



# Multisite Implementation of Electronic Health Record Tools for Clinical Pre-Test Probability of Pulmonary Embolism in the Emergency Department

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## INTRODUCTION

- Use of validated risk stratification tools for the workup of suspected pulmonary embolism (PE) is recommended by ASH and the American College of Emergency Physicians.
- The use, documentation, and implementation of these tools vary widely.
- Current processes do not allow for electronic capture and quality reporting at most institutions.

## AIM

- We sought to design, implement, and test **clinical pre-test probability (PTP)** tools at three large healthcare institutions for use in emergency departments (ED).

## METHOD

- Each site designed and implemented PTP tools in clinical workflows (Table 1).
- A major goal of implementation was integration into clinical workflow and automatic documentation.
- After design and implementation, awareness and education of the new EHR tool was distributed electronically to ED providers.
- Use of PTP tools was analyzed between September 12, 2022 and January 11, 2023. PTP use was examined as percent of visits for which patients underwent **CT pulmonary angiography (CTPA)**.

Table 1: Implementation Comparison

Implementation Characteristic	Site 1	Site 2	Site 3
Location in EHR	Scoring tools flowsheet	Flowsheet in "navigator" tab with other scoring tools for ED clinicians	Only available when ordering CTPA
Date PTP available to ED clinicians in EHR	8/10/22	9/5/22	6/1/2022
Date ED clinicians first educated about PTP	9/7/22	9/5/22	6/1/22
Versions available	3-tier Wells' PERC	3-tier Wells', PERC, and YEARS algorithm combined	3-tier Wells'
Prompts to complete PTP	No prompt, clinician must find PTP on their own	No prompt, clinician must find PTP on their own	Pop-up box when ordering CTPA; <u>allowed to bypass if D-dimer present in prior 48 hours</u>
Auto-population of fields	All fields must be entered by clinician	Age, pregnancy status, heart rate, and oxygen saturation <u>auto-populate</u> ; scans for other variables if available in EHR and flags for clinical review of accuracy; any fields not populated must be entered by clinician	All fields must be entered by clinician
Score calculation method	Calculated automatically by EHR when all questions complete	Calculated automatically by EHR when all questions complete	<u>Clinician calculates score</u> ; EHR does not have a location to capture score
Interpretation method	Clinician matches score with interpretation provided in text	Assigned by EHR based on PTP score along with recommendation for further diagnostic testing as needed	Clinician matches score with interpretation and enters that in a prompt

Table 2: Clinical Pre-test Probability (PTP) Uptake and Utilization

	Site	Sep	Oct	Nov	Dec	Jan
Total ED visits, N	1	6,747	8,690	8,730	9,217	4,565
	2	16,590	26,416	26,253	26,256	10,117
	3	20,231	31,912	31,123	31,123	11,365
Visits with CTPA, N (% of total ED visits)	1	239 (3.5%)	249 (3.4%)	305 (3.5%)	331 (3.6%)	187 (4.1%)
	2	902 (5.4%)	1,458 (5.5%)	1,549 (5.9%)	1,703 (6.4%)	660 (6.5%)
	3	665 (3.3%)	1,064 (3.3%)	1,047 (3.4%)	1,171 (3.7%)	408 (3.6%)
Visits with PE diagnosis and CTPA, N (% of visits with PE among visits with CTPA)	1	8 (3.4%)	12 (4.1%)	16 (5.3%)	14 (4.2%)	11 (5.9%)
	2	87 (9.7%)	139 (9.5%)	137 (8.8%)	154 (9.0%)	70 (10.6%)
	3	55 (8.3%)	89 (8.4%)	79 (7.6%)	75 (6.4%)	34 (8.3%)
Visits with PTP and CTPA, N (% of visits with PTP among visits with CTPA)	1	4 (1.7%)	2 (0.7%)	10 (3.3%)	10 (3.0%)	6 (3.2%)
	2	19 (2.1%)	27 (1.9%)	34 (2.2%)	46 (2.7%)	13 (2.0%)
	3	343 (51.6%)	565 (53.1%)	518 (49.5%)	613 (52.4%)	209 (51.2%)

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## RESULTS

- Over the 4-month evaluation timeframe, there was a total of 270,214 ED encounters from 38 EDs located in the United States along the East Coast and Midwest regions. Uptake and utilization of the PTP tools are shown in Table 2.
- Use of PTP was highest at the site with forced PTP documentation which ranged from 49-53% of ordered CTPAs, compared to Site 2 where use was 2-3%, and Site 1 where use ranged from 1-3%.
- At Site 1, use of PTP increased slightly over the study period with signs that PE yield on imaging was increasing as well (3.4% to 5.9%). At Site 2, PE yield on imaging was overall high (9-10%), and remained similar with similar use of PTP tools over the study period. Use of PTP and PE yield (6-8%) on imaging also remained similar throughout the study at Site 3.

## CONCLUSIONS

- Increasing PTP use and rising PE yield at Site 1 demonstrated ongoing potential for improvements past this study.
- **PE yield at each site was at or above the 5% yield for PE on CTPA which has been previously reported.**
- Given that PTP uptake was relatively stable over the measurement period at Site 2 and 3, this indicates the process had mostly stabilized and **that other strategies are needed to improve the uptake of PTP, reduce utilization of CTPA, and further increase yield on CTPA.**