

# Individualised prognosis in out-of-hospital cardiac arrest: The case for P-ROSC in Asian people

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*The art of life is a constant readjustment to our surroundings*

Kakuzo Okakura

Out-of-hospital cardiac arrest (OHCA) is a leading cause of global mortality, with more than 200,000 people in the USA dying suddenly from it every year, often due to coronary heart disease.<sup>1</sup> Moreover, despite strong advances in cardiac resuscitation techniques, overall prognosis and neurological outcomes seem to be post-OHCA and have not showed a clear improvement in the past 30 years.<sup>2</sup> In community-wide studies, overall survival rates ranged from 4% to 33%. In particular, the estimated survival to discharge rate, weighted by person-years, was 6.8% in North America, 7.6% in Europe, and 3% in Asia.<sup>3</sup> This variability highlights the need for a thorough investigation of determining factors, thus leading to an improvement in OHCA management and outcomes. Hence the creation of different scores, such as Return of spontaneous circulation After Cardiac Arrest (RACA) and Utstein-Based Return of Spontaneous Circulation (ROSC)(UB-ROSC), designed to identify weak points in the chain of survival and to evaluate the quality of resuscitation strategies and Emergency Medical Services (EMS) systems.

In 2011, Gräsner et al. developed a score to predict the probability of ROSC after OHCA, the RACA score.<sup>4</sup> The RACA score was developed with data from the German Resuscitation Registry and incorporates multiple pre-resuscitation variables that have a crucial impact on

the probability of ROSC. The RACA score was not designed as a prediction tool to facilitate resuscitation decisions but, by providing a predicted ROSC rate, the score could identify weak points in the chain of survival, serving as a quality indicator of resuscitation strategies and EMS systems. Moreover, since the original study was performed with data from a German registry, its application in other cohorts with different EMS systems and populations led to mixed results.<sup>5</sup>

Recently, Baldi et al. generated the UB-ROSC score to identify the probability of ROSC and survival to hospital admission of patients with OHCA.<sup>6</sup> Differently from the RACA score, the UB-ROSC score is able to take into account random effects related to centre, thus making it usable in the field, and possibly supporting resuscitation-related decisions. However, UB-ROSC is a relatively new instrument and has not been widely validated with external patient cohorts, particularly in Asia.

For this reason, considering the impactful differences in population characteristics and EMS systems between Asian and European or American cohorts, in this issue of *eClinicalMedicine*, Nan Liu et al. attempted to develop a Prehospital ROSC (P-ROSC) score suited for patients with OHCA in Asia.<sup>7</sup> To better understand OHCA events in Asian cohorts, the authors queried the PAROS Registry, an international clinical research network founded in 2010. The collected variables ranged from patient-related, event-related, EMS-related, to patient outcomes, thus addressing different parts of the survival chain.<sup>8</sup> At present, the progressive expansion of the use of electronic health records (EHRs) allows the use of the growing quantity and diversity of data to create modern risk models with advanced machine learning solutions.<sup>9</sup> By contrast, although EHRs are indeed rich data sources, numerous data items are collected in a non-systematic way, causing the accumulation of irrelevant and redundant information. Actually, in risk models, more variables do not necessarily lead to better performance.<sup>10</sup> The PAROS Registry has been developed with common taxonomy and a standardised case report form in order to collect and record data in a systematic way, thus making the creation of the risk model effective and precise. In this study, AutoScore, a

