



SHAREABLE PDF

# Derivation and validation of a clinical prediction rule for thrombolysis-associated major bleeding in patients with acute pulmonary embolism: the BACS score

Luis Jara-Palomares <sup>1,2</sup>, David Jiménez <sup>2,3,4</sup>, Behnood Bikdeli<sup>5,6,7</sup>, Alfonso Muriel<sup>8</sup>, Parth Rali <sup>9</sup>, Yugo Yamashita<sup>10</sup>, Takeshi Morimoto <sup>11</sup>, Takeshi Kimura<sup>10</sup>, Raphael Le Mao<sup>12</sup>, Antoni Riera-Mestre <sup>13,14</sup>, Ana Maestre<sup>15</sup>, Fares Moustafa <sup>16</sup> and Manuel Monreal<sup>2,17,18</sup>, the RIETE investigators<sup>19</sup>

**Affiliations:** <sup>1</sup>Respiratory Dept, Virgen del Rocío Hospital and Instituto de Biomedicina, Seville, Spain. <sup>2</sup>CIBER de Enfermedades Respiratorias (CIBERES), Instituto de Salud Carlos III, Madrid, Spain. <sup>3</sup>Respiratory Dept, Hospital Ramón y Cajal and Instituto Ramón y Cajal de Investigación Sanitaria (IRYCIS), Madrid, Spain. <sup>4</sup>Medicine Dept, Universidad de Alcalá, (IRYCIS) Madrid, Spain. <sup>5</sup>Division of Cardiology, Dept of Medicine, Columbia University Medical Center, New York-Presbyterian Hospital, New York, NY, USA. <sup>6</sup>Center for Outcomes Research and Evaluation (CORE), Yale University School of Medicine, New Haven, CT, USA. <sup>7</sup>Cardiovascular Research Foundation, New York, NY, USA. <sup>8</sup>Biostatistics Dept, Ramón y Cajal Hospital and Instituto Ramón y Cajal de Investigación Sanitaria IRYCIS, CIBERESP, Madrid, Spain. <sup>9</sup>Division of Thoracic Medicine and Surgery, Temple University Hospital, Philadelphia, PA, USA. <sup>10</sup>Dept of Cardiovascular Medicine, Graduate School of Medicine, Kyoto University, Kyoto, Japan. <sup>11</sup>Dept of Clinical Epidemiology, Hyogo College of Medicine, Nishinomiya, Japan. <sup>12</sup>EA3878, Groupe d'Etude de la Thrombose de Bretagne Occidentale (GETBO), Université Européenne de Bretagne, Brest, France. <sup>13</sup>Dept of Internal Medicine, Hospital Universitari de Bellvitge, Bellvitge Biomedical Research Institute (IDIBELL), L'Hospitalet de Llobregat, Barcelona, Spain. <sup>14</sup>Faculty of Medicine and Health Sciences, Universitat de Barcelona, Barcelona, Spain. <sup>15</sup>Dept of Internal Medicine, Hospital del Vinalopó, Elche, Spain. <sup>16</sup>Dept of Emergency, Clermont-Ferrand University Hospital, Clermont-Ferrand, France. <sup>17</sup>Dept of Internal Medicine, Hospital Universitari Germans Trias i Pujol, Badalona, Spain. <sup>18</sup>Universidad Católica de Murcia, Murcia, Spain. <sup>19</sup>A full list of the RIETE investigators is given in the acknowledgements section.

**Correspondence:** David Jiménez, Respiratory Dept and Medicine Dept, Ramón y Cajal Hospital and Alcalá University, IRYCIS CIBER de Enfermedades Respiratorias (CIBERES), Instituto de Salud Carlos III, 28034 Madrid, Spain. E-mail: djimenez.hrc@gmail.com



@ERSpublications

The BACS score, based on easily available patient characteristics, could support physicians in their assessment of the risk of bleeding with systemic thrombolysis for acute pulmonary embolism  
<https://bit.ly/3eVd0SH>

**Cite this article as:** Jara-Palomares L, Jiménez D, Bikdeli B, *et al.* Derivation and validation of a clinical prediction rule for thrombolysis-associated major bleeding in patients with acute pulmonary embolism: the BACS score. *Eur Respir J* 2020; 56: 2002336 [<https://doi.org/10.1183/13993003.02336-2020>].

This single-page version can be shared freely online.

## ABSTRACT

**Background:** Improved prediction of the risk of major bleeding in patients with acute pulmonary embolism (PE) receiving systemic thrombolysis is crucial to guide the choice of therapy.

**Methods:** The study included consecutive patients with acute PE who received systemic thrombolysis in

the RIETE registry. We used multivariable logistic regression analysis to create a risk score to predict 30-day major bleeding episodes. We externally validated the risk score in patients from the COMMAND VTE registry. In addition, we compared the newly created risk score against the Kuijer and RIETE scores.

**Results:** Multivariable logistic regression identified four predictors for major bleeding: recent major bleeding (3 points), age >75 years (1 point), active cancer (1 point) and syncope (1 point) (BACS). Among 1172 patients receiving thrombolytic therapy in RIETE, 446 (38%) were classified as having low risk (none of the variables present, 0 points) of major bleeding according to the BACS score, and the overall 30-day major bleeding rate of this group was 2.9% (95% CI 1.6–4.9%), compared with 44% (95% CI 14–79%) in the high-risk group (>3 points). In the validation cohort, 51% (149 out of 290) of patients were classified as having low risk, and the overall 30-day major bleeding rate of this group was 1.3%. In RIETE, the 30-day major bleeding event rates in the Kuijer and RIETE low-risk strata were 5.3% and 4.4%, respectively.

**Conclusions:** The BACS score is an easily applicable aid for prediction of the risk of major bleeding in the population of PE patients who receive systemic thrombolysis.