

Aim: To standardize evaluation, accurately diagnose, and efficiently treat acute PE

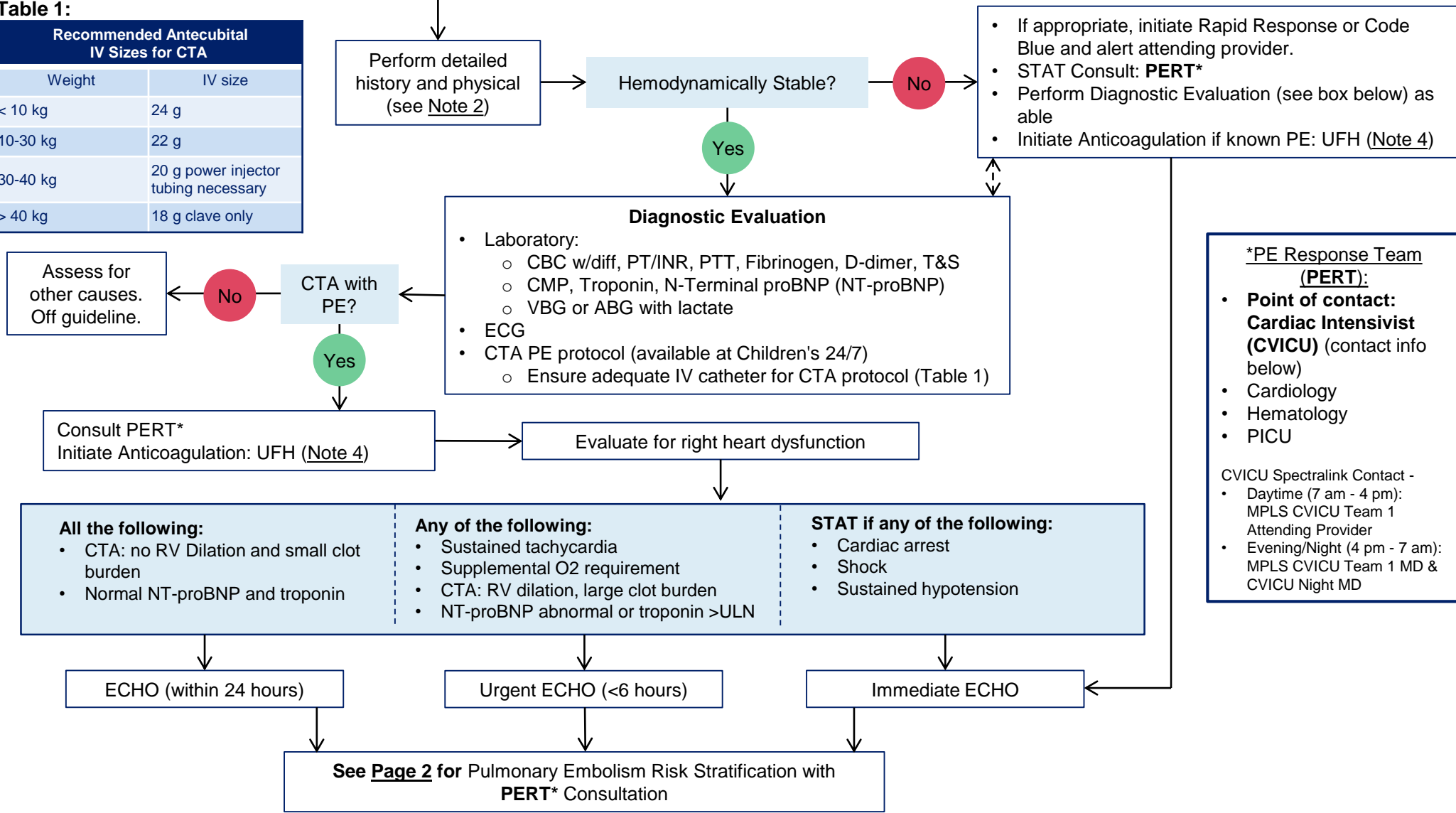
Exclusions:

