Algorithm 1. Use of PE Criteria Based on Patient Location at Time of Event

Any suspicion for PE
(Table 1 on pg. 3)

Inpatient

Calculate Wells criteria

Outpatient or ED Patient

Do any (PERC) criteria apply?

PERC is used for low pretest probability when justification to do nothing is needed. It should never dissuade a clinician from doing a test when he/she thinks one is needed.

NO

PE excluded

YES

Exclude other clinical etiologies based on clinical judgment and individual signs/symptoms

Calculate Wells criteria and see Algorithm 2 for additional treatment recommendations

Pulmonary Embolism Rule-out Criteria (PERC)

- Age ≥ 50
- HR ≥ 100 bpm (In pregnant women, HR ≥ 105 bpm)
- Room air SaO₂ < 95%
- Prior history of DVT/PE
- Recent trauma or surgery (< 4 weeks)
- Hemoptysis
- Exogenous estrogen**
- Unilateral leg swelling

**Etonogestrel/Ethinyl estradiol (NuvaRing) must be included as a source of estrogen when doing the PERC

Patient meets ANY of the above PERC criteria: PE is not ruled out

Patient DOES NOT meet any of the above PERC criteria:
There is < 2% risk of PE and therefore, the patient will not benefit from an evaluation for PE

Wells Criteria: Pretest Probability for PE

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspected DVT</td>
<td>3.0</td>
</tr>
<tr>
<td>PE is more likely than an alternative diagnosis***</td>
<td>3.0</td>
</tr>
<tr>
<td>HR &gt; 100 bpm</td>
<td>1.5</td>
</tr>
<tr>
<td>Immobilization or surgery in past 4 weeks</td>
<td>1.5</td>
</tr>
<tr>
<td>Previous DVT/PE</td>
<td>1.5</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>1.0</td>
</tr>
<tr>
<td>Malignancy (On treatment, treated in the past 6 months, or palliative)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

***Chest X-ray reviewed, with no reasonable evidence found for alternative diagnosis.
Algorithm 2. Patient PE Risk Stratification Based on Wells Criteria Score

Calculated Wells criteria score

Score ≤ 4
PE not likely

Score > 4
PE likely

NEGATIVE

High sensitivity d-dimer* (see below for age and obstetrical adjusted d-dimers)

POSITIVE

CTPE Study
- V/Q scan for patients with contraindication to CTPE
- Evaluate with Prospective Investigation of Pulmonary Embolism Diagnosis (PIOPED) interpretation criteria

PE not confirmed

PE confirmed

Calculate Simplified Pulmonary Embolism Severity Index (PESI) score

Notes*
- Adjust high-sensitivity d-dimer for age among patients ≥ 50 years:
  - (Age x 0.01)
- Adjust high-sensitivity d-dimer for trimester of pregnancy:
  - First trimester: 0.75
  - Second trimester: 1.00
  - Third trimester: 1.25

See page 5 for d-dimer references.

Possible repeat CTPE study
Consult with radiology prior to ordering any additional imaging

Enoxaparin 1 mg/kg sq12hrs
or
Heparin treatment 80 units/kg bolus-maximum 10,000 units
  - Follow with 18 units/kg/hr infusion
  - Recheck the PTT within 3 hours and rebolus if indicated

Simplified PESI

<table>
<thead>
<tr>
<th>Patient Characteristic</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 80</td>
<td>1</td>
</tr>
<tr>
<td>History of cancer</td>
<td>1</td>
</tr>
<tr>
<td>History of chronic cardiopulmonary disease</td>
<td>1</td>
</tr>
<tr>
<td>HR ≥ 110 bpm</td>
<td>1</td>
</tr>
<tr>
<td>SBP &lt; 100 mmHg</td>
<td>1</td>
</tr>
<tr>
<td>$O_2$ saturation &lt; 90%</td>
<td>1</td>
</tr>
</tbody>
</table>

*High sensitivity d-dimer values adjusted for age and obstetrical factors.
Algorithm 3. Patient PE Stratification Based on Pulmonary Embolism Severity Index (PESI) Score

**Obtain Simplified Pulmonary Embolism Severity Index (PESI) Score**

- **Very low and low-risk strata** (Simplified PESI score = 0)
  - Hemodynamically Stable
    - SBP > 100 mmHg
    - No syncope
  - **Anticoagulant treatment** (see page 4)
    - Consider outpatient treatment **or**
    - Admit to CDU or med/surg monitored unit for observation

- **Intermediate to high-risk strata** (Simplified PESI score ≥ 1)
  - Hemodynamically Stable
    - SBP > 100 mmHg
    - No syncope
  - **Biomarkers and RV strain on ECHO or CT**
    - Normal
      - BNP ≤ 100 pg/mL
      - NT-proBNP ≤ 900 pg/mL
      - Troponin normal
      - **Anticoagulant treatment** (see page 4)
      - Stat consult to PE triage physician; call transfer center at 6-8111.
    - Abnormal
      - BNP > 100 pg/mL
      - NT-proBNP > 900 pg/mL
      - Troponin increased
      - Echocardiogram
        - Shows evidence of RV strain:
          - RV dilatation / LV dilatation > 0.9
          - Septal bowing
          - RV hypokinesis
          - RVSP > 40 mmHg
      - **Anticoagulant treatment** (see page 4)

**Massive PE**
- Hemodynamically Unstable
  - SBP < 100 mmHg for >15 minutes (secondary to PE)
  - Syncope
  - Shock index >1
  - Respiratory distress
  - **Anticoagulant treatment** (see page 4)
  - Stat consult to PE triage physician; call transfer center at 6-8111.
  - Treatment options include:
    - Surgical thrombectomy
    - Full-dose systemic thrombolytics
    - Ultrasound-assisted thrombolytic
  - **Note:** Bleeding risk should be taken into consideration when contemplating the use of systemic thrombolytic therapy.

