Venous Thrombosis and Pulmonary Embolism: Common Complications and Conditions

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Link to Codes

Prevention

- Prevention issues and possible preventive measures include(1)(2)(3)(4)(5)(6)(7)(8):
  - Awareness of risk factors for venous thromboembolism, including[A](9)(11)(12)(13):
    - Previous venous thromboembolism
    - Thrombophilic state (eg, protein C or protein S deficiencies, factor V Leiden, prothrombin gene mutation, antiphospholipid antibody, use of hormonal treatment)(14)
    - Morbid obesity (BMI 40 or greater) BMI Calculator
    - Pregnancy or postpartum period(15)
    - Recent surgery, particularly orthopedic or surgery for malignancy(16)
    - Recent trauma
    - Critical illness (eg, admission to ICU)(17)
    - Use of erythropoiesis-stimulating agents
    - Nephrotic syndrome
    - Cardiac dysfunction (eg, acute MI, uncompensated heart failure)
    - Aortic aneurysm
    - Cancer or myeloproliferative disorder(9)(18)
    - Sickle cell disease and other hemoglobinopathies
    - Severe infection; examples include:
      - Sepsis
      - Pneumonia

        - Abdominal infection
        - Pyelonephritis
        - Complicated skin and soft tissue infection
        - COVID-19 infection(19)
    - Acute neurologic disease (eg, stroke, traumatic brain injury)(20)(21)
    - Decreased mobility (eg, anticipated bed rest for 3 days or more)
    - Active inflammatory bowel disease(22)
    - Active collagen vascular disease (eg, rheumatoid arthritis, systemic lupus erythematosus, Sjogren syndrome, polymyositis)
    - Severe pulmonary disease; examples include:
        - Exacerbation of COPD
        - Respiratory failure
        - Severe pulmonary hypertension
    - Central venous catheterization(13)
    - Lower limb paralysis
    - Malnutrition(9)
    - Hypoalbuminemia
    - Older age (eg, older than 75 years)(13)
    - Use of vasoactive medication(13)
    - Varicose veins(12)

- Preventive measures include:
    - Use of educational interventions, reminders (eg, pharmacist rounds, computerized alert systems), standardized admission order sets, or audits with feedback to increase physician use of prophylactic measures in at-risk hospitalized patient(23)(24)(25)
    - Patient education, including encouragement of early and frequent ambulation and ankle flexion and extension exercises when feasible
    - Early and frequent ambulation when feasible
    - Avoidance of central venous access, especially femoral access, when feasible(26)
    - Acutely ill hospitalized medical patient at high risk for venous thromboembolism should receive one of the following, depending on assessed risk for major bleeding[B][C](1)(28):
        - Patient at high risk for thromboembolism (eg, Padua Prediction Score greater than 3) who is not bleeding and not thought to be at high risk for major bleeding[B] should receive subcutaneous low-molecular-weight heparin, low-dose unfractionated heparin, fondaparinux, or oral betrixaban.
        - Critically ill (eg, admitted to ICU) patient who is not bleeding and not thought to be at high risk for major bleeding[B] should receive low-molecular-weight heparin or low-dose unfractionated heparin.[D](30)
        - Patient at high risk for thromboembolism who is bleeding or thought to be at high risk for major bleeding[B] or with contraindications to unfractionated heparin, low-molecular-weight heparin (eg, history of heparin-induced thrombocytopenia), and fondaparinux should receive mechanical thromboprophylaxis with intermittent pneumatic compression devices or graduated compression stockings.[E]
    - Hospitalized patient with cancer and reduced mobility, and not thought to be at high risk for major bleeding, should receive prophylaxis with low-molecular-weight heparin or fondaparinux if creatinine clearance is 30 mL/min/1.73m^2 (0.5 mL/sec/1.73m^2) or greater, or unfractionated heparin if creatinine clearance is less than 30 mL/min/1.73m^2 (0.5 mL/sec/1.73m^2).(31)(32)
    - Hospitalized patient with myeloma receiving thalidomide-based or lenalidomide-based chemotherapy should receive prophylaxis with aspirin or low-molecular-weight heparin.(6)(18)
    - Hospitalized patient with pancreatic cancer receiving chemotherapy should receive prophylaxis with low-molecular-weight heparin.(6)(31)

- Hospitalized pregnant patient with homozygous Factor V Leiden deficiency or prothrombin gene mutation, antithrombin deficiency, combined thrombophilia, or antiphospholipid antibody should receive prophylaxis with low-molecular-weight heparin or unfractionated heparin.(15)
- Hospitalized patient with COVID-19 infection should receive one of the following(19)(33):
    - Non-critically ill patient without contraindications and with low risk of bleeding should receive pharmacologic prophylaxis with therapeutic doses of low-molecular-weight heparin (preferred) or unfractionated heparin.(19)(33)
    - Non-critically ill patient who does not receive therapeutic doses of low-molecular-weight heparin or unfractionated heparin (eg, due to bleeding risk) should receive standard-dose pharmacoprophylaxis.(33)
    - Critically ill patient without contraindication or prohibitive bleeding risk should receive pharmacologic prophylaxis with standard-dose low-molecular-weight heparin or unfractionated heparin; combined treatment with mechanical prophylaxis may be considered.[F](19)(33)
    - Patient with contraindication to anticoagulant or prohibitive bleeding risk should receive mechanical prophylaxis.
- Acutely ill hospitalized neurologic patient should receive one of the following(20):
    - Patient with acute ischemic nonhemorrhagic stroke should receive low-molecular-weight heparin and intermittent pneumatic compression device.
    - Patient with acute ischemic stroke undergoing hemicraniotomy or endovascular procedure may receive low-dose unfractionated heparin, low-molecular-weight heparin, or intermittent pneumatic compression device post procedure. Pharmacoprophylaxis should be delayed 24 hours if thrombolysis has been administered.
    - Patient with intracranial hemorrhage should receive intermittent pneumatic compression device or graduated compression stockings on admission. Consider adding low-dose unfractionated heparin or low-molecular-weight heparin within 48 hours of admission if hematoma is stable and there is no coagulopathy.[G]
    - Patient with aneurysmal subarachnoid hemorrhage should receive intermittent pneumatic compression device on admission, then low-dose unfractionated heparin at least 24 hours after surgical repair or endovascular coiling of the causative aneurysm.
    - Patient with acute spinal cord injury should receive intermittent pneumatic compression device until bleeding is controlled, then low-molecular-weight heparin or low-dose unfractionated heparin as early as possible.
    - Patient with neuromuscular disease should receive low-dose unfractionated heparin, low-molecular-weight heparin, or fondaparinux. An intermittent pneumatic compression device should be used if pharmacoprophylactic agents are contraindicated (eg, bleeding risk is too high, allergy, heparin-induced thrombocytopenia).
    - Patient undergoing standard elective spinal surgery should receive early ambulation and mechanical prophylaxis with intermittent pneumatic compression device. For patient at high risk of thromboembolism (eg, surgery for malignant disease), low-molecular-weight heparin should be added after hemostasis is established and when risk of bleeding decreases.(2)
    - Patient undergoing complicated spinal surgery should receive low-molecular-weight heparin or unfractionated heparin with intermittent pneumatic compression device.
    - Patient undergoing craniotomy should receive low-molecular-weight heparin or unfractionated heparin with intermittent pneumatic compression device within 24 hours after surgery.
- Patient undergoing general or abdominal-pelvic surgery should receive one of the following, depending on assessed risk for venous thromboembolism and major bleeding[B][H](2)(7)(36)(37)(38):
    - Patient at very low risk (eg, Caprini score of 0 or 1) for thromboembolism should undergo early ambulation.
    - Patient at low risk (eg, Caprini score of 2) for thromboembolism should receive intermittent pneumatic compression device.
    - Patient at moderate risk (eg, Caprini score of 3 or 4) for thromboembolism and not at high risk for major bleeding[B] should receive low-molecular-weight heparin, low-dose unfractionated heparin, or intermittent pneumatic compression device.
    - Patient at high risk (eg, Caprini score of 5 or higher) for thromboembolism and not at high risk for major bleeding[B] should receive pharmacologic thromboprophylaxis with low-molecular-weight heparin or low-dose unfractionated heparin, and mechanical prophylaxis with an intermittent pneumatic compression device.[I]