- Age ≥ 21yo
- Children with congenital heart disease

<21 yo patient with **Suspected or Confirmed** pulmonary embolism (See [Note 1](#))
(**CVICU Attending as Primary Point of Contact**)

Table 1:

Recommended Antecubital IV Sizes for CTA	
Weight	IV size
< 10 kg	24 g
10-30 kg	22 g
30-40 kg	20 g power injector tubing necessary
> 40 kg	18 g clave only



***PE Response Team (PERT):**

- **Point of contact: Cardiac Intensivist (CVICU)** (contact info below)
- Cardiology
- Hematology
- PICU

CVICU Spectralink Contact -

- Daytime (7 am - 4 pm): MPLS CVICU Team 1 Attending Provider
- Evening/Night (4 pm - 7 am): MPLS CVICU Team 1 MD & CVICU Night MD

Disclaimer: This guideline is designed for general use with most patients; each clinician should use their own independent judgment to meet the needs of each individual patient. This guideline is not a substitute for professional medical advice, diagnosis or treatment.

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See page 1 for Diagnostic Evaluation.
Assess Pulmonary Embolism Risk Stratification with **PERT*** Consultation

Low Risk PE

Clinical, Diagnostic Criteria: All of the following

- Normotensive
- CTA: no RV dilation
- NT-proBNP normal
- Troponin < ULN
- Normal ECHO

Consult

- Hematology

Treatment

- Anticoagulation – discuss with hematology:
 - 1) Unfractionated heparin or low molecular weight heparin ([Note 4](#))
 - 2) Alternative: May consider DOAC treatment (if ≥ 50 kg) ([Note 4](#))

Intermediate Risk PE

Clinical, Diagnostic Criteria: All of the following

- Normotensive
- Any of the following:
 - CTA: RV dilation
 - NT-pro BNP abnormal
 - Troponin > ULN
 - Abnormal ECHO Findings

Consult

- Ongoing **PERT*** involvement

Treatment

- Consider systemic tPA on a case-by-base basis if no contraindications ([Note 5](#)) in discussion with **PERT*** ([Note 4](#))
- Anticoagulation: Unfractionated heparin or low molecular weight heparin ([Note 4](#))

High Risk PE

Clinical, Diagnostic Criteria: Any of the following

- Cardiac arrest
- Sustained hypotension or shock

Consult

- Ongoing **PERT*** involvement
- CV Surgery

Treatment

- Consider systemic tPA ([Note 4](#)) if no contraindications ([Note 5](#)) in discussion with **PERT***
- Anticoagulation with unfractionated heparin ([Note 4](#))

Consider Additional Interventions

- VA-ECMO
- Surgical thrombectomy (consult CV surgery)

Admit to CVICU

- Discussion with Hematology for ongoing anticoagulation and workup to consider ([Note 3](#))
- In any menstruating person with a uterus (patient does not need to be actively menstruating): consult Gynecology, obtain menstrual history, use pad counts if menstruating currently

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Utilize AMION or Children's Physician Access for on-call priority

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NOTES

NOTE 1: Admit locations: do not delay work up while awaiting patient admission/transfer

- If patient is external to Children's, consider ED to ED transfer OR ED to CVICU direct admit (would require CPA phone call with CVICU attending)
- If patient in Children's MN ED, admit to CVICU
- If patient is in Children's MN PICU, can remain in PICU
- If patient is on another unit within Children's Minnesota, discuss with PERT consult about if/how transfer.

