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Clinical Research

Global adoption of TRI-SCORE digital tools for the risk stratification of patients with tricuspid regurgitation

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ABSTRACT

Background: The TRI-SCORE is a dedicated risk-stratification tool for patients with isolated severe tricuspid regurgitation (TR) that is freely accessible via a web-based platform or mobile application.
Aims: To evaluate the global uptake of the TRI-SCORE and to describe the clinical characteristics of patients considered for intervention.
Methods: We collected all TRI-SCORE calculations and related parameters entered by users into the web-based calculator or mobile application between June 2024 and June 2025, along with the users' geographic location. The clinical profiles derived from these data were compared with those of the TRIGISTRY cohort.
Results: Overall, 36,001 calculations were recorded across 117 countries, with 83% performed through the web-based platform. Most patients were aged ≥ 70 years (70%), 58% were women and 70% had atrial fibrillation or flutter. TR was functional in 73% of cases. Patients were generally severely symptomatic (58% in New York Heart Association class III–IV, 58% with right heart failure signs) and many presented with advanced disease stages, with 33% and 27% falling into intermediate (4–5 points) and high (≥ 6 points) TRI-SCORE categories, respectively. Patient profiles were broadly consistent with those in TRIGISTRY, although left ventricular, hepatic and renal dysfunction were less commonly encountered.
Conclusion: These findings demonstrate the widespread adoption of the TRI-SCORE through free, user-friendly digital platforms and suggest its potential utility as a tool to monitor disease stage when considering interventions in patients with TR.

1. Background

With the advent of transcatheter therapies and building on the established trajectories of aortic and mitral valve interventions, tricuspid regurgitation (TR) has gained unprecedented clinical attention [1,2]. Our work – and that of others – has demonstrated that it is the clinical presentation and stage of TR disease rather than the intervention itself that primarily drives the high or prohibitive surgical mortality reported in many observational studies [3–5]. The TRI-SCORE, which integrates the severity of TR clinical presentation and its end-organ consequences, is a dedicated risk model designed to predict in-hospital mortality following isolated tricuspid valve surgery [6]. The TRI-SCORE is based on eight easy to ascertain clinical, biological and echocardiographic parameters (age, New York Heart Association [NYHA] class, signs of right heart failure, daily dose of loop diuretics, renal function, liver function, left ventricular function and right ventricular function).

Initially developed in a French cohort of patients who underwent isolated tricuspid valve surgery for both functional and organic TR, the TRI-SCORE has since been validated in multiple external cohorts encompassing wide geographical areas including in Asia [7]. Its predictive value has also been extended to patients managed conservatively or referred for transcatheter interventions [8,9]. In practice, three TRI-SCORE risk categories have been defined, low (≤ 3 points), intermediate (4–5 points) and high (≥ 6 points), to support decision-making in patients with TR. The TRI-SCORE is now incorporated into the TR management algorithm of the 2025 European Society of Cardiology (ESC)/European Association for Cardio-Thoracic Surgery (EACTS) guidelines [10].

To facilitate access, we launched a free web-based calculator (https://www.tri-score.com/) followed, in June 2024, by a mobile application for iOS and Android. These digital tools offer a unique opportunity to collect information regarding the clinical presentations and

Abbreviations: CIED, cardiac implantable electronic device; EACTS, European Association for Cardio-Thoracic Surgery; ESC, European Society of Cardiology; NYHA, New York Heart Association; TR, tricuspid regurgitation.

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Table 1
Characteristics of patients for whom the TRI-SCORE was calculated using digital platforms, overall and according to the mechanism of tricuspid regurgitation.

