

Ian Ward A. Maia, MD  
Department of Emergency Medicine, Universidade de São Paulo, São Paulo, Brazil

Lucas Oliveira J. e Silva, MD, PhD  
Department of Emergency Medicine, Hospital de Clinicas de Porto Alegre, Porto Alegre, Brazil

<https://doi.org/10.1016/j.annemergmed.2024.04.016>

**Funding and support:** By *Annals'* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see [www.icmje.org](http://www.icmje.org)). The authors have stated that no such relationships exist. The authors report this article did not receive any outside funding or support.

1. von Hellmann R, Fuhr N, Maia IWA, et al. Effect of bougie use on first-attempt success in tracheal intubations: a systematic review and meta-analysis. *Ann Emerg Med.* 2024;83:132-144.
2. Zhao Y, Zang B, Wang Q. The effectiveness of bougie use on first-attempt success in tracheal intubations. *Ann Emerg Med.* 2024;84:331-332.
3. Gluud C, Wetterslev J, Higgins J, et al. Cochrane Scientific Committee. Recommendation statement/report. Review of approaches to cumulative meta-analyses for systematic reviews lead developers/ investigators. *Cochrane Methods.* Accessed March 20, 2024. [http://methods.cochrane.org/sites/methods.cochrane.org/files/uploads/scientific\\_committee\\_statement\\_report\\_cumulative\\_ma\\_final\\_301017.pdf](http://methods.cochrane.org/sites/methods.cochrane.org/files/uploads/scientific_committee_statement_report_cumulative_ma_final_301017.pdf)

## Optimizing the Use of Pulmonary Embolism Severity Indices in Electronic Clinical Decision Support



### To the Editor:

We were delighted to learn about the performance of the natural language processing algorithm developed by Amin et al<sup>1</sup> in identifying computed tomography pulmonary angiography interpretations that were likely positive for pulmonary embolism (PE). We were also excited by their pioneering linkage of real-time natural language processing results with alerts directing clinicians to clinical decision support for patients who may be eligible for outpatient management. Automatic hourly score updates were another impressive innovation. Indeed, we would have benefited from these valuable technological capacities when designing our PE clinical decision support tool 12 years ago.

We have 2 questions for the investigators. First, are the authors using the simplified PE Severity Index (sPESI) as a standalone decision support tool? The sPESI, like its

more nuanced parent PE Severity Index (PESI), was designed to predict 30-day all-cause mortality.<sup>2</sup> Both indices fall short when used alone as triage tools, as they were not designed to address important variables needed for safe emergency department (ED) disposition decisions, eg, significant thrombocytopenia, severe renal insufficiency, or lack of access to outpatient anticoagulation. The Hospitalization or Out-treatment Management of Patients With Pulmonary Embolism: a Randomized Controlled Trial study authors explained that sPESI “cannot be applied as a standalone rule to decide on the feasibility of home treatment. It requires an implicit assessment of medical or social conditions precluding home treatment.”<sup>3</sup> Physicians in HOME-PE supplemented sPESI with clinical judgment and subsequently hospitalized 8.9% of patients designated low-risk by sPESI. The need to supplement sPESI (and PESI) supports an *assistive* rather than a *directive* approach to PE clinical prediction tools, a practice recommended by the American College of Chest Physicians.<sup>4</sup>

The potential for misclassification by sPESI when used as a triage tool works in both directions—some patients designated high-risk for 30-day all-cause mortality may be entirely suitable for home care. In the sPESI triage algorithm (unlike PESI), a history of cancer, even if remote and resolved, contraindicates outpatient management, as does age >80 years, irrespective of the patient’s broader clinical profile.<sup>3</sup>

Second, why select sPESI over the higher performing PESI? In a multicenter study of 15,531 patients, sPESI accurately identified those at low-risk of adverse outcomes but classified a smaller proportion of patients as low-risk than PESI and had lesser discriminatory power.<sup>5</sup> Similar results have been found in other settings. As Amin et al<sup>1</sup> are calculating the index score electronically, the advantage of simplification disappears. PESI was initially simplified because its complexity was thought to hinder use by clinicians calculating scores with pencil and paper; the sPESI designers were concerned that PESI “requires computation” by busy emergency clinicians.<sup>2</sup> However, that impediment is moot in hospitals that can present to clinicians “the automatic sPESI score calculation,” as these investigators are doing.<sup>1</sup> Computers find PESI no more difficult than sPESI.

Accumulating evidence continues to demonstrate that outpatient treatment of ED patients with low-risk PE is safe and effective. Whichever risk stratification algorithm investigators select to guide ED disposition decisionmaking, this creative linkage of natural language processing with

clinical decision support is a welcome step forward in the ongoing endeavor to better match ED site-of-care decisions with each patient's individualized risks and needs.

David R. Vinson, MD

The Permanente Medical Group and the Kaiser Permanente Division of Research, Oakland, CA

The Department of Emergency Medicine, Kaiser Permanente Roseville Medical Center, Roseville, CA

Samuel G. Rouleau, MD

Department of Emergency Medicine, University of California, Davis, Sacramento, CA

Scott D. Casey, MD, MS

The Permanente Medical Group and the Kaiser Permanente Division of Research, Oakland, CA

The Department of Emergency Medicine, Kaiser Permanente Vallejo Medical Center, Vallejo, CA

William B. Stubblefield, MD, MPH

Department of Emergency Medicine, Vanderbilt University Medical Center, Nashville, TN

Lauren M. Westafer, DO, MPH

Departments of Emergency Medicine and Healthcare Delivery and Population Science, UMass Chan Medical School-Baystate, Springfield, MA

<https://doi.org/10.1016/j.annemergmed.2024.03.031>

**Funding and support:** By *Annals'* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see [www.icmje.org](http://www.icmje.org)). The authors have stated that no such relationships exist. The authors report this article did not receive any outside funding or support.

