Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Performance of the Pulmonary Embolism Severity Index in Predicting Mortality in Acute Pulmonary Embolism at a Kenyan Tertiary Referral Hospital: A Retrospective Cohort Study

Beth Wambui Githambo

bethgithambo@gmail.com

Aga Khan University

Jasmit Shah

Aga Khan University

Martin Musumbi

Aga Khan University

Mzee Ngunga

Aga Khan University

Research Article

Keywords: Pulmonary embolism, Pulmonary Embolism Severity Index, Risk stratification, Prognosis, In-hospital mortality, 30-day mortality, Sub-Saharan Africa, Kenya

Posted Date: November 25th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11457188/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Pulmonary embolism is a leading cause of cardiovascular hospitalization and death. The Pulmonary Embolism Severity Index (PESI) is recommended for risk stratification, but evidence on its performance in Sub-Saharan Africa is limited. This study assessed the association between observed 30-day mortality and PESI-predicted mortality in patients with acute pulmonary embolism at a Kenyan tertiary referral hospital.

Methods

We conducted a retrospective cohort study of adults admitted between January 2020 and December 2024 with acute pulmonary embolism confirmed by computed tomography pulmonary angiography or ventilation-perfusion scan. PESI scores were calculated at admission, and patients were assigned to risk classes I to V. Classes I and II were grouped as low risk and classes III to V as high risk. The primary outcome was all-cause 30-day mortality. Logistic regression, adjusted for age and sex, was used to estimate the association between PESI risk group and mortality.

Results

Of 500 patients screened, 386 were included. Median age was 51.6 years and 41.5% were male. Cancer was the most common comorbidity (15.3%), followed by chronic lung disease (9.8%), heart failure (4.1%) and HIV infection (2.8%). The distribution across PESI classes I to V was 44.0%, 19.4%, 17.4%, 11.1% and 8.0%. In-hospital mortality rose from 0% in Class I to 22.6% in Class V, and 30-day mortality from 0% to 30.8% ($p < 0.001$). High-risk patients were older, more often male, stayed longer in hospital and carried a greater comorbidity burden. Thirty-day mortality was 10.9% in high-risk and 1.7% in low-risk patients (adjusted odds ratio 9.4, 95% confidence interval 2.4–37.3). Anticoagulation was given to 97.9% of patients and thrombolysis to 2.1%.

Conclusions

PESI stratified short-term mortality effectively in this younger African cohort with a high cancer burden. The findings support routine use of PESI for risk stratification in resource-limited settings and point to the need for multicentre validation across diverse African healthcare environments.

BACKGROUND

Pulmonary embolism (PE) is the most severe clinical manifestation of venous thromboembolism (VTE) and the third most common cardiovascular disease after ischemic heart disease and stroke [1, 2]. Short-

term mortality remains substantial despite advances in diagnostic imaging and anticoagulation. Presentation ranges from incidental, asymptomatic emboli to obstructive shock or cardiac arrest. Fewer than 5% of patients present with hemodynamic collapse, yet early mortality in this group is high, which makes rapid risk assessment at presentation essential [3].

Risk stratification guides the intensity of therapy, the use of thrombolysis, the level of care and eligibility for early discharge [4, 5]. International guidelines recommend validated clinical prediction rules, particularly the Pulmonary Embolism Severity Index (PESI) and its simplified version, to estimate in-hospital and 30-day mortality [6, 7]. PESI combines 11 clinical variables, including age, sex, cancer, heart failure, chronic lung disease, vital signs, oxygen saturation and mental status, and assigns patients to five classes from Class I (very low risk) to Class V (very high risk). In the derivation cohort, 30-day mortality rose from 0.8% in Class I to over 25% in Class V [6]. Validation studies in Europe, Asia and South America have since confirmed its prognostic value, and PESI is widely used in emergency and acute care [8–10].