Characteristics	Overall (n = 36,001)	Functional (n = 26,123)	Organic (n = 5504)	Mixed (n = 4374)	P*
Clinical					
Age ≥ 70 years	25,183 (70)	18,936 (72)	3,359 (61)	2,888 (66)	< 0.001
Female sex	20,782 (58)	14,937 (57)	3,214 (58)	2,631 (60)	< 0.001
Prior left heart valve intervention	8,577 (24)	6,199 (24)	1,024 (19)	1,354 (31)	< 0.001
Surgery	6,465 (18)	4,600 (18)	805 (15)	1,060 (24)	
Transcatheter	2,112 (6)	1,599 (6)	219 (4)	294 (7)	
Permanent CIED	7,197 (20)	4,950 (19)	852 (15)	1,395 (32)	< 0.001
Pacemaker	5,615 (16)	3,875 (15)	685 (12)	1,055 (24)	
Defibrillator	1,582 (4)	1,075 (4)	167 (3)	340 (8)	
NYHA functional class III–IV	20,924 (58)	15,344 (59)	2,957 (54)	2,623 (60)	< 0.001
Right-sided heart failure signs	20,828 (58)	15,023 (58)	3,074 (56)	2,731 (62)	< 0.001
Daily dose of loop diuretics ≥ 125 mg	7,664 (21)	5,492 (21)	1,017 (18)	1,155 (26)	< 0.001
Atrial fibrillation or flutter	25,062 (70)	18,429 (71)	3,397 (62)	3,236 (74)	< 0.001
Laboratory parameters					
Glomerular filtration rate < 30 mL/min	1,212 (3)	927 (4)	135 (2)	150 (3)	< 0.001
Elevated total bilirubin	6,791 (19)	4,925 (19)	1,037 (19)	829 (19)	0.99
Echocardiographic parameters					
Left ventricular ejection fraction < 60%	15,119 (42)	10,986 (42)	2,082 (38)	2,051 (47)	< 0.001
Moderate/severe right ventricular dysfunction	13,239 (37)	9,404 (36)	1,923 (35)	1,912 (44)	< 0.001
TRI-SCORE	4 (2–6)	4 (2–6)	4 (2–5)	4 (3–6)	< 0.001
Low (≤ 3)	14,325 (40)	10,306 (39)	2,461 (45)	1,558 (36)	< 0.001
Intermediate (4–5)	12,069 (33)	8,809 (34)	1,819 (33)	1,441 (33)	
High (≥ 6)	9,607 (27)	7,008 (27)	1,224 (22)	1,375 (31)	

Data are expressed as number (%) or median (interquartile range). CIED: cardiac implantable electronic device; NYHA: New York Heart Association; TR: tricuspid regurgitation; *: P-value calculated for comparison between the three TR mechanisms (functional, organic and mixed).

risk profiles of patients being considered for a tricuspid valve intervention. In the present study, we aimed to evaluate the global adoption of the TRI-SCORE digital tools across web-based and mobile platforms over a recent 12-month period, and to characterize the clinical profiles of patients for whom the tool is used in routine practice.

2. Methods

We collected all TRI-SCORE calculations and related parameters entered by users for the calculation of the TRI-SCORE through either the official web-based calculator or the dedicated mobile applications between June 2024 (date of the release of the mobile application) and June 2025. All TRI-SCORE calculations were included but as the data were fully anonymized, there may have been repeated entries for some patients. In both the web-based and mobile applications, all TRI-SCORE variables encoded as binary (present/absent) are by default set to absent unless actively selected by the user. All patient-related data were collected in a fully anonymized manner, without any patient identifiers. Geographic location and professional background were collected only for users of the mobile application, for which explicit user consent was obtained.

The clinical profiles derived from the digital calculators were compared with those of patients included in TRIGISTRY, a contemporary international real-world registry comprising 2,413 patients with isolated functional TR, defined by the absence of significant left-sided valvular disease, in whom the TRI-SCORE was available. These patients were recruited from more than 30 heart valve centres across 10 countries and managed with medical therapy, isolated tricuspid valve surgery (repair or replacement without concomitant procedures) or transcatheter tricuspid valve repair utile [9].