NOTE 2: History and Physical Exam should include, but not limited to:

HPI

- Cough, shortness of breath, cyanosis
- Hemoptysis
- Chest pain, palpitations
- Dizziness, syncope
- Leg swelling, pain
- Current or recent venous thromboembolism (VTE)
- Estrogen containing medications

PMH

- History of previous clots
- Known clotting disorder
- Presence of Central Venous Catheter (CVC)

Family History

- History of VTE in 1st degree relative < 40 years old

Physical Exam

- Vital signs: Tachycardia, tachypnea, hypoxia
- Signs of impending, existing cardiorespiratory failure
- Signs of Deep Vein Thrombosis (i.e., leg swelling)

Risk Factors

Acute Conditions

- Active cancer
- Burns > 50% total body surface area
- Critically ill: Currently in an intensive care unit or recently admitted in prior 30 days
- Major trauma within 30 days
- Pregnancy
- Severe dehydration
- Severe systemic infection within 30 days
- Spinal cord injury within 30 days
- Surgery within 30 days
- Decreased mobility within 30 days

Chronic Conditions

- Estrogen containing medications within 1-3months
- Inflammatory disorders: IBD, SLE, Chronic extensive GVHD, etc.
- Known acquired or inherited thrombophilia
- Protein losing disorders: Nephrotic syndrome, PLE, Draining chylous effusion
- Sickle cell disease

NOTE 3: Further Hematologic Workup to consider (labs should not delay initiation of anticoagulation, but ideally would be drawn before)

- 4 Extremity Doppler Ultrasound
- For 'provoked' VTE: no further initial workup suggested
- For 'unprovoked' VTE: APLAs (lupus inhibitor, cardiolipin antibody, beta2glycoprotein), Protein C, Protein S, Antithrombin III, Factor V Leiden genetic mutation, Prothrombin genetic mutation, ANA, ESR, CRP, Factor VIII assay, iron studies (ferritin, fe/tibc, retic)
- In any menstruating female: **consult Gynecology**, obtain menstrual history, use pad counts

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NOTE 4: Anticoagulation Treatment Options (See Anticoagulation Management Guideline on internal Star Net page)

Medication	Typical Dosing	Treatment Monitoring	Comments
Heparin Treatment Options:			
Unfractionated heparin (Preferred)	< 1 yo: 28 units/kg/hr ≥ 1 yo: 20 units/kg/hr	Anti-Xa Goal: 0.35 - 0.7 units/mL	Give a 75 unit/kg IV load dose upon treatment initiation unless contraindicated. See Anticoagulation Management Guidelines for contraindications. HOLD Heparin drip while giving tPA at this dosing. Resume heparin drip withOUT bolus once tPA completed. Check heparin level 4 hours later.
Low molecular weight heparin (Enoxaparin)	1 – 3 months old: 1.7 mg/kg/dose SubQ q12h 3 – 12 months old: 1.5 mg/kg/dose SubQ q12h ≥ 1 yo: 1 mg/kg/dose SubQ q12h	Anti-Xa Goal: 0.5 - 1 units/mL	See Anticoagulation Management Guidelines for contraindications.

Direct-Acting Oral Anticoagulant Treatment Options: Requires 5 days of parenteral anticoagulation "bridge therapy" unless patient is equal to greater than 50 kg; and must be approved by hematology. Options include: rivaroxaban, apixaban, and edoxaban. Refer to Anticoagulation Management Guideline for dosing guidance.

Alteplase (tPA) (Note 5)

Order in EMR: alteplase (tPA) Infusion PULM EMBOLISM	<p><u>tPA dosing for intermediate or high risk PE:</u> < 60kg: 0.1 mg/kg over 10 min, following by 0.9 mg/kg over 2 hours ≥ 60kg: 10 mg over 10 min, followed by 90 mg over 2 hour -This dosing is consensus by Workgroup extrapolated from adult dosing -Total Treatment Duration: 2 Hours</p> <p>HOLD Heparin drip while giving tPA at this dosing. Resume heparin drip withOUT bolus once tPA completed. Check heparin level 4 hours later.</p>	<p>Assess for contraindications (Note 5) prior to initiating tPA.</p> <p>Thrombolysis may be considered for children with Intermediate or High Risk and Immediate risk PE in discussion with PERT.</p>
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NOTE 5: Contraindications to tPA

- Major surgery within 7-10 days
- Active bleeding
- CNS surgery/trauma/ischemia/hemorrhage within 30 days
- Platelet count < 75,000 k/uL
- Fibrinogen < 100 mg/dL
- Uncontrolled hypertension
- Severe coagulopathy

Obtain head ultrasound in all infants < 1 month or head CT in older children whose neurologic status is difficult to assess.

