

Clinical Decision Support (CDS) Content and Health Level 7 (HL7)- Compliant Knowledge Artifacts (KNARTs)

Cardiology: Venous Thromboembolism (VTE) Prophylaxis Clinical Content White Paper

Department of Veterans Affairs (VA)



**Knowledge Based Systems (KBS)
Office of Informatics and Information Governance (OIIG)
Clinical Decision Support (CDS)**

Clinical Decision Support (CDS) Content and Health Level 7 (HL7)-Compliant Knowledge Artifacts (KNARTs): Cardiology: Venous Thromboembolism (VTE) Prophylaxis Clinical Content White Paper

by Department of Veterans Affairs (VA)

Publication date April 2018

Contract: VA118-16-D-1008, Task Order (TO): VA-118-16-F-1008-0007

Table 1. Relevant KNART Information: Cardiology: Venous Thromboembolism (VTE) Prophylaxis KNARTs

KNART Name	Associated CLIN
VTE Prophylaxis - Order Set	CLIN0008CA

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Introduction

The VA is committed to improving the ability of clinicians to provide care for patients while increasing quality, safety, and efficiency. Recognizing the importance of standardizing clinical knowledge in support of this goal, VA is implementing the Health Level 7 (*HL7*) Knowledge Artifact Specification for a wide range of VA clinical use cases. Knowledge Artifacts, referred to as (*KNARTs*), enable the structuring and encoding of clinical knowledge so the knowledge can be integrated with electronic health records to enable clinical decision support.

The purpose of this Clinical Content White Paper (*CCWP*) is to capture the clinical context and intent of *KNART* use cases in sufficient detail to provide the *KNART* authoring team with the clinical source material to construct the corresponding knowledge artifacts using the HL7 Knowledge Artifact Specification. This paper has been developed using material from a variety of sources: VA artifacts, clinical practice guidelines, evidence in the body of medical literature, and clinical expertise. After reviewing these sources, the material has been synthesized and harmonized under the guidance of VA subject matter experts to reflect clinical intent for this use case.

Unless otherwise noted, items within this white paper (e.g., documentation template fields, orderable items, etc.) are chosen to reflect the clinical intent at the time of creation. To provide an exhaustive list of all possible items and their variations is beyond the scope of this work.

Conventions Used

Conventions used within the knowledge artifact descriptions include:

<obtain>: Indicates a prompt to obtain the information listed

- If possible, the requested information should be obtained from the underlying system(s). Otherwise, prompting the user for information may be required
- The technical and clinical notes associated with a section should be consulted for specific constraints on the information (e.g., time-frame, patient interview, etc.)
- Default Values: Unless otherwise noted, *<obtain>* indicates to obtain the most recent observation. It is recognized that this default time-frame value may be altered by future implementations

[...]: Square brackets enclose explanatory text that indicates some action on the part of the clinical user, or general guidance to the clinical or technical teams. Examples include, but are not limited to:

[Begin ...], [End ...]: Indicates the start and end of specific areas to clearly delineate them for technical purposes.

[Activate ...]: Initiates another knowledge artifact or knowledge artifact section.

[Section Prompt: ...]: If this section is applicable, then the following prompt should be displayed to the user.

[Section Selection Behavior: ...]: Indicates technical constraints or considerations for the selection of items within the section.

[Attach: ...]: Indicates that the specified item should be attached to the documentation template if available.

[Link: ...]: Indicates that rather than attaching an item, a link should be included in the documentation template.

[Clinical Comment: ...]: Indicates clinical rationale or guidance.

[Technical Note: ...]: Indicates technical considerations or notes.

[If ...]: Indicates the beginning of a conditional section.

[Else, ...]: Indicates the beginning of the alternative branch of a conditional section.

[End if ...]: Indicates the end of a conditional section.

☐ *[Check box]*: Indicates items that should be selected based upon the section selection behavior.

Chapter 1. Cardiology: Venous Thromboembolism Prophylaxis

1.1. Clinical Context

[Begin Clinical Context.]

The Venous Thromboembolism (VTE) Prophylaxis KNART is intended for users caring for hospitalized adult patients. This KNART is designed to facilitate ordering for mechanical and/or pharmacological VTE prophylaxis in medical and surgical inpatients without known VTE.

The American Academy of Orthopedic Surgeons (AAOS) and the American College of Chest Physicians (ACCP) are the primary sources for this KNART:

- American Academy of Orthopaedic Surgeons. Preventing venous thromboembolic disease in patients undergoing elective hip and knee arthroplasty: evidence-based guideline and evidence report, second edition. American Academy of Orthopaedic Surgeons website. Published 2011.
- Gould MK, Garcia DA, Wren SM, et al. Prevention of VTE in nonorthopedic surgical patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest. 2012 Feb;141(2 Suppl):e227S-e277S.
- Kahn SR, Lim W, Dunn AS, et al. Prevention of VTE in nonsurgical patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest. 2012 Feb;141(2 Suppl):e195S-e226S.
- VA Pharmacy Benefits Management Services, Medical Advisory Panel, and VISN Pharmacist Executives, Direct Oral Anticoagulants (DOACs) (formerly called TSOACs), Rivaroxaban (Xarelto), Apixaban (Eliquis), and Dabigatran (Pradaxa), Criteria for Use for VTE Prophylaxis for Total Hip or Total Knee Replacement Surgery. February 2015

This KNART also includes a link to the American College of Chest Physicians Pregnancy Anticoagulation Guidelines in Appendix C (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3278054/>), although pregnancy shall not be a primary focus of the KNART. The clinical context domains are summarized in Table 1, below.

Table 1.1. Clinical Context Domains

Target User	Hospitalist, residents, and other ordering providers involved in managing the patient cohort, and nurses
Patient	Adult inpatients without known VTE and not pregnant
Priority	Routine
Specialty	Medical and/or Surgical Service
Location	Inpatient

[End Clinical Context.]

1.2. Knowledge Artifacts

[Begin Knowledge Artifacts.]

The CDS knowledge artifact that defines the clinical use case is described in detail in the following sections:

- Order Set: VTE KNART
 - Orderable items

- Logic for appropriate display of the order set

[End Knowledge Artifacts.]

Chapter 2. VTE Prophylaxis - Order Set

[Begin VTE Prophylaxis - Order Set.]

