

PICO SEARCH ASSIGNMENT WORKSHEET

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Brief description of patient problem/setting (summarize the case very briefly)

A 56 yo Caucasian female w/ PMHx of HTN presents to the ED with sudden onset SOB on exertion, pleuritic chest pain, and tachycardia. She recently had surgery 2 weeks ago. Exam shows mild hypoxia and unilateral leg swelling. Concern for pulmonary embolism,

Search Question: In adults presenting to the ED with suspected pulmonary embolism, does the use of clinical decision tools (Wells + D-dimer) reduce the need for CT pulmonary angiography compared to immediate imaging?

Question Type: What kind of question is this? (boxes now checkable in Word)

☐ Prevalence

☐ Screening

☒ **Diagnosis**

☐ Prognosis

☐ Treatment

☐ Harms

Assuming that the highest level of evidence to answer your question will be meta-analysis or systematic review, what other types of study might you include if these are not available (or if there is a much more current study of another type)?

Please explain your choices

If meta-analysis or systematic reviews are not available, randomized controlled trials and prospective cohort studies can be used. These help evaluate diagnostic accuracy and outcomes when using clinical decision tools versus imaging. These study designs were chosen because diagnostic questions are best answered using studies that evaluate sensitivity, specificity, and clinical outcomes in real-world settings.

PICO search terms:

P	I	C	O
Adults	Wells criteria	CT angiography	Diagnostic accuracy
Suspected PE	D-dimer	Immediate imaging	Reduced imaging use
Dyspnea/chest pain	Clinical decision rules	Standard workup	Missed PE
			PE Complications

Search tools and strategy used:

Please indicate what databases/tools you used, provide a list of the terms you searched together in each tool, and how many articles were returned using those terms and filters.

Explain how you narrowed your choices to the few selected articles. For example, if your search returned 25 articles among the several databases used, what was the process used to determine which four articles to use?

Database	Search Term Used	# of Results	Filters/Limiters Applied	Notes/Observers
PubMed	(adult OR adults) AND (“pulmonary embolism” OR “PE”) AND (“Wells criteria” OR “clinical decision rule” OR “D-dimer”) AND (“CT angiography” OR “imaging”) AND (“diagnostic accuracy” OR “outcomes”)	40 results	Last 5 years, Free full text, English, Human studies	
Cochrane Library	("Pulmonary Embolism"[MeSH] OR "pulmonary embolism") AND ("Wells Score" OR "PERC Rule" OR "D-Dimer") AND ("Computed Tomography Angiography" OR CTPA) AND ("Diagnosis" OR "Diagnostic Accuracy")	22 results	2022, 2023, 2024, 2025, 2026, English, Research articles	Returned 22 results, but most were systematic reviews focused on imaging modalities (CTPA, V/Q scans) or inpatient populations rather than ED-based clinical decision tools such as Wells criteria or PERC. Only a few were partially applicable.
Google scholar	("pulmonary embolism") AND ("Wells criteria" OR "PERC" OR "clinical decision rule" OR "D-dimer") AND ("emergency department") AND ("diagnostic accuracy" OR outcomes)	860 results	2022-2026, review articles	The Google Scholar search yielded ~ 860 results. Articles were narrowed by publication date (2022–2026) and screened for relevance to ED populations, clinical decision tools, and diagnostic outcomes. Studies focusing on imaging, biomarkers, or different populations were excluded. A systematic review was selected as it best addressed the research question and provided high-quality evidence.

From the three databases, a total of around 900 articles were initially found. After screening for relevance and how well they addressed the research question, 1 article was selected from PubMed, 1 from Google Scholar, and 1 from Cochrane. The Cochrane search returned limited results, and many focused on imaging or non-ED populations such as inpatient or those with other comorbidities like COPD, but one relevant study was selected. The Google Scholar search yielded the most results; however, many were excluded after reviewing titles and abstracts due to focus on imaging, biomarkers, or unrelated populations. The final articles were chosen based on their relevance to emergency department patients and use of clinical decision tools such as Wells criteria, PERC, and D-dimer, including a systematic review, randomized controlled trial, and meta-analysis.

