261</td>
<td>Medicine Thornton</td>
<td>MODERATE/HIGH</td>
<td>No Anticoag Med</td>
<td>No Anticoag Dose</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>2262A</td>
<td>Medicine Thornton</td>
<td>LOW</td>
<td>enoxaparin (LOVENOX) injection 40 mg</td>
<td>40 mg DAILY Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2262B</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>enoxaparin (LOVENOX) injection 40 mg</td>
<td>40 mg DAILY Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2263</td>
<td>Medicine Thornton</td>
<td>MODERATE/HIGH</td>
<td>No Anticoag Med</td>
<td>No Anticoag Dose</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2264</td>
<td>Pulmonary Vascular Medicine</td>
<td>MODERATE</td>
<td>warfarin (COUMADIN) tablet 5 mg</td>
<td>5 mg EVERY EVENING Oral</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>2265</td>
<td>Pulmonary Vascular Medicine</td>
<td>LOW</td>
<td>heparin injection 5,000 Units</td>
<td>5000 Units EVERY 8 HOURS Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2266</td>
<td>Pulmonary Vascular Medicine</td>
<td>LOW</td>
<td>warfarin (COUMADIN) tablet 10 mg</td>
<td>10 mg EVERY EVENING Oral</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>2266</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>heparin injection 5,000 Units</td>
<td>5000 Units EVERY 8 HOURS Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2267</td>
<td>Pulmonary Vascular Medicine</td>
<td>HIGH</td>
<td>enoxaparin (LOVENOX) injection 100 mg</td>
<td>100 mg EVERY 12 HOURS Subcutaneous</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>2268</td>
<td>Cardiothoracic Surgery</td>
<td>LOW</td>
<td>enoxaparin (LOVENOX) injection 40 mg</td>
<td>40 mg DAILY Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>2269</td>
<td>Cardiothoracic Surgery</td>
<td>No Risk Category</td>
<td>No Anticoag Med</td>
<td>No Anticoag Dose</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
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<tr>
<td>2270</td>
<td>Cardiothoracic Surgery</td>
<td>No Risk Category</td>
<td>No Anticoag Med</td>
<td>No Anticoag Dose</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2271</td>
<td>Medicine Thornton</td>
<td>MODERATE</td>
<td>heparin injection 5,000 Units</td>
<td>5000 Units EVERY 12 HOURS Subcutaneous</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2272</td>
<td>Pulmonary Vascular Medicine</td>
<td>HIGH</td>
<td>fondaparinux (ARIXTRA) injection 7.5 mg</td>
<td>7.5 mg DAILY Subcutaneous</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>
Effect of Situational Awareness on Prevalence of VTE Prophylaxis by Nursing Unit

**Hospital A, 1st Nursing Unit**

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Post-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCL</td>
<td>93%</td>
<td>104%</td>
</tr>
<tr>
<td>Mean</td>
<td>73%</td>
<td>99% (p &lt; 0.01)</td>
</tr>
<tr>
<td>LCL</td>
<td>53%</td>
<td>93%</td>
</tr>
</tbody>
</table>

**Hospital A, 2nd Nursing Unit**

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Post-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCL</td>
<td>90%</td>
<td>102%</td>
</tr>
<tr>
<td>Mean</td>
<td>68%</td>
<td>87% (p &lt; 0.01)</td>
</tr>
<tr>
<td>LCL</td>
<td>46%</td>
<td>72%</td>
</tr>
</tbody>
</table>

**Hospital B, 1st Nursing Unit**

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Post-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCL</td>
<td>89%</td>
<td>108%</td>
</tr>
<tr>
<td>Mean</td>
<td>71%</td>
<td>98% (p &lt; 0.01)</td>
</tr>
<tr>
<td>LCL</td>
<td>53%</td>
<td>88%</td>
</tr>
</tbody>
</table>

UCL = Upper Control Limit
LCL = Lower Control Limit
Patient Enemy #1: Bed

Complications associated with hospital beds:

- Aspiration pneumonia
- Deep vein thrombosis
- Delirium
- Pulmonary emboli
- Pressure ulcers
- Ileus, bowel paralysis
PICC Lines

- Increasing use
- Symptomatic VTE associated with PICC during hospitalization – 3.0 -7.8%
- Significant CLABSI burden
- Occlusion complications/thrombolytics
Practices to Reduce PICC complications

- Minimize exposure to PICCs
  - Maximize midline/PIV
  - Remove asap
- Size matters – smaller PICCs = less DVT
- Smallest number of lumens
- Proper flushing
- Following all infection control practices
- Fewer attempts to place PICC

- Appropriately sized catheter in proper position
- Appropriate DVT prophylaxis probably helps some, but not as much as for leg DVT
- Special catheters?

