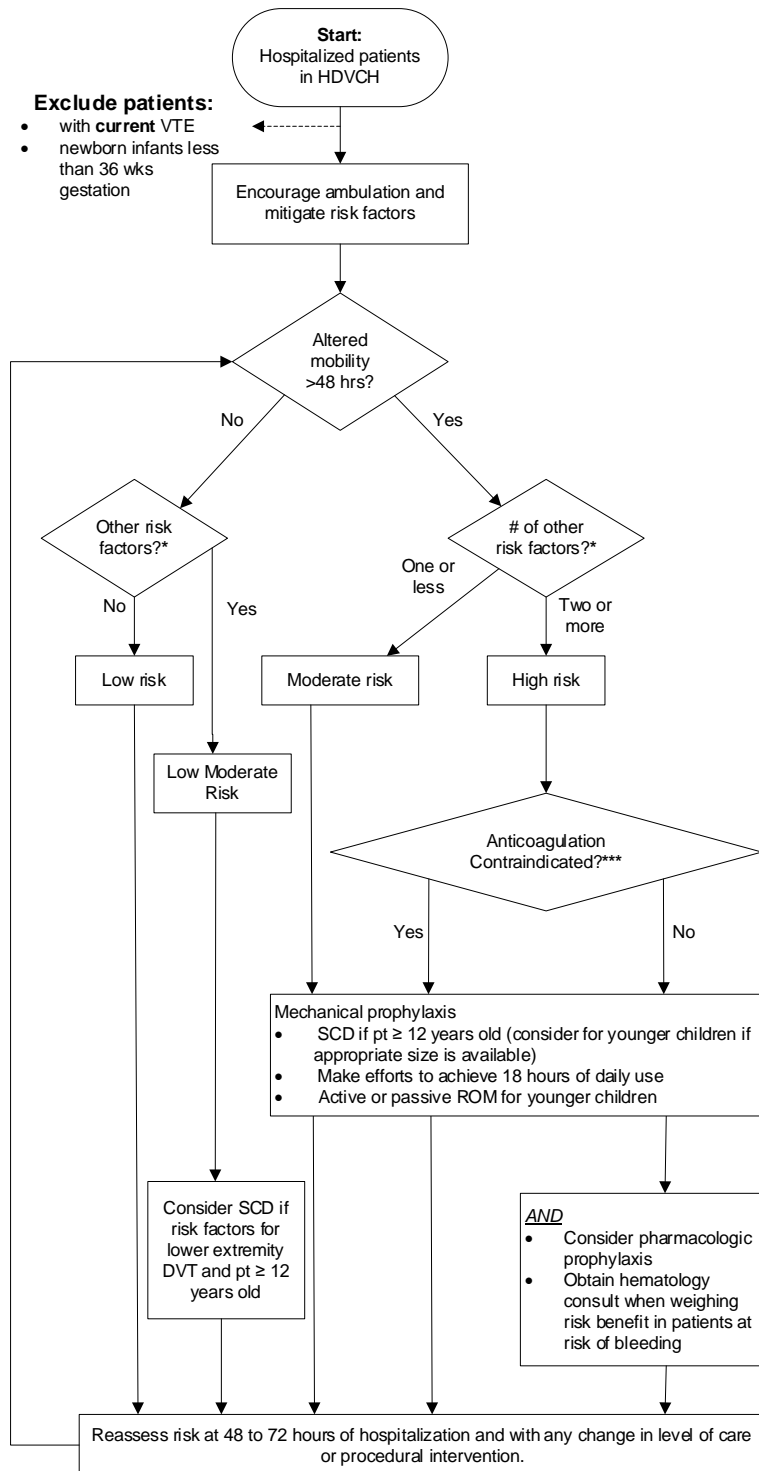


GUIDELINE: VENOUS THROMBOEMBOLISM (VTE) PROPHYLAXIS IN CHILDREN AND ADOLESCENTS, INPATIENT

Updated: March 22, 2022

Clinical algorithm:



***VTE Risk Factors**

Blood stream infection
 Central venous catheter (including non-tunneled, tunneled and PICCs)
 Personal history of venous thrombosis
 Severe dehydration/hyperosmolar state (serum osmolality >320 mOsm/L)
 Inflammatory diseases acute and/or chronic (e.g. elevated inflammatory markers, IBD, SLE, COVID-19/ MISC)
 Medications: Asparaginase
 Medications: Estrogen use (within past two months)
 Obesity (BMI > 95th percentile for age, use BMI >30 if >18 years old)
 Oncologic diagnosis
 Recent surgery – within last 30 days
 Protein losing disorders (PLE, nephrotic syndrome, persistent chylothorax)
 Thrombophilia – known, or family history of clots
 Major trauma: >1 lower extremity long bone fracture, complex pelvic fractures, spinal cord injury, or requiring admission to the PCCU
 Critical illness: Admitted to the PCCU and has any of the following – sepsis or SIRS, acute mechanical ventilation (not home vent dependent on usual settings), requires a vasoactive infusion, cyanotic heart disease or poor myocardial contractility (SF <15%)

****Contraindications to Mechanical Prophylaxis**

DVT, suspected or existing
 Extremity to be used has acute fracture
 Extremity to be used has PIV access
 Skin conditions affecting extremity (e.g. dermatitis, burn)
 Unable to achieve correct fit due to patient size

*****Contraindications to Anticoagulation**

Absolute:
 Bleeding disorder; known or tendency
 Hemorrhage; present, or at high risk
 Unable to sustain platelet count >50,000 mm³
 LMWH with epidural catheter in place
 Lumbar puncture within the last 18 hours
 Epidural catheter removal within the last 2 hours or planned epidural catheter placement (see Table 8); decision must be discussed and approved by anesthesia

Relative:
 Intracranial mass
 Neurosurgical procedure
 Spinal surgery within the past 48 hours
 Pelvic fracture within past 48 hours
 Uncontrolled hypertension
 Incomplete or complete spinal cord injury with suspected/known paraspinial hematoma
 HIT or allergy to pork products

If decision to initiate pharmacologic prophylaxis:

- In surgical patients, seek surgical input regarding bleeding risks, prior to initiation
- See Table 6 & 7 for management of VTE prophylaxis
- Obtain hematology consult when considering alternative pharmacologic agents

Clinical guideline summary

CLINICAL GUIDELINE NAME: Venous Thromboembolism (VTE) Prophylaxis in Children and Adolescents, Inpatient

PATIENT POPULATION AND DIAGNOSIS: VTE risk screening is strongly encouraged for all pediatric patients, regardless of age. Children 12 years old and above must be screened for VTE risk since their VTE risk profile becomes similar to that of adult patients. Initial screening should be completed within 24 hours of admission. Reassessment of risk should be done when the patient changes level of care, has a surgical/ invasive procedure, or a catheter placed during the inpatient stay. Prophylaxis should be considered based on the risk score algorithm. Mechanical and pharmacologic dosing recommendations are found in this guideline. *Consultation with Pediatric Hematology is not necessary unless a VTE is identified.*

Included:

All patients admitted to the children's hospital

Excluded:

Patients with current venous thromboembolism

Premature infants (less than 36 weeks gestation)

APPLICABLE TO: Spectrum Health Grand Rapids Hospitals, Helen DeVos Children's Hospital

BRIEF DESCRIPTION: The rate of venous thromboembolism (VTE) among hospitalized children and adolescents is low compared to adults, but substantially increasing over time. Recent statistics report nearly 60 events of VTE per 10,000 admissions. At Helen DeVos Children's Hospital, VTE is the second most common hospital acquired condition behind Central Line Associated Blood Stream Infection. The incidence of VTE occurrence is bimodal, peaking in children less than 1 year old (mostly associated with central venous lines) and those over the age of 10. In addition, many children's hospitals care for individuals in the 18-25-year age range who should also follow VTE prophylaxis guidelines. Although there are no validated scoring systems for VTE risk in children under 18 years of age, risk factors are clear and protocols have been established, evaluated, and published for a single center experience.