Results found:

1. Effect of a Diagnostic Strategy Using an Elevated and Age-Adjusted D-Dimer Threshold on Thromboembolic Events in Emergency Department Patients With Suspected Pulmonary Embolism: A Randomized Clinical Trial

Citation: Freund, Y., Chauvin, A., Jimenez, S., Philippon, A. L., Curac, S., Fémy, F., Gorlicki, J., Chouihed, T., Goulet, H., Montassier, E., Dumont, M., Lozano Polo, L., Le Borgne, P., Khellaf, M., Bouzid, D., Raynal, P. A., Abdessaied, N., Laribi, S., Guenezan, J., Ganansia, O., ... Simon, T. (2021). Effect of a Diagnostic Strategy Using an Elevated and Age-Adjusted D-Dimer Threshold on Thromboembolic Events in Emergency Department Patients With Suspected Pulmonary Embolism: A Randomized Clinical Trial. JAMA, 326(21), 2141–2149. <https://doi.org/10.1001/jama.2021.20750>

Article Type: Randomized controlled trial

Abstract

Importance: Uncontrolled studies suggest that pulmonary embolism (PE) can be safely ruled out using the YEARS rule, a diagnostic strategy that uses varying D-dimer thresholds.

Objective: To prospectively validate the safety of a strategy that combines the YEARS rule with the pulmonary embolism rule-out criteria (PERC) rule and an age-adjusted D-dimer threshold.

Design, settings, and participants: A cluster-randomized, crossover, noninferiority trial in 18 emergency departments (EDs) in France and Spain. Patients (N = 1414) who had a low clinical risk of PE not excluded by the PERC rule or a subjective clinical intermediate risk of PE were included from October 2019 to June 2020, and followed up until October 2020.

Interventions: Each center was randomized for the sequence of intervention periods. In the intervention period (726 patients), PE was excluded without chest imaging in patients with no YEARS criteria and a D-dimer level less than 1000 ng/mL and in patients with 1 or more YEARS criteria and a D-dimer level less than the age-adjusted threshold (500 ng/mL if age <50 years or age in years $\times$ 10 in patients $\geq$ 50 years). In the control period (688 patients), PE was excluded without chest imaging if the D-dimer level was less than the age-adjusted threshold.

Main outcomes and measures: The primary end point was venous thromboembolism (VTE) at 3 months. The noninferiority margin was set at 1.35%. There were 8 secondary end points, including chest imaging, ED length of stay, hospital admission, nonindicated anticoagulation treatment, all-cause death, and all-cause readmission at 3 months.

Results: Of the 1414 included patients (mean age, 55 years; 58% female), 1217 (86%) were analyzed in the per-protocol analysis. PE was diagnosed in the ED in 100 patients (7.1%). At 3 months, VTE was diagnosed in 1 patient in the intervention group (0.15% [95% CI, 0.0% to 0.86%]) vs 5 patients in the control group (0.80% [95% CI, 0.26% to 1.86%]) (adjusted difference, -0.64% [1-sided 97.5% CI, - ∞ to 0.21%], within the noninferiority margin). Of the 6 analyzed secondary end points, only 2 showed a statistically significant difference in the intervention group compared with the control group: chest imaging (30.4% vs 40.0%; adjusted difference, -8.7% [95% CI, -13.8% to -3.5%]) and ED median length of stay (6 hours [IQR, 4 to 8 hours] vs 6 hours [IQR, 5 to 9 hours]; adjusted difference, -1.6 hours [95% CI, -2.3 to -0.9]).

Conclusions and relevance: Among ED patients with suspected PE, the use of the YEARS rule combined with the age-adjusted D-dimer threshold in PERC-positive patients, compared with a conventional diagnostic strategy, did not result in an inferior rate of thromboembolic events.

