Over the past ten years, despite thousands of professional articles, new research and new technology, pulmonary embolism continues to be one of the most commonly missed medical diagnosis. The epidemiology of PE is difficult to determine because it may remain asymptomatic, or its diagnosis may be an incidental finding; in some cases, the first presentation of PE may be sudden death. It is frequently found only during autopsy. Recently, however, we have bent the curve 180 degrees and feel we are over imaging and over treating pulmonary embolism.

Pulmonary embolism is a common clinical disorder that is associated with high morbidity and mortality, if untreated. It is important to confirm or rule out the diagnosis in patients with clinical suspicion of the disease. Pulmonary embolism is both under and over diagnosed, which leads to patients either failing to receive treatment or receiving unnecessary, potentially life-threatening treatment. Rational diagnosis and management of suspected PE is now possible.

A review of diagnostic strategies based on new technology and more sensitive D-dimers reveal a selective approach for optimal efficiency would be an appropriate method of choosing the initial diagnostic test. Selection should be guided by clinical assessment of the pretest probability of pulmonary embolism and by patient characteristics that may influence test accuracy. Goal is to establish an evidence-based thought process utilizing tools in our armamentarium to be selective on what tests we order and when; choosing wisely, selecting the right test for the right patient.
Are we getting it right?
At what cost?
19 year of female student presents after sudden onset of SOB and CP, after using cocaine and marijuana for the first time at a party. On OCPs for 2 years.

On presentation RN noted: HR 100/min
You noted a HR of 70/min

Your thoughts?
Forty five year old morbidly obese male presented to our clinic for monthly weight check visit which is requirement for pre bariatric surgery.

During visit states by the way my left knee is hurting more than usual. Had moved furniture few days prior and thinks just twisted knee awkwardly took wife’s naproxen couple times with some relief.

Vitals: HR at 100/min, 95% on room air
Exam: knee is negative, not able to reproduce pain on ROM or palpation

PHM: hypothyroidism, chronic joint pain, obesity,

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During visit states by the way my left knee is hurting more than usual. Had moved furniture few days prior and thinks just twisted knee awkwardly took wife’s naproxen couple times with some relief.

Vitals: HR at 100/min (usually 80), 95% on room air

Exam: knee is negative, not able to reproduce pain on ROM or palpation

PHM: hypothyroidism, chronic joint pain, obesity,

Thoughts?..................
Your Thought Process
**High Risk**
35 - 65%

**Moderate Risk**
15 - 35%

**Low Risk**
2 - 15%

**Very Low Risk**
0 - 2%

---

ONE: “PrePERC” Trusting your alternative diagnosis

TWO: PERC Rule

THREE: Wells Criteria

FOUR: D-dimer

FIVE: CT pulmonary angiogram (CT venogram)

Safe to discharge home
High Risk
35 - 65%

Moderate Risk
15 - 35%

Low Risk
2 - 15%

Very Low Risk
0 - 2%

ONE: “PrePERC” Trusting your alternative diagnosis
ONE: “PrePERC” Trusting your alternative diagnosis

TWO: PERC rule

- Age < 50
- Pulse < 100
- SpO2 > 94%
- No unilateral leg swelling
- No hemoptysis
- No recent surgery
- No history of PE or DVT
- No hormone use
### Risk Groups

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Percentage</th>
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#### Wells et al. criteria for assessment of pretest probability for PE.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points</th>
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<tbody>
<tr>
<td>Suspected DVT</td>
<td>3.0</td>
</tr>
<tr>
<td>An alternative diagnosis is less likely than PE</td>
<td>3.0</td>
</tr>
<tr>
<td>Heart rate &gt;100 beats/min</td>
<td>1.5</td>
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<tr>
<td>Immobilization or surgery in the previous 4 wk</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 mo or palliative)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

#### Score Range

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Mean Probability of PE, %</th>
<th>% With This Score</th>
<th>Interpretation of Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2 points</td>
<td>3.6</td>
<td>40</td>
<td>Low</td>
</tr>
<tr>
<td>2–6 points</td>
<td>20.5</td>
<td>53</td>
<td>Moderate</td>
</tr>
<tr>
<td>&gt;6 points</td>
<td>66.7</td>
<td>7</td>
<td>High</td>
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High Risk
35 - 65%

Moderate Risk
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Low Risk
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ONE: “PrePERC” Trusting your alternative diagnosis

TWO: PERC Rule

THREE: Wells Criteria

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Total points

< 4 points get a D-dimer
> 4 go to imaging
When to order a D-dimer?