OVERSIGHT TEAM LEADER(S): Chi Braunreiter, Rick Hackbarth, John Huntington

OWNING EXPERT IMPROVEMENT TEAM (EIT): HDVCH VTE EIT

MANAGING CLINICAL PRACTICE COUNCIL (CPC): Children's Health CPC

CPC APPROVAL DATE: April 21, 2022

OTHER TEAM(S) IMPACTED: Hospitalist, PCICU, Nursing

IMPLEMENTATION DATE: March 2022

LAST REVISED: February 2022

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Clinical pathways clinical approach

TREATMENT AND MANAGEMENT:

1. Purpose

- 1.1. **Background** – The rate of venous thromboembolism (VTE) among hospitalized children and adolescents is low compared to adults, but substantially increasing over time. Recent statistics report nearly 60 events of VTE per 10,000 admissions. At Helen DeVos Children's Hospital, VTE is the second most common hospital acquired condition behind Central Line Associated Blood Stream Infection. The incidence of VTE occurrence is bimodal, peaking in children less than 1 year old (mostly associated with central venous lines) and those over the age of 10. In addition, many children's hospitals care for individuals in the 18-25-year age range who should also follow VTE prophylaxis guidelines. Although there are no validated scoring systems for VTE risk in children under 18 years of age, risk factors are clear and protocols have been established, evaluated, and published for a single center experience.
- 1.2. **Target Population for Guideline Recommendation** – VTE risk screening is strongly encouraged for all pediatric patients, regardless of age. Children 12 years old and above must be screened for VTE risk since their VTE risk profile becomes similar to that of adult patients. Initial screening should be completed within 24 hours of admission. Reassessment of risk should be done when the patient changes level of care, has a surgical/ invasive procedure, or a catheter placed during the inpatient stay. Prophylaxis should be considered based on the risk score algorithm. Mechanical and pharmacologic dosing recommendations are found in this guideline. *Consultation with Pediatric Hematology is not necessary unless a VTE is identified.*
 - 1.2.1. Included: All patients admitted to the children's hospital
 - 1.2.2. Excluded:
 - 1.2.2.1. Patients with current venous thromboembolism
 - 1.2.2.2. Premature infants (less than 36 weeks gestation)

2. Definitions

- 2.1. Altered mobility: a permanent or temporary state in which the child has a limitation in independent, purposeful physical movement of the body or of one or more extremities
 - 2.1.1. Immobility: permanent state of altered mobility (e.g., paralysis)
 - 2.1.2. Impaired physical mobility: temporary state of immobility (e.g., cast, post-op)
- 2.2. Bleeding, defined by The International Society of Hemostasis and Thrombosis:
 - 2.2.1. Major Bleeding: fatal bleeding, overt bleeding with hemoglobin drop of greater than or equal to 2 g/dL in 24 hours, bleeding into a critical organ (brain, lung, retroperitoneal), or bleeding requiring surgical intervention
 - 2.2.2. Minor Bleeding: overt or macroscopic bleeding that does not meet criteria for major bleeding.
- 2.3. Mechanical prophylaxis: any method to assist the flow of blood in the deep veins of the leg (e.g., sequential compression devices).
 - 2.3.1. Sequential Compression Device (SCD): a device designed to intermittently squeeze blood from underlying deep veins in the leg upon compression of an inflatable sleeve, and to allow the blood to flow again when it decompresses; also known as intermittent compression device (ICD) or intermittent pneumatic compression (IPC)
- 2.4. Superior Vena Cava (SVC) Syndrome: thrombus that obstructs the superior vena cava causing swelling of the face and neck
- 2.5. Thrombophilia: an inherent or acquired condition that may result in the increased formation of blood clots / thrombus (blood clotting disorder)
- 2.6. Venous Thromboembolism (VTE): a blood clot (thrombus) in a vein or one that has broken free and is carried in the bloodstream (embolus)

- 2.7. Critical Illness: Admitted to PCCU **and** has any of the following-sepsis or systemic inflammatory response syndrome (SIRS), acute mechanical ventilation (not home vent dependent on usual settings), requires a vasoactive infusion, cyanotic heart disease or poor myocardial contractility (SF < 15%)

3. Guideline Recommendations

- A. VTE prophylaxis with a sequential compression device (SCD) is indicated for the following-
- i. During surgery for patients greater than 12 years old who are expected to undergo a procedure lasting greater than 60 minutes. SCDs should be applied to the lower extremities from time of induction of general anesthesia; Refer to **Table 1** for contraindications to mechanical prophylaxis.
 - ii. For patients falling into the moderate risk category for VTE (and a few in the low moderate risk category) who are greater than or equal to 12 years old. Evidence to support mechanical prophylaxis in younger children is sparse, but active or passive range of motion (ROM) should be encouraged in younger children with altered mobility. SCDs should be considered in younger children at risk for VTE if appropriately sized sleeves are available, especially in higher risk children for whom pharmacologic prophylaxis would be contraindicated: Refer to **Table 1** for contraindications to mechanical prophylaxis.