2.1. Knowledge Narrative

[Begin Knowledge Narrative.]

[See Clinical Context in Chapter 1, Section 1.1.]

Venous thromboembolism (VTE) is a common medical problem that results in substantial morbidity and mortality. Despite its prevalence, physicians often fail to appreciate the risks for VTE and often fail to recognize its signs and symptoms; this has led the National Academy of Sciences to cite it as a frequent cause of diagnostic error (National Academies of Sciences 2015). The problem of diagnostic error in VTE is compounded by therapeutic error—largely involving anticoagulants, which are perennially among the medications most often associated with adverse drug events (Shehab 2016). Remediating the problem requires the adoption of evidence-based guidelines, notably those of the American College of Chest Physicians for medical patients and nonorthopedic surgery patients and those of the American College of Orthopedic Surgeons for orthopedic surgery patients, across an entire health system. Rendering such guidelines operational requires meticulous curation of an array of granular elements across the full spectrum of clinical conditions (e.g., medical versus surgical patients, orthopedic versus nonorthopedic surgical patients, intracranial/spinal surgery, etc.) and the management of numerous comorbidities and factors that have potential to complicate care and predispose patients to iatrogenic bleeding (hemorrhagic diathesis, renal failure, etc.). Deploying such decision support within the VA system offers the potential for significant cost savings, improvement in patient care, and avoidance of preventable morbidity and mortality.

[End Knowledge Narrative.]

2.2. Resources and Risk Stratification: Medical Patients

[Begin Resources and Risk Stratification: Medical Patients.]

[Section Prompt: This section should be available for all medical patients.]

[Technical Note: A link to the Padua prediction scoring algorithm (<https://www.mdcalc.com/padua-prediction-score-risk-vte>) should be provided.]

[End Resources and Risk Stratification: Medical Patients.]

2.3. Medications: Medical Patients

[Begin Medications: Medical Patients.]

[Section Prompt: Medications: Medical Patients]

[Technical Note: This section should be available for all medical patients requiring pharmacological VTE prophylaxis.]

[Section Prompt: Acutely Ill Patients - This subsection applies to all acutely ill medical patients at increased risk of thrombosis who are not bleeding or at high risk for bleeding.]

☐ Enoxaparin 40 mg subcutaneous once daily (routine)

☐ Dalteparin 5000 Units subcutaneous once daily (routine)

- ☐ Heparin 5000 Units subcutaneous two times daily (routine)
- ☐ Heparin 5000 Units subcutaneous three times daily (routine)
- ☐ Fondaparinux 2.5 mg subcutaneous once daily (routine)

[Section Prompt: Critically Ill Patients - This subsection applies to all critically ill medical patients at increased risk of thrombosis who are not bleeding or at high risk for bleeding.]

- ☐ Enoxaparin 40 mg subcutaneous once daily (routine)
- ☐ Dalteparin 5000 Units subcutaneous once daily (routine)
- ☐ Heparin 5000 Units subcutaneous two times daily (routine)

[End Medications: Medical Patients.]

2.4. Procedures: Medical Patients

[Begin Procedures: Medical Patients.]

[Section Prompt: Mechanical VTE Prophylaxis, Medical Patients]

[Technical Note: This section should be available for all medical patients requiring mechanical VTE prophylaxis, particularly those who are at increased risk of bleeding events.]

[Section Prompt: Acutely Ill Patients - This subsection applies to all acutely ill medical patients at increased risk of thrombosis who are bleeding or at high risk for major bleeding.]

- ☐ Graduated compression stockings (routine)
- ☐ Intermittent pneumatic compression (routine)

[Section Prompt: Critically Ill Patients - This subsection applies to all critically ill medical patients at increased risk of thrombosis who are bleeding or at high risk for major bleeding.]

- ☐ Graduated compression stockings (routine)
- ☐ Intermittent pneumatic compression (routine)

[End Procedures: Medical Patients.]

2.5. Resources and Risk Stratification: Nonorthopedic Surgical Patients

[Begin Resources and Risk Stratification: Nonorthopedic Surgical Patients.]

[Section Prompt: VTE Risk Stratification for surgical patients]

[Technical Note: This section should be available for all nonorthopedic surgical patients.]

[Technical Note: A link to the Rogers scoring algorithm ([http://www.journalacs.org/article/S1072-7515\(07\)00327-4/fulltext](http://www.journalacs.org/article/S1072-7515(07)00327-4/fulltext)) should be provided.]

[Technical Note: A link to the Caprini scoring algorithm (<http://venousdisease.com/caprini-dvt-risk-assessment/>) should be provided.]

[Technical Note: A link to the American College of Chest Physicians pregnancy anticoagulation guidelines (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3278054/>) should be provided.]

[End Resources and Risk Stratification: Nonorthopedic Surgical Patients.]

2.6. Activity: Nonorthopedic Surgical Patients

[Begin Activity: Nonorthopedic Surgical Patients.]

[Section Prompt: Activity Order for nonorthopedic surgical patients]

[Technical Note: This section should be available for all nonorthopedic surgery patients requiring VTE prophylaxis.]

[Section Prompt: General and Abdominal-Pelvic Surgery Patients at Very Low Risk for VTE]

- ☐ Ambulate with assistance 1 time per shift (routine)
- ☐ Bed to chair 1 time per shift (routine)
- ☐ Up ad lib now

[End Activity: Nonorthopedic Surgical Patients.]

2.7. Medications: Nonorthopedic Surgical Patients

[Begin Medications: Nonorthopedic Surgical Patients.]

[Section Prompt: Medications – Nonorthopedic Surgical Patients]

[Technical Note: This section should be available for all nonorthopedic surgery patients requiring pharmacological VTE prophylaxis.]

[Section Prompt: General and Abdominal-Pelvic Surgery Patients at Moderate Risk for VTE - This subsection applies to all general and abdominal-pelvic surgery patients at moderate risk for VTE who are not at high risk for major bleeding complications.]

- ☐ Enoxaparin 40 mg subcutaneous once daily (routine)
- ☐ Dalteparin 2500 Units subcutaneous once daily (routine)
- ☐ Heparin 5000 Units subcutaneous two times daily (routine)

[Section Prompt: General and Abdominal-Pelvic Surgery Patients at High Risk for VTE - This subsection applies to all general and abdominal-pelvic surgery patients at high risk for VTE who are not at high risk for major bleeding complications.]