Most validation cohorts, however, were drawn from North America and Europe, where demographics, comorbidity patterns and access to care differ from Sub-Saharan Africa. African patients with PE present younger, with mean ages of 50–52 years compared with about 59 years in the original PESI studies [1, 5, 11, 12]. This raises the question of whether PESI remains well calibrated in younger populations with a heavy comorbidity burden. HIV infection increases VTE risk two- to tenfold [13, 14]. Malignancy increases it four- to sevenfold, and VTE is a leading cause of non-cancer death among patients with cancer [15, 16]. Aga Khan University Hospital, Nairobi (AKUHN) is a regional referral and cancer centre, so a substantial share of its PE cases occur in patients with active malignancy.

Reported outcomes also vary widely. Trials of direct oral anticoagulants report 30-day mortality of 2–3%, whereas observational studies in African populations have reported mortality as high as 40–70% [11, 17]. These differences likely reflect disease severity at presentation, delayed diagnosis, comorbidity and access to care. Socioeconomic and cultural factors that delay health-seeking may compound them [18].

PESI is used in some emergency departments, including at AKUHN, but its performance in local populations has not been evaluated, and data on short-term PE outcomes in Kenya are scarce. Whether prognostic models developed in high-income settings remain accurate in African contexts is therefore an open question. This study assessed the association between observed 30-day mortality and PESI-predicted mortality in patients with acute PE managed at a tertiary referral hospital in Kenya.

METHODS

This retrospective cohort study was conducted at AKUHN, a tertiary referral hospital and regional cancer centre in Nairobi, Kenya between 1st January 2020 and 31st December 2024.

Medical records of patients admitted between January 2020 and December 2024 with an International Classification of Diseases, 10th revision (ICD-10) diagnosis of PE (I26) were reviewed. Patients were

eligible if they were aged 18 years or older, had acute PE confirmed by computed tomography pulmonary angiography (CTPA) or ventilation-perfusion (V/Q) scan, and were admitted to AKUHN inpatient services. Patients were excluded if they had chronic or recurrent PE, no PE on CTPA or V/Q scan, were managed as outpatients, or had missing data needed to calculate the PESI score. Of 500 patients with a new diagnosis of acute PE, 114 were excluded for various reasons such as exclusion criteria, missing data, leaving 386 for analysis.

Data were obtained from paper medical records for 2020–2022 and from the electronic health record for 2023–2024 and all data was entered into REDCap.

PESI scores at admission were calculated using MDCalc and classified as Class I (≤65, very low risk), Class II (66–85, low risk), Class III (86–105, intermediate risk), Class IV (106–125, high risk) and Class V (>125, very high risk). For the dichotomized analysis, Classes I and II were defined as low risk and Classes III to V as high risk. Observed mortality in each class was compared with the predicted 30-day mortality range reported for that class in the PESI derivation and validation study [6]. The primary outcome was all-cause 30-day mortality. Secondary outcomes were in-hospital mortality and length of hospital stay. Deaths after discharge were identified from documented post-discharge hospital revisits.

Categorical variables are summarized as frequencies and percentages, and continuous variables as medians with interquartile ranges (IQR). Mortality across PESI classes and between risk groups was compared using Fisher's exact test. Odds ratios (OR) with 95% confidence intervals (CI) for in-hospital and 30-day mortality in the high-risk group were estimated by logistic regression, first unadjusted and then adjusted for age and sex. Statistical significance was set at a two-tailed $p \leq 0.05$. Analyses were performed in SPSS version 23 (IBM Corp., Armonk, NY, USA).

Ethics approval and consent to participate

The study was approved by the Aga Khan University Institutional Scientific and Ethics Review Committee (ISERC; reference 2024/ISERC-128(v3)) and the National Commission for Science, Technology and Innovation (NACOSTI; licence no. NACOSTI/P/25/417744). The Institutional Scientific and Ethics Review Committee waived the requirement for informed consent because the study used retrospective, de-identified record data.

RESULTS

Baseline characteristics

The median age for the overall cohort (n=386) was 51.6 years (IQR 39.6–67.4) and 58.5% were female, a male-to-female ratio of 1:1.4. Median length of stay was 5.0 days (IQR 3.0–8.0). Cancer was the most common comorbidity (15.3%), followed by chronic lung disease (9.8%), heart failure (4.1%) and HIV infection (2.8%). The largest share of patients was in PESI Class I (44.0%), followed by Class II (19.4%),

Class III (17.4%), Class IV (11.1%) and Class V (8.0%). Table 1 summarises the overall demographic and clinical characteristics and PESI classification of the cohort.