Table 1: Contraindications to Mechanical Prophylaxis

- | |
|---|
| <ul style="list-style-type: none">• Lower extremity Deep Vein Thrombosis (DVT), present or suspected• Extremity with an acute fracture• Extremity with peripheral IV (PIV) access in place• Skin conditions involving the extremity (e.g., dermatitis, burn)• Unable to achieve correct fit due to patient size |
|---|

- B. Patients should be assessed for VTE risk factors (see **Table 2**) and assigned to the risk category (see **Table 3**) respective to their assessment:
- i. At the time of inpatient admission, and
 - ii. Reassessed every 72 hours of hospitalization, and
 - iii. With procedural intervention, any change in level of care, or catheter placement

Table 2: VTE Risk Factors*	
•	Blood stream infection
•	Central venous catheter (including non-tunneled, tunneled and Peripherally Inserted Central Catheters (PICC))
•	Personal history of venous thrombosis
•	Severe dehydration / hyperosmolar state (serum osmolality > 320 mOsm/kg)
•	Inflammatory diseases acute and/or chronic (e.g., elevated inflammatory markers, Inflammatory Bowel Disease (IBD), Systemic Lupus Erythematosus (SLE))
•	COVID/ MISC
•	Medications: e.g., Asparaginase
•	Medications: Estrogen use (within past two months)
•	Obesity Body Mass Index (BMI) > 95 th percentile for age, use BMI > 30 if > 18 years old)
•	Oncologic diagnosis,
•	Recent surgery- within the last 30 days
•	Protein losing disorders (protein-losing enteropathy, nephrotic syndrome, persistent chylothorax)
•	Thrombophilia – known, or family history of clots
•	Major Trauma: > 1 lower extremity long bone fracture, complex pelvic fractures, spinal cord injury, or requiring admission to the Pediatric Critical Care Unit
•	Critical Illness- as defined in section 2.7

*to be used in conjunction with risk category scoring Table 3 (see below)

Table 3: Determining VTE Risk Category		
Expected altered mobility > 48 hours	Number of VTE risk factors	Risk category
NO	None	Very Low
NO	1 or more	Low Moderate
YES	0 or 1	Moderate
YES	2 or more	High

- C. VTE risk assessment will be completed by an ordering provider (i.e. attending physician, resident, Physician Assistant, Nurse Practitioner) and documented accordingly in the medical record.
- D. When indicated, it is recommended that VTE prophylaxis (see **Table 4**) begin no later than 24 hours after admission, unless contraindicated (see **Table 1** and **Table 5**).
 - i. **NOTE:** Example strategies for risk factor mitigation include removing venous catheters as soon as possible, treating infections, encouraging mobility, and avoiding estrogen therapy

Table 4: VTE Prophylaxis Stratified by Risk Category		
Very Low/ Low Moderate risk	Moderate risk	High risk
<ul style="list-style-type: none"> • Encourage early ambulation • Mitigate risk factors (see NOTE under 3D) • Low/Moderate- also consider SCD while at rest for those patients with risk factors for lower extremity DVT 	<ul style="list-style-type: none"> • Encourage early ambulation • Mitigate risk factors (see NOTE under 3D) • Administer mechanical prophylaxis (see Table 1) <ul style="list-style-type: none"> ○ SCD preferred ○ Make efforts to achieve 18 hours of daily use 	<ul style="list-style-type: none"> • Encourage early ambulation • Mitigate risk factors (see NOTE under 3D) • Administer mechanical prophylaxis (see Table 1) <ul style="list-style-type: none"> ○ SCD preferred ○ Make efforts to achieve 18 hours of daily use • Consider pharmacologic prophylaxis (see Table 5) <ul style="list-style-type: none"> ○ Consider Pediatric Hematology consult when weighing risk versus benefit in patients at risk of bleeding