- Patient at moderate to high risk (eg, Caprini score of 3 or higher) for thromboembolism and at high risk for major bleeding[B] should receive mechanical prophylaxis with intermittent pneumatic compression device.[E]
- Patient at high risk (eg, Caprini score of 5 or higher) for thromboembolism and with contraindications to unfractionated heparin or low-molecular-weight heparin (eg, history of heparin-induced thrombocytopenia) and not at high risk for major bleeding[B] should receive fondaparinux, low-dose aspirin, or intermittent pneumatic compression device.
- Patient undergoing cancer surgery and not at high risk for major bleeding should receive prophylaxis with low-molecular-weight heparin or unfractionated heparin.[J](18)(31)
- Patient undergoing cancer surgery with contraindications to unfractionated heparin or low-molecular-weight heparin (eg, history of heparin-induced thrombocytopenia) or at high risk for major bleeding should receive mechanical prophylaxis.(18)(31)

- Cardiac surgery patient with uncomplicated postoperative course should receive intermittent pneumatic compression device.(2)
- Cardiac surgery patient with prolonged hospital course due to nonhemorrhagic complications should receive low-molecular-weight heparin or low-dose unfractionated heparin and intermittent pneumatic compression device.(2)
- Thoracic surgery patient should receive one of the following(2):
  - Patient at moderate risk for thromboembolism and not at high risk for major bleeding[B] should receive low-molecular-weight heparin, low-dose unfractionated heparin, or intermittent pneumatic compression device.
  - Patient at high risk for thromboembolism and not at high risk for major bleeding[B] should receive low-molecular-weight heparin or low-dose unfractionated heparin and intermittent pneumatic compression device.
  - Patient at high risk for major bleeding[B] or with contraindications to unfractionated heparin or low-molecular-weight heparin (eg, history of heparin-induced thrombocytopenia) should receive mechanical prophylaxis with intermittent pneumatic compression device.[E]
- Major trauma patient should be treated with one of the following(2)(20)(37)(42):
  - Patient at high risk for thromboembolism (eg, acute spinal cord injury or spinal trauma surgery, traumatic brain injury) should receive low-molecular-weight heparin or low-dose unfractionated heparin and intermittent pneumatic compression device if not contraindicated by active bleeding or lower extremity injury.
  - Patient with blunt solid organ injury should be treated with low-molecular-weight heparin if there is no ongoing bleeding.(43)
  - Patient with contraindications to heparin or low-molecular-weight heparin (eg, due to bleeding risk) should be treated with intermittent pneumatic compression device.[E]
  - Other major trauma patient should receive pharmacoprophylaxis (low-molecular-weight heparin or low-dose unfractionated heparin), an intermittent pneumatic compression device, or both.
- Patient undergoing total hip or total knee arthroplasty should receive one of the following for at least 10 to 14 days (recommended for up to 35 days after surgery)(3)(37)(44):
  - Low-molecular-weight heparin
  - Fondaparinux(45)
  - Oral factor Xa inhibitor (eg, rivaroxaban, apixaban)(46)(47)
  - Oral direct thrombin inhibitor (dabigatran)(46)
  - Low-dose heparin
  - Adjusted-dose vitamin K antagonist
- Patient undergoing hip fracture repair should receive low-molecular-weight heparin (preferred), fondaparinux, low-dose unfractionated heparin, or adjusted-dose vitamin K antagonist for at least 10 to 14 days (recommended for up to 35 days after surgery).(3)(37)
- Burn patient should receive low-molecular-weight heparin or low-dose unfractionated heparin as soon as clinically safe to give anticoagulant. Patient at high bleeding risk should receive graduated compression stockings and intermittent pneumatic compression device if burns do not involve lower extremities.
- Palliative care patient should be considered for prophylaxis with low-molecular-weight heparin if not in last days of life.(6)

- Vascular surgery, head and neck surgery, or endovascular repair patient should be considered for prophylaxis with low-molecular-weight heparin, or with mechanical prophylaxis if pharmacologic prophylaxis is contraindicated.(6)

− Risk factors for in-hospital bleeding for which mechanical prophylaxis may be preferred over pharmacologic prophylaxis include(1)(20):
- Active uncontrolled bleeding
- Gastroduodenal ulcer
- Clinically significant bleeding within 3 months of admission
- Severe thrombocytopenia (platelet count less than 50,000/mm^3 (50 $x10^9$/L))
- Intracranial bleeding
- Traumatic brain injury
- Incomplete spinal cord injury with suspected or proven spinal hematoma
- Active hepatitis (eg, liver function tests more than 10 times normal)
- Severe hepatic insufficiency (eg, significantly elevated prothrombin time)
- Bacterial endocarditis
- Conditions that significantly increase bleeding risk (eg, coagulopathy, epidural analgesia catheter in place)

Clinical Indications for Ongoing Inpatient Care

- Ongoing inpatient care is indicated for **1 or more** of the following(8)(48)(49)(50)(51)(52)(53)(54)(55):
  - Patient at high risk for bleeding complications upon initiation of anticoagulation
  - Significant bleeding, or allergic, autoimmune (thrombocytopenia), or coagulopathic reaction in response to anticoagulation (current)(56)(57)(58)
  - Inpatient anticoagulation needed
  - Limb-threatening thrombosis (eg, phlegmasia cerulea dolens)(8)(48)(52)
  - Thrombolysis (systemic or catheter-directed) needed[K](48)(50)(54)(57)(62)(65)(71)
  - Thrombectomy or embolectomy needed[L](48)(50)(54)(57)(59)(62)(65)(71)(72)
  - Inferior vena cava filter placement appropriate (57)(73)
  - − Pulmonary embolism[M] and **1 or more** of the following:
    - Hypoxemia (52)(55)(56)
    - Vital sign abnormality (48)(52)(55)(56)
    - History of chronic cardiopulmonary disease (eg, heart failure, coronary artery disease, COPD, cor pulmonale)(52)(55)(56)
    - Cardiac arrhythmias of immediate concern (77)
    - Right ventricular dysfunction or strain (eg, by echocardiogram, CT angiogram, or ECG)[N](48)(55)(62)(67)
    - Positive cardiac biomarker (eg, troponin level greater than the 99th percentile for the assay used, BNP or N-terminal pro-BNP greater than assay threshold)[N](62)(67)
    - Need for IV opioids (eg, to treat dyspnea, severe pain)(48)(52)
    - Respiratory symptoms (eg, Tachypnea, dyspnea) that are severe (eg, ventilatory assistance[O] needed or likely to be needed) or persistent despite initial treatment(8)
    - Pregnancy[P](15)(79)(80)(81)

Alternatives to Inpatient Care

- Alternatives to inpatient stay extension include:
  - Home care[M][Q](49)(50)(83)(84)

- Nursing visits with assessment, daily contact, laboratory testing, and initiation of low-molecular-weight heparin, fondaparinux, warfarin, oral factor Xa inhibitor (eg, rivaroxaban, apixaban), or oral direct thrombin inhibitor (dabigatran)[R][S][T][U]
- Warfarin monitoring and patient teaching for self-injection of low-molecular-weight heparin as indicated
- Serial imaging without anticoagulation (for isolated distal lower extremity thrombosis with minimal symptom burden and no risk factors for extension)[V](50)(90)(91)

- Recovery facility[W](28)(50)
  - Low-molecular-weight heparin, fondaparinux, warfarin, oral factor Xa inhibitor (eg, rivaroxaban, apixaban), or oral direct thrombin inhibitor (dabigatran)[R][S][T][U](83)(84)
  - Laboratory testing and warfarin anticoagulation adjustment as indicated
  - Frequent assessment
  - Management of comorbidities