- ☐ Enoxaparin 40 mg subcutaneous once daily (routine)
- ☐ Dalteparin 5000 Units subcutaneous once daily (routine)
- ☐ Heparin 5000 Units subcutaneous two times daily (routine)

[Section Prompt: General and Abdominal-Pelvic Surgery Patients at High Risk for VTE with Inability to Use Either LMWH or UFH - This subsection applies to all general and abdominal-pelvic surgery patients at high risk for VTE for whom both LMWH and UFH are contraindicated or unavailable and who are not at high risk for major bleeding complications.]

- ☐ Fondaparinux 2.5 mg subcutaneous once daily (routine)
- ☐ Aspirin 160 mg tablet oral once daily (routine)

[Section Prompt: Cardiac Surgery Patients with Nonhemorrhagic Surgical Complications - This subsection applies to all cardiac surgery patients whose inpatient stay is prolonged by nonhemorrhagic surgical complications.]

- ☐ Heparin 5000 Units subcutaneous two times daily (routine)

☐ Enoxaparin 40 mg subcutaneous once daily (routine)

☐ Dalteparin 5000 Units subcutaneous once daily (routine)

[Section Prompt: Thoracic Surgery Patients at Moderate Risk for VTE - This subsection applies to all thoracic surgery patients at moderate risk for VTE who are not at high risk for perioperative bleeding.]

☐ Heparin 5000 Units subcutaneous two times daily (routine)

☐ Enoxaparin 40 mg subcutaneous once daily (routine)

☐ Dalteparin 5000 Units subcutaneous once daily (routine)

[Section Prompt: Thoracic Surgery Patients at High Risk for VTE - This subsection applies to all thoracic surgery patients at high risk for VTE who are not at high risk for perioperative bleeding.]

☐ Heparin 5000 Units subcutaneous two times daily (routine)

☐ Enoxaparin 40 mg subcutaneous once daily (routine)

☐ Dalteparin 5000 Units subcutaneous once daily (routine)

[Section Prompt: Craniotomy Patients at Very High Risk for VTE - This subsection applies to all craniotomy patients at very high risk for VTE once adequate hemostasis is established and the risk of bleeding decreases.]

☐ Heparin 5000 Units subcutaneous two times daily (routine)

☐ Enoxaparin 40 mg subcutaneous once daily (routine)

☐ Dalteparin 5000 Units subcutaneous once daily (routine)

☐ Fondaparinux 2.5 mg subcutaneous once daily (routine)

[Section Prompt: Spinal Surgery Patients at High Risk for VTE - This subsection applies to all spinal surgery patients at high risk for VTE once adequate hemostasis is established and the risk of bleeding decreases.]

☐ Heparin 5000 Units subcutaneous two times daily (routine)

☐ Enoxaparin 40 mg subcutaneous once daily (routine)

☐ Dalteparin 5000 Units subcutaneous once daily (routine)

☐ Fondaparinux 2.5 mg subcutaneous once daily (routine)

[Section Prompt: Major Trauma Patients - This subsection applies to all major trauma patients without contraindication.]

☐ Heparin 5000 Units subcutaneous two times daily (routine)

☐ Enoxaparin 40 mg subcutaneous once daily (routine)

☐ Dalteparin 5000 Units subcutaneous once daily (routine)

[End Medications: Nonorthopedic Surgical Patients.]

2.8. Procedures: Nonorthopedic Surgical Patients

[Begin Procedures: Nonorthopedic Surgical Patients.]

[Section Prompt: This section applies to all nonorthopedic surgical patients requiring mechanical VTE prophylaxis, particularly those who are at increased risk of bleeding events.]

[Technical Note: This section should be available for all nonorthopedic surgical patients requiring mechanical VTE prophylaxis, particularly those who are at increased risk of bleeding events.]

[Section Prompt: General and Abdominal-Pelvic Surgery Patients at Low Risk for VTE]]

- ☐ Intermittent pneumatic compression (routine)

[Section Prompt: General and Abdominal-Pelvic Surgery Patients at Moderate Risk for VTE]

- ☐ Intermittent pneumatic compression (routine)

[Section Prompt: General and Abdominal-Pelvic Surgery Patients at High Risk for VTE }

- ☐ Intermittent pneumatic compression (routine)

- ☐ Graduated compression stockings (routine)

[Section Prompt: Cardiac Surgery Patients]

- ☐ Intermittent pneumatic compression (routine)

[Section Prompt: Thoracic Surgery Patients at Moderate Risk for VTE - This subsection applies to all thoracic surgery patients at moderate risk for VTE who are not at high risk for perioperative bleeding.]

- ☐ Intermittent pneumatic compression (routine)

[Section Prompt: Thoracic Surgery Patients at High Risk for VTE]

- ☐ Intermittent pneumatic compression (routine)

- ☐ Graduated compression stockings (routine)

[Section Prompt: Craniotomy Patients]

- ☐ Intermittent pneumatic compression (routine)

[Section Prompt: Spinal Surgery Patients]

- ☐ Intermittent pneumatic compression (routine)

[Section Prompt: Major Trauma Patients - This subsection applies to all major trauma patients without contraindication due to lower-extremity injury.]

- ☐ Intermittent pneumatic compression (routine)

[End Procedures: Nonorthopedic Surgical Patients.]

2.9. Activity: Orthopedic Surgical Patients

[Begin Activity: Orthopedic Surgical Patients.]

[Section Prompt: Activity Orders for Orthopedic Surgical Patients]

[Technical Note: This section should be available for all orthopedic surgical patients requiring VTE prophylaxis.]

[Section Prompt: Consider early postoperative mobilization as indicated for the given surgery, context, and objectives related to weightbearing status.]

[End Activity: Orthopedic Surgical Patients.]

2.10. Medications: Orthopedic Surgical Patients

[Begin Medications: Orthopedic Surgical Patients.]

[Section Prompt: VTE Prophylaxis Medication Orders for Orthopedic Surgical Patients]

[Technical Note: This section should be available for all orthopedic surgery patients requiring pharmacological VTE prophylaxis.]