Table 5: Contraindications to Pharmacologic Prophylaxis	
Absolute contraindications	Relative contraindications
<ul style="list-style-type: none"> • Bleeding disorder; known or tendency • Hemorrhage; present, or at high risk • Unable to sustain platelet count > 50,000 mm³ • Twice daily dosing of Low Molecular Weight Heparin (LMWH) with epidural catheter in place • Lumbar puncture within the last 4 hours • Epidural catheter removal within the last 4 hours or planned epidural catheter placement; decision must be <u>discussed</u> and <u>approved</u> by anesthesiology 	<ul style="list-style-type: none"> • Intracranial mass • Neurosurgical procedure • Spine surgery within the past 48 hours • Pelvic fracture within past 48 hours • Uncontrolled hypertension • Incomplete or complete spinal cord injury with suspected/known paraspinous hematoma • Heparin use in patients with Heparin-Induced Thrombocytopenia (HIT) or allergy to pork products

- E. Recommendations to consider prior to prescribing pharmacologic prophylaxis:
- i. In surgical patients – seek input regarding bleeding risk prior to initiation
 - a. Discuss timing of initiation or delay in therapy with surgical team (e.g., neurosurgery, orthopedic surgery).
 - ii. Consider Pediatric Hematology consultation when considering alternative pharmacologic agents, when weighing risk versus benefit in patients at risk of bleeding, or if patient is thought to have a confirmed VTE
- F. Review dosing and monitoring section for pharmacologic prophylaxis
- i. Evaluate renal function (i.e., serum creatinine) upon initiation & every 2 weeks while receiving anticoagulation prophylaxis; dose may need to be adjusted for patients with renal dysfunction.
 - ii. Obtain a complete blood count (CBC) upon initiation & approximately every 2 weeks while receiving anticoagulation prophylaxis.
 - a. Maintain platelet count > 50,000 mm³; risk of bleeding may outweigh benefit of prophylaxis if the patient is unable to maintain the platelet parameter.
 - b. Monitor for evidence of heparin-induced thrombocytopenia (HIT)
 - c. A significant drop in hemoglobin should prompt re-assessment.

4. Pharmacologic Prophylaxis Medication Recommendations

- A. Pharmacologic agent dosing and administration
 - i. Subcutaneous (SQ) administration of prophylactic unfractionated heparin (UFH) or LMWH (enoxaparin) is recommended.
 - a. continuous infusion of UFH can be used in certain situations at any dose \leq 10 units/kg/hr. No monitoring is required unless signs or symptoms of bleeding
 - ii. **Always** discuss prophylaxis start and timing thereof with attending surgeon or anesthesia (when neuraxial procedure has been done or epidural catheter is in place or recently removed) prior to initiation
 - iii. Initiate prophylactic therapy as described in **Tables 6, 7**
 - a. UFH: is preferred for patients who are recent post-op patients and those who are anticipated to go to surgery soon due to the ease of reversal with protamine and short half-life of the drug. It also may be considered instead of LMWH for patients with significant renal dysfunction or burn patients requiring VTE prophylaxis.
 - b. LMWH (enoxaparin) is the preferred agent for thromboprophylaxis unless there is evidence of CNS bleeding, anticipated surgery, or epidural catheter in place.
 - iv. The anti-factor Xa level is used as a measure of efficacy for low-molecular weight heparins (LMWH), when appropriate.
 - a. **Note:** Epic identifies anti-factor Xa levels for LMWH as “LMWH level”
 - b. Monitor anti-factor Xa when indicated, as noted in **Table 6**
 - c. Check the anti-factor Xa level 4 hours following dose administration (subcutaneous delivery).
 - d. Maintain an anti-factor Xa level between 0.2 to 0.4 units/mL in patients receiving prophylactic LMWH therapy (hyperbilirubinemia or high plasma hemoglobin levels may interfere with assay and cause anti Xa levels to be falsely low). Consult lab for the most recent reference range for LMWH.
 - e. Close monitoring is recommended for the following patient populations: young patients, obese patients, and patients with renal impairment or failure.
 - v. Rivaroxaban (direct Xa inhibitor) may be used for VTE prophylaxis in some adolescent young adult patients with cancer. Discuss management with Pediatric Hematology and Oncology.
 - vi. On rare occasions, agents other than LMWH, heparin, or rivaroxaban may be indicated for VTE prophylaxis. Consider Pediatric Hematology and pharmacy consultation.