Discharge

- Extended stay beyond goal length of stay for primary condition may be needed until **ALL** of the following are present(50):
  - Hemodynamic stability
  - Dyspnea absent
  - New oxygen requirement absent or manageable at next level of care
  - Tachypnea absent
  - Dangerous arrhythmia absent
  - No bleeding or evidence of new emboli
  - Pain absent or managed
  - No evidence of cardiac dysfunction (eg, right ventricular heart failure)
  - Lower extremity examination at baseline, stable, or improved
  - Anticoagulation adequate and tolerated (eg, no allergic reaction)[R][S][T][U]
  - Outpatient anticoagulation plan established
  - No requirement for hospital level of care for primary condition or comorbidities

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Footnotes

[A] Risk assessment models have been proposed to identify patients most at risk for hospital-acquired venous thromboembolism for whom pharmacologic prophylaxis would be beneficial, while reducing the risk of bleeding by withholding pharmacologic prophylaxis in patients at low risk.(5)(9) However, a systematic review has found the predictive accuracy of these models to be weak, with insufficient evidence to recommend any one risk assessment model, and suggests that a strategy of thromboprophylaxis for all patients at low risk of bleeding may be the most cost-effective approach.(10) [A in Context Link 1]

[B] Examples of strong independent risk factors for major bleeding include active gastroduodenal ulcer, major or clinically significant bleeding within previous 3 months, or platelet count of less than 50,000/mm^3 (50 x10^9/L).(1) Definitions of major bleeding vary, but usually include intracranial or intraocular bleeding, gastrointestinal bleeding, need for hospitalization, need for transfusion, or bleeding that leads to hemodynamic instability or need for a surgical procedure.(1)(2)(3) [B in Context Link 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]

[C] Acutely ill hospitalized medical (nonsurgical) patients can be classified as either low risk or high risk for venous thromboembolism (VTE) via the use of risk assessment tools (eg, Padua Prediction Score).(1)(25) An online calculator is available at www.mdcalc.com/padua-prediction-score-risk-vte. Randomized trials showing reduction in VTE with the use of prophylactic pharmacotherapy in acutely ill hospitalized medically ill patients provided prophylaxis for 6 to 14 days, which is longer than current average hospital stays. Patients with moderate-risk factors may therefore require home prophylaxis after discharge to complete a total course of 6 to 14 days.(25) Extended prophylaxis (up to 45 days) has also been studied; a meta-analysis of 7 studies, encompassing 40,846 adult patients hospitalized for acute medical illness with reduced mobility or other elevated risk for VTE randomized to extended prophylaxis (low-molecular-weight heparin (5 studies; 28,593 participants) or rivaroxaban (2 studies; 12,253 participants)) or in-hospital prophylaxis only found that extended prophylaxis reduced the risk of symptomatic VTE by 40% (risk ratio (RR) 0.60, 95% confidence interval (CI) 0.46 to 0.78); however, the risk of major bleeding doubled (RR 2.05, 95% CI 1.51 to 2.79).(27) [C in Context Link 1]

[D] For critically ill medical patients, adjunctive intermittent pneumatic compression devices provide no added benefit compared with pharmacologic prophylaxis alone.(29) [D in Context Link 1]

[E] Pharmacologic thromboprophylaxis should be substituted when bleeding risk improves.(1)(2) [E in Context Link 1, 2, 3, 4]

[F] Specialty society guidelines recommend standard doses over therapeutic doses of low-molecular-weight heparin or unfractionated heparin for critically ill patients with COVID-19 because the lower risk of venous thromboembolism is offset by a higher risk of bleeding, and there is no effect on reducing mortality.(19)(33) [F in Context Link 1]

[G] A systematic review and meta-analysis of 20 randomized and 8 nonrandomized studies encompassing 3697 patients with intracranial hemorrhage randomized to pharmacoprophylaxis or control within 4 days of admission found that prophylaxis reduced the risk of DVT (3.4% vs 14.7%, relative risk (RR) 0.24 (95% confidence interval (CI) 0.18 to 0.32)) and pulmonary embolism (0.9% vs 4.3%, RR 0.37 (95% CI 0.21 to 0.66)) without increasing the risks of hematoma expansion or rebleeding (2.4% vs 2.8%, RR 0.80 (95% CI 0.49 to 1.30)) or mortality (12.6% vs 15.4%, RR 0.83 (95% CI 0.66 to 1.04)).(34) A meta-analysis of 15 retrospective studies of patients with intracranial hemorrhage treated with early (early criteria varied, and all were less than 72 hours) or late pharmacologic thromboembolism prophylaxis found that early prophylaxis was associated with a lower risk of developing venous thromboembolism (5.5% vs 7.7% for early vs late prophylaxis, respectively; RR 0.54 (95% CI 0.41 to 0.73)), but no significant difference was seen in intracranial hemorrhage progression (7 studies, 2797 patients; 8.9% vs 9.3%, RR 0.85 (95% CI 0.68 to 1.06)).(35) [G in Context Link 1]

[H] Nonorthopedic surgical patients can be classified as being at very low, low, moderate, or high risk for venous thromboembolism via the use of risk assessment tools (eg, Caprini Risk Assessment Model).(2) An online calculator is available at www.mdcalc.com/caprini-score-venous-thromboembolism-2005. Extension of pharmacologic prophylaxis for at least 2 weeks after abdominal or pelvic surgery further reduces the risk of postoperative venous thromboembolism by 60%.(36) A specialty society guideline recommends that patients undergoing major surgery use pharmacologic prophylaxis (low-molecular-weight heparin preferred) over mechanical prophylaxis and suggests extended prophylaxis beyond 3 weeks.(37) Extended pharmacologic prophylaxis (2 to 6 weeks) should also be considered for cancer patients undergoing abdominal or pelvic surgery.(38)(39) [H in Context Link 1]

[I] A meta-analysis of 34 randomized studies (encompassing 14,931 patients) found that the combination of adjunctive intermittent pneumatic compression devices with pharmacologic prophylaxis provided additional benefit in reducing venous thromboembolism after surgery compared with either method alone.(40) However, no added benefit was found from the addition of graduated compression stockings to low-molecular-weight heparin alone in a meta-analysis of 2 studies (2653 surgical patients).(41) [I in Context Link 1]

[J] Extended (4-week) prophylaxis is recommended.(31)(32) For patients with cancer undergoing a procedure that has inherent high risk for thrombosis, a specialty society guideline suggests a combination of mechanical (intermittent pneumatic compression device) and low-molecular-weight heparin thromboprophylaxis.(32) [J in Context Link 1]

[K] Routine use of thrombolysis is not recommended due to bleeding risk.(48)(50)(59)(60)(61)(62) For venous thrombosis, thrombolysis may be indicated in patients with limb-threatening thrombosis and for selected patients at high risk for post-thrombotic syndrome (eg, iliac and common iliac vein thrombus).(48)(50)(57)(59) Thrombolysis may also be considered for failure of initial anticoagulation (eg, progression of thrombus, ongoing or worsening clinical symptoms).(63) Clinical guidelines note that there is limited evidence to support the use of thrombolysis in children, and suggest reserving its use for pediatric cases with acute limb-threatening thrombosis or rapid progression despite anticoagulation.(57)(59) The use of thrombolysis to reduce the risk of post-thrombotic syndrome in children is controversial.(64) Pharmacomechanical or surgical thrombectomy may be indicated for critical venous thrombosis, for thrombus resistant to thrombolysis, or for those with contraindications to anticoagulation or thrombolysis.(59)(65) For pulmonary embolism, thrombolysis may be indicated for high-risk pulmonary embolism (eg, prolonged hypotension, bradycardia). Thrombolysis may also be considered for pulmonary embolism with acute right ventricular strain, elevated cardiac biomarkers, thrombus-in-transit, failure of therapeutic anticoagulation, or post cardiac arrest with suspected pulmonary embolism.(50)(62) Cardiac biomarkers (eg, BNP, N-terminal pro-BNP level, troponin), severity scores (eg, Pulmonary Embolism Severity Index (PESI) or simplified sPESI), lactate levels, and right ventricular imaging (echocardiogram or CT angiogram) are useful in assessing mortality risk for thrombolysis evaluation.(62)(66) Multidisciplinary pulmonary embolism response teams (PERT) have been advocated to help with decision-making regarding the use of thrombolysis and other advanced therapies for treatment of massive and submassive pulmonary embolism.(67)(68)(69) PERT teams have been shown to improve collaboration, increase the utilization of advanced therapies, shorten the time to diagnosis and treatment, and in some studies, reduce mortality.(69)(70) [K in Context Link 1]