Table 1 Demographic and clinical characteristics and PESI classification of the cohort (n = 386)

Variable	n (%) or median [IQR]
Male sex	160 (41.5)
Age, years	51.6 [39.6, 67.4]
Clinical outcomes	
In-hospital mortality	16 (4.1)
30-day mortality[a]	18 (5.0)
Length of hospital stay, days	5.0 [3.0, 8.0]
Comorbidities	
Cancer	59 (15.3)
Chronic lung disease	38 (9.8)
Heart failure	16 (4.1)
HIV infection	11 (2.8)
Vital signs at admission	
Heart rate, beats/min	92.5 [80.0, 111.0]
Systolic blood pressure, mmHg	129.0 [117.0, 142.0]
Respiratory rate, breaths/min	18.0 [18.0, 20.0]
Temperature, °C	36.5 [36.3, 36.7]
Oxygen saturation, %	95.0 [91.0, 97.0]
Altered mental status	11 (2.8)
Treatment	
Anticoagulation (SC/IV)	378 (97.9)
Thrombolysis	8 (2.1)
PESI risk class	
Class I (≤65)	170 (44.0)
Class II (66–85)	75 (19.4)
Class III (86–105)	67 (17.4)
Class IV (106–125)	43 (11.1)
Class V (>125)	31 (8.0)

Association of Variables with PESI risk groups

Based on the risk group categorization, 245 patients were in the low-risk group and 141 in the high-risk group. Age, gender and hospital stay was significantly associated with the risk groups where high-risk patients were older (median 69.0 [IQR 57.1–78.3] vs 43.6 [IQR 35.9–54.0] years, $p < 0.001$), more often males (49.6% vs 36.7%, $p = 0.014$) and stayed longer in hospital (median 6.0 [4.0–11.0] vs 4.0 [3.0–7.0] days, $p = 0.003$). Furthermore, the high risk group had a higher history of cancer (36.9% vs 2.9%, $p < 0.001$), chronic lung disease (19.1% vs 4.5%, $p < 0.001$) and heart failure (7.8% vs 2.0%, $p = 0.014$) as compared to low risk and was statistically significant. High-risk patients also had a higher respiratory rate, lower oxygen saturation and more frequent altered mental status, all of which are PESI components. Subcutaneous or intravenous anticoagulation was the primary treatment and was given to 97.9% of patients. Thrombolysis was used in 2.1% overall, in 0.8% of low-risk and 4.3% of high-risk patients. The differences among high risk and low risk with demographic and clinical characteristics is described in Table 2.

Table 2: Characteristics and outcomes of patients in the low-risk and high-risk PESI groups

Variable	Low risk (n = 245)	High risk (n = 141)	p-value
Male sex	36.7%	49.6%	0.014
Age, years	43.6 [35.9, 54.0]	69.0 [57.1, 78.3]	<0.001
In-hospital mortality	1.6%	8.5%	0.002
30-day mortality (n = 361)	1.7%	10.9%	<0.001
Length of hospital stay, days	4.0 [3.0, 7.0]	6.0 [4.0, 11.0]	0.003
Comorbidities			
Cancer	2.9%	36.9%	<0.001
Chronic lung disease	4.5%	19.1%	<0.001
Heart failure	2.0%	7.8%	0.014
HIV infection	3.7%	1.4%	0.341
Vital signs at admission			
Heart rate, beats/min	92.0 [80.0, 108.0]	84.0 [80.0, 117.0]	0.672
Systolic blood pressure, mmHg	129.0 [120.0, 141.0]	130.0 [113.0, 144.0]	0.817
Respiratory rate, breaths/min	18.0 [17.0, 20.0]	20.0 [18.0, 22.0]	0.009
Temperature, °C	36.5 [36.3, 36.7]	36.5 [36.2, 36.7]	0.463
Oxygen saturation, %	96.0 [94.0, 98.0]	92.0 [86.0, 96.0]	<0.001
Altered mental status	0.0%	7.8%	<0.001
Treatment			
Anticoagulation (SC/IV)	99.2%	95.7%	0.055
Thrombolysis	0.8%	4.3%	–

Low risk, PESI Classes I–II; high risk, PESI Classes III–V. Data are percentages or median [IQR]. IQR, interquartile range; IV, intravenous; PESI, Pulmonary Embolism Severity Index; SC, subcutaneous.