Table 6: Prophylactic LMWH (enoxaparin) Dosing & Monitoring

Patient type/age	Enoxaparin dosing	Monitoring / Notes*
< 2 months	0.75 mg/kg/dose SQ Q12 hours	Monitoring of anti-factor Xa levels indicated/recommended
2 months or < 60 kg (up to 18 years)	0.5 mg/kg/dose SQ Q12 hours (max starting dose of 30 mg/dose)	Monitoring of anti-factor Xa levels <i>may be</i> indicated if enoxaparin continued \geq 3 days
> 18 years or \geq 60 kg (up to 125 kg)	40 mg SQ once daily OR 30 mg SQ every 12 hours	Monitoring of anti-factor Xa levels <i>may be</i> indicated if enoxaparin continued \geq 7 days
> 125 kg	40 mg SQ every 12 hours	Monitoring of anti-factor Xa levels indicated/recommended

Renal dysfunction	Consider decreasing dose, switching to UFH, and/or consult pharmacy)	Monitoring of anti-factor Xa levels indicated/recommended
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* Anti-Xa levels should be drawn 4 hours post the 3rd or 4th SQ dose and should be 0.2-0.4 units/mL for prophylaxis. Consult lab for the most recent reference range for LMWH. Consult with pharmacy for dose change recommendations.

Table 7: Prophylactic Unfractionated Heparin (UFH) Dosing & Monitoring		
Patient type/age	UF Heparin dosing	Monitoring / Notes
≤ 60 kg	75 units/kg/dose SQ Q12 hours	Consider CBC monitoring
> 60 kg	5000 units SQ every 12 hours	
> 18 yrs or > 125 kg	5000 units SQ every 8 hours	
Continuous infusion	≤ 10units/kg/hr	
Renal dysfunction	No adjustment required	

- B. Adhere to the following precautions when administering LMWH:
- i. **Always discuss prophylaxis timing with attending surgeon prior to initiation / re-initiation**
 - ii. Avoid intramuscular injections and arterial punctures while receiving LMWH prophylaxis; consider appropriate precautions if arterial punctures are warranted.
 - iii. Avoid aspirin or other antiplatelet drugs while receiving LMWH prophylaxis; acetaminophen is the preferred drug if analgesia or an antipyretic is required.
 - iv. Hold the 2 doses of LMWH prior to a scheduled lumbar puncture (at least 12 hours from last injection).
 - a. Note: Paraspinal hematomas and paralysis have been reported in patients having a lumbar puncture while receiving LMWH.
 - v. Do NOT use twice daily dosing of LMWH in patients receiving continuous epidural anesthesia. **Any** VTE prophylaxis with an epidural catheter in place should be discussed with anesthesia.
 - vi. Discontinue LMWH 24 to 36 hours prior to scheduled surgical procedures (e.g., administer the last dose of LMWH in the morning the day prior to the procedure).
- C. American Society of Regional Anesthesia and Pain Medicine Guidelines
Spectrum Health Anesthesia follows these guidelines for **ADULT** VTE prophylaxis and neuraxial blockage.
- i. Refer also to Neuraxial Anesthesia and Anticoagulation Guidelines
 - ii. Discuss with anesthesiology, primary care team, and pharmacy
 - a. about how long to hold prophylaxis anticoagulation prior to epidural catheter placement or manipulation
 - b. whether prophylaxis anticoagulation can be restarted while a catheter remains in place, and
 - c. when to restart prophylaxis anticoagulation after a catheter is removed.
- D. Medication management
- i. The primary care team is responsible for communicating with involved surgical teams regarding recommendations on holding anticoagulation prior to and following procedures / surgeries
 - ii. Primary care team is responsible for entering appropriate orders into the Electronic Medical Record and communicating the plan.

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