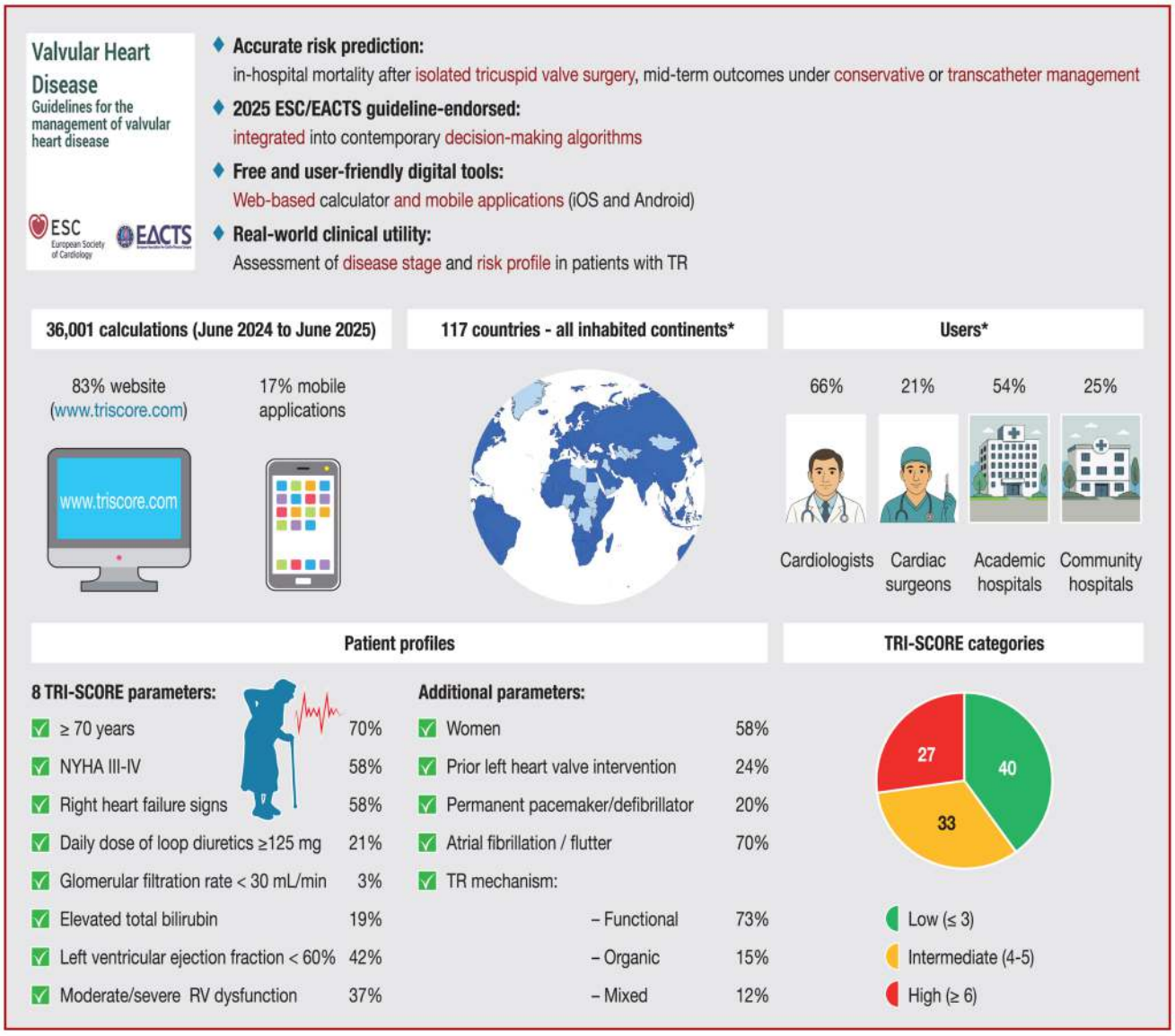
3. Results

Between June 2024 and June 2025, 36,001 TRI-SCORE calculations were performed, corresponding to an average of approximately 100 per day. The majority were completed via the web-based platform (n = 29,734, 83%), while the mobile applications accounted for the remaining 17% (n = 6,267). Data on country of origin and professional background of mobile users showed that the TRI-SCORE was calculated in 117 countries across all five continents, with 66% of users identified as cardiologists and 21% as cardiac surgeons. Most calculations were performed in academic hospitals (54%), followed by community hospitals (25%) (Central Illustration).

Regarding patient characteristics, 70% were aged ≥ 70 years, 58% were women and 70% had atrial fibrillation or flutter (Table 1, Central Illustration). A prior left-sided valve intervention was reported in 24% and 20% had a cardiac implantable electronic device (CIED). Most patients were severely symptomatic: 58% were in NYHA class III–IV, 58% presented with signs of right-sided heart failure, and 21% were receiving ≥ 125 mg of loop diuretics daily. Severe renal dysfunction (glomerular filtration rate < 30 mL/min) was observed in 3%, while 19% had elevated total bilirubin. Left ventricular ejection fraction was < 60% in 42% of patients, and moderate/severe right ventricular dysfunction was reported in 37%. The median (interquartile range) TRI-SCORE was 4 (2–6). According to TRI-SCORE categories, 40% of patients were classified as low risk (≤ 3 points), 33% as intermediate risk (4–5 points) and 27% as high risk (≥ 6 points).

Functional TR was the predominant mechanism (reported in 73% of calculations, n = 26,123 patients), while organic and mixed TR accounted for 15% (n = 5,504) and 12% (n = 4,374), respectively (Central Illustration). Compared with patients with functional or mixed TR, those with organic TR were younger, less frequently in atrial fibrillation or flutter, less likely to have a CIED or a prior left-sided valve surgery, were overall less symptomatic, and consequently presented with lower TRI-SCORE risk (P < 0.001). Compared with those with functional TR, patients with mixed TR were also younger but had more prior left-sided valve surgery, more frequent CIED, more pronounced symptoms, had higher rates of atrial fibrillation or flutter, left ventricular and right ventricular dysfunction, and had higher TRI-SCORE risk (P < 0.001) (Table 1).