Mortality by PESI class

In-hospital mortality was 4.1% and differed significantly across PESI classes ($p < 0.001$). There were no deaths in Class I, consistent with its very low predicted risk. Observed in-hospital mortality was 5.3% (95% CI 1.5–13.1) in Class II against a predicted 1.7–3.5%, 4.5% (0.9–12.5) in Class III against 3.2–7.1%, 4.7% (0.6–15.8) in Class IV against 4.0–11.4%, and 22.6% (9.6–41.1) in Class V against 10.0–24.5%. Two patients died after discharge, one in Class IV and one in Class V. Twenty-five records lacked

documentation of a post-discharge hospital revisit. Table 3 describes the mortality outcome by PESI class.

Thirty-day mortality was 5.0% and also differed significantly across classes. Class I again had no deaths (predicted 0.0–1.6%). Observed 30-day mortality was 5.8% (95% CI 1.6–14.2) in Class II, 4.7% (1.0–13.1) in Class III, 7.9% (1.7–21.4) in Class IV and 30.8% (14.3–51.8) in Class V. Table 3 describes the in-hospital mortality, 30-day mortality and also shows the standard reference predicted 30 day mortality.

Table 3 Observed in-hospital and 30-day mortality versus PESI-predicted 30-day mortality by risk class

PESI class	Reference Predicted 30-day mortality, %	In-hospital mortality, % (95% CI)	30-day mortality, % (95% CI)	P value
Class I	0.0%–1.6%	0.0%	0.0	<0.001
Class II	1.7%–3.5%	5.3% (1.5–13.1)	5.8 (1.6–14.2)	
Class III	3.2%–7.1%	4.5% (0.9–12.5)	4.7 (1.0–13.1)	
Class IV	4.0%–11.4%	4.7% (0.6–15.8)	7.9% (1.7–21.4)	
Class V	10.0%–24.5%	22.6% (9.6–41.1)	30.8% (14.3–51.8)	

Predicted ranges are from the PESI derivation and validation study [6]. CI, confidence interval; PESI, Pulmonary Embolism Severity Index.

In-hospital mortality was 8.5% in the high-risk group and 1.6% in the low-risk group ($p = 0.002$), and 30-day mortality was 10.9% and 1.7%, respectively ($p < 0.001$). High-risk classification was associated with 5.6-fold higher unadjusted odds of in-hospital death, rising to 9.1-fold after adjustment for age and sex. For 30-day mortality, the odds were sevenfold higher before adjustment and 9.4-fold higher after. Table 4 summarises the association between mortality and PESI risk class, both unadjusted and adjusted for age and sex.

Table 4 Logistic regression results for association between high-risk PESI classification and mortality.

Outcome	OR (95% CI)	p-value	aOR (95% CI)	p-value
In-hospital mortality	5.6 (1.8–17.3)	0.003	9.1 (2.2–37.8)	0.002
30-day mortality	7.0 (2.3–21.8)	0.001	9.4 (2.4–37.3)	0.001

Reference category: low risk (PESI Classes I–II). Adjusted odds ratios are adjusted for age and sex. aOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio; PESI, Pulmonary Embolism Severity Index.

