Actionable Patient Safety Solutions (APSS) #12A:

Venous Thromboembolism (VTE)

How to use this guide

This guide gives actions and resources for creating and sustaining safe practices for VTE. In it, you'll find:

Patient Safety MOVEMENT

Executive summary checklist

Venous thromboembolism (VTE) is associated with increased mortality, poor patient outcomes, increased length of stay, and decreased patient satisfaction. It is the most common preventable hospital complication as well as the most common cause of preventable mortality in hospitals.

Use this checklist to help prioritize your actions and measure your organization's progress in each area.

Ensure best patient care

- ☐ Ensure that providers perform a VTE risk assessment that accurately stratifies risk
- ☐ Assess risk using a validated risk assessment model as the basis for for VTE among patients hospitalized patients
  - ☐ Medically ill patients: PADUA and IMPROVE
  - ☐ Surgical patients: Caprini
- ☐ Trauma patients: Roger Score
- ☐ Educate patient and families on VTE risks, complications, and the importance of mechanical and medication prophylaxis
- ☐ Ensure staff comply with VTE prophylaxis modalities based on VTE risk assessment including:
  - ☐ Medication prophylaxis (such as anticoagulants)
  - ☐ Mechanical prophylaxis (such as compression therapy)

Use data to inform action

- ☐ Measure appropriate quality measures related to VTE to close performance gap
- ☐ Complete in-depth chart review for hospital-associated thrombosis events to identify opportunities for improvement and then act on lessons learned
- ☐ Use patient stories – in written and video form – to help teach and inspire change in your staff

Follow best practices

- ☐ Follow VTE best practices from national organizations such as the Agency for Healthcare Research and Quality's VTE Safety Toolkit (AHRQ, 2016) . The toolkit contains 10 components that are evidence-based guidelines for preventing, diagnosing, treating, and educating patients and providers about VTE. The components are as follows:
  - ☐ VTE prophylaxis guidelines, VTE risk assessment tool, DVT diagnostic algorithm, PE diagnostic algorithm, HIT (heparin-induced thrombocytopenia) assessment, VTE treatment pathway, DVT outpatient treatment order set, Vascular laboratory requisition, Neural-axial anesthesia guidelines, Patient education (prevention and treatment) pamphlets
- ☐ Ensure healthcare professionals receive at least annual training on new VTE policies and processes
- ☐ Select technologies that show early evidence to reduce VTEs and positively impact both patient and provider outcomes in the clinical settings such as:
  - ☐ An EHR (electronic health records) system with prompt decision making support to ensure every hospitalized patient has a valid VTE prevention plan in place at all times

What we know about VTEs

VTEs are one of the three major cardiac events and a contributing cause to the global disease burden. In the United States, the prevalence increased from 2002 to 2004 from 3.2 per 1000 to 4.2 per 1000 persons (Raskob et al., 2014). For those aged 65 years and older the prevalence of VTE increases to 13.8 per 1000 persons and the highest rate of VTE is seen in Black men followed by White men (Raskob et al., 2014). However, VTE can still affect those under the age of 65 and all ethnicities.

While incidence rates of VTE vary by world region with a range of 0.138-2.69 per 1000 persons per year, VTE affects individuals in high-income countries and low- and middle-income countries (Raskob et al., 2014). The incidence of VTE per 100 hospitalizations is 3.0 in low- and middle-income countries as compared to 3.3 in high-income countries (Raskob et al., 2014). The estimated number of annual VTE cases is 3.9 million in high-income countries and 6.0 million in low- and middle-income countries (Raskob et al., 2014).

VTE has been identified as the leading cause of DALYs lost in hospitalizations accounting for one-third of total DALYs (Raskob et al., 2014). Additionally, "VTE is the leading cause of DALYs lost in low- and middle-income countries and ranked second in high income countries … with premature death as the source of 64% of the DALYs lost in high-income countries and for 66% of the DALYs lost in low- and middle-income countries" (Raskob et al., 2014, p. 2368).