1. Amin KD, Weisler EH, Ratliff W, et al. Development and validation of a natural language processing model to identify low-risk pulmonary embolism in real time to facilitate safe outpatient management. *Ann Emerg Med.* 2024;84:118-127.
2. Jiménez D, Aujesky D, Moores L, et al. Simplification of the pulmonary embolism severity index for prognostication in patients with acute symptomatic pulmonary embolism. *Arch Intern Med.* 2010;170:1383-1389.
3. Roy PM, Penaloza A, Hugli O, et al. Triaging acute pulmonary embolism for home treatment by Hestia or simplified PESI criteria: the HOME-PE randomized trial. *Eur Heart J.* 2021;42:3146-3157.
4. Vinson DR, Mark DG, Ballard DW. Outpatient management of patients with pulmonary embolism. *Ann Intern Med.* 2019;171:228.
5. Venetz C, Jiménez D, Mean M, Aujesky D. A comparison of the original and simplified Pulmonary Embolism Severity Index. *Thromb Haemost.* 2011;106:423-428.

*In reply:*



We thank Vinson et al<sup>1</sup> for their thoughtful response to our work.<sup>2</sup> They raise several important and valid points regarding (1) the use of the simplified pulmonary embolism severity index (sPESI) as a standalone triage tool and (2) the decision to use the sPESI over the more expansive pulmonary embolism severity index (PESI) score.

As outlined in our article, the purpose of our tool is to aid clinical decisionmaking by identifying patients with low-risk pulmonary embolism (PE) as candidates for discharge. This is achieved through automated calculation of the sPESI score and development of a clinical workflow to facilitate safe and timely outpatient follow up. Importantly, this tool is intended to *complement* clinical judgment rather than replace it. As alluded to by Vinson et al, there are many reasons outside of the 6 discrete variables captured by the sPESI that may warrant inpatient management of low-risk PE. In the HOME-PE trial, investigators found that the sPESI score was a safe and effective triage tool only when a clinician could overrule the qualification issued by the score based on a patient's medical or social context (which occurred 28.5% of the time).<sup>3</sup> Similarly, chart abstraction of all low-risk PE patients admitted for inpatient management in our cohort revealed that 39.8% were admitted for alternative diagnoses aside from PE, further underscoring that this tool should not supplant clinical judgement.<sup>2</sup> To the best of our knowledge, there are no PE risk stratification scores—or any clinical risk score for that matter—that can capture the many nuanced reasons that may warrant inpatient management of a patient. As such, this tool is not intended to serve as a standalone triage tool.

The point that PESI has greater discriminatory power compared to sPESI is well taken. From a logistical standpoint, the PESI score is heavily weighted by altered mental status, which is defined in the PESI derivation and validation study as “disorientation, lethargy, stupor, or coma.”<sup>4</sup> This is not information that can reliably be extracted from the electronic health record at our institution without more advanced text mining methods. It would be possible to use the Glasgow Coma Scale as a proxy for mental status in future iterations of our model only if it is consistently captured in a discrete field early in a patient's emergency department encounter. In contrast, all the variables included in the sPESI score calculation are readily captured in the electronic health record. Finally, the sPESI score in particular has been shown to reduce *both* clinical and economic burdens from admission for

acute PE, which reflects the ultimate objective of this project.<sup>5</sup>

*Krunal D. Amin, MD*  
*Department of Medicine, Duke University School of*  
*Medicine, Durham, NC*

*Alexander E. Sullivan, MD*  
*Division of Cardiology, Vanderbilt University Medical Center,*  
*Nashville, TN*

*William Schuyler Jones, MD*  
*Department of Medicine, Duke University School of*  
*Medicine, Durham, NC*  
*Division of Cardiology, Department of Medicine, Duke*  
*University School of Medicine, Durham, NC*

*Mark Sendak, MD, MPP*  
*Duke Institute for Health Innovation, Duke University School*  
*of Medicine, Durham, NC*

<https://doi.org/10.1016/j.annemergmed.2024.04.017>

*Funding and support:* By *Annals'* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see [www.icmje.org](http://www.icmje.org)). The authors have stated that no such relationships exist. Funded by Duke Institute for Health Innovation.

1. Vinson DR, Rouleau SG, Casey SD, Stubblefield WB, Westafer LM. Optimizing the use of pulmonary embolism severity indices in electronic clinical decision support. *Ann Emerg Med.* 2024;84:333-334.
2. Amin KD, Weissler EH, Ratliff W, et al. Development and validation of a natural language processing model to identify low-risk pulmonary embolism in real time to facilitate safe outpatient management. *Ann Emerg Med.* 2024;84:118-127.
3. Roy PM, Penaloza A, Hugli O, et al. Triaging acute pulmonary embolism for home treatment by Hestia or simplified PESI criteria: the HOME-PE randomized trial. *Eur Heart J.* 2021;42:3146-3157.
4. Aujesky D, Obrosky DS, Stone RA, et al. Derivation and validation of a prognostic model for pulmonary embolism. *Am J Respir Crit Care Med.* 2005;172(8):1041-1046.
5. Wells P, Peacock WF, Fermann GJ, et al. The value of sPESI for risk stratification in patients with pulmonary embolism. *J Thromb Thrombolysis.* 2019;48:149-157.