[L] Embolectomy may be performed surgically or using an aspiration catheter.(62) Routine use of thrombectomy or embolectomy is not recommended.(50) Thrombectomy or embolectomy may be indicated for shock requiring immediate reversal (eg, death likely before thrombolysis can take effect), for critical venous thrombosis, for embolism resistant to thrombolysis, or for those with high-risk or high-intermediate-risk pulmonary embolism who have contraindications to anticoagulation or thrombolysis.(50)(62)(71)(72) [L in Context Link 1]

[M] The feasibility and safety of treating low-risk patients with pulmonary embolism on an outpatient basis have been demonstrated in randomized clinical trials and summarized in systematic reviews and practice guidelines.(48)(50)(56)(74)(75)(76) Prognostic scores (eg, simplified Pulmonary Embolism Severity Index (sPESI) score or Hestia criteria) and negative cardiac biomarkers (eg, troponin) can identify patients with pulmonary embolism at low risk who may be candidates for outpatient treatment, with 24% to 60% of patients so classified depending on the population studied.(56) Calculators for the sPESI score and Hestia criteria are available at www.mdcalc.com/simplified-pesi-pulmonary-embolism-severity-index and www.mdcalc.com/hestia-criteria-outpatient-pulmonary-embolism-treatment. [M in Context Link 1, 2, 3]

[N] Intermediate-high-risk pulmonary embolism is characterized by right ventricular strain **and** acutely elevated cardiac biomarker and may be treated with anticoagulation or catheter-directed therapy (thrombolysis or embolectomy) based on clinical acuity or deterioration.(55)(62) Intermediate-low-risk pulmonary embolism is characterized by either right ventricular strain **or** acutely elevated cardiac biomarkers and is generally treated with anticoagulation and not thrombolysis.(62) A specialty society guideline and clinical reviews recommend that patients at intermediate-low or intermediate-high risk be hospitalized and monitored closely due to the risk of hemodynamic collapse and potential need for thrombolytic therapy.(49)(55)(78) [N in Context Link 1, 2]

[O] Ventilatory assistance includes noninvasive methods (eg, high-flow nasal cannula (HFNC), CPAP, BPAP) and invasive methods (intubation with mechanical ventilation). [O in Context Link 1]

[P] An evidence-based specialty society guideline recommends hospitalization for the initiation of anticoagulation therapy in pregnant women in cases of hemodynamic instability, large clots, maternal comorbidities, or when intravenous unfractionated heparin is appropriate for the initial treatment of pulmonary embolism, such as situations in which delivery, surgery, or thrombolysis may be necessary.(79) On the other hand, the validated Hestia clinical decision tool (designed to assist with inpatient vs outpatient treatment of pulmonary embolism determination) includes pregnancy (without qualification) as an indication for inpatient treatment.(80)(81) [P in Context Link 1]

[Q] A systematic review of the evidence and specialty society guidelines conclude that most patients with a DVT can be treated as outpatients.(48)(57)(82) [Q in Context Link 1]

[R] The use of an oral direct thrombin inhibitor (eg, dabigatran) or an oral coagulation factor Xa inhibitor (eg, rivaroxaban, apixaban, edoxaban) for treatment of patients with acute pulmonary embolism has been found in randomized trials to have similar outcomes to vitamin K antagonists (eg, warfarin) in terms of recurrent venous thromboembolism and all-cause mortality.(85) Further, it has been found that these alternatives to warfarin have a lower risk of clinically relevant bleeding, such that the use of a direct thrombin inhibitor or a factor Xa inhibitor is recommended as first-line treatment for most patients with venous thromboembolism.(48)(50)(78)(86) [R in Context Link 1, 2, 3]

[S] Specialty society guidelines recommend low-molecular-weight heparin (preferred) or a direct oral anticoagulant over unfractionated heparin plus warfarin for patients with cancer and venous thromboembolism.(32)(87) Low-molecular-weight heparin is also recommended for pregnancy-associated DVT, with a possible switch to unfractionated heparin close to delivery (due to its shorter half-life and reversibility with protamine).(57)(79) Patients with suspected or proven heparin-induced thrombocytopenia should be anticoagulated with a non-heparin anticoagulant (eg, direct thrombin inhibitor, fondaparinux, direct oral anticoagulant).(88) [S in Context Link 1, 2, 3]

[T] Patients using low-molecular-weight heparin, fondaparinux, an oral direct thrombin inhibitor, or an oral coagulation factor Xa inhibitor achieve full anticoagulation rapidly (eg, a few hours after first dose).(50) [T in Context Link 1, 2, 3]

[U] A systematic review of relevant randomized controlled trials concludes that direct oral anticoagulants (ie, oral factor Xa inhibitors and oral thrombin inhibitors) should not be standard treatment for patients with mechanical heart valves, atrial fibrillation with rheumatic mitral stenosis, or thrombotic antiphospholipid syndrome.(89) For these indications, the use of a vitamin K antagonist (eg, warfarin) is preferred.(89) The review further concludes that the efficacy and safety of direct oral anticoagulants (DOACs) is uncertain in patients with left ventricular thrombus, catheter-associated deep venous thrombosis, or cerebral venous sinus thrombosis.(89) Concerning patients with end-stage renal disease, the review states that the choice of an anticoagulant should be individualized due to the lack of definitive data, balancing the pros and cons of DOAC and vitamin K antagonist-based anticoagulation.(89) Patients who are pregnant or breast-feeding should avoid DOACs pending further study concerning safety.(89) [U in Context Link 1, 2, 3]

[V] Risk factors for extension of a distal venous thrombosis include elevated D-dimer, active malignancy, involved vein diameter greater than 7 mm, clot length greater than 5 cm, involvement of the axial vein, clot in proximity to the popliteal vein, irreversible provoking factor, active COVID-19 infection, and prior history of venous thromboembolism.(50)(90) [V in Context Link 1]

[W] A recovery facility may be appropriate for a patient who is unable to manage self-injection of low-molecular-weight heparin or fondaparinux at home and in whom an oral factor Xa inhibitor or oral direct thrombin inhibitor is not feasible or is contraindicated, or for a patient who requires anticoagulation and is at increased risk of falling.(28)(50) [W in Context Link 1]

Definitions

Altered mental status

- Altered mental status (ie, different from baseline), as indicated by **1 or more** of the following(1)(2)(3)(4):
  - Confusional state (eg, disorientation, difficulty following commands, deficit in attention)
  - Lethargy (eg, awake or arousable, but with drowsiness; reduced awareness of self and environment)
  - Obtundation (ie, arousable only with strong stimuli, lessened interest in environment, slowed responses to stimulation)
  - Stupor (ie, may be arousable but patient does not return to normal baseline level of awareness)
  - Coma (ie, not arousable)

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Cardiac arrhythmias of immediate concern

- Cardiac arrhythmias or findings of immediate concern, as indicated by **1 or more** of the following(1)(2)(3):
  - Heart rhythms that are inherently dangerous or unstable, as indicated by **1 or more** of the following(4)(5)(6):
    - Resuscitated ventricular fibrillation or cardiac arrest
    - Ventricular escape rhythm
    - Sustained ventricular tachycardia (30 seconds or more of ventricular rhythm at greater than 100 beats per minute)
    - Nonsustained ventricular tachycardia and **1 or more** of the following:
      - Suspected cardiac ischemia as cause or consequence of ventricular tachycardia