[Section Prompt: Total Hip Arthroplasty, Total Knee Arthroplasty, and Hip Fracture Surgery Patients]

- ☐ Enoxaparin 30 mg subcutaneous every 12 hours (routine)
- ☐ Enoxaparin 40 mg subcutaneous once daily (routine)
- ☐ Dalteparin 5000 Units subcutaneous once daily (routine)
- ☐ Fondaparinux 2.5 mg subcutaneous once daily (routine)
- ☐ Warfarin tablet oral per protocol (routine)
- ☐ Apixaban 2.5 mg tablet oral two times daily (routine)
- ☐ Rivaroxaban 10 mg tablet oral once daily (routine)
- ☐ Aspirin 81 mg tablet oral once daily with intermittent pneumatic compression device begun intraoperatively and continued postoperatively through duration of hospital stay (routine)

[End Medications: Orthopedic Surgical Patients.]

2.11. Procedures: Orthopedic Surgical Patients

[Begin Procedures: Orthopedic Surgical Patients.]

[Technical Note: This section should be available for all orthopedic surgical patients requiring mechanical VTE prophylaxis, particularly those who are at increased risk of bleeding events.]

[Section Prompt: Total Hip Arthroplasty, Total Knee Arthroplasty, and Hip Fracture Surgery Patients]

- ☐ Intermittent pneumatic compression (routine)

[End Procedures: Orthopedic Surgical Patients.]

2.12. Laboratory Tests

[Begin Laboratory Tests.]

[Technical Note: This section should be available for all patients requiring VTE prophylaxis.]

[Section Prompt: The following laboratory studies should be considered for patients who will receive warfarin. These laboratory studies may also be indicated for patients on other medications for VTE prophylaxis if clinically indicated per clinician judgment.]

- ☐ Complete blood count once daily (routine)
- ☐ Basic metabolic panel once daily (routine)
- ☐ Activated partial thromboplastin time once daily (routine)
- ☐ International normalized ratio once daily (routine)

[End Laboratory Tests.]

[End VTE Prophylaxis - Order Set.]

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U.S. National Library . *ASPIRIN 81 MG- aspirin tablet, coated [DOLGENCORP, LLC]*. Revised January 2017. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=b4064039-2345-4227-b83d-54dc13a838d3>.

U.S. National Library of Medicine. *ELIQUIS- apixaban tablet, film coated [Cardinal Health]*. Revised March 2017. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=a454cd24-0c6d-46e8-b1e4-197388606175>.

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Appendix A. Existing Sample VA Artifacts

The following sample artifacts are referenced from the Portland VAMC.