DISCUSSION

This study is one of the largest evaluations of PESI reported from Africa. The cohort was young, with a median age of 51.6 years, and predominantly female. This matches other African cohorts, including a median age of 50.5 years in an earlier Kenyan study [12], 52 years in Mali [1] and a mean of 54.2 years in Togo [19]. Cohorts from the United States and Europe are considerably older. Two large US analyses of 299,016 and 1,124,204 PE hospitalizations reported median ages of 63 and 65 years [18, 20], and an Italian validation study a mean age of 70.6 years [21]. Asian cohorts fall in between, with mean ages of 57 to 62 years in Thailand and Singapore [2, 22–24] and 67.5 years in China [25]. These differences largely reflect the younger population structure in Africa. Despite the younger age profile, the mortality gradient across PESI classes resembled that seen in older populations, which supports the robustness of the score.

Cancer was the most frequent comorbidity, followed by chronic lung disease and heart failure. This ordering is consistent with registry data in which cancer, respiratory disease and cardiovascular disease accounted for 27.0%, 6.7% and 12.1% of deaths after PE [26], and with the 19% cancer prevalence in the PESI derivation cohort [6]. Between 15% and 20% of patients hospitalized with PE have concomitant cancer, and cancer-associated PE carries higher short-term mortality. A US national inpatient sample reported in-hospital mortality of 11.8% with cancer and 6.6% without [27], Sorour et al. reported 17.3% and 7.3% [28], and the RIETE registry has shown the same pattern [26, 29]. Cancer adds 30 points to the PESI score, which moves affected patients into higher classes and explains the concentration of cancer in the high-risk group (36.9% vs 2.9%). In a cohort with this level of malignancy, part of the mortality likely reflects competing cancer-related risk rather than PE alone. PESI nonetheless remained useful for stratifying baseline PE severity.

The distribution across classes resembled the external validation sample of Aujesky et al., in which Class I was the largest group and Class V the smallest [6]. Distributions vary by setting. In a Southeast Asian cohort, Class V was the largest group (27%) and Class I accounted for only 8.9% [22]. Because age in years contributes directly to the PESI score, the predominance of Classes I and II in this cohort is consistent with its younger age.

Overall 30-day mortality of 5.0% was higher than the 3.3% (95% CI 2.9–3.8%) reported in a large registry [30] and lower than the 19.1% and 23% reported in Asian cohorts with mean ages of 57 and 65 years [2, 23]. The stepwise rise in mortality with PESI class mirrors the original derivation and validation study [6] and later validations by Chan and colleagues and by Soriano et al. in Brazil, all of which showed progressively higher 30-day mortality with advancing class [5, 31].

High-risk classification identified patients with substantially higher in-hospital and 30-day mortality. Adjustment for age and sex strengthened rather than weakened these associations. This suggests that once demographic differences are accounted for, the clinical variables that drive patients into the higher PESI classes, such as cancer, hypoxemia and altered mental status, carry strong independent prognostic weight. Soriano et al. in Brazil [5] and a systematic review by Elias et al. [32] reported similar findings.

The main clinical value of PESI lies in reliably identifying patients at low risk of death within 30 days. Classes I and II had markedly lower mortality than the higher classes, and patients in these classes may be considered for early discharge and outpatient management, an approach shown to shorten hospital stay and reduce costs without compromising safety [5, 8]. Low-risk patients in this cohort still stayed a median of 4 days, which suggests scope for PESI-guided early discharge to free inpatient capacity. Observed mortality in Class II (5.8%) did, however, exceed the predicted range, although with wide confidence intervals. Discharge decisions for Class II patients in this setting should therefore also weigh comorbidities and access to follow-up. Soriano et al. found that grouping patients into low-risk and high-risk categories improved the accuracy of PESI in predicting 30-day mortality [5].

Anticoagulation was given to nearly all patients (97.9%), in line with guideline-directed management in which anticoagulation is first-line therapy for patients without hemodynamic instability [7]. Thrombolysis was used sparingly (2.1%) and more often in high-risk patients (4.3% vs 0.8%). This is consistent with European Society of Cardiology and American College of Chest Physicians recommendations, which reserve thrombolysis mainly for high-risk PE or hemodynamic compromise [7, 33].