Although the classic symptoms of a deep vein thrombosis (DVT) can often be seen, such as redness and/or painful swelling of a limb, the clinical examination for DVT is known for being neither sensitive nor specific. In some studies of hospitalized patients, only a minority of those found to have DVT have classical clinical findings to suggest the diagnosis (Cook et al., 2005). Because of this, clinical decision rules have been developed to help guide the diagnostic evaluation (Wells et al., 1997).

Patients who develop a VTE have a higher in-hospital mortality rate, and have around a 33% chance of developing another clot within 10 years (CDC, 2014).

Although patients with an acute PE usually have shortened breaths, tachypnea and/or tachycardia, sudden cardiac arrest is the first symptom in 25% of PE patients ("Department of Health and Human Services", 2014). A healthcare institution must maintain a high level of clinical suspicion to diagnose VTE.

The importance of VTE risk assessment

From a patient safety and a cost-aware point of view, primary prevention addresses VTEs before they begin. An institution should evaluate all patients admitted to the acute care setting for their risk of VTE, and then utilize guideline-appropriate VTE prophylaxis. This strategy results in far fewer hospital-acquired VTEs.

Diagnosis and treatment

Once clinically suspected, an institution should use clinical prediction rules to guide their diagnosis of a patient. Diagnostic imaging for confirmation includes venous doppler, V/Q scans or the highly sensitive computerized tomography angiography (CTA) of the chest. With the latter, small subsegmental, possibly non-clinical, pulmonary emboli can now be detected thus increasing a hospital's reported VTE rate.

Patients with an acute VTE require a secondary prophylaxis program (ongoing treatment). For

most patients, this means extended use of anticoagulation and a close follow-up to carefully manage the risk and benefits of the secondary prophylaxis.

Leadership plan

- Identify senior executive leadership that is committed to reducing VTEs
- Assign a team that takes ownership over VTE from administrative, physician, and nursing champions, such as a chief nursing officer
- Gather staff that have in-depth knowledge of disease process and prevention of VTE such as:
  - Physicians
  - Nursing leaders
  - Advanced practice providers (nurse practitioners and physician assistants), such as
  - Physical and occupational therapists
  - Physicians in training
  - Residents
  - Bedside nurses
  - Quality Improvement staff
  - Safety/risk
  - Pharmacy
  - Information technology team with EMR
- Senior executive leadership and clinical/safety leaders should agree on the best ways to close their performance gap including measuring appropriate quality metrics
  - Senior executive leadership should set a timeline and budget for their goal
  - Clinical and safety leaders should act as agents of change and drive the execution of the goal
- Utilize patient stories – in written and video form – to identify gaps and inspire change in your staff.
  - The story of Charles Yogiraj Bates II, husband of Vonda Vaden Bates, is an excellent example of a story of a HA-VTE that could have been prevented. It can be viewed freely here: **http://patient.sm/xqtGId**

Action plan

Find areas for improvement

- Complete in-depth chart review of hospital-associated thrombosis events and identify trends in these events, such as:
  - Service line
  - Physician
  - Diagnosis
  - Risk score (See Appendix A for examples such as: Caprini Score, Padua Prediction Score, IMPROVE score, or "3-bucket" model)
  - Hospital units

    - Pharmacological prophylaxis ordered
        - Pharmacological prophylaxis missed doses
        - Patient refusal of pharmacological prophylaxis
    - Mechanical prophylaxis ordered
        - Mechanical prophylaxis missed therapy
        - Patient refusal of mechanical prophylaxis
- Identify gaps in care that promote VTE development
- Review HospitalCompare.com to see what is publicly posted about your hospital's VTE rates