Trial registration: ClinicalTrials.gov Identifier: [NCT04032769](https://clinicaltrials.gov/ct2/show/study/NCT04032769).

[PubMed Disclaimer](#)

Important Findings:

- The study evaluated a diagnostic strategy using clinical decision rules combined with D-dimer testing in patients with suspected pulmonary embolism
- The intervention strategy reduced the use of CT pulmonary angiography without increasing missed PE cases
- The rate of missed pulmonary embolism was very low, demonstrating non-inferiority compared to standard diagnostic approaches in terms of thromboembolic outcomes
- Use of adjusted D-dimer thresholds improved efficiency by safely ruling out PE in more patients

I chose this article because it directly compares different diagnostic strategies for pulmonary embolism in a real-world emergency department setting. It includes multiple centers and evaluates outcomes that are clinically relevant, such as missed PE rates and reduction in unnecessary imaging. This study demonstrates how combining clinical decision rules with D-dimer testing can safely reduce the need for CT scans. One interesting finding from this article is that increasing the D-dimer threshold based on clinical probability did not compromise patient safety, which challenges the traditional approach of using a fixed cutoff for all patients.

2. PECSS: Pulmonary Embolism Comprehensive Screening Score to safely rule out pulmonary embolism among suspected patients presenting to emergency department

Citation: Tang, L., Hu, Y., Pan, D. et al. PECSS: Pulmonary Embolism Comprehensive Screening Score to safely rule out pulmonary embolism among suspected patients presenting to emergency department. *BMC Pulm Med* 23, 287 (2023). <https://doi.org/10.1186/s12890-023-02580-8>

Article Type: Retrospective cohort study

Abstract

Background

Pulmonary embolism is a severe cardiovascular disease and can be life-threatening if left untreated. However, the detection rate of pulmonary embolism using existing pretest probability scores remained relatively low and clinical rule out often relied on excessive use of computed tomographic pulmonary angiography.

Methods

We retrospectively collected data from pulmonary embolism suspected patients in Zhongshan Hospital from July 2018 to October 2022. Pulmonary embolism diagnosis and severity grades were confirmed by computed tomographic pulmonary angiography. Patients were randomly divided into derivation and validation set. To construct the Pulmonary Embolism Comprehensive Screening Score (PECSS), we first screened for candidate clinical predictors using univariate logistic regression models. These predictors were then included in a searching algorithm with indicators of Wells score, where a series of points were assigned to each predictor. Optimal D-Dimer cutoff values were investigated and incorporated with PECSS to rule out pulmonary embolism.

Results

In addition to Wells score, PECSS identified seven clinical predictors (anhelation, abnormal blood pressure, in critical condition when admitted, age > 65 years and high levels of pro-BNP, CRP and UA,) strongly associated with pulmonary embolism. Patients can be safely ruled out of pulmonary embolism if $PECSS \leq 4$, or if $4 < PECSS \leq 6$ and $D\text{-Dimer} \leq 2.5 \text{ mg/L}$. Comparing with Wells approach, PECSS achieved lower failure rates across all pulmonary embolism severity grades. These findings were validated in the held-out validation set.

Conclusions

Compared to Wells score, PECSS approaches achieved lower failure rates and better compromise between sensitivity and specificity. Calculation of PECSS is easy and all predictors are readily available upon emergency department admission, making it widely applicable in clinical settings.

Important findings:

- The study developed and validated the PECSS scoring system for patients with suspected pulmonary embolism in the ED
- PECSS incorporates additional clinical and laboratory variables beyond the Wells score to improve risk stratification
- Patients with low PECSS scores (≤ 4 , or ≤ 6 with low D-dimer) could be safely ruled out for PE without further imaging
- Compared to the Wells criteria, PECSS demonstrated lower failure rates and better balance between sensitivity and specificity

Even though this retrospective cohort study is not the highest level of evidence, I chose this article because it develops and validates a new clinical decision tool specifically for emergency department patients with suspected pulmonary embolism. It uses real patient data and incorporates both clinical findings and lab values, making it more comprehensive than traditional scoring systems. This study highlights how improving risk stratification can help reduce unnecessary CT imaging while still maintaining patient safety. One interesting finding from this article is that adding additional biomarkers and clinical variables improved diagnostic accuracy compared to the Wells score alone, suggesting that traditional tools may be too limited when used in isolation.