Recognized as 2015 CDC HA-VTE Prevention Challenge – VTEP Champions

Baseline:
- 700 HA VTE/year
- No standardized approach to VTE risk assessment
- Different EHRs and different versions of Epic
- Poor adherence to mechanical prophylaxis, suboptimal metrics

Objective: Reduce HA VTE by > 20% in all adult medical/surgical patients

Methods:
- Collaborative infrastructure – webinars, e-mail, minutes, project management, task lists, DropBox, REDCap, tool sharing, AHRQ toolkit
- Common metrics –
  - Adequate (not just any) prophylaxis by protocol, audits across entire stay (not just first 24 hours)
  - Incidence of HA VTE: Those that developed de-novo in the hospital, and readmitted within 30 days of prior stay with new VTE. Also looked at adherence to orders
Updated Model – More c/w AT9 guidelines

Updated “3 bucket” model, now in use at authors’ site (UC San Diego)

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Description</th>
<th>Prophylaxis Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Risk</strong></td>
<td>Observation status, expected LOS &lt; 48 hours. Minor ambulatory surgery unless multiple strong risk factors. Medical patients ambulatory in hall and not Moderate or High Risk. Ambulatory cancer patients admitted for short chemotherapy infusion.</td>
<td>No prophylaxis, reassess periodically, ambulate.</td>
</tr>
<tr>
<td><strong>Moderate Risk</strong></td>
<td>(Most general medical / surgical patients): Most general, thoracic, open gynecologic or urologic surgery patients. Active cancer or past VTE / known thrombophilia in medical patient with LOS &gt; 48 hours. Medical patient with decrease in usual ambulation AND VTE risk factors (MI, Stroke, CHF, PNA, active inflammation / infection, dehydration, age &gt; 65)</td>
<td>UFH or LMWH prophylaxis*</td>
</tr>
<tr>
<td><strong>High Risk</strong></td>
<td>Hip or knee arthroplasty, hip fracture surgery, multiple major trauma, spinal cord injury or major neurosurgery, abdominal-pelvic surgery for cancer</td>
<td>IPCD AND LMWH or other anticoagulant*</td>
</tr>
</tbody>
</table>

*For those at moderate or high VTE risk and contraindications to anticoagulation, use IPCD alone until bleeding risk subsides.
Intervention bundle:

- Hardwire simple VTE risk assessment – admit, transfer, post-op
- Education – staff and patient
- Increase mobility and adherence to prophylaxis
- Improve diagnostic coding
- Mini-RCAs of HA VTE for lessons learned, new interventions
- Audit and feedback on VTEP and HA VTE
- Active surveillance (a.k.a. measure-vention)
- Customize special populations (e.g., Orthopedics, OB-GYN, Neurosurgery, CABG)

Analysis:

- Medical vs. surgical, cancer vs. non-cancer
Recognized as 2015 CDC HA-VTE Prevention Challenge – VTEP Champions

• Adequate VTEP increased from < 82% to > 96% at all sites

• 2,431 HA VTE in 306,906 encounters

• HA VTE reduced by 24%
  • 28% reduction – surgical
  • 10% reduction – medical

• 170 averted HA VTE 2014 vs. 2011

• Est. $1.9 million in cost savings/year

• Cancer patients and surgical patients have higher risk than medical patients

• No increase in bleeding or HIT

METHODS

Setting, patients and timeframe:

- 35 community hospitals (varied sizes, teach status, and paper vs. electronic ordering systems)
- Compared 2011 (the baseline) to 2014 (the final state)
- Excluded were: Rehab, hospice, psychiatry, OB and pediatric patients
- Nine “pilot” sites developed a RAM/VTEP protocol and implementation plan which was disseminated to 26 “spread” hospitals
- All sites formed QI teams and received monthly collaborative webinars, data management support and site visits
METHODS