**eClinicalMedicine**  
**2022;48: 101446**

Published online xxx

<https://doi.org/10.1016/j.eclinm.2022.101446>

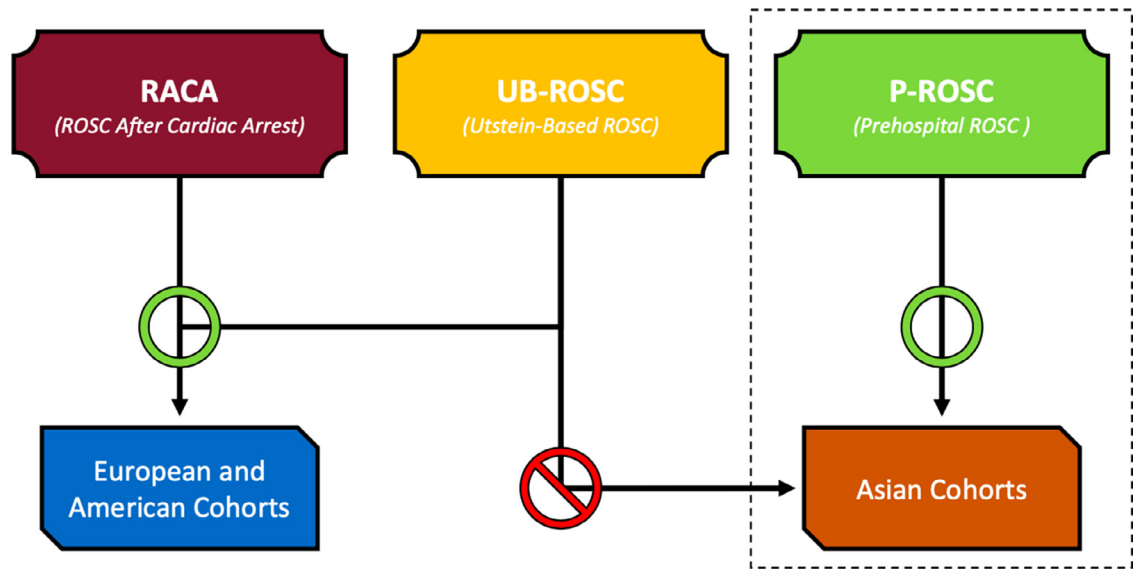
eclinm.2022.101446

DOI of original article: <http://dx.doi.org/10.1016/j.eclinm.2022.101422>

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**Figure 1.** Rationale for and development process of the P-ROSC score to predict prognosis in Asian patients with out-of-hospital cardiac arrest.

RACA: Return of spontaneous circulation After Cardiac Arrest, ROSC: return of spontaneous circulation, UB-ROSC: Utstein-Based Return of Spontaneous Circulation.

framework developed to automate the derivation of risk scores using a combination of machine learning and regression modelling, has been used to generate a point-based score, easy to apply to different clinical settings. To check if the P-ROSC score was actually more suitable for Asian populations, RACA score and UB-ROSC score were calculated on the same cohort, using the original formulas developed by the creators, respectively Gräsner et al. and Baldi et al. In this study, the newly developed P-ROSC score showed itself to be a readily accessible risk prediction tool for ROSC probability estimation (Figure 1).

Thanks to this study, an accessible and easy-to-use score was therefore developed for estimating the probability of ROSC. Moreover, four variables out of five are shared with RACA and UB-ROSC scores, but the P-ROSC score shows a better performance in Asian cohorts than the other two scores. In conclusion, differences in populations and cohorts are crucial and should be taken into consideration when developing scores that can help evidence-based clinical practice, especially in critical situation such as OHCA. Regarding this context, P-ROSC was the first score to estimate the ROSC probability of patients with OHCA in Asia effectively, and it showed great discrimination capabilities, thus serving as a potentially helpful tool to aid clinical decision-making.

## Contributors

Alberto Testa has drafted the manuscript and approved the final version. Francesco Versaci has revised the

manuscript for important critical content, and approved the final version. Giuseppe Biondi-Zoccai has conceived the manuscript, revised it for important critical content, and approved the final version.

## Funding

None.

## Declaration of interests

Giuseppe Biondi-Zoccai has consulted for Cardionovum, Crannmedical, Innovheart, Meditrial, Opsens Medical, Replycare, and Terumo. All other authors report no conflict of interest.

## Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:[10.1016/j.eclinm.2022.101446](https://doi.org/10.1016/j.eclinm.2022.101446).

## References

- 1 Adrie C, Cariou A, Mourvillier B, et al. Predicting survival with good neurological recovery at hospital admission after successful resuscitation of out-of-hospital cardiac arrest: the OHCA score. *Eur Heart J*. 2006;27:2840–2845.
- 2 Myat A, Song KJ, Rea T. Out-of-hospital cardiac arrest: current concepts. *Lancet*. 2018;391:970–979.
- 3 Berdowski J, Berg RA, Tijssen JG, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: systematic review of 67 prospective studies. *Resuscitation*. 2010;81:1479–1487.
- 4 Gräsner JT, Meybohm P, Lefering R, et al. ROSC after cardiac arrest—the RACA score to predict outcome after out-of-hospital cardiac arrest. *Eur Heart J*. 2011;32:1649–1656.

- 5 Kupari P, Skrifvars M, Kuisma M. External validation of the ROSC after cardiac arrest (RACA) score in a physician staffed emergency medical service system. *Scand J Trauma Resusc Emerg Med.* 2017;25:34.
- 6 Baldi E, Caputo ML, Savastano S, et al. An utstein-based model score to predict survival to hospital admission: the UB-ROSC score. *Int J Cardiol.* 2020;308:84–89.
- 7 Liu N, Liu M, Chen X, et al. Development and validation of an interpretable prehospital return of spontaneous circulation (P-ROSC) score for patients with out-of-hospital cardiac arrest using machine learning: a retrospective study. *eClinicalMedicine.* 2022. in press.
- 8 Ong ME, Shin SD, De Souza NN, et al. Outcomes for out-of-hospital cardiac arrests across 7 countries in Asia: the Pan Asian Resuscitation Outcomes Study (PAROS). *Resuscitation.* 2015;96:100–108.
- 9 Xie F, Chakraborty B, Ong MEH, Goldstein BA, Liu N. AutoScore: a machine learning-based automatic clinical score generator and its application to mortality prediction using electronic health records. *JMIR Med Inform.* 2020;8:e21798.
- 10 Sanchez-Pinto LN, Venable LR, Fahrenbach J, Churpek MM. Comparison of variable selection methods for clinical predictive modeling. *Int J Med Inform.* 2018;116:10–17.