Interobserver agreement of the Out-of-Hospital Advanced Triage Model (META, 2020) using vignette cases among medical students

Concordancia interobservador del Modelo Extrahospitalario de Triaje Avanzado (META, 2020) mediante casos viñeta entre alumnos de medicina

Víctor Cabrera García[1,2], Pablo Avanzas Fernández[3-6], Graciela Álvarez Cuervo[1], Tatiana Cuartas Álvarez[2,7], Rafael Castro-Delgado[2,4,7]

In 2010, research conducted by a multidisciplinary group from the University of Oviedo (Asturias, Spain) resulted in a new prehospital triage system for mass casualty incidents (MCIs) called the "Advanced Prehospital Triage Model" (META). In 2020, the system was updated by incorporating improvements in its management and the latest available scientific evidence[1] to enhance the system, and in 2022 it demonstrated high sensitivity and specificity with real MCI patients.[2] By 2025, it had already been adopted by most emergency medical services in Spain. META requires previous training in advanced life support for severe trauma, and among critically injured patients it identifies those with high surgical priority who should undergo essential prehospital interventions before rapid evacuation.[3]

As is well known, MCIs involve great complexity in management and development, with a marked disproportion between available resources and the number of victims involved.[4] Therefore, continuous training in the management of these situations and the triage systems used has become an essential part of curricula for the education and preparation of future health care professionals.[5] To face these unusual situations in a controlled manner, simulated environments provide students with effective educational and training strategies to acquire techniques applicable to subsequent clinical practice.[6] One of the main difficulties in implementing MCI triage systems is achieving adequate interobserver agreement, which guarantees their objectivity and scientific validity.

The objective of this study was to analyze interobserver agreement among medical students using the META system through a simulated case exercise. Four seminars were conducted with fifth-year students from the Faculty of Medicine of the University of Oviedo. After a 20-minute explanation of the META system by an expert, 40 vignette-format cases based on real cases were presented. The vignettes had a single correct solution and included all the necessary data for completion, using terminology that avoided confusion or ambiguity (Figure 1). Participation was voluntary, and discussion or interaction among students during the exercise was not allowed. The cases were reviewed by META experts to determine the correct solution. In addition to case solutions, participants' sociodemographic variables were studied. This study was approved by the Ethics Committee of the Principality of Asturias (CEimPA) (Code 2023.236).

A total of 100 5th-year medical students participated in the study, with a mean age of 23 years (SD, 3.38). Overall agreement among all participants was $\kappa = 0.439$ (95% CI, 0.437-0.441; $P < .05$). Table 1 illustrates agreement according to each priority level of the system. The priority with the lowest agreement was

	Injuries	A	B	C	D
Basic triage	Back pain	Normal speech	RR 15	HR 110 CRT < 2	Oriented
Advanced triage	Pain on palpation of the spinal column	Normal speech	O_2 Sat 95	HR 110 CRT < 2 BP 110/70	GCS 15 Paresthesia and loss of strength in both extremities

Figure 1. Example of a vignette case. This corresponds to case number 36 of 40 from the exercise.
A: airway; B: breathing; C: circulation; D: neurologic deficit; E: exposure/examination; HR: heart rate (beats per minute); RR: respiratory rate (breaths per minute); GCS: Glasgow Coma Scale; BP: blood pressure (mm Hg); CRT: capillary refill time (seconds); O_2 Sat: oxygen saturation (%).

"Red C" (κ = 0.176; 95% CI, 0.171-0.180), whereas the highest agreement was obtained for "Black" (κ = 0.762; 95% CI, 0.758-0.766). The total number of correctly performed triages (40 cases and 100 participants) was 2,530 (63% of the 4,000 possible). The mean number of correctly performed triages (n = 40) per participant was 24 (SD, 4.55), with a range of 8-33. The mean overtriage rate (triages assigned a higher priority than the correct result) per student was 6.8 (17%), whereas the mean undertriage rate (triages assigned a lower priority than the correct result) was 8.0 (20%). For demographic characteristics, participants were divided into 3 groups according to their number of correct answers: "fewer than 20," "between 20 and 29," and "30 or more." No significant differences were found between participants and accuracy according to previous knowledge and training in emergency situations (triage, MCIs). Table 2 shows all sociodemographic variables studied.

Medical students achieved moderate overall agreement after a brief explanatory session conducted by experts in the META system. The Black priority level achieved the highest degree of agreement (substantial), whereas Red priority levels showed slight-to-moderate agreement. In previous studies using simpler triage systems such as Simple Triage and Rapid Treatment (START) with nonexpert personnel, almost perfect agreement was obtained.[7] However, when more complex systems such as the South African Triage Scale (SATS) were studied, results were more similar to those obtained in the present study.[8] The fact that the Red C category achieved the lowest agreement is probably due to the need for clinical expertise for its identification, which has not yet been fully developed in 5th-year medical students. META had previously demonstrated superiority over START in the evacuation and treatment of patients during a simulated mass casualty exercise.[9] Since simulation exercises are considered valid educational models,[10] the introduction of the META system into medical and nursing schools through seminars may provide students with initial skills for MCI triage management and also incorporate tabletop exercise systems into their education.[11] Identification of the triage priorities with lower agreement allows reinforcement of educational strategies directed at these specific groups. These results may be explained by limited training in severe trauma management among fifth-year medical students; therefore, considering the results obtained in students without previous training in MCIs or advanced trauma life support, good agreement is expected among emergency professionals, although this should be confirmed.