Figure A.1. Surgical Inpatient Menu

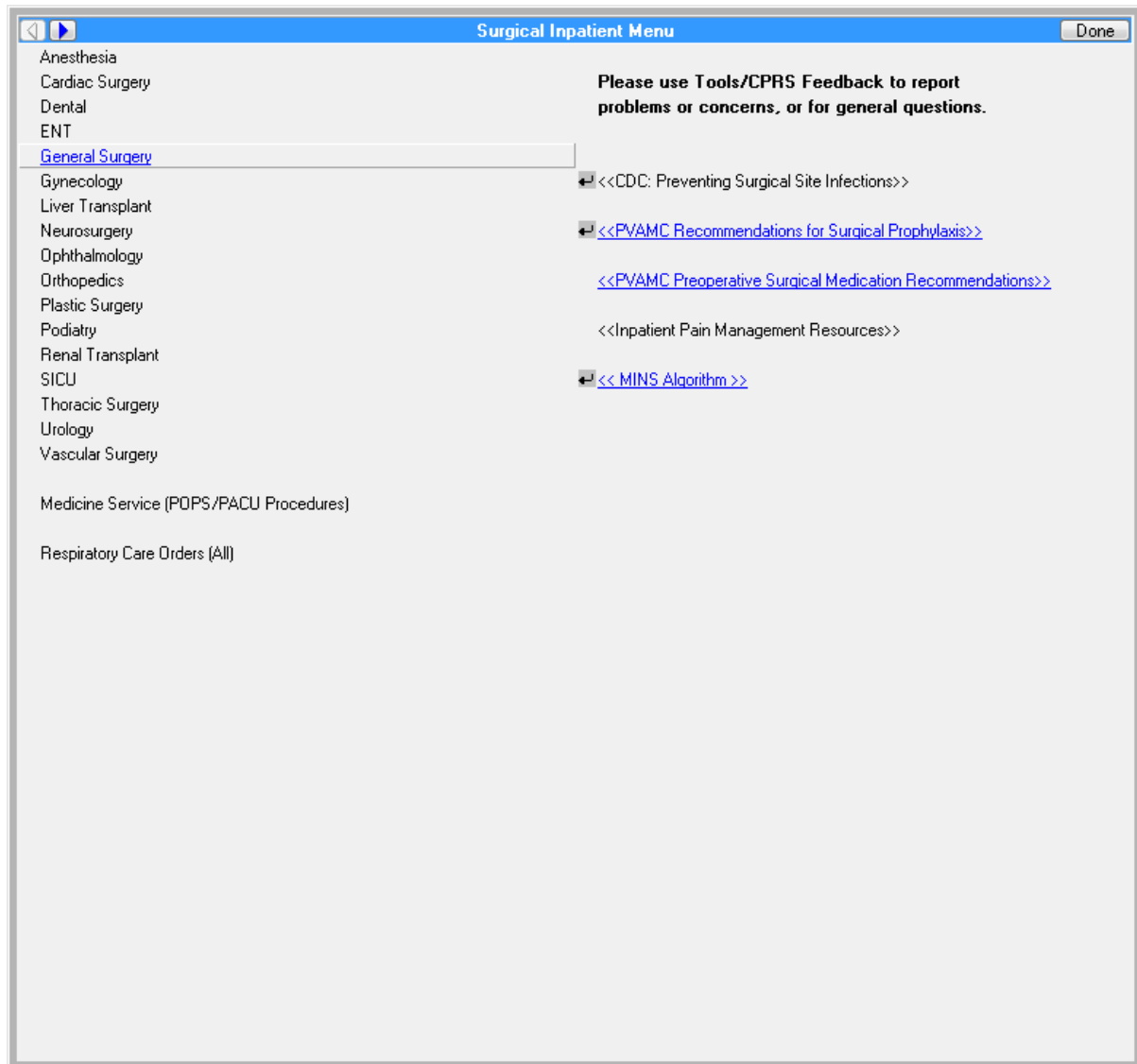


Figure A.2. General Surgery Inpatient Orders

General Surgery Inpatient			Done
ADMIT ORDERS	ADDITIONAL ORDERS	TOOLS/LINKS	
Admission Orders	Consults	Dictation Instructions	
Admit/Preop (Immediate surgery)	Code Status	Inter-Facility Notification	
+Consent to be obtained via IMED Consent	Contrast Prophylaxis	<input checked="" type="checkbox"/> MD Web Page (Tools)	
PRE-OP ORDERS	Diet Orders	<input checked="" type="checkbox"/> Surgical Antibiotic Prophylaxis	
Preoperative Orders	Fall Prevention/Post Fall Orders	Preoperative Medication Recommendations	
DVT Surgical Prophylaxis (Rev 4.15)	Imaging Orders	Inpatient Pain Management Resources	
POST-OP ORDERS	IV Fluids	<< SURGERY REQUEST >>	
Postop SICU	Labs - Blood	<< General Surgery Minor Procedure Request >>	
Postop Ward	Labs - Other Specimens		
Post Operative DVT Prophylaxis (Rev 4.15)	Blood Bank		
CVC New PROVIDERS ONLY	Legal Status		
DAY SURGERY ORDERS	Medications - ICU		
Day Surgery Orders	Medications - Surgery Ward		
	Nursing Text Orders		
TRANSFER ORDERS	Procedures/ECGs		
Transfer Orders	Respiratory Care Orders (All)		
	Restraint - Med/Surg		
DISCHARGE ORDERS	Smoking Cessation		
Discharge Orders/Instructions	Telemetry Orders		
Travel Orders	Vascular Lab		
	Foley Orders		
SPECIALTY ORDERS	Central Line Maintenance		
General Surgery Imaging			
Wound/Vac Consult Request			
Wound Specialist Consult...			
Ostomy Specialist Consult			

Figure A.3. DVT Surgical Prophylaxis Orders

The screenshot shows a software window titled "DVT Surgical Prophylaxis (Rev 4.15)" with a "Done" button in the top right corner. Inside the window, there is a section titled "Orders for PRE-OPERATIVE AND GENERAL prophylaxis. Select your service". Below this title, there is a list of medical services arranged in two columns:

Orders for PRE-OPERATIVE AND GENERAL prophylaxis. Select your service	
Cardiothoracic Surgery	Neurology
ENT	Neurosurgery
General Surgery	Orthopedic Surgery
Gynecology	Urology
Medicine Service	Vascular

Figure A.4. Cardiothoracic Surgery DVT Preoperative Prophylaxis Options

The screenshot shows a software window titled "Cardiothoracic Surgery DVT Preoperative Prophylaxis" with a "Done" button in the top right corner. Below the title bar is a section header "Prophylaxis Options". Under this header, there are three lines of text, each preceded by a double less-than sign: "<<Early Ambulation>>", "<<TEDs and SCDs>>", and "<<Heparin 5000 units SQ Q12H>>".

Figure A.5. Early Ambulation Order - Preoperative Low DVT Risk

The screenshot shows a software window titled "C-DVT EARLY AMBULATION" with a close button (X) in the top right corner. The window contains a text area labeled "Nursing:" with the text "Preop Low DVT Risk: Up out of bed TID as tolerated." Below this is a large empty text area. At the bottom, there is a section labeled "Order Sig" containing the text "C-DVT EARLY AMBULATION" and "Preop Low DVT Risk: Up out of bed TID as tolerated." To the right of this text are two buttons: "Accept Order" and "Quit".

Figure A.6. Reason for Request for Mechanical DVT

The screenshot shows a software window titled "Reason for Request: MECHANICAL DVT". The window contains a form with the following elements:

- A header bar with a yellow icon and the title "Reason for Request: MECHANICAL DVT".
- A main area with the text "Please apply:" followed by a row of checkboxes: ☐ SCD Left, ☐ SCD Right, ☐ SCD Bilateral, ☐ TED Left, and ☐ TED Right.
- A second row with checkboxes: ☐ TED Bilateral and ☐ Other Instructions: followed by a text input field.
- A footer area containing the text "* Indicates a Required Field" and three buttons: "Preview", "OK", and "Cancel".

Figure A.7. ENT DVT Preoperative Prophylaxis - Low and Medium Risk

The screenshot shows a window titled "ENT DVT Preoperative Prophylaxis" with a "Done" button in the top right corner. The window is divided into two columns: "Low risk" and "Medium risk".

Low risk
risk 0.4-2%
For patients < 40y and no risk factors

Medium risk
risk 15-80%
Includes patients with chronic or critical illness, CHF, COPD, immobilization, active ischemic CAD, malignancy, or known hypercoagulable states

At the bottom of the window, there are two buttons: "<<Early Ambulation>>" on the left and "<<Heparin 5000 units SQ Q12H>>" on the right.

Figure A.8. Early Ambulation Orders - Preoperative Low DVT Risk

The screenshot shows a window titled "C-DVT EARLY AMBULATION" with a close button in the top right corner. The window contains a text area for a nursing order and an "Order Sig" section at the bottom.

Nursing: Preop Low DVT Risk: Up out of bed TID as tolerated.

Order Sig
C-DVT EARLY AMBULATION
Preop Low DVT Risk: Up out of bed TID as tolerated.

At the bottom right of the window, there are two buttons: "Accept Order" and "Quit".

Figure A.9. General Surgery Preoperative DVT Prophylaxis Options

The screenshot shows a software window with a blue title bar containing the text "General Surgery Preoperative DVT Prophylaxis (Rev 1.2015)" and a "Done" button on the right. The main content area is light gray and contains the following text:

Prophylaxis Options

Average risk patients with one or more medical comorbidities OR anticipating epidural/intrathecal procedures
[<<Heparin 5000U SQ Q12h>>](#)

Pts > 60y with medical comorbidities malignancy or obesity or hypercoagulability
NOT FOR USE WITH EPIDURALS
[<<Enoxaparin for normal renal function>>](#)
[<<Enoxaparin for renal insufficiency \(not dialysis\)>>](#)

Contraindications to pharmacologic prophylaxis
[<<SCD and TED>>](#)

Figure A.10. OB-GYN Preoperative DVT Prophylaxis - Low, Medium, and High Risk

The form is titled "OB-GYN Preoperative DVT Prophylaxis" and includes a "Done" button in the top right corner. It is organized into three columns representing different risk levels: Low risk, Medium risk, and High risk. Each column contains a risk percentage, a description of the patient population, and a recommended prophylaxis protocol.