This study has several limitations. First, it was a retrospective, single-centre study at a tertiary referral and cancer centre, which limits generalizability to public, district and rural hospitals in Kenya. Second, 54 patients were excluded for incomplete records, which may have introduced selection bias. Third, 30-day status after discharge depended on documented hospital revisits, and 25 records lacked this documentation, so post-discharge deaths may be underestimated. Fourth, the small number of deaths produced wide confidence intervals, particularly within individual PESI classes, and limited multivariable adjustment to age and sex. Fifth, discrimination and calibration were assessed descriptively through mortality gradients, comparison with predicted ranges and odds ratios, rather than with formal measures such as the C-statistic. Finally, cause of death was not determined, so deaths attributable to PE could not be separated from those due to cancer and other comorbidities, and markers of right ventricular dysfunction were not incorporated.

CONCLUSIONS

PESI stratified in-hospital and 30-day mortality effectively in a younger Kenyan cohort with a high cancer burden. Higher PESI classes were independently associated with mortality after adjustment for age and sex, and low-risk patients had low mortality, which supports their consideration for early discharge. PESI is a practical tool for routine risk stratification of acute PE in resource-limited settings. Larger multicentre, prospective studies that include public and rural hospitals are needed to confirm these findings across Sub-Saharan Africa. Future work should also test whether adding troponin, N-terminal pro-B-type natriuretic peptide and imaging markers of right ventricular dysfunction improves prognostic accuracy, and should use competing-risk models to separate PE-related deaths from deaths due to comorbid conditions.

Declarations

Authors' contributions: BWG conceptualized the study, administered the project, designed the study, collected the data and drafted the manuscript. MN contributed to conceptualization, refined the methodology and critically reviewed the manuscript. MM provided statistical guidance and methodological input and edited the manuscript. JS contributed to methodology, performed the formal data analysis, interpreted the results and reviewed and edited the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate: The study was approved by the Aga Khan University Institutional Scientific and Ethics Review Committee (ISERC; reference 2024/ISERC-128(v3)) and the National Commission for Science, Technology and Innovation (NACOSTI; licence no. NACOSTI/P/25/417744).

Consent for publication: Not applicable.

Clinical trial number: not applicable.

Data availability statement : Data supporting this study are included within the article and/or supporting materials

Competing interests: The authors declare that they have no competing interests.

Funding: None

Acknowledgements: The authors thank the Department of Internal Medicine and its departmental research committee at Aga Khan University Hospital, Nairobi, for their support. We are grateful to the institutional management, faculty and library staff for their guidance, and to the medical records and biostatistics teams for assistance with data retrieval and analysis. We also acknowledge the patients whose clinical data made this study possible.

References

1. Konaté M, Sako M, Sonfo B, Sidibé S, Mariko S, Sow DS, et al. Pulmonary embolism: epidemiological, clinical, therapeutic and evolution aspects in the medicine department of Hospital of Mali Bamako. World J Cardiovasc Dis. 2021;11(4):4. 10.4236/wjcd.2021.114024.
2. Pirompanich P, Sathitakorn O, Suppakomonnun T, Sapankaew T. Clinical characteristics, risk factors, and outcomes of acute pulmonary embolism in Thailand: 6-year retrospective study. Tuberc Respir Dis. 2024;87(3):349–56. 10.4046/trd.2023.0108.
3. de Wit K, D'Arsigny CL. Risk stratification of acute pulmonary embolism. J Thromb Haemost. 2023;21(11):3016–23. 10.1016/j.jtha.2023.05.003.
4. Leidi A, Bex S, Righini M, Berner A, Grosgurin O, Marti C. Risk stratification in patients with acute pulmonary embolism: current evidence and perspectives. J Clin Med. 2022;11(9):2533. 10.3390/jcm11092533.