Create protocols and provide staff training

- Ensure the use of patient-centered interventions
- Follow the Agency for Healthcare Research and Quality's Venous Thromboembolism Safety Toolkit: A System's Approach to Patient Safety
- Incorporate VTE risk assessment into EHR for all new patient admissions
    - Reassess risk periodically when there is a change in the level of care, clinicians, and prior to discharge
- Ensure staff ordering appropriate VTE prophylaxis according to risk assessment
    - Consider adopting VTE power plans/order sets
    - Continue VTE prophylaxis past discharge if recommended
- Ensure timely and reliable delivery of pharmacological and/or mechanical prophylaxis as indicated
    - Track and find trends in missed doses and patient refusals
    - Educate patients that resist or refuse prophylaxis on their purpose and risks if not administered
- Develop specific and reliable protocols, endorsed by local surgical champions, for applying reliable mechanical or pharmacologic prophylaxis before anesthesia
- Consider nursing protocols for using mechanical prophylaxis in pre-op areas
- Understand your staff's perception of the importance of VTE prophylaxis
    - Educate staff without the information needed on VTE prophylaxis
    - Consider yearly competence in VTE
    - Ensure that all team members - physicians, nurses, patient care assistants, trainees, pharmacists, transport personnel, physical therapists, patients, and family members are aware of their role in VTE-P (prophylaxis)
    - Assess patient mobility, such as through mobility trackers
- Set a plan for when pharmacological prophylaxis isn't possible or recommended, such as using proactive monitoring
- Educate patients and families about the risks, complications, and importance of VTE prophylaxis, and the symptoms of DVT and PE

Misconceptions about Ambulation

"although we encourage early and frequent ambulation that is not sufficient enough to reduce the risk of VTE." Brandyn - There is no evidence that ambulation is effective alone for VTE treatment.

Technology plan

These suggested practices and technologies have shown proven benefit or, in some cases, are the only known technologies for certain tasks. If you know of other options not listed here, please complete the form for the PSMF Technology Vetting Workgroup to consider: **patient.sm/dgQogJ**

With regard to VTE, there are a few novel technology platforms that offer a low entry cost that work alongside the Electronic Health Record (EHR). These technology platforms are secure with multimedia functions and can host checklists, education and much more to improve best practices and engagement across the care continuum. There is also technology that is important in the prevention of blood clots, like compression devices. Examples of those devices and technology solutions are detailed below and may be helpful in VTE prevention.

Electronic Health Record (EHR) system

Use an ONC Meaningful Use-certified EHR system with the following capabilities:

- Computerized Provider Order Entry (CPOE)
- Drug-drug interaction check
- Drug-allergy interaction check
- Clinical Decision Support (CDS) tools
    - Use to ensure every patient has a valid VTE prevention plan at all times (Morrison and England, 2015; Doyle and Hospital, n.d.)
- Vital signs (BP, Temp, HR, RR, and SpO2)
- Lab results
- Nurses notes and event reports

Compression devices

Graduated Compression Stockings (GCS)

Examples include:

- Anti-embolism stockings
- anti-thrombosis stockings
- elastic support hose
- graduated compression elastic stockings
- surgical hose
- TED hose
- white hose
- thrombosis stockings.

Note: When using GCS, proper fitting is essential to ensure safety from injury and effectiveness. Notably, 15-20% of patients cannot effectively wear AES because of unusual limb size or shape (Geerts et al., 2001).

Intermittent Pneumatic Compression (IPC) devices and anti-embolic (AE) pumps:

Examples include:

- Alternating Leg Pressure (ALP)
- athrombic pumps-calf/thigh
- Continuous Enhanced Circulation Therapy (CECT)

- DVT boots-calf/thigh
- EPC cuffs/ stockings-External pneumatic compression-calf/thigh
- Intermittent pneumatic compression stockings
- Intermittent compression device (ICD)
- Leg pumpers
- PAS (Pulsatile anti-embolic stockings)
- Rapid inflation asymmetrical compression (RIAC) devices
- Sequential compression device
- Sequential pneumatic hose
- Thrombus pumps-calf/thigh
- PAS (Pulsatile anti-embolic stockings)
- Rapid inflation asymmetrical compression (RIAC) devices

Note: when using IPC AE, appropriate fitting is essential to ensure safety from injury and effectiveness.

Measuring outcomes

Key performance indicator 1

Hospital acquired potentially preventable venous thromboembolism rate (VTE-6)

VTE-6 assesses the number of patients diagnosed with confirmed VTE during hospitalization (not present at admission) who did not receive VTE prophylaxis between hospital admission and the day before date of the first positive VTE diagnostic test.