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REFERENCES:

1. Konstantinides, S. V., Meyer, G., Becattini, C., Bueno, H., Geersing, G.-J., Harjola, V.-P., Huisman, M. V., Humbert, M., Jennings, C. S., Jiménez, D., Kucher, N., Lang, I. M., Lankeit, M., Lorusso, R., Mazzolai, L., Meneveau, N., Áinle, F. N., Prandoni, P., Pruszczyk, P., ... Zamorano, J. L. (2019). 2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS): The Task Force for the diagnosis and management of acute pulmonary embolism of the European Society of Cardiology (ESC). *The European Respiratory Journal*, *54*(3), 1901647.
2. Ross, C., Kumar, R., Pelland-Marcotte, M.-C., Mehta, S., Kleinman, M. E., Thiagarajan, R. R., Ghbeis, M. B., VanderPluym, C. J., Friedman, K. G., Porras, D., Fynn-Thompson, F., Goldhaber, S. Z., & Brandão, L. R. (2022). Acute Management of High-Risk and Intermediate-Risk Pulmonary Embolism in Children: A Review. *Chest*, *161*(3), 791–802.
3. Rivera-Lebron, B., McDaniel, M., Ahrar, K., Alrifai, A., Dudzinski, D. M., Fanola, C., Blais, D., Janicke, D., Melamed, R., Mohrien, K., Rozycki, E., Ross, C. B., Klein, A. J., Rali, P., Teman, N. R., Yarboro, L., Ichinose, E., Sharma, A. M., Bartos, J. A., ... Channick, R. (2019). Diagnosis, Treatment and Follow Up of Acute Pulmonary Embolism: Consensus Practice from the PERT Consortium. *Clinical and Applied Thrombosis/Hemostasis*, *25*, 1076029619853037.
4. Giri, J., Sista, A. K., Weinberg, I., Kearon, C., Kumbhani, D. J., Desai, N. D., Piazza, G., Gladwin, M. T., Chatterjee, S., Kobayashi, T., Kabrhel, C., & Barnes, G. D. (2019). Interventional Therapies for Acute Pulmonary Embolism: Current Status and Principles for the Development of Novel Evidence: A Scientific Statement From the American Heart Association. *Circulation (New York, N. Y.)*, *140*(20), e774–e801.
5. Sharifi, M., Bay, C., Skrocki, L., Rahimi, F., & Mehdipour, M. (2013). Moderate Pulmonary Embolism Treated With Thrombolysis (from the “MOPETT” Trial). *The American Journal of Cardiology*, *111*(2), 273–277.
6. Choaib, A., AlKhader, A., Azzam, M., Kawtharany, H., Betensky, M., Raffini, L., Bercovitz, R., Vesely, S. K., Monagle, P., & Mustafa, R. A. (2025). Updating clinical guidelines with limited evidence: case study of ASH/ISTH pediatric VTE treatment guidelines. *Blood Advances*, *9*(20), 5347–5349.
7. Zia, A., Goldenberg, N. A., & Rajpurkar, M. (2025). How I treat pediatric pulmonary embolism. *Blood*, *146*(14), 1643–1653.
8. Children's Minnesota Guideline: [VTE Risk Stratification in Hospitalized Patients \(includes Patients with COVID\)](#)
9. Children's Hospital of Philadelphia, Whitworth et al, Nov 2025. Acute Pulmonary Embolism Clinical Pathway – Emergency Department, ICU and Inpatient. Available from: [Acute Pulmonary Embolism Clinical Pathway – Emergency Department, ICU and Inpatient | Children's Hospital of Philadelphia](#)

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