- Acute myocarditis
- Unstable cardiac conduction defects, as indicated by **1 or more** of the following(7)(8):
  - Type II second-degree atrioventricular block
  - Third-degree atrioventricular block
  - New-onset left bundle branch block with suspected myocardial ischemia(9)
- Any heart rhythm and **1 or more** of the following(5)(8)(10)(11)(12)(13):
  - Continuous long-term ECG monitoring needed (eg, initiation of drug requiring monitoring beyond observation care)
  - Patient has automatic implantable cardioverter-defibrillator that is repeatedly firing, malfunctioning, or in need of immediate adjustment of settings beyond scope of observation care.
- Heart rhythms of concern due to **1 or more** of the following(8):
  - Hypotension
  - Respiratory distress
  - Association with other significant symptoms (eg, syncope)(10)(11)

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Dangerous arrhythmia absent

- Dangerous arrhythmia absent, as indicated by absence of **ALL** of the following(1)(2)(3)(4)(5)(6)(7)(8)(9)(10):
  - Resuscitated ventricular fibrillation or cardiac arrest
  - Ventricular escape rhythm
  - Sustained ventricular tachycardia (30 seconds or more of ventricular rhythm at greater than 100 beats per minute)
  - Nonsustained ventricular tachycardia with myocarditis or ischemia
  - Type II second-degree atrioventricular block
  - Third-degree atrioventricular block
  - New-onset left bundle branch block with suspected myocardial ischemia
  - Heart rhythms of concern due to association with Hypotension, Respiratory distress, or other significant symptoms (eg, syncope)

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Hemodynamic stability

- Hemodynamic stability, as indicated by **1 or more** of the following:
  - Hemodynamic abnormalities at baseline or acceptable for next level of care
  - Patient hemodynamically stable, as indicated by **ALL** of the following(1)(2):
    - Tachycardia absent
    - Hypotension absent
    - No evidence of inadequate perfusion (eg, no myocardial ischemia)

- No other hemodynamic abnormalities (eg, no Orthostatic hypotension)

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Hypotension

- Hypotension, as indicated by **1 or more** of the following:
  - Hypotension in adult patient, as indicated by **1 or more** of the following:
    - Systolic blood pressure less than 90 mm Hg[A][B](1)
    - Mean arterial pressure[C] less than 70 mm Hg[A][B] MAP Calculator(1)(2)
    - Decrease in baseline systolic blood pressure of 30 mm Hg or more, with significant signs or symptoms due to lower blood pressure (eg, near syncope, syncope, chest pain)[A][B](1)
  - Hypotension in pediatric patient, as indicated by **1 or more** of the following:
    - Systolic blood pressure less than 110 mm Hg in child 13 to 17 years of age[A][D](3)
    - Systolic blood pressure less than 100 mm Hg in child 6 to 12 years of age[A][D](3)
    - Systolic blood pressure less than 95 mm Hg in child 3 to 5 years of age[A][D](3)
    - Systolic blood pressure less than 90 mm Hg in child 1 or 2 years of age[A][D](3)
    - Systolic blood pressure less than 80 mm Hg in infant 6 to 11 months of age[A][D](3)
    - Systolic blood pressure less than 70 mm Hg in infant 3 to 5 months of age[A][D](3)
    - Systolic blood pressure less than 65 mm Hg in infant 1 or 2 months of age[A][D](3)

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Footnotes

A. Criteria based upon clinician-acquired numeric values (eg, vital signs, oxygen saturation) should be used if they are accurate reflections of the patient's condition. Transitory findings (eg, abnormal only upon initial emergency department intake or only one time out of multiple readings) that rapidly improve with no or minimal treatment usually do not reflect disease severity or risk for deterioration. This does not imply that an initial or one-time reading cannot ever be applicable. The goal is to separate erroneous or incidental findings from those that truly represent the patient's clinical picture.

B. Interpretation of blood pressure requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline blood pressure, medications, and clinical impact. For example, an elderly patient with heart failure may be prescribed medication with the intentional goal of a reduced pressure. If the patient's baseline SBP is 92 mm Hg to 96 mm Hg, absent signs or symptoms of hypotension, an emergency department SBP of 86 mm Hg should not automatically be categorized as hypotensive. This would hold for mean arterial pressure (MAP) as well. The numeric values included in this definition are

provided to allow for consistency in terms of a technical definition of the term hypotension. Whether a blood pressure below the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment.

C. The mean arterial pressure (MAP) takes into account both SBP and DBP readings.

D. Interpretation of blood pressure requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline blood pressure, medications, and clinical impact. The numeric values included in this definition are provided to allow for consistency in terms of a technical definition of the term hypotension. Whether a blood pressure below the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment.

Hypotension absent

- Hypotension absent,[A] as indicated by **1 or more** of the following:
  - Hypotension absent in adult patient, as indicated by **1 or more** of the following:
    - Systolic blood pressure greater than or equal to 90 mm Hg[A](1)
    - Mean arterial pressure[B] greater than or equal to 70 mm Hg MAP Calculator[A](1)(2)
    - Blood pressure at patient's baseline (eg, healthy adult with low systolic blood pressure), at intentional therapeutic goal (eg, patient with heart failure), or acceptable for next level of care (eg, blood pressure stable and no significant signs or symptoms due to low blood pressure)
  - Hypotension absent in pediatric patient, as indicated by **1 or more** of the following:
    - Systolic blood pressure greater than or equal to 110 mm Hg in child 13 to 17 years of age[A](3)
    - Systolic blood pressure greater than or equal to 100 mm Hg in child 6 to 12 years of age[A](3)
    - Systolic blood pressure greater than or equal to 95 mm Hg in child 3 to 5 years of age[A](3)
    - Systolic blood pressure greater than or equal to 90 mm Hg in child 1 or 2 years of age[A](3)
    - Systolic blood pressure greater than or equal to 80 mm Hg in infant 6 to 11 months of age[A](3)
    - Systolic blood pressure greater than or equal to 70 mm Hg in infant 3 to 5 months of age[A](3)
    - Systolic blood pressure greater than or equal to 65 mm Hg in infant 1 or 2 months of age[A](3)
    - Blood pressure at patient's baseline (eg, healthy child with low systolic blood pressure), at intentional therapeutic goal, or acceptable for next level of care (eg, blood pressure stable and no significant signs or symptoms due to low blood pressure)

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3. Anderson CC, Kapoor S, Mark TE. Pediatric parameters and equipment. In: Anderson CC, Kapoor S, Mark TE, editors. The Harriet Lane Handbook: A Manual for Pediatric House Officers. 23rd ed. Elsevier; 2024:i-iii.

Footnotes

A. Criteria based upon clinician-acquired numeric values (eg, vital signs, oxygen saturation) should be used if they are accurate reflections of the patient's condition. Transitory findings (eg, abnormal only upon initial emergency department intake or only one time out of multiple readings) that rapidly improve with no or minimal treatment usually do not reflect disease severity or risk for deterioration. This does not imply that an initial or one-time reading cannot ever be applicable. The goal is to separate erroneous or incidental findings from those that truly represent the patient's clinical picture.

B. The mean arterial pressure (MAP) takes into account both SBP and DBP readings.

Hypoxemia

- Hypoxemia, as indicated by **1 or more** of the following(1):
  - Patient without baseline need for supplemental oxygen with oxygen saturation (SpO_2) of less than 90% or arterial blood gas partial pressure of oxygen (PaO_2) of less than 60 mm Hg (8.0 kPa) on room air[A][B]
  - Patient without baseline need for supplemental oxygen who now requires supplemental oxygen to keep SpO_2 greater than 89% or PaO_2 greater than 59 mm Hg (7.9 kPa)[A]
  - Patient with baseline need for supplemental oxygen who now requires increased supplemental oxygen to maintain oxygenation at baseline or acceptable level

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Footnotes

A. Pulse oximetry (SpO_2) may underestimate arterial saturation (SaO_2), especially in people with dark skin pigmentation, thick skin, cold body temperature, or who are wearing colored nail polish, and thus may not accurately detect hypoxemia.(2) Where appropriate, pulse oximetry should be measured after warming fingers or removing nail polish. Pulse oximetry results should be assessed within the context of the patient's clinical presentation, and performance of an arterial blood gas considered for a more accurate assessment of oxygenation if indicated.(2) Specific target values may require adjustment when care is delivered at high altitude.(3)

B. Criteria based upon clinician-acquired numeric values (eg, vital signs, oxygen saturation) should be used if they are accurate reflections of the patient's condition. Transitory findings (eg, abnormal only upon initial emergency department intake or only one time out of multiple readings) that rapidly improve with no or minimal treatment usually do not reflect disease severity or risk for deterioration. This does not imply that an initial or one-time reading cannot ever be applicable. The goal is to separate erroneous or incidental findings from those that truly represent the patient's clinical picture.