*Interventions:*

- QI mentorship at 9 pilot sites
- Education: site leads, staff, patients
- RAM/protocol: patients at low, medium or high risk with paired prophylaxis options
- Measure-vention: pilot sites were grant funded for real-time measurement/intervention
- Spread sites received partial support via Hospital Engagement Network (HEN) funds
- Same bundle components as UC collaborative
METHODS

**Metrics (similar to UC collaborative):**

- TJC VTEP measures (VTE-1 and 2)
- Adequate VTEP (per protocol) rates at pilot sites (per month of measure-vention)
- HA-VTE rates (coding data) including service and whether occurring during index stay (NPOA) or POA within 30 days of hospitalization (readmit)
- Rates for HIT and adverse effects of anticoagulation (coding data)
Results – VTE Prophylaxis Rates

- 1.15 million admissions > 36,000 audits for adequate VTEP per protocol
- Adequate VTEP Improved from < 80% to > 97% at pilot sites
- >46,000 TJC audits showed improvement to > 95%
Results – HA VTE

- There were 5,370 HA-VTE during the study (51% medical, 49% surgical)
- The HA-VTE rate was higher in surgical than medical patients
- Most (75%) medical HA VTE occurred after discharge (readmit)
- Most (61%) surgical HA VTE occurred during index admission
- HA VTE fell 22% – 428 fewer HA VTE per year
  - Readmit VTE fell 28%, NPOA VTE fell 12%
  - In medical patients, HA VTE fell 31% with improvements in both NPOA and readmit cases
  - In surgical cases, RR 0.90 [95% CI 0.81 – 1.01]

Selected for plenary, SHM meeting. Submitted to JHM
Medical vs. Surgical HA VTE Rates
NPOA vs. Readmit
### A Multi-Center, Mentored Quality Collaborative Reduced Hospital-Associated VTE

Ian Jenkins, MD, SFHM; Tamra O’Bryan, MHA, RHIA, CPHQ; Janet Holdych, PharmD, CPHQ; Gregory A. Maynard MD, MSc, MHM

Selected for plenary, SHM meeting. Submitted to JHM

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2014 vs 2011 RR [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admissions</td>
<td>301,968</td>
<td>290,160</td>
<td>282,216</td>
<td>280,725</td>
<td></td>
</tr>
<tr>
<td>NPOA HA-VTE</td>
<td>630 (2.09)</td>
<td>596 (2.05)</td>
<td>543 (1.92)</td>
<td>517 (1.84)</td>
<td>0.88 [0.79 – 0.99]*</td>
</tr>
<tr>
<td>Readmit HA-VTE</td>
<td>954 (3.16)</td>
<td>768 (2.65)</td>
<td>723 (2.56)</td>
<td>639 (2.28)</td>
<td>0.72 [0.65 – 0.80]*</td>
</tr>
<tr>
<td>Total HA-VTE</td>
<td>1,584 (5.25)</td>
<td>1,364 (4.70)</td>
<td>1,266 (4.49)</td>
<td>1,156 (4.12)</td>
<td>0.78 [0.73 – 0.85]*</td>
</tr>
<tr>
<td>HIT events</td>
<td>178 (0.59)</td>
<td>157 (0.54)</td>
<td>140 (0.50)</td>
<td>109 (0.39)</td>
<td>0.66 [0.52 – 0.84]*</td>
</tr>
<tr>
<td>Adverse effects</td>
<td>348 (1.15)</td>
<td>348 (1.20)</td>
<td>361 (1.28)</td>
<td>328 (1.17)</td>
<td>1.01 [0.87 – 1.18]NS</td>
</tr>
</tbody>
</table>
Summary

- Practical approach, proven effective in academic and community hospital setting. Free AHRQ toolkit
- Multi-pronged interventions, including standardized, protocol-driven order sets and active surveillance
- Metrics for outcomes that capture readmitted VTE cases, as well as new NPOA VTE
- Metrics for VTE prophylaxis that measure whether *appropriate* (not just any) *prophylaxis delivered* (not just ordered) *across entire stay* (not just day 1)
Questions?