Low risk	Medium risk	High risk
risk 0.4-2% For patients < 40y and no risk factors	risk 15-20% For pts 40-60y with additional comorbidities cancer, chronic, or critical illness, CHF, COPD immobilization or active ischemic CAD	risk 20-80% For pts > 60y and medical comorbidities and additional risks including hormone replacement therapy or suspected hypercoagulable state
<<Early Ambulation>>	<<Heparin 5000 units SQ Q12H>>	<<Heparin 5000 units SQ Q8H>>

Figure A.11. Hospital Specialty Medicine DVT Prophylaxis - Low, Medium, and High Risk

Hospital Specialty Medicine DVT Prophylaxis Menu (Rev 1.2015)			
DECISION SUPPORT			
Low Risk Criteria risk < 5% (least common category) For pts without known VTE risk factors or chronic medical illnesses >> Ambulatory pts with expected LOS < 24h >> Age < 40y >> Anticipate minor procedure lasting < 30 min	Medium Risk Criteria risk 5-30% (most common category) Includes pts with chronic illnesses, malignancy, or critical illness >> Congestive heart failure >> History of VTE or stroke >> Respiratory failure >> Pneumonia >> Known hypercoagulable states >> Sepsis >> Renal failure	High Risk Criteria risk > 30% estimated Includes patients anticipating major surgical procedures +/- comorbidities >> Major orthopedic surgery >> Spinal cord injury or major trauma >> Abd/pelvis cancer undergoing surgery >> Lower extremity arthroplasty >> Hip/pelvis fracture >> Pts with neuraxial anesthesia (epidural) >> Malignancy	Contraindications to Prophylaxis If patient has a contraindication to pharmacologic prophylaxis but would otherwise be a candidate For pts with a relative contraindication to tx, use clinical judgement when selecting pharmacologic or mechanical prophylaxis. Use order items in "Medium Risk" column.
ORDER OPTIONS			
Low Risk Patient Orders <<Early Ambulation Orders>> <<SCDs and TEDs nursing order>>	Medium Risk Patient Orders <<Heparin 5000 units SQ Q12H>> or <<Enoxaparin for normal renal function>> <<Enoxaparin for renal insufficiency (not dialy)>>	Patients with Malignancy <<Enoxaparin for normal renal function>> <<Enoxaparin for renal insufficiency (not dialy)>> Postoperative Patients <<Prophylaxis Options>> Neuraxial Anaesthesia Options <<Epidural Option>>	Contraindication Order Options <<Active life threatening bleed>> <<History of HIT>> <<INR above 1.5>> <<On therapeutic anticoagulation>> <<Known bleeding diathesis>> <<Severe uremia with bleeding>> <<Plt count under 50K>> <<Patient refuses injection>> Relative Contraindications <<GI or GU hemorrhage in past 6m>> <<ICH within past 6m>> <<Other Contraindications>>

Figure A.12. Exemplar Alert Contraindication for Pharmacologic DVT

DVT: RECENT HEMORRHAGE	
NURSING	DVT Contraindication: GI/GU Hemorrhage w/in past 6 months.
Order Sig DVT: RECENT HEMORRHAGE DVT Contraindication: GI/GU Hemorrhage w/in past 6 months.	
<div>Accept Order</div> <div>Quit</div>	

Figure A.13. Neurology Preoperative DVT Prophylaxis - Low, Medium, and High Risk

Low risk	Medium risk	High risk
risk < 5% For patients without known pre-existent VTE risk factors or chronic medical comorbidities or immobilization	risk 10-20% Chronic illness or immobilization or medical comorbidities	risk 20-50% Patients with CVA
<<Early ambulation>>	<<Heparin 5000 units SQ Q12H>>	<<Heparin 5000 units SQ Q12H>> and <<SCD and TED hose>>

Figure A.14. Neurosurgery Preoperative DVT Prophylaxis - Low, Medium, High, and Very High Risk

Low risk	Medium risk	High risk	Very high risk
risk < 5% For patients without known pre-existent VTE risk factors or chronic medical comorbidities or immobilization	risk 5-30% For patients expecting major neurosurgical procedures and with medical comorbidities including chronic illness or immobilization	risk 15-40% For patients with malignant disease or prior but stable CVA	risk 60-80% For pts with recent spinal cord injuries and trauma
<<Early ambulation>>	<<Heparin 5000 units SQ Q12H>> <div></div>	<<Heparin 5000 units SQ Q12H>> and <<SCD and TED hose>>	<<Enoxaparin 30mg SQ Q12H>> Renal insufficiency For patients with CrCl < 30ml/min but not on hemodialysis <<Enoxaparin 30mg SQ Q24H>>

Figure A.15. Orthopedic DVT Preoperative Prophylaxis

The screenshot shows a software window with a blue title bar containing the text "Orthopedic Surgery DVT Preoperative Prophylaxis" and a "Done" button on the right. The main content area is light gray and contains the following text:

Orthopedic Surgery Patients
<<Heparin 5000 units SQ Q12H>>

Hip Fracture Patients
<<Enoxaparin 30mg SQ Q12H>>

Contraindication to anticoagulants
<<Early Ambulation Order>>

Renal insufficiency
For patients with CrCl < 30ml/min
but not on hemodialysis

No dose adjustment required
for heparin SQ Q8 or Q12

For pts requiring enoxaparin:
<<Enoxaparin 30mg SQ Q24H>>

Figure A.16. Urologic Surgery Preoperative DVT Prophylaxis - Low, Medium, and High Risk

Urologic Surgery Preoperative DVT Prophylaxis (Rev 1.2015)			Done
Low risk risk < 1% Anticipated transurethral surgeries and no other VTE risk factors or medical comorbidities <<Early ambulation>>	Medium risk risk 15-30% Includes patients with chronic comorbidities or critical illness or immobilization or active CAD <<Heparin 5000 units SQ Q12H>> For patients anticipating epidural or intrathecal or spinal procedures <<Epidural Option>>	High risk risk 15-40% Major or open urologic surgery expected. Prior documented malignancy hypercoagulable state or thromboembolism <<Enoxaparin for normal renal function>> <<Enoxaparin for renal insufficiency (not dialysis)>> For patients anticipating epidural or intrathecal or spinal procedures <<Epidural Option>>	