Inferior vena cava filter placement appropriate

- Vena cava filter placement appropriate, as indicated by **1 or more** of the following[A][B](1)(3)(4)(5)(6)(7)(12):
  - Recurrence or progression of venous thromboembolism[C] while anticoagulated, as indicated by **ALL** of the following:
    - Confirmation of recurrence or progression while fully anticoagulated (eg, patient adherent, correct dosage)
    - Recurrence or progression occurred while being treated with low-molecular-weight heparin, or low-molecular-weight heparin is contraindicated (eg, heparin-induced thrombocytopenia, allergy to heparin).
    - Recurrence or progression occurred after treatment with increased dose of low-molecular-weight heparin (25% to 33% above usual dose), low-molecular-weight heparin is contraindicated (eg, heparin-induced thrombocytopenia, allergy to heparin), or risk of bleeding is too high to increase dose.
  - Venous thromboembolism and contraindication to anticoagulation, as indicated by **1 or more** of the following(2)(16)(17):
    - Active uncontrolled bleeding(16)(17)
    - Major bleeding diathesis (eg, coagulopathy, severe thrombocytopenia)(16)(17)
    - History of active bleeding while anticoagulated necessitating discontinuation of anticoagulant

- Recent or planned surgery that increases risk of catastrophic bleeding (eg, neurosurgery, eye surgery)(16)(17)
- Recent significant GI bleeding with high risk of recurrence (eg, esophageal varices, active peptic ulcer)(16)
- Cerebral lesion at high risk of bleeding (eg, vascular malformation, recent large ischemic stroke, tumor)(17)
- Intraspinal tumor(16)
- History of intracranial bleeding (eg, hemorrhagic stroke)(16)(17)
- Aortic dissection(16)(17)
- Pericardial disease(17)
- Endocarditis(17)
- Threatened abortion(17)
- Malignant hypertension, eclampsia, or preeclampsia that is not rapidly controlled(17)
- Recent major trauma that increases risk of catastrophic bleeding (eg, liver or splenic laceration)

- Acute pulmonary embolism and very poor cardiopulmonary reserve (eg, pulmonary hypertension), or massive pulmonary embolism[D](3)

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Footnotes

A. There is limited and inconsistent evidence that inferior vena cava (IVC) filter placement is beneficial.(1)(2)(3)(4)(5)(6)(7) In general, employment of an IVC filter is justified for venous thromboembolism when there are absolute contraindications to anticoagulation, or venous thromboembolism recurs or progresses despite full, adequate anticoagulation with low-molecular-weight heparin.(1)(2)(3)(4)(5)(6)(7)(8) Filter use in other contexts, such as for primary prophylaxis or thrombus characteristics (eg, size, location, morphology), is unproven and not recommended by evidence-based guidelines, editorials, or reviews.(1)(3)(4)(5)(8)(9)(10)(11) An evidence-based guideline suggests anticoagulation alone and recommends against filter placement for patients with acute pulmonary embolism and hemodynamic compromise.(2) A systematic review and meta-analysis including 11 studies (6 randomized controlled trials, 5 prospective observational studies, 4204 patients) that examined the utility of IVC filter placement found that patients receiving filters had a lower risk for subsequent pulmonary embolism (1.9% vs 4.6%) and a higher risk of deep venous thrombosis (4.7% vs 2.7%), with no difference in pulmonary embolism mortality or overall mortality.(12) The authors concluded that the evidence base is limited and that, pending further evidence, use of IVC filters be directed to those with current guideline-recommended indications (ie, contraindications to anticoagulation, recurrence despite anticoagulation).(12) Considering the known potential adverse consequences of filter use (eg, increased rate of subsequent deep venous thrombosis, venous insufficiency, thrombus formation on filter, vessel or organ perforation, device migration or embolization(13)(14)) and the uncertainty of benefit in most contexts, whenever possible, a retrievable filter should be used (eg, patient with time-limited contraindications to anticoagulation), with arrangements made for retrieval when the contraindication to anticoagulation is no longer present.(1)(2)(3)(4)(5)(7)(8) Temporary (as opposed to retrievable) filters are tethered to a femorally placed central venous catheter; they can be placed if the contraindication to anticoagulation is expected to be brief and then removed when the catheter is pulled without requiring interventional radiology guidance.(5) Newer filter technologies with novel materials are also available that can spontaneously bioconvert filters to an open (nonfiltering) IVC stent configuration, or to completely absorb over a 32-week period for patients in whom the risk for venous thromboembolism or contraindication to anticoagulation is anticipated to be temporary.(5)

B. Several of the contraindications to anticoagulation require clinical judgment and patient-specific assessment of risk, as precise terms and quantification are not agreed upon or established (eg, what is meant by recent surgery or GI bleed).(1)(3)(4)(5) Filters cannot be placed in children weighing less than 22 lb (10 kg).(8)

C. True recurrence or progression while fully anticoagulated is unusual. Insufficient anticoagulation (eg, nonadherence or subtherapeutic heparin or warfarin dosing) is more common. If adherence is assured, an evidence-based specialty society guideline suggests that, prior to consideration of an inferior vena cava (IVC) filter, patients being treated with other than low-molecular-weight heparin be switched to low-molecular-weight heparin, at least temporarily. If already on low-molecular-weight heparin, an increase in dose by 25% to 33% is suggested.(1) For patients who have cancer and recurrent venous thromboembolism, a specialty society guideline suggests either continuing therapeutic low-molecular-weight heparin or increasing dosing to supratherapeutic levels, and recommends against placement of an IVC filter based on low-certainty evidence suggesting lack of benefit and potential harm.(15)

D. A precise definition of very poor cardiopulmonary reserve is not agreed upon. A proposed definition of massive pulmonary embolism is acute pulmonary embolism with sustained hypotension (SBP less than 90 mm Hg for at least 15 minutes or requiring inotropic support, and not due to a cause other than pulmonary embolism (eg, arrhythmia, hypovolemia, sepsis, or left ventricular dysfunction)).(3) This is an area of controversy, with one evidence-based specialty society guideline suggesting against filter placement for patients with acute pulmonary embolism and hemodynamic compromise due to questionable efficacy and the potential of harm from the procedure.(2)

Inpatient anticoagulation needed

- Contraindication to outpatient use of medication with rapid anticoagulation effect (eg, IV unfractionated heparin and warfarin indicated),[A] as indicated by **ALL** of the following(1)(2)(4)(5):
  - Contraindication to use of low-molecular-weight heparin, as indicated by **1 or more** of the following:
    - Current or history of heparin-induced thrombocytopenia
    - Severe thrombocytopenia (eg, platelet count less than 50,000/mm^3 (50 $x10^9$/L))
    - Allergy to heparin, low-molecular-weight heparin, or product components
    - Need for neuraxial anesthesia or spinal puncture anticipated
    - Inability to manage self-injection (eg, by patient, caregiver, or visiting nurse)
  - Contraindication to use of fondaparinux, as indicated by **1 or more** of the following:
    - Severe thrombocytopenia (eg, platelet count less than 50,000/mm^3 (50 $x10^9$/L))
    - Allergy to fondaparinux, related drugs, or product components
    - Renal failure (creatinine clearance less than 30 mL/min/1.73m^2 (0.50 mL/sec/1.73m^2) or on dialysis) eGFR - Adult Calculator eGFR - Pediatric Calculator
    - Pregnancy(4)
    - Severe liver disease (eg, Child-Pugh class C or coagulopathy (eg, elevated INR) due to liver disease)
    - Mechanical heart valve
    - Need for neuraxial anesthesia or spinal puncture anticipated
    - Inability to manage self-injection (eg, by patient, caregiver, or visiting nurse)
    - BMI greater than or equal to 50[B]
  - Contraindication to use of oral direct thrombin inhibitor (eg, dabigatran) or oral factor Xa inhibitor (eg, apixaban, edoxaban, rivaroxaban), as indicated by **1 or more** of the following[C][D](11):
    - Severe thrombocytopenia (eg, platelet count less than 50,000/mm^3 (50 $x10^9$/L))
    - Allergy to medication or product components
    - Pregnancy or breast-feeding[D](4)(11)
    - Severe liver disease (eg, Child-Pugh class C or coagulopathy (eg, elevated INR) due to liver disease)(12)
    - Renal failure (creatinine clearance less than 15 mL/min/1.73m^2 (0.25 mL/sec/1.73m^2) or on dialysis)[D](11) eGFR - Adult Calculator eGFR - Pediatric Calculator
    - Mechanical heart valve[D](11)(13)
    - Atrial fibrillation with rheumatic mitral stenosis[D](11)
    - Thrombotic antiphospholipid syndrome[D](11)
    - Left ventricular thrombus[D](11)
    - Catheter-associated deep venous thrombosis[D](11)
    - Cerebral venous sinus thrombosis[D](11)
    - Need for neuraxial anesthesia or spinal puncture anticipated
    - BMI greater than or equal to 50[B]