Outcome measure formula

Numerator: Patients who received no VTE/PE prophylaxis prior to the day before the date of the first positive VTE diagnostic test.

Denominator: Patients who developed confirmed VTE/PE during hospitalization. Rate is typically displayed: Numerator/Denominator*1000

Metric recommendations

Indirect impact:
All admitted patients

Direct impact:
All admitted patients

Lives spared harm:
Lives Spared Harm = (VTE or PE $\text{Rate}_{\text{baseline}}$ - VTE or PE $\text{Rate}_{\text{measurement}}$) X Total Patient $\text{Days}_{\text{baseline}}$

Lives saved:
Lives Saved = Lives Spared Harm X 0.104

Notes:
Measure exclusions age < 18 years, LOS > 120 days, comfort measures only, clinical trials, principal diagnosis of VTE or VTE present on admission, provider reason for not administering mechanical and pharmacologic prophylaxis.

Data collection

Chart abstraction.

Mortality

(Will be calculated by the Patient Safety Movement Foundation)

Estimated mortality per VTE is 0.104

Reference:

Mortality and cost-per-case Information from AHRQ

PfP Hospital Acquired Condition (HAC) for 2010-2014	Estimated Additional Cost per HAC (2010 dollars)	Estimated Additional Inpatient Mortality per HAC
Adverse Drug Events	$5,000	.020
Catheter-Associated Urinary Tract Infections	$1,000	.023
Central Line-Associated Bloodstream Infections	$17,000	.185
Falls	$7,234	.055
Obstetric Adverse Events	$3,000	.0015
Pressure Ulcers	$17,000	.072
Surgical Site Infections	$21,000	.028
Ventilator-Associated Pneumonia	$21,000	.144
Postoperative Venous Thromboembolism	$8,000	.104

Key performance indicator 2

Hospital acquired **venous thromboembolism rate Rate of patients having a hospital-acquired VTE/PE**

Outcome measure formula

Numerator: Number of patients having a VTE/PE (note ICD codes below)

Denominator: Total patient days

Rate is typically displayed: Numerator/Denominator * 1,000

Use the following ICD diagnosis codes to identify hospital-acquired VTEs:

ICD9: 45111, 45119, 45181, 45340, 45341, 4151, 41511, 41513, 41519

ICD10: I8010, I8011, I8012, I8013, I80201, I80202, I80203, I80209, I80211, I80212, I80213, I80219, I80222, I80223, I80229, I80231, I80232, I80233, I80239, I80291, I80292, I80293, I80299, I82401, I82402, I82403. I82409, I82411, I82412, I82413, I82419, I82421, I82422, I82423, I82429, I82431, I82432, I82433,I82439, I824Y1, I824Y2, I824Y3, I824Y9, I2602, I2609, I2692, I2699

Note: If a patient has a qualifying diagnosis at admission, exclude from the numerator.

Total patient days come from daily census counts for each inpatient nursing unit. Census counts are electronically derived at the same time of day each day. These counts may be collected manually if an electronic source is not available.

Metric recommendations

Indirect impact:
All admitted patients

Direct impact:
All admitted patients

Lives spared harm:
Lives Spared Harm = (VTE or PE Rate$_{baseline}$ - VTE or PE Rate$_{measurement}$) X Total Patient Days$_{baseline}$

Lives saved:
Lives Saved = Lives Spared Harm X 0.104

Data collection:

Data collected from final diagnosis codes for encounter as determined by a professional health information coder.

Mortality (will be calculated by the Patient Safety Movement Foundation): Estimated mortality per VTE is 0.104, as listed under Topic 1.

Conflicts of interest disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers. Some of the APSSs recommend technologies that are offered by companies involved in the Patient Safety Movement Foundation. The workgroups have concluded, based on available evidence, that these technologies work to address APSS patient safety issues. Workgroup members are required to disclose any potential conflicts of interest.