5. Soriano LA, Castro TT, Vilalva K, Borges MC, Pazin-Filho A, Miranda CH. Validation of the Pulmonary Embolism Severity Index for risk stratification after acute pulmonary embolism in a cohort of patients in Brazil. J Bras Pneumol. 2019;45:e20170251. 10.1590/1806-3713/e20170251.
6. Aujesky D, Obrosky DS, Stone RA, Auble TE, Perrier A, Cornuz J, et al. Derivation and validation of a prognostic model for pulmonary embolism. Am J Respir Crit Care Med. 2005;172(8):1041–6. 10.1164/rccm.200506-862OC.
7. Konstantinides SV, Meyer G, Becattini C, Bueno H, Geersing GJ, Harjola VP, et al. 2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS). Eur Heart J. 2020;41(4):543–603. 10.1093/eurheartj/ehz405.
8. Choi WH, Kwon SU, Jwa YJ, Kim JA, Choi YH, Chang JH, et al. The Pulmonary Embolism Severity Index in predicting the prognosis of patients with pulmonary embolism. Korean J Intern Med. 2009;24(2):123–7. 10.3904/kjim.2009.24.2.123.
9. Hassine M, Kallala MY, Mahjoub M, Boussaada M, Bouchahda N, Gamra H. [Pulmonary embolism: the Pulmonary Embolism Severity Index (PESI) score and mortality predictors]. Pan Afr Med J. 2023;45:48. 10.11604/pamj.2023.45.48.39031.
10. Zhou XY, Ben SQ, Chen HL, Ni SS. The prognostic value of pulmonary embolism severity index in acute pulmonary embolism: a meta-analysis. Respir Res. 2012;13:111. 10.1186/1465-9921-13-111.
11. Danwang C, Temgoua MN, Agbor VN, Tankeu AT, Noubiap JJ. Epidemiology of venous thromboembolism in Africa: a systematic review. J Thromb Haemost. 2017;15(9):1770–81. 10.1111/jth.13769.
12. Riunga FM. Prevalence and clinical characteristics of venous thromboembolism at the Aga Khan University Hospital, Nairobi [dissertation]. Aga Khan University; 2014. https://ecommons.aku.edu/theses_dissertations/631/. Accessed 27 Jun 2024.
13. Bibas M, Biava G, Antinori A. HIV-associated venous thromboembolism. Mediterr J Hematol Infect Dis. 2011;3(1):e2011030. 10.4084/MJHID.2011.030.
14. Jareño Esteban JJ, de Miguel Díez J, Fernández Bermejo LA. Pulmonary embolism and comorbidity. Open Respir Arch. 2022;4(3):100188. 10.1016/j.opresp.2022.100188.
15. Biedka M, Ziółkowska E, Windorbska W. Acute pulmonary embolus in the course of cancer. Contemp Oncol (Pozn). 2012;16(5):388–93. 10.5114/wo.2012.31766.
16. Poenou G, Dumitru Dumitru T, Lafaie L, Mismetti V, Ayoub E, Duvillard C, et al. Pulmonary embolism in the cancer associated thrombosis landscape. J Clin Med. 2022;11(19):5650. 10.3390/jcm11195650.
17. Otair HAKA, Al-Boukai AA, Ibrahim GF, Shaikh MKA, Mayet AY, Al-Hajjaj MS. Outcome of pulmonary embolism and clinico-radiological predictors of mortality: experience from a university hospital in Saudi Arabia. Ann Thorac Med. 2014;9(1):18–22. 10.4103/1817-1737.124420.
18. Farmakis IT, Valerio L, Giannakoulas G, Hobohm L, Cushman M, Piazza G, et al. Social determinants of health in pulmonary embolism management and outcome in hospitals: insights from the United

States nationwide inpatient sample. Res Pract Thromb Haemost. 2023;7(3):100147. 10.1016/j.rpth.2023.100147.

