Evaluation of the Years Algorithm for the Diagnosis of Pulmonary Embolism at the University Hospital Centre in Lomé (Togo)

Pessinaba S[1]*, Kpelafia MI[1], Afassinou M[2], Donmani D[1], Yayehd K[1], Togbossi E[1], Pio M[3], Baragou S[2] and Damorou F[1]

[1]*Cardiology Department, Lomé University Hospital, Lomé, Togo.*

[2]*Cardiology Department, Sylvanus Olympio University Hospital, Lomé, Togo.*

***Correspondence:**
Pessinaba Soulemane, Associate Professor of Cardiology, Lomé University Hospital, Lomé, Togo.

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ABSTRACT

Introduction: *Pulmonary embolism (PE) is a medical emergency whose diagnosis relies on costly and invasive paraclinical tools, particularly chest CT angiography. The YEARS algorithm combines simple clinical criteria and D-dimer testing to limit unnecessary examinations.*

Objective: *To evaluate the performance of the YEARS algorithm at the Lomé University Hospital Campus and determine its ability to reduce requests for CT angiography.*

Methods: *Retrospective cross-sectional study (2015-2021) including patients hospitalised for suspected PE with D-dimers and CT angiography available. Diagnostic performance indices (sensitivity, specificity, PPV, NPV) calculated according to standard formulas.*

Results: *238 patients included (mean age 56.5 ±16.2 years; male-to-female ratio =0.31). PE confirmed in 126 patients (52.9%). The YEARS algorithm would have ruled out PE in 26 patients (23.2%) with low clinical probability and D-dimers <1000 ng/mL. Sensitivity: 90.9%, NPV: 76.4%. With local prevalence (3.1%), adjusted NPV: 99%. Eight patients (3.4%) would have been false negatives.*

Conclusion: *The YEARS algorithm is a reliable and effective tool for limiting unnecessary CT angiograms in suspected PE cases at the Lomé University Hospital Campus.*

Keywords
Pulmonary embolism, YEARS, Sensitivity, Specificity, Togo.

Introduction
Pulmonary embolism (PE) is defined as the sudden, total or partial occlusion of the pulmonary artery trunk or one of its branches by an embolus, most often fibrin-cruoric, secondary to deep vein thrombosis in 90% of cases [1]. PE is a diagnostic and therapeutic emergency whose prognosis depends on the speed of treatment.

At the Lomé University Hospital Campus, the prevalence of PE was estimated at 3.1% in 2017 [2]. A positive diagnosis is based on a chest CT angiogram, which is an expensive and sometimes difficult-to-access test. The non-specific symptoms of PE often lead to over-prescription of imaging tests. The challenge of overprescribing chest CT angiography is a major public health issue in a context of scarce financial resources and geographical inaccessibility. All these difficulties in obtaining a positive diagnosis have led to the development of clinical tools to reduce the prescription of chest CT angiography. Among the most recent tools are the Geneva and Wells simplified scores [3,4], the PERC (Pulmonary Embolism-Rule-Out Criteria) rule [5] and the YEARS algorithm [6]. The YEARS algorithm [6] is based on three clinical criteria (signs of DVT, haemoptysis, absence of other diagnoses more likely than PE) and adjusts the D-dimer threshold to decide whether to perform a CT angiogram. This approach has been

shown internationally to significantly reduce the number of CT angiograms without compromising patient safety. The aim of this study was to evaluate the performance of the YEARS algorithm and estimate the proportion of patients in whom CT angiography could have been avoided.

Methods
Type and setting
This study is a retrospective cross-sectional study conducted from January 2015 to December 2021 in the cardiology department of the Campus University Hospital. The cardiology department of the Campus University Hospital is one of the national reference departments for the management of cardiovascular diseases in Togo.

Study population
We included in this study all patients aged 18 years or older who were hospitalised for suspected PE, with available D-dimer and chest CT angiography results. We excluded incomplete and unusable records.

Data collection
The information extracted included: age, sex, risk factors (hypertension, obesity, history of thromboembolism), symptoms, physical signs, ECG and ultrasound results, D-dimer levels and CT angiography results.

Definition of variables
The clinical probability according to YEARS was determined as follows: low if no criteria were present, high if at least one criterion was present. PE was excluded if the probability was low and D-dimers were <1000 ng/mL. PE was probable if the probability was high and D-dimers were ≥500 ng/mL, or if the probability was low and D-dimers were ≥1000 ng/mL.

Statistical analysis
The data were analysed using RStudio v3.6.3 software. Quantitative variables are presented as mean ± standard deviation, and qualitative variables as numbers and percentages. Performance indices: sensitivity (Se), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV) were calculated using standard formulas.

Ethical considerations
Ethical approval for the study was obtained from the Health Ethics Committee of the Faculty of Health Sciences at the University of Lomé. The study was conducted in accordance with the guidelines of the International Conference on Harmonisation of Good Clinical Practice and the Declaration of Helsinki.

Results
General characteristics
A total of 238 patients were included. The mean age was 56.5 ± 16.2 years with a male-tofemale ratio of 0.31. Hypertension (57.1%) and obesity (42.1%) were the main cardiovascular risk factors. Table 1 presents the main characteristics of the patients.

Table 1: General characteristics of patients.

Characteristics	number (%) or means ± SD
Nombre de patients	238
Age mean (years)	56.5 ± 16.2
Female	183 (76.9)
Male	55 (23.1)
Hypertension	136 (57.1)
Obesity	100 (42.1)
Dyspnoea	185 (77.8)
Chest pain	95 (39.7)
Tachycardia	117 (49.2)
Oxygen desaturation	104 (43.7)

In terms of paraclinical findings, D-dimers were ≥ 1000 ng/mL in 89.7% of cases and PE was confirmed in 52.9% of patients admitted with suspected PE, as shown in Table 2. PE was proximal in 69% of cases.