Figure A.17. Vascular Surgery Preoperative DVT Prophylaxis - Very Low, Low, Medium, and High Risk

Vascular Surgery DVT Preoperative Prophylaxis (Rev 1.2015)			
Very low risk	Low risk	Medium risk	High risk
<p>risk 2-3%</p> <p>For pts without known pre-existent VTE risk factors including chronic medical illness, malignancy, or immobilization</p>	<p>risk 10-20%</p> <p>Includes patients with cancer, chronic or critical illness, CHF, COPD, immobilization or active ischemic CAD</p>	<p>risk 20-30%</p> <p>For patients with advanced age or limb ischemia or malignancy or additional risk factors including hypercoagulable states</p>	<p>risk 20-50%</p> <p>Patients with prior CVA</p>
<<Early ambulation>>	<<Heparin 5000U SQ Q12h>>	<<Heparin 5000U SQ Q12h>> or <<Enoxaparin for normal renal function>> <<Enoxaparin for renal insufficiency (not dialy:	<<Enoxaparin for normal renal function>> <<Enoxaparin for renal insufficiency (not dialy: and <<SCDs and TEDs nursing order>>
		For patients anticipating spinal intrathecal or epidural procedures <<Epidural Heparin Option>>	For patients anticipating spinal intrathecal or epidural procedures <<Epidural Heparin Option>>

Figure A.18. Vascular Surgery Preoperative DVT Prophylaxis - Very Low, Low, Medium, and High Risk

Vascular Surgery DVT Preoperative Prophylaxis (Rev 1.2015) Done			
Very low risk	Low risk	Medium risk	High risk
<p>risk 2-3%</p> <p>For pts without known pre-existent VTE risk factors including chronic medical illness, malignancy, or immobilization</p>	<p>risk 10-20%</p> <p>Includes patients with cancer, chronic or critical illness, CHF, COPD, immobilization or active ischemic CAD</p>	<p>risk 20-30%</p> <p>For patients with advanced age or limb ischemia or malignancy or additional risk factors including hypercoagulable states</p>	<p>risk 20-50%</p> <p>Patients with prior CVA</p>
<<Early ambulation>>	<<Heparin 5000U SQ Q12h>>	<<Heparin 5000U SQ Q12h>> or <<Enoxaparin for normal renal function>> <<Enoxaparin for renal insufficiency (not dialy:	<<Enoxaparin for normal renal function>> <<Enoxaparin for renal insufficiency (not dialy: and <<SCDs and TEDs nursing order>>
		For patients anticipating spinal intrathecal or epidural procedures <<Epidural Heparin Option>>	For patients anticipating spinal intrathecal or epidural procedures <<Epidural Heparin Option>>

Figure A.19. Postoperative DVT Prophylaxis

The screenshot shows a software window titled "Post Operative DVT Prophylaxis (Rev 4.15)" with a "Done" button in the top right corner. The main content area has a light gray background and contains the following text:

POST-OPERATIVE DVT prophylaxis options
Please selecting the treating specialty to proceed

Cardiothoracic Surgery	Neurosurgery
ENT	Orthopedic Surgery
General Surgery	Urology
Gynecology	Vascular Surgery

Figure A.20. Cardiothoracic Surgery Postoperative DVT Prophylaxis

Cardiothoracic Surgery DVT Postoperative Prophylaxis Done

VTE Prophylaxis Options

<<SCDs and TEDs>>

<<Heparin 5000 units SQ Q12H>>

For pts undergoing epidural, intrathecal, or spinal procedures

<<Neuraxial Options>>

For pts with contraindications to tx

Select contraindication below

<<Known Bleeding Diathesis>>

<<Active Life Threatening Bleed>>

<<INR over 1.5>>

<<On therapeutic anticoagulation>>

<<Thrombocytopenia>>

<<Severe Uremia with Bleeding>>

Figure A.21. DVT Prophylaxis in Presence of a Bleeding Diathesis

Reason for Request: C-DVT BLEEDING DIATHESIS

Please apply: ☐ SCD Left ☐ SCD Right ☐ SCD Bilateral ☐ TED Left ☐ TED Right
☐ TED Bilateral ☐ Other Instructions:

* Indicates a Required Field

Preview OK Cancel

Figure A.22. ENT DVT Postoperative Prophylaxis

ENT DVT Postoperative Prophylaxis			
Low VTE risk risk 0.4-2% For patients < 40y and no risk factors and minor surgery < 30min	Medium VTE risk risk 15-20% For pts 40-60y with minor surgery < 30 min or pts < 40y with major surgery > 30m	High VTE risk risk 20-40% For pts > 60y and minor surgery < 30 min or pts > 40y and major surgery > 30min or ENT pts with additional risks including known hypercoagulable states or malignancy	For patients with contraindications to tx Select contraindications below
<<Early ambulation>>	<<Heparin 5000 units SQ Q12H>>	<<Heparin 5000 units SQ Q8H>>	<<Known Bleeding Diathesis>>
<<SCDs and TEDs>>	For pts undergoing epidural, intrathecal, or spinal procedures <<Neuraxial Option>>	For pts undergoing epidural, intrathecal, or spinal procedures <<Neuraxial Option>>	<<Active Life Threatening Bleed>>
			<<INR over 1.5>>
			<<On therapeutic anticoagulation>>
			<<Thrombocytopenia>>
			<<Severe Uremia with Bleeding>>

Figure A.23. General Surgery DVT Postoperative Prophylaxis

General Surgery DVT Postoperative Prophylaxis (Rev 1.2015) Done

DVT Prophylaxis Options	For patients with contraindications to tx Select contraindication below
Postop patients with one or more comorbidities and average risk <<Heparin 5000 units SQ Q12H>>	<<Known Bleeding Diathesis>>
High risk patients with morbid obesity or malignancy or hypercoagulability NOT FOR USE WITH EPIDURALS <<Enoxaparin for normal renal function>> <<Enoxaparin for renal insufficiency (not dialysis)>>	<<Active Life Threatening Bleed>> <<INR over 1.5>> <<On therapeutic anticoagulation>>
For pts undergoing epidural, intrathecal, or spinal procedures <<Epidural Option>>	<<Thrombocytopenia>> <<Severe Uremia with Bleeding>>