The 26,123 patients with functional TR collected via the digital platforms and the 2413 enrolled in TRIGISTRY showed some overall similarities in their profiles. Nevertheless, differences were observed



Central Illustration. Global adoption of the TRI-SCORE powered by digital tools. ESC: European Society of Cardiology; EACTS: European Association for Cardio-Thoracic Surgery; NYHA: New York Heart Association; RV: right ventricular; TR: tricuspid regurgitation. *: based on mobile application data only.

across the majority of baseline parameters, including lower rates of left ventricular, renal and hepatic dysfunction in the digital cohort (all $P < 0.001$), as well as a higher proportion of low TRI-SCORE and a lower proportion of high TRI-SCORE ($P < 0.001$).

Patient characteristics were overall similar between the web-based platform and the mobile application (Online supplement Table A.1). Although multiple differences reached statistical significance, these were largely driven by the large sample size and were associated with broadly comparable absolute proportions across groups.

4. Discussion

Although relatively recent, the TRI-SCORE has quickly become an essential tool in the decision-making process for patients with isolated TR [6,10]. Amid increasing recognition of TR and the rapid development of transcatheter therapies, this study demonstrates the widespread global uptake of the TRI-SCORE. The TRI-SCORE calculator was used in 117 countries across all inhabited continents, underscoring the value of accessible digital tools to enhance patient care regardless of national wealth or healthcare infrastructure. This is particularly noteworthy given that TR has historically been under-recognized and undertreated, with limited therapeutic options until recently. Interestingly, the majority of calculations were performed through the website, with relatively limited use of the dedicated mobile applications. This lower uptake of the applications was somewhat unexpected but may be explained by the fact that most calculations are performed during consultations, where clinicians already have a computer open, making the web platform more convenient. Nevertheless, offering both formats remains important to ensure clinicians can access the tool in the way that best suits their workflow.

Beyond its global uptake, this registry provides important epidemiological insights into contemporary real-world practice. It captures a large and geographically diverse population of patients, including clinical characteristics extending beyond the variables required for TRI-SCORE calculation, such as mechanisms of TR. This breadth makes the dataset particularly informative for characterizing current patterns of TR assessment worldwide. When comparing patients with functional TR identified through the digital platforms with those enrolled in TRIGISTRY, overall profiles were broadly comparable, although patients in

TRIGISTRY more frequently exhibited markers of advanced disease. This difference is consistent with the distinct nature of the two data sources. TRIGISTRY predominantly includes patients referred to expert centres for advanced evaluation or intervention, whereas the digital tools are used by a broader spectrum of clinicians across outpatient settings, community hospitals and academic centres, and therefore may capture patients at earlier stages of the disease course. Importantly, despite this broader and less selected population, nearly two-thirds of patients (60%) in the digital cohort fell into intermediate or high TRI-SCORE categories, highlighting that a substantial proportion of patients remain assessed at an advanced stage of the disease.

This analysis has several limitations. First, as the data were fully anonymized, no patient-level identifiers were available, precluding the identification of repeated calculations performed for the same patient. In real-world practice, repeated entries may occur to explore the impact of modifying one or more clinical parameters during a single hospitalization or when the same patient is assessed by different clinicians (e.g. junior and senior physicians or during Heart Team discussions). Thus, TRI-SCORE calculations might be slightly different from individual calculations. Although the exact magnitude of such duplication cannot be quantified, the very large number of calculations and the wide geographic and institutional distribution of users make it unlikely that repeated entries substantially influenced the overall distribution of clinical characteristics, with any potential effect expected to introduce random variability rather than systematic bias. In both the web-based and mobile applications, all TRI-SCORE variables were encoded as binary (present/absent) and by default set to absent, potentially resulting in underestimation of the TRI-SCORE in some patients. Second, the population captured through digital tools reflects voluntary use by clinicians and is therefore subject to selection bias, potentially limiting its representativeness of the overall population of patients with TR. Accordingly, differences between these populations should be interpreted with caution. Third, no information was available regarding patient management after the TRI-SCORE calculation. While such data would have been valuable, it would have required patient identifiers and repeated follow-up connections (as management decisions may occur weeks or months after the calculation), along with ethics approval not compatible with maintaining free and unrestricted access to the digital platforms. Finally, geographic and professional information were collected only through the mobile application and therefore reflects a subset of users. Nevertheless, these data should be interpreted as a qualitative indicator of the global reach of the TRI-SCORE rather than as a precise quantitative representation of country-level usage.

5. Conclusions

Our results, based on TRI-SCORE calculations performed through a free and user-friendly website and mobile application, highlight its widespread adoption. The ability to extract aggregated data from these digital tools provides insights into real-world patient profiles. The potential impact of such tools on clinical decision-making and timing of intervention warrants further investigation. Adoption of the TRI-SCORE is expected to grow further, supported by the expansion of transcatheter treatment options and its integration into the 2025 ESC/EACTS guidelines (Central Illustration).

Data availability

The data underlying this article will be shared upon reasonable request to the corresponding author.

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Disclosure of interest

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Online supplement. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.acvd.2026.04.003.

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