Table 2: Electrocardiogram and echocardiography results.

	number (%)
Electrocardiogram	238 (100)
− Sinus tachycardia	105 (44.4)
− Negative T waves V1-V4	58 (24.6)
− S1Q3T3	47 (19.8)
− Right bundle branch block	28 (11.9)
Echocardiography	238 (100)
− Dilatation of right cavities	47 (19.8)
− Pulmonary hypertension	19 (7.9)
− Intracardiac thrombus	6 (2.4)
D-dimers ≥1000 ng/mL	213 (89.7)

Application of the YEARS algorithm
Using the YEARS algorithm, 161 patients had no YEARS items, 34 had D-dimers 500– 1,000 ng/mL, and 26 had negative CT angiography (76.5%). The algorithm would have made it possible to avoid 23.2% of chest CT angiograms (Table 3). Figure 1 illustrates the algorithm's decision path and the number of patients for whom CT angiography could have been avoided.

Table 3: Application of the YEARS algorithm.

Category according to YEARS	Number of patients	Positive chest CT angiography	Negative chest CT angiography	Percentage avoided
No item YEARS and D-dimers <1000	26	0	26	100 %
No item YEARS and D-dimers 500-1000	34	8	26	76.5 %
≥1 item YEARS and D-dimers ≥500	77	63	14	0 %

Table 4 summarises the performance indices of the YEARS algorithm. The NPV was 76.4%. Adjusted for the prevalence of PE, which was 3.1% at the time, the NPV rose to 99%. Eight

patients (3.4%) would have been false negatives.

Table 4: Diagnostic performance of YEARS algorithm.

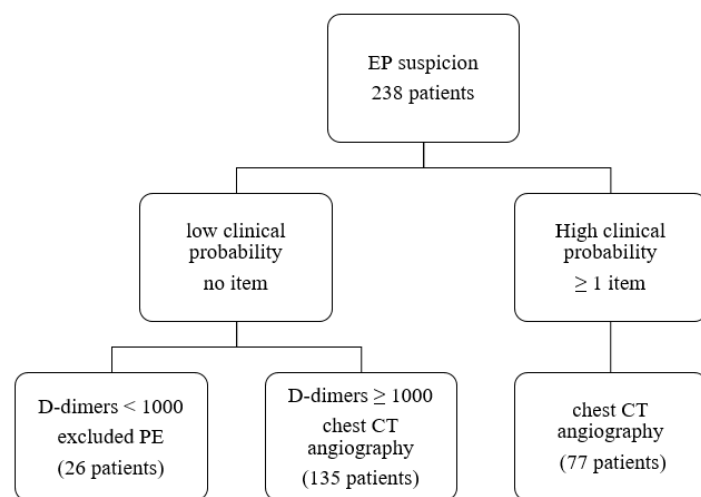| Indicator	Valeur
Sensibility	90.9 %
Specificity	68.2 %
Positive predictive value	82.1 %
Negative predictive value	76.4 %
Ajusted negative predictive value (prevalence 3.1 %)	99 %
False negatives	3.4 %

Figure 1: Flowchart of the YEARS algorithm

Discussion

To our knowledge, our study is the first evaluation of the YEARS algorithm in a cardiology department in French-speaking sub-Saharan Africa. The results confirm the value of this tool in streamlining the diagnosis of PE.

Comparison with the literature

The performance observed in our series (sensitivity 90.9%, NPV 76.4%) is similar to that reported in the original studies by van der Hulle et al. [6], which showed a sensitivity of 98% and an NPV greater than 99% in a low-risk population. Similarly, the work of Kearon et al. [7] showed a 17.6% reduction in the number of chest CT angiograms thanks to the use of the YEARS algorithm, without an increase in the false negative rate.

In our series, 3.4% of patients would have had PE despite being excluded by the algorithm. This proportion remains lower than that observed in European cohorts (4–5%) [8,9]. This confirms that, even in an African context, the algorithm remains reasonably reliable, provided that the initial clinical probability is correctly assessed.

Relevance in the Togolese context

In a resource-limited environment such as that of the CHU Campus, access to chest CT angiography remains restricted by cost and availability. The judicious application of the YEARS algorithm would reduce unnecessary examinations by about a quarter, representing a substantial saving for the health system and patients.

The high proportion of patients presenting with isolated dyspnoea and moderately elevated D-dimers highlights the importance of initial clinical assessment in order to avoid overdiagnosis due to the low specificity of D-dimers, particularly in the inflammatory and infectious contexts that are common in Africa.

Limitations of the study

The main limitation of our work is its retrospective nature, which exposes it to selection and information biases. Furthermore, the lack of follow-up assessment at 3 months after exclusion from the PE does not allow us to estimate the rate of subsequent thromboembolic events. Finally, the limited availability of standardised quantitative D-dimer testing limits the complete reproducibility of the algorithm.

Outlook

A prospective multicentre study involving emergency departments and internal medicine departments would confirm these results and enable the adaptation of a national diagnostic protocol based on the YEARS algorithm. The integration of this tool into care protocols could contribute to a more efficient use of diagnostic resources in Togo.

Conclusion

The evaluation of the YEARS algorithm at the Lomé University Hospital Campus shows that this tool has excellent sensitivity and high negative predictive value, justifying its use in low-resource settings. Its adoption could significantly reduce the financial burden and exposure to unnecessary radiation while maintaining acceptable diagnostic certainty.

Prospective studies are needed to validate its implementation in national protocols for the management of pulmonary embolism in Togo.

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