19. Esiéné A, Etoundi PO, Tochie JN, Metogo JAM, Minkande JZ. Validity of four clinical prediction scores for pulmonary embolism in a sub-Saharan African setting: a protocol for a Cameroonian multicentre cross-sectional study. BMJ Open. 2019;9(10):e031322. 10.1136/bmjopen-2019-031322.
20. Westafer LM, Presti T, Shieh MS, Pekow PS, Barnes GD, Kapoor A, et al. Trends in initial anticoagulation among US patients hospitalized with acute pulmonary embolism 2011–2020. Ann Emerg Med. 2024;84(5):518–29. 10.1016/j.annemergmed.2024.05.009.
21. Dentali F, Riva N, Turato S, Grazioli S, Squizzato A, Steidl L, et al. Pulmonary embolism severity index accurately predicts long-term mortality rate in patients hospitalized for acute pulmonary embolism. J Thromb Haemost. 2013;11(12):2103–10. 10.1111/jth.12420.
22. Bumroongkit C, Limsukon A, Liwsrisakun C, Deesomchok A, Pothirat C, Theerakittikul T, et al. Validation of the Pulmonary Embolism Severity Index risk classification and the 2019 European Society of Cardiology risk stratification in the Southeast Asian population with acute pulmonary embolism. J Atheroscler Thromb. 2023;30(11):1601–11. 10.5551/jat.64094.
23. Bumroongkit C, Deesomchok A, Liwsrisakun C, Pothirat C, Theerakittikul T, Limsukon A, et al. Clinical characteristics, risk factors, and outcomes of acute pulmonary embolism in Asian population. J Clin Med. 2022;11(23):6954. 10.3390/jcm11236954.
24. Soo JEJ, Takashima K, Tiah L, Leong BYG. Factors associated with mortality among Asian patients diagnosed with acute pulmonary embolism in the emergency department. J Emerg Crit Care Med. 2021;5. 10.21037/jeccm-20-96.
25. Zhen K, Tao Y, Xia L, Wang S, Gao Q, Wang D, et al. Epidemiology of pulmonary embolism in China, 2021: a nationwide hospital-based study. Lancet Reg Health West Pac. 2024;54:101258. 10.1016/j.lanwpc.2024.101258.
26. Jiménez D, de Miguel-Díez J, Guijarro R, Trujillo-Santos J, Otero R, Barba R, et al. Trends in the management and outcomes of acute pulmonary embolism: analysis from the RIETE registry. J Am Coll Cardiol. 2016;67(2):162–70. 10.1016/j.jacc.2015.10.060.
27. Park DY, An S, Kashoor I, Ezegwu O, Gupta S. In-hospital prognosis of malignancy-related pulmonary embolism: an analysis of the national inpatient sample 2016–2018. J Thromb Thrombolysis. 2022;54(4):630–8. 10.1007/s11239-022-02684-8.
28. Sorour L, Anagreh T, Faris ME, Varghese B, Hieu TH, Nikolaishvili M, et al. Pulmonary embolism in cancer patients: clinical insights and outcomes from a community hospital. J Clin Oncol. 2025;43(16 Suppl):e23084. 10.1200/JCO.2025.43.16_suppl.e23084.
29. Pérez-Jacoiste Asín MA, Blanco Molina Á, Gómez-Cuervo C, Díaz-Pedroche MDC, Pedrajas JM, López-Núñez JJ, et al. Venous thromboembolism in women with hormone-dependent breast cancer. To continue or discontinue hormonal treatment? Insights from the RIETE registry. Thromb Res. 2024;241:109087. 10.1016/j.thromres.2024.109087.

30. Laporte S, Mismetti P, Décousus H, Uresandi F, Otero R, Lobo JL, et al. Clinical predictors for fatal pulmonary embolism in 15,520 patients with venous thromboembolism: findings from the Registro Informatizado de la Enfermedad TromboEmbolica venosa (RIETE) Registry. Circulation. 2008;117(13):1711–6. 10.1161/CIRCULATIONAHA.107.726232.
31. Chan CM, Woods C, Shorr AF. The validation and reproducibility of the pulmonary embolism severity index. J Thromb Haemost. 2010;8(7):1509–14. 10.1111/j.1538-7836.2010.03888.x.
32. Elias A, Mallett S, Daoud-Elias M, Poggi JN, Clarke M. Prognostic models in acute pulmonary embolism: a systematic review and meta-analysis. BMJ Open. 2016;6(4):e010324. 10.1136/bmjopen-2015-010324.
33. Kearon C, Akl EA, Ornelas J, Blaivas A, Jimenez D, Bounameaux H, et al. Antithrombotic therapy for VTE disease: CHEST guideline and expert panel report. Chest. 2016;149(2):315–52. 10.1016/j.chest.2015.11.026.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- CopyofPESIDataForManuscript.xls