Figure A.24. OB-GYN DVT Postoperative Prophylaxis

OB-GYN DVT Postoperative Prophylaxis Done			
Low VTE risk risk 0.4-2% For patients < 40y and no risk factors and minor surgery < 30min or laproscopic procedures without additional risk factors <<Early Ambulation>> <<SCDs and TEDs>>	Medium VTE risk risk 15-20% For pts 40-60y with non-major surgery or pts < 40y with major surgery > 30m or pts getting laproscopic surgery with risk factors <<Heparin 5000 units SQ Q12H>> For pts undergoing epidural intrathecal, or spinal procedures <<Neuraxial Option>>	High VTE risk risk 20-40% For pts > 60y and non-major surgery or pts > 40y and major surgery > 30min or gen-surg pts with additional risks including oral contraceptives or known hypercoagulable state <<Heparin 5000 units SQ Q8H>> For pts undergoing epidural intrathecal, or spinal procedures <<Neuraxial Option>>	For patients with contraindications to tx Select contraindication below <<Known Bleeding Diathesis>> <<Active Life Threatening Bleed>> <<INR over 1.5>> <<On therapeutic anticoagulation>> <<Thrombocytopenia>> <<Severe Uremia with Bleeding>>

Figure A.25. Neurosurgery DVT Postoperative Prophylaxis

Neurosurgery DVT Postoperative Prophylaxis

Done

Prophylaxis Options

Recent post-op
<<SCD and TED hose>>

For pts > 48h post-op and medical comorbidities or age > 40y, or malignancy
<<Heparin 5000 units SQ Q12H>>

For pts with SCI or trauma, or hypercoagulability
<<Enoxaparin 30mg SQ Q12H>>

For patients with CrCl < 30ml/min but not on hemodialysis
<<Enoxaparin 30mg SQ Q24H>>

For pts undergoing epidural intrathecal, or spinal procedures
<<Epidural Option>>

For patients with contraindications to tx
Select contraindication below:

<<Known Bleeding Diathesis>>

<<Active Life Threatening Bleed>>

<<INR over 1.5>>

<<On therapeutic anticoagulation>>

<<Thrombocytopenia>>

<<Severe Uremia with Bleeding>>

Figure A.26. Orthopedic Surgery DVT Postoperative Prophylaxis

Orthopedic Surgery DVT Postoperative Prophylaxis (Rev 1.2015) Done

Select prophylaxis based upon procedure

Arthroscopic Surgery
<<Early ambulation order>>
or
<<Heparin 5000U SQ Q12 and TED/SCDs>>

Hip Fracture/Arthroplasty and Knee Arthroplasty
NOT FOR USE WITH EPIDURALS
<<Enoxaparin for normal renal function>>
<<Enoxaparin for renal insufficiency (not dialysis)>>
and <<TED/SCD nursing order>>
or
<<Hip/Knee Surgery Warfarin 5mg>>
<<Hip/Knee Surgery Warfarin 2.5mg>>
or
<<ASA 325mg PO Q12h>>

Epidural Options
<<Epidural Option Heparin>>

For patients with contraindications to tx

<<Known bleeding diathesis>>
<<Active life threatening bleed>>
<<INR over 1.5>>
<<On therapeutic anticoagulation>>
<<Thrombocytopenia>>
<<Severe uremia with bleeding>>

Figure A.27. Urologic Surgery DVT Postoperative Prophylaxis

Urologic Surgery DVT Postoperative Prophylaxis (Rev 1 2015) Done			
Low VTE risk risk < 1% Transurethral surgeries and no major medical comorbidities <<SCDs and TEDs>>	Medium VTE risk risk 15-30% Transurethral surgeries and medical comorbidities including COPD, CHF, coronary artery disease <<Heparin 5000 units SQ Q12H>> For pts undergoing epidural intrathecal, or spinal procedures <<Epidural Heparin>>	High VTE risk risk 15-40% Major or open urologic surgery. Prior documented malignancy hypercoagulable state or thromboembolism <<Enoxaparin for normal renal function>> <<Enoxaparin for renal insufficiency (not dialysis)>> and <<SCDs and TEDs nursing order>> For pts undergoing epidural intrathecal, or spinal procedures <<Epidural Heparin>>	For patients with contraindications to tx Select contraindications below <<Known Bleeding Diathesis>> <<Active Life Threatening Bleed>> <<INR over 1.5>> <<On therapeutic anticoagulation>> <<Thrombocytopenia>> <<Severe Uremia with Bleeding>>

Figure A.28. Vascular Surgery DVT Postoperative Prophylaxis

Vascular Surgery DVT Postoperative Prophylaxis (Rev 1.2015) Done

Prophylaxis Options

Most postop pts with comorbidities
<<Heparin 5000U SQ Q12h>>
and <<SCDs and TEDs nursing order>>
or
<<Enoxaparin for normal renal function>>
<<Enoxaparin for renal insufficiency (not dialysis)>>
and <<SCDs and TEDs nursing order>>

For pts undergoing epidural, intrathecal, or spinal procedures
<<Epidural Option>>
and <<SCDs and TED hose>>

For patients with contraindications to tx
Select contraindication below

<<Known Bleeding Diathesis>>
<<Active Life Threatening Bleed>>
<<INR over 1.5>>
<<On therapeutic anticoagulation>>
<<Thrombocytopenia>>
<<Severe Uremia with Bleeding>>

Appendix B. Basic Laboratory Panel Definition

- Blood Urea Nitrogen
- Calcium
- Chloride
- CO₂ (Carbon Dioxide, Bicarbonate)
- Creatinine
- Glucose
- Potassium
- Sodium

Appendix C. VTE Guidelines

American College of Chest Physicians pregnancy anticoagulation guidelines
(<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3278054/>>

Acronyms

ACCP	American College of Chest Physicians
AAOS	American Academy of Orthopedic Surgeons
CCWP	Clinical Content White Paper
HL7	Health Level 7
KNART	Knowledge Artifact
KNARTs	Knowledge Artifacts
VAMC	VA Medical Center
VTE	Venous Thromboembolism