A. PERC negative
B. Low probability per Wells’ criteria.
C. Moderate probability per Wells’ criteria
D. High probability per Wells’ criteria
High Risk
35 - 65%

Moderate Risk
15 - 35%

Low Risk
2 - 15%

Very Low Risk
0 - 2%

ONE: “PrePERC” Trusting your alternative diagnosis

TWO: PERC Rule

THREE: Wells Criteria

FOUR: D-dimer

When to order a D-dimer?

Wells PE Score

< 4

- DD
0.5% PE

+ DD
23% PE

> 4

- DD
16% PE

+ DD
60% PE

Christoper, JAMA 2006
VIDAS and Tinaquant D-dimer assays
When to order a D-dimer?

Wells PE Score

- **< 4**
  - Order D-dimer

- **> 4**
  - Go to CT

**High Risk**
35 - 65%

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ONE: “PrePERC” Trusting your alternative diagnosis

TWO: PERC Rule

THREE: Wells Criteria

FOUR: D-dimer

Christoper, JAMA 2006
VIDAS and Tinaquant D-dimer assays
ONE: “PrePERC” Trusting your alternative diagnosis

TWO: PERC Rule

THREE: Wells Criteria

FOUR: D-dimer

FIVE: CT pulmonary angiogram (CT venogram)

1. Single detector Helical CT
2. Multi Section Spiral CT (64 slice)
3. CT Pulmonary Angiogram (arterial imaging).
4. Chest CT with contrast (venous imaging)
5. High resolution CT
19 year of female student presents after sudden onset of SOB and CP, after using cocaine and marijuana for the first time at a party. On OCPs for 2 years.

HR 100, now 70
RISK GROUPS:

**High Risk** 35 - 65%

**Moderate Risk** 15 - 35%

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- **ONE:** “PrePERC” Trusting your alternative diagnosis
- **TWO:** PERC Rule
- **THREE:** Wells Criteria
- **FOUR:** D-dimer
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Safe to discharge home
ONE: “PrePERC” Trusting your alternative diagnosis

19 year of female student presents after sudden onset of SOB and CP, after using cocaine and marijuana for the first time at a party. On OCPs for 2 years.

HR 100, now 70
19 year of female student presents after sudden onset of SOB and CP, after using cocaine and marijuana for the first time at a party. On OCPs for 2 years.

HR 100, now 70

Not necessary or good practice to

Apply PERC rule

order D-dimer

Order a CT
35 year old woman complains of pleuritic chest pain and intermittent SOB.

PMH: Negative
On OCP
120/78, 100/min, RR 20/min, Afebrile, O2% 95%
Exam: edema on left ankle

ONE: “PrePERC” Trusting your alternative diagnosis
ONE: “PrePERC” Trusting your alternative diagnosis

TWO: PERC rule

Age < 50

**Pulse** < 100

SpO2 > 94%

No unilateral leg swelling

No hemoptysis

No recent surgery

No history of PE or DVT

No hormone use
### High Risk
35 - 65%

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#### ONE: “PrePERC” Trusting your alternative diagnosis

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**Diagnostic Approaches**

**ONE:** “PrePERC” Trusting your alternative diagnosis

**TWO:** PERC Rule

**THREE:** Wells Criteria

**FOUR:** D-dimer

---

**When to order a D-dimer?**

Wells PE Score

- **< 4**
  - Order D’ dimer
- **>4**
  - Go to CT

---

*Christopher, JAMA 2006*

*Wells, et al, Thromb Haemost, 2000*

*VIDAS and Tinaquant D-dimer assays*
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Safe to discharge home

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### ONE: “PrePERC” Trusting your alternative diagnosis

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- < 4 points get a D-dimer
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When to order a D-dimer?
Wells PE Score

- Wells PE Score < 4: Order D’ dimer
- Wells PE Score > 4: Go to CT

Reference:
Christopher, JAMA 2006
VIDAS and Tinaquant D-dimer assays
Plan:
Continue naproxen PRN
Follow up in one week if not better

Three days later (Saturday), develops sudden onset of chest pain and SOB, Went to ER

Diagnosis:
PE
DVT (Left popliteal)

Thoughts? ..................
Scenario

A 31 year old African-American female complains of “total body pain” for 4 days due to a painful sickle cell crisis. She also reports dyspnea for the last 4 days. Her vital signs include a pulse of 126, respiratory rate of 24, blood pressure of 134/74, and oxygen saturation while on room air of 92%. She is afebrile. She smokes 1 pack of cigarettes per day and drinks a moderate amount of alcohol. The remainder of her physical examination is normal.
High Risk
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ONE: “PrePERC” Trusting your alternative diagnosis

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### Protocol

**ONE: “PrePERC” Trusting your alternative diagnosis**

- **TWO: PERC Rule**
- **THREE: Wells Criteria**

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RISK GROUP

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TWO: PERC Rule
THREE: Wells Criteria
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Wells PE Score

< 4
Order D-dimer

> 4
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