3. Diagnostic management of acute pulmonary embolism: a prediction model based on a patient data meta-analysis

Citation: Nick van Es, Toshihiko Takada, Noémie Kraaijpoel, Frederikus A Klok, Milou A M Stals, Harry R Büller, D Mark Courtney, Yonathan Freund, Javier Galipienzo, Grégoire Le Gal, Waleed Ghanima, Menno V Huisman, Jeffrey A Kline, Karel G M Moons, Sameer Parpia, Arnaud Perrier, Marc Righini, Helia Robert-Ebadi, Pierre-Marie Roy, Phil S Wells, Kerstin de Wit, Maarten van Smeden, Geert-Jan Geersing, Diagnostic management of acute pulmonary embolism: a prediction model based on a patient data meta-analysis, European Heart Journal, Volume 44, Issue 32, 21 August 2023, Pages 3073–3081, <https://doi.org/10.1093/eurheartj/ehad417>

Article Type: **Meta-analysis**

Abstract		uest on 22 March 2026
Aims	Risk stratification is used for decisions regarding need for imaging in patients with clinically suspected acute pulmonary embolism (PE). The aim was to develop a clinical prediction model that provides an individualized, accurate probability estimate for the presence of acute PE in patients with suspected disease based on readily available clinical items and D-dimer concentrations.	
Methods and results	An individual patient data meta-analysis was performed based on sixteen cross-sectional or prospective studies with data from 28 305 adult patients with clinically suspected PE from various clinical settings, including primary care, emergency care, hospitalized and nursing home patients. A multilevel logistic regression model was built and validated including ten <i>a priori</i> defined objective candidate predictors to predict objectively confirmed PE at baseline or venous thromboembolism (VTE) during follow-up of 30 to 90 days. Multiple imputation was used for missing data. Backward elimination was performed with a P-value <0.10. Discrimination (c-statistic with 95% confidence intervals [CI] and prediction intervals [PI]) and calibration (outcome:expected [O:E] ratio and calibration plot) were evaluated based on internal-external cross-validation. The	

accuracy of the model was subsequently compared with algorithms based on the Wells score and D-dimer testing. The final model included age (in years), sex, previous VTE, recent surgery or immobilization, haemoptysis, cancer, clinical signs of deep vein thrombosis, inpatient status, D-dimer (in $\mu\text{g/L}$), and an interaction term between age and D-dimer. The pooled c-statistic was 0.87 (95% CI, 0.85–0.89; 95% PI, 0.77–0.93) and overall calibration was very good (pooled O:E ratio, 0.99; 95% CI, 0.87–1.14; 95% PI, 0.55–1.79). The model slightly overestimated VTE probability in the lower range of estimated probabilities. Discrimination of the current model in the validation data sets was better than that of the Wells score combined with a D-dimer threshold based on age (c-statistic 0.73; 95% CI, 0.70–0.75) or structured clinical pretest probability (c-statistic 0.79; 95% CI, 0.76–0.81).

Conclusion The present model provides an absolute, individualized probability of PE presence in a broad population of patients with suspected PE, with very good discrimination and calibration. Its clinical utility needs to be evaluated in a prospective management or impact study.

Registration PROSPERO ID 89366.