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1. Stevens SM, et al. Antithrombotic therapy for VTE disease: second update of the CHEST guideline and expert panel report. Chest 2021;160(6):e545-e608. DOI: 10.1016/j.chest.2021.07.055. (Reaffirmed 2025 Jan)

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Footnotes

A. Patients using low-molecular-weight heparin, fondaparinux, an oral direct thrombin inhibitor, or an oral factor Xa inhibitor achieve full anticoagulation rapidly (eg, a few hours after first dose).(1)(2)(3)

B. The clinical utility of factor Xa inhibitors or direct thrombin inhibitors in patients with a BMI greater than or equal to 50 is unclear, due to a relative paucity of data in these patients.(6)(7)(8) While some do advocate the use of factor Xa inhibitors or direct thrombin inhibitors in this patient group, others suggest that absent clear evidence of efficacy, it is preferable to use heparin (low-molecular-weight or unfractionated) transitioning to warfarin because of the long established ability to carefully adjust dosage based on measurement of anticoagulant effect (eg, via measurement of anti-factor Xa level, prothrombin/INR).(6)(7)(8)

C. With caution and dose adjustment, apixaban can be administered to patients with stage 5 renal failure (creatinine clearance less than 15 mL/min/1.73m^2 (0.25 mL/sec/1.73m^2)) or who are receiving hemodialysis.(5)(9)(10) Rivaroxaban and edoxaban are not recommended for patients with stage 5 or hemodialysis-dependent renal failure.

D. A systematic review of relevant randomized controlled trials concludes that direct oral anticoagulants (ie, oral factor Xa and oral thrombin inhibitors) should not be standard treatment for patients with mechanical heart valves, atrial fibrillation with rheumatic mitral stenosis, or thrombotic antiphospholipid syndrome.(11) For these indications, use of a vitamin K antagonist (eg, warfarin) is preferred.(11) The review further concludes that the efficacy and safety of direct oral anticoagulants is uncertain in patients with left ventricular thrombus, catheter-associated deep venous thrombosis, or cerebral venous sinus thrombosis.(11) Concerning patients with end-stage renal disease, the review states that the choice of an anticoagulant should be individualized due to the lack of definitive data,

balancing the pros and cons of a direct oral anticoagulant and vitamin K antagonist-based anticoagulation.(11) Patients who are pregnant or breast-feeding should avoid direct oral anticoagulants pending further study concerning safety.(11)

Orthostatic hypotension

- Orthostatic hypotension,[A][B] as indicated by **1 or more** of the following(1)(2)(3):
  - Fall in SBP of 20 mm Hg or more 1 to 3 minutes after patient sits or stands from recumbent position
  - Fall in DBP of 10 mm Hg or more 1 to 3 minutes after patient sits or stands from recumbent position

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Footnotes

A. Concomitant measurements of the heart rate are important to measure to help diagnose subtypes of orthostatic hypotension (eg, the lack of a compensatory increase in heart rate is typical of autonomic failure and an exaggerated tachycardia may be reflective of volume depletion). However, the heart rate is not a component of the definition of orthostatic hypotension, which relies upon blood pressure alone.(1)(2)(3)

B. Criteria based upon clinician acquired numeric values (eg, vital signs, oxygen saturation) should be used if they are accurate reflections of the patient's condition. Transitory findings (eg, abnormal only upon initial emergency department intake or only one time out of multiple readings) that rapidly improve with no or minimal treatment usually do not reflect disease severity or risk for deterioration. This does not imply that an initial or one-time reading cannot ever be applicable. The goal is to separate erroneous or incidental findings from those that truly represent the patient's clinical picture.

Patient at high risk for bleeding complications upon initiation of anticoagulation

- Patient at high risk for acute complications (eg, hemorrhage) upon initiation of anticoagulation, as indicated by **1 or more** of the following(1)(2):
  - Gastrointestinal bleeding within preceding 14 days(1)
  - Major surgery (eg, intra-abdominal, intrathoracic, CNS, vascular, orthopedic) within preceding 14 days(1)
  - Stroke (hemorrhagic or ischemic) within preceding 4 weeks(1)
  - Bleeding disorder not readily reversible (eg, coagulopathy from liver disease)(1)(3)
  - Thrombocytopenia (platelet count less than 75,000/mm^3 (75 $x10^9$/L))(1)
  - Uncontrolled hypertension (eg, systolic blood pressure greater than 180 mm Hg or diastolic blood pressure greater than 110 mm Hg)(1)
  - Intracranial or intraspinal tumor(2)
  - Aortic dissection(2)
  - Known increased risk of gastrointestinal bleed (eg, esophageal varices, current ulcer)(3)
  - Personal or family history of significant bleeding or allergic, autoimmune (thrombocytopenia), or coagulopathic reaction in response to anticoagulation
  - Personal or family history of significant bleeding tendency or bleeding disorder(1)
  - Recent or ongoing blood loss (not due to anticoagulation) at time of initiation of anticoagulation (eg, need to anticoagulate despite blood loss)(2)

- Other risk factor thought to place patient at high risk such that ability to rapidly reverse anticoagulation is necessary (eg, discontinue parenteral unfractionated heparin, use of reversal agent)

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Respiratory distress

- Respiratory distress, as indicated by **ALL** of the following(1)(2)(3)(4):
  - Patient with **1 or more** of the following:
    - Dyspnea (difficulty breathing)
    - Tachypnea
    - Abnormal breathing pattern (eg, chest retractions)
    - Other evidence of difficulty breathing
  - Evidence of respiratory compromise, as indicated by **1 or more** of the following:
    - Hypoxemia
    - Altered mental status
    - Other evidence of respiratory compromise (eg, respiratory acidosis)

References

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Tachycardia

- Tachycardia,[A][B] as indicated by **1 or more** of the following:
  - Heart rate greater than 100 beats per minute in adult[A][B](1)
  - Heart rate greater than 85 beats per minute in child 13 to 17 years of age[A][C](2)
  - Heart rate greater than 95 beats per minute in child 6 to 12 years of age[A][C](2)
  - Heart rate greater than 110 beats per minute in child 1 to 5 years of age[A][C](2)
  - Heart rate greater than 120 beats per minute in infant 3 to 11 months of age[A][C](2)

- Heart rate greater than 150 beats per minute in infant 1 or 2 months of age[A][C](2)

References

1. Schriger DL. Approach to the patient with abnormal vital signs. In: Goldman L, Cooney KA, editors. Goldman-Cecil Medicine. 27th ed. Elsevier; 2024:32-35.
2. Anderson CC, Kapoor S, Mark TE. Pediatric parameters and equipment. In: Anderson CC, Kapoor S, Mark TE, editors. The Harriet Lane Handbook: A Manual for Pediatric House Officers. 23rd ed. Elsevier; 2024:i-iii.