**Anticoagulant treatment** (see page 4)

**PE Triage MD Team to determine need for and facilitate:**
- Placement in PCU or ICU
- Follow-up monitoring / testing
- Consideration of escalation of therapy

Later hemodynamic deterioration?
- **Yes**
  - Admit to ICU
- **No**
  - Usual care as indicated
**Suspicion of Pulmonary Embolism (PE)**

**Table 1. Factors Associated with Presence of PE**

| Symptoms   | • Unexplained shortness of breath  
|            | • Hemoptysis  
| Signs      | • Unilateral leg swelling  
|            | • Tachycardia  
|            | • Hypoxemia (SaO₂ < 95%)  
| Risk Factors | • Immobility  
|            | • Recent surgery (past 4 weeks)  
|            | • Thrombophilia  
|            | • > 50 years of age  
|            | • Cancer (adeno and GBM)  

**Table 2. Factors Associated with Absence of PE**

| Symptoms   | • Substernal chest pain  
|            | • Non-specific dizziness  
| Signs      | • Wheezing  
|            | • Temp > 102°F  
|            | • SaO₂ 100%  
|            | • Bilateral lower extremity edema  
| Risk Factors | • > 30 years of age  
|            | • COPD  
|            | • Asthma  

**Table 3. Factors Contributing to Decision to Evaluate for PE but **DO NOT** Distinguish Presence or Absence of PE**

| Symptoms   | • Pleuritic CP  
|            | • Syncope  
|            | • Non-productive cough  
|            | • Anxiety  
| Signs      | • Rales  
|            | • Temp < 102°F  
|            | • Respiratory distress with SaO₂ 95-99%  
| Risk Factors | • History of PE/DVT on therapeutic anticoagulation and no thrombophilia  
|            | • Pregnant or postpartum  
|            | • Estrogen therapy  
|            | • Lung or breast cancer  
|            | • CHF  
|            | • Recent travel  

**Additional Considerations**

- PE most often missed in obese, young, healthy, hemodynamically stable women on estrogen **AND** older patients with a good alternative diagnosis
- Sudden onset of chest pain occurs in 39% of PE (+) and 51% of PE (-) patients
- Reproducible chest pain occurs in 20% of PE (+) patients

**Anticoagulant Treatment**

- **Alteplase**
  - **Associated with cardiac arrest:**
    - Alteplase 0.6 mg/kg (max of 50 mg) given over 2 – 15 minutes
    - This dose may be repeated in 15 minutes if there is no return of spontaneous circulation
  - **Not associated with cardiac arrest:**
    - Alteplase bolus of 10 mg followed by 90 mg infused over 2 hours
    - See OSUWMC Pharmacy for recommendations on the use of alteplase

- **EKOs / Catheter Directed Lytics**
  - One catheter:
    - 1 mg/hr for 24 hours
  - Two catheters:
    - 1 mg/hr/catheter for 12 hours
  - Heparin no-upward titration
    - 5 units/kg/hr

- **Long-term / Outpatient Management of PE**
  - Rivaroxaban*
    - 15 mg PO BID for 21 days
    - Then, 20 mg PO daily with dinner
  - Apixaban*
    - 10 mg PO BID for 7 days
    - Then, 5 mg PO BID
  - Enoxaparin (off label)*
    - 1 mg/kg Q12H
    - AVOID 1.5 mg/kg Q24H
  - Warfarin**

*Note: Contraindicated in CrCl < 30 mL/min.
**Note: Use parenteral anticoagulation as a bridge to warfarin.

**Inferior Vena Cava (IVC) Filters:**

- IVC filters should be used in patients with any confirmed acute PE (or proximal DVT) with contraindications to anticoagulation or with active bleeding complication.

**OSUWMC Tools**

- **Smart Phrases:**
  - EBPVTEPERC
  - EBPVTEPESI
  - EBPVTEWELLSCRITERIA

- **Order Sets:**
  - OSUWMC PVS: EKOS Device Orders [1775]

- **Medication Fact Sheets:**
  - Apixaban (Eliquis®)
  - Dabigatran etexilate (Pradaxa®)
  - Rivaroxaban (Xarelto®)
Clinical Practice Guidelines

- Rivaroxaban (Xarelto®), Apixaban (Eliquis®), Edoxaban (Savaysa®): Factor Xa Inhibitors- Reversal Treatment for Bleeding
- Dabigatran (Pradaxa®) Reversal Treatment for Bleeding Events
- Warfarin: Management of Elevated INR and Reversal

References


Quality Measures

- Appropriate use of CTPE study
- Appropriate use of echocardiogram
- Appropriate risk stratification

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Disclaimer: Clinical practice guidelines and algorithms at The Ohio State University Wexner Medical Center (OSUWMC) are standards that are intended to provide general guidance to clinicians. Patient choice and clinician judgment must remain central to the selection of diagnostic tests and therapy. OSUWMC’s guidelines and algorithms are reviewed periodically for consistency with new evidence; however, new developments may not be represented.

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