Structured Graphical Abstract

Key Question

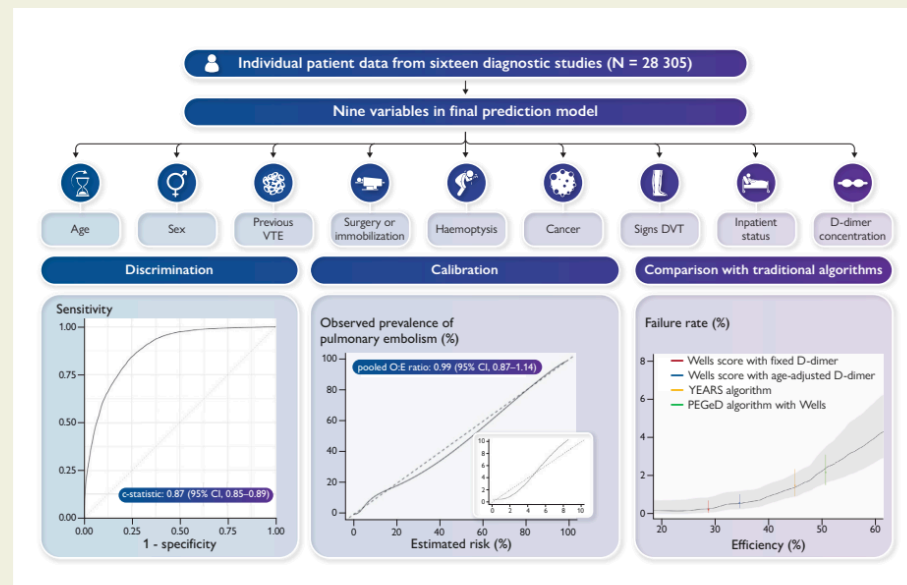
Can we develop a clinical prediction model for the diagnostic management of acute pulmonary embolism that provides an individualized, accurate probability estimate based on readily available clinical items and D-dimer concentrations?

Key Finding

Sixteen studies (N=28 305) were used to develop and validate a prediction model, including eight objective clinical items and D-dimer concentration. Discrimination (c-statistic, 0.87) and overall calibration were very good, and better than that of some traditional scores.

Take Home Message

This diagnostic clinical prediction model provides an individualized probability of pulmonary embolism in patients with suspected disease, which can be used as an alternative to traditional algorithms to guide decision about the need for imaging. External validation is needed.



A clinical prediction model for the diagnostic management of acute pulmonary embolism was developed and validated using data from 28 305 patients across 16 studies. Eight clinical variables and quantitative D-dimer levels were included in the final model, which showed good discrimination and calibration. Overall performance was comparable to that of current diagnostic strategies, but, unlike traditional decision rules, the model can be used to calculate absolute probabilities of pulmonary embolism.

Keywords Pulmonary embolism • venous thromboembolism • diagnosis • prediction model • D-dimer

Important Findings:

- The study developed and validated a prediction model for pulmonary embolism using a large pooled dataset of over 28,000 patients
- Clinical decision rules combined with D-dimer testing were effective in safely ruling out PE in low-risk patients

- Adjusting D-dimer thresholds based on clinical probability improved diagnostic efficiency and reduced unnecessary imaging
- The model demonstrated improved accuracy compared to traditional strategies when applied across different patient subgroups

This article reinforces the importance of combining clinical decision tools with D-dimer testing rather than relying on a single diagnostic method. It highlights how individualized risk assessment can improve both safety and efficiency in diagnosing pulmonary embolism. Similar to other studies, it shows that imaging should not be used as the first step in all patients, but rather guided by clinical probability. One important takeaway from this article is that adjusting D-dimer thresholds based on patient risk can safely reduce unnecessary CT scans, which challenges the traditional approach of using a fixed cutoff for all patients.

What is the clinical “bottom line” derived from these articles in answer to your question?

Based on these articles, using clinical decision tools like Wells criteria or newer models combined with D-dimer can safely rule out pulmonary embolism in low-risk patients and help reduce unnecessary CT scans. These tools improve how efficiently we diagnose PE, but they shouldn't be used alone and always need to be interpreted with clinical judgment. Overall, a stepwise approach using risk stratification followed by targeted testing is the safest and most effective way to evaluate suspected PE in the emergency department. One limitation is that most studies focus on low-risk populations, so these strategies may not be as reliable in high-risk or unstable patients who require immediate imaging.