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Appendix A

Calculation of the Caprini Risk Score

The table below shows the different scores for the factors represented in the Caprini score (Caprini, 1991). Calculate the Caprini score by adding the scores of all factors present in the patient. (Caprini, 2005)

5 points	3 points	2 points	1 point
☐ Stroke (in the previous month)	☐ Age≥ 75 years	☐ Age: 61-74 years	☐ Age 41-60 years
☐ Fracture of the hip, pelvis, or leg	☐ Prior episodes of VTE	☐ Arthroscopic surgery	☐ BMI > 25 Kg/m2
☐ Elective arthroplasty	☐ Positive family history for VTE	☐ Laparoscopy lasting more than 45 minutes	☐ Minor surgery
☐ Acute spinal cord injury (in the previous month)	☐ Prothrombin 20210 A	☐ General surgery lasting more than 45 minutes	☐ Edema in the lower extremities
	☐ Factor V Leiden	☐ Cancer	☐ Varicose veins
	☐ Lupus anticoagulants	☐ Plaster cast	☐ Pregnancy
	☐ Anticardiolipin antibodies	☐ Bed bound for more than 72 hours	☐ Post-partum
	☐ High homocysteine in the blood	☐ Central venous access	☐ Oral contraceptive
	☐ Heparin induced thrombocytopenia		☐ Hormonal therapy
	☐ Other congenital or acquired thrombophilia		☐ Unexplained or recurrent abortion
			☐ Sepsis (in the previous month)
			☐ Serious lung disease such as pneumonia (in the previous month)
			☐ Abnormal pulmonary function test
			☐ Acute myocardial infarction
			☐ Congestive heart failure (in the previous month)
			☐ Bed rest
			☐ Inflammatory bowel disease

Scoring and Recommended Prophylaxis (Gould et al., 2012)

Caprini Score	Risk	VTE Incidence	Recommended Prophylaxis
0-2	Very low-low	<1.5%	Early ambulation, IPC
3-4	Moderate	3%	LMWH; UFH; or IPC *If high bleeding risk, IPC until bleeding risk diminishes.*
5-8	High	6%	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.*

Abdominal or pelvic surgery for cancer should receive extended VTE prophylaxis with LMWH x 30 days (AHRQ, 2016).

IPC = intermittent pneumatic compression

LMWH = low-molecular-weight heparin

UFH = unfractionated heparin

Calculation of the Padua prediction score

The table below depicts the Padua Predictiction score for VTE among hospitalized patients (Barbar et al., 2010). A score of:

- ≥4: high risk of VTE
- ≤4: low risk for VTE.

Variable	Score
Active cancer	3
Previous VTE	3
Decreased mobility	3
Thrombophilia	3
Previous trauma or surgery within that last month	2
Age≥ 70	1
Heart and/or respiratory failure	1
Ischemic stroke or acute myocardial infarction	1
Acute rheumatologic disorder and/or acute infection	1
Obesity	1
Hormonal therapy	1

Calculation of the IMPROVE Predictive Score

The IMPROVE score for VTE assesses the risk of VTE among hospitalized patients. The predictive score includes 4 independent risk factors for VTE, which are present at admission. The associative score includes 7 variables present either at admission or during hospitalization (Spyropoulos et al., 2011).

IMPROVE Predictive Score

Variable	Score
Prior episode of VTE	3
Thrombophilia	3
Malignancy	1
Age more than 60 years	1

Interpretation of the IMPROVE Predictive Score

Score	Predicted VTE risk through 3 months
0	0.5%
1	1.0%
2	1.7%
3	3.1%
4	5.4%
5-8	11%

IMPROVE Associative Score

Variable	Score
Prior episode of VTE	3
Thrombophilia	2
Paralysis of the lower extremity during the hospitalization	2
Current malignancy	2
Immobilization for at least 7 days	1
ICU or CCU admission	1
Age more than 60 years	1

Interpretation of the IMPROVE Associative Score

Score	Predicted VTE risk through 3 months
0	0.4%
1	0.6%
2	1.0%
3	1.7%
4	2.9%
5-10	7.2%