Footnotes

A. Criteria based upon clinician acquired numeric values (eg, vital signs, oxygen saturation) should be used if they are accurate reflections of the patient's condition. Transitory findings (eg, abnormal only upon initial emergency department intake or only one time out of multiple readings) that rapidly improve with no or minimal treatment usually do not reflect disease severity or risk for deterioration. This does not imply that an initial or one-time reading cannot ever be applicable. The goal is to separate erroneous or incidental findings from those that truly represent the patient's clinical picture.
B. Interpretation of heart rate requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline heart rate, medications, and clinical impact. For example, an elderly patient on a beta-blocker medication with a baseline resting heart rate of 60 beats per minute may be clinically tachycardic at a heart rate of 94 beats per minute. Likewise, a patient who is upset, in pain, or nervous in the emergency department with a heart rate of 106 beats per minute may meet the technical definition of tachycardia, but this tachycardia (absent associated findings such as chest pain or hypotension) may not be clinically important. The numeric values included in this definition are provided to allow for consistency in terms of a technical definition of the term tachycardia. Whether a heart rate above or below the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment.
C. Interpretation of heart rate requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline heart rate, medications, and clinical impact. A patient who is upset, in pain, or nervous in the emergency department with an elevated heart rate may meet the technical definition of tachycardia, but this tachycardia (absent associated findings such as hypotension) may not be clinically important. The numeric values included in this definition are provided to allow for consistency in terms of a technical definition of the term tachycardia. Whether a heart rate above or below the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment.

Tachycardia absent

- Tachycardia[A][B] absent, as indicated by **1 or more** of the following:
  - Heart rate less than or equal to 100 beats per minute in adult[A][B](1)
  - Heart rate less than or equal to 85 beats per minute in child 13 to 17 years of age[A][B](2)
  - Heart rate less than or equal to 95 beats per minute in child 6 to 12 years of age[A][B](2)
  - Heart rate less than or equal to 110 beats per minute in child 1 to 5 years of age[A][B](2)
  - Heart rate less than or equal to 120 beats per minute in infant 3 to 11 months of age[A][B](2)
  - Heart rate less than or equal to 150 beats per minute in infant 1 or 2 months of age[A][B](2)

References

1. Schriger DL. Approach to the patient with abnormal vital signs. In: Goldman L, Cooney KA, editors. Goldman-Cecil Medicine. 27th ed. Elsevier; 2024:32-35.
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Tachypnea

- Tachypnea,[A][B] as indicated by **1 or more** of the following:
  - Respiratory rate greater than 20 breaths per minute in adult[A][B](1)
  - Respiratory rate greater than 18 breaths per minute in child 13 to 17 years of age[A][B](2)
  - Respiratory rate greater than 22 breaths per minute in child 6 to 12 years of age[A][B](2)
  - Respiratory rate greater than 25 breaths per minute in child 3 to 5 years of age[A][B](2)
  - Respiratory rate greater than 30 breaths per minute in child 1 or 2 years of age[A][B](2)
  - Respiratory rate greater than 40 breaths per minute in infant 6 to 11 months of age[A][B](2)
  - Respiratory rate greater than 45 breaths per minute in infant 3 to 5 months of age[A][B](2)
  - Respiratory rate greater than 55 breaths per minute in infant 1 or 2 months of age[A][B](2)

References

1. Schriger DL. Approach to the patient with abnormal vital signs. In: Goldman L, Cooney KA, editors. Goldman-Cecil Medicine. 27th ed. Elsevier; 2024:32-35.
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B. Interpretation of respiratory rate requires clinical judgment and consideration of several patient-specific factors, such as the patient's baseline respiratory rate and whether the respiratory rate is indicative of significant underlying respiratory or other pathology. A mildly increased respiratory rate (eg, 20 to 22 breaths per minute in an adult), absent other indications of serious illness (eg, hypoxemia, metabolic acidosis, decreased tidal volume, pain), may be transitory and not clinically important. The numeric values included in this definition are provided to allow for consistency in terms of a technical definition of the term tachypnea. Whether a respiratory rate above the technical threshold is clinically meaningful is a matter of persistence, context, and clinical judgment. In addition, the measurement of the respiratory rate is subject to error. A medical textbook states that because there can be significant breath-to-breath variation in respiratory rate, the rate should be assessed for at least 30 seconds, preferably for a full minute.(1) This same textbook also states that new technologies designed to measure the respiratory rate have not proved to be clinically useful.(1)

Tachypnea absent

- Tachypnea[A][B] absent, as indicated by **1 or more** of the following:
  - Respiratory rate less than or equal to 20 breaths per minute in adult[A][B](1)
  - Respiratory rate less than or equal to 18 breaths per minute in child 13 to 17 years of age[A][B](2)
  - Respiratory rate less than or equal to 22 breaths per minute in child 6 to 12 years of age[A][B](2)
  - Respiratory rate less than or equal to 25 breaths per minute in child 3 to 5 years of age[A][B](2)
  - Respiratory rate less than or equal to 30 breaths per minute in child 1 or 2 years of age[A][B](2)
  - Respiratory rate less than or equal to 40 breaths per minute in infant 6 to 11 months of age[A][B](2)
  - Respiratory rate less than or equal to 45 breaths per minute in infant 3 to 5 months of age[A][B](2)
  - Respiratory rate less than or equal to 55 breaths per minute in infant 1 or 2 months of age[A][B](2)

References

1. Schriger DL. Approach to the patient with abnormal vital signs. In: Goldman L, Cooney KA, editors. Goldman-Cecil Medicine. 27th ed. Elsevier; 2024:32-35.
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Vital sign abnormality

- Vital sign abnormality, as indicated by **ALL** of the following(1)(2):
  - Vital sign findings not as expected for chronic patient condition or baseline (eg, intentionally low blood pressure in heart failure)
  - Vital sign abnormality, as indicated by **1 or more** of the following:
    - Tachycardia
    - Hypotension
    - Orthostatic hypotension

References

1. Schriger DL. Approach to the patient with abnormal vital signs. In: Goldman L, Cooney KA, editors. Goldman-Cecil Medicine. 27th ed. Elsevier; 2024:32-35.
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Codes

ICD-10 Diagnosis: I26.01, I26.02, I26.03, I26.04, I26.09, I26.90, I26.92, I26.93, I26.94, I26.99, I27.82, I80.10, I80.11, I80.12, I80.13, I80.201, I80.202, I80.203, I80.209, I80.211, I80.212, I80.213, I80.219, I80.221, I80.222, I80.223, I80.229, I80.231, I80.232, I80.233, I80.239, I80.241, I80.242, I80.243, I80.249, I80.251, I80.252, I80.253, I80.259, I80.291, I80.292, I80.293, I80.299, I80.3, I82.401, I82.402, I82.403, I82.409, I82.411, I82.412, I82.413, I82.419, I82.421, I82.422, I82.423, I82.429, I82.431, I82.432, I82.433, I82.439, I82.441, I82.442, I82.443, I82.449, I82.451, I82.452, I82.453, I82.459, I82.461, I82.462, I82.463, I82.469, I82.491, I82.492, I82.493, I82.499, I82.4Y1, I82.4Y2, I82.4Y3, I82.4Y9, I82.4Z1, I82.4Z2, I82.4Z3, I82.4Z9, I82.501, I82.502, I82.503, I82.509, I82.511, I82.512, I82.513, I82.519, I82.521, I82.522, I82.523, I82.529, I82.531, I82.532, I82.533, I82.539, I82.541, I82.542, I82.543, I82.549, I82.551, I82.552, I82.553, I82.559, I82.561, I82.562, I82.563, I82.569, I82.591, I82.592, I82.593, I82.599, I82.5Y1, I82.5Y2, I82.5Y3, I82.5Y9, I82.5Z1, I82.5Z2, I82.5Z3, I82.5Z9, I82.91, O03.7, O08.2, O22.30, O22.31, O22.32, O22.33, O87.1, O88.211, O88.212, O88.213, O88.219, O88.22, O88.23 [Hide]

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