We consider several limitations of the study. MCI conditions, the stress of the situation itself, and working under adverse environmental conditions (rain, darkness) are mitigated in simulated exercises with controlled external conditions. Furthermore, the time spent performing each triage was not measured, thereby eliminating time-triage pressure. A 2022 study had already demonstrated that triage accuracy is related to the amount of time devoted to each case.[12]

Finally, the META system achieved a moderate level of agreement among medical students after a theoretical seminar and simulated practical cases. Future sessions should further focus on Red priority levels (ABC) and Yellow, which achieved the lowest agreement levels to fully exploit

Table 1. Interobserver agreement (Fleiss κ) among participants using the Advanced Prehospital Triage Model (META)

Priority	Kappa	P	95% CI	Agreement
Global	0.439	< **.001**	0.437-0.441	Moderate
Black	0.762	< **.001**	0.758-0.766	Substantial
Red Q	0.303	< **.001**	0.299-0.308	Fair
Red A	0.392	< **.001**	0.388-0.396	Fair
Red B	0.488	< **.001**	0.483-0.492	Moderate
Red C	0.176	< **.001**	0.171-0.180	Slight
Yellow D	0.547	< **.001**	0.542-0.551	Moderate
Yellow	0.316	< **.001**	0.312-0.321	Fair
Green	0.528	< **.001**	0.524-0.532	Moderate

CI: confidence interval.
Data include 40 items and 100 evaluators.
Bold values indicate statistical significance ($P < .05$).

Table 2. Sociodemographic variables of participants according to the number of correctly performed triages

Variable	Total N = 100 n (%)	≤ 19 correct triages (N = 15) n (%)	20-29 correct triages (N = 77) n (%)	≥ 30 correct triages (N = 8) n (%)	*P*
Age [mean (SD)]	23 (3.38)	24 (5.05)	23 (3.15)	22 (0.75)	.597
Female sex	68 (68.0)	10 (66.6)	51 (66.3)	7 (87.5)	.478
Education					
MCI	31 (31.0)	6 (40.0)	23 (29.8)	2 (25.0)	.690
Training					
MCI triage	10 (10.0)	3 (20.0)	7 (9.1)	0 (0.0)	.273
META	9 (9.0)	2 (13.3)	6 (7.8)	1 (12.5)	.743
ATLS	71 (71.0)	8 (53.3)	57 (74.0)	6 (75.0)	.233
Triage [mean (SD)]					
Correct	24 (4.55)	16 (2.83)	24.8 (2.59)	31.3 (1.04)	< **.001**
Undertriage	7.99 (3.72)	12.33 (4.61)	7.38 (3.01)	5.75 (2.12)	< **.001**
Overtriage	6.81 (3.30)	9.87 (3.62)	6.62 (2.79)	2.88 (2.30)	< **.001**

MCI: mass casualty incident; META: Advanced Prehospital Triage Model; ATLS: Advanced Trauma Life Support; n: number; SD: standard deviation; %: percentage.
Bold values indicate statistical significance ($P < .05$).

the advantages of the META system regarding high detection of patients with ABC instability and its specific classification of surgical patients.[13]

References

1 Arcos González P, Castro Delgado R, Cuartas Álvarez T, Garijo Gonzalo G, Martínez Monzón C, Peláez Corres N, et al. Ten years using the advanced triage model for out-of-hospital emergencies (META): the 2020 version. Emergencias. 2021;33:387-91.

2 Castro Delgado R, Gan RK, Cabrera García V, Arcos González P. Sensitivity and Specificity of Spanish Prehospital Advanced Triage Method (META). Prehosp Disaster Med. 2022;37:321-6.

3 Castro-Delgado R, Garijo-Gonzalo G, Cuartas-Alvarez T. Tranexamic acid needs to be implemented in mass casualty incident protocols. Eur J Trauma Emerg Surg. 2024 May 27. (Accessed 17 September 2024). Available at: https://link.springer.com/10.1007/s00068-024-02517-8

4 Christian MD. Triage. Critical Care Clinics. 2019;35:575-89.

5 Pandit K, Healy E, Todman R, Kingon A, Wright M, Raymond M, et al. Disaster Triage Skills Training: An Introductory Virtual Simulation for Medical Students. Cureus. 2023 May 23. (Accessed 16 November 2023). Available at: https://www.cureus.com/articles/154222-disaster-triage-skills-training-an-introductory-virtual-simulation-for-medical-students

6 Nnaemeka Ajemba M, Ikwe C, Judith Iroanya C. Effectiveness of simulation-based training in medical education: Assessing the impact of simulation-based training on clinical skills acquisition and retention: A systematic review. World J Adv Res Rev. 2024;21:1833-43.

7 Hong R, Sierzenski PR, Bollinger M, Durie CC, O'Connor RE. Does the simple triage and rapid treatment method appropriately triage patients based on trauma injury severity score? Am J Disaster Med. 2008;3:265-71.

8 Mould-Millman NK, Dixon JM, Burkholder T, Pigoga JL, Lee M, De Vries S, et al. Validity and reliability of the South African Triage Scale in prehospital providers. BMC Emerg Med. 2021;21:8.

9 Ferrandini Price M, Arcos González P, Pardo Ríos M, Nieto Fernández-Pacheco A, Cuartas Álvarez T, Castro Delgado R. Comparación de los sistemas de triaje META y START en un ejercicio simulado de múltiples víctimas. Emergencias. 2018;30:224-30.

10 Yu E, Coffey C. Prehospital mass casualty incident triage simulation builds knowledge and confidence in medical trainees. AEM Education and Training. 2024;8:e10962.

11 Castro Delgado R, Fernández García L, Cernuda Martínez JA, Cuartas Álvarez T, Arcos González P. Training of Medical Students for Mass Casualty Incidents Using Table-Top Gamification. Disaster Med Public Health Prep. 2023;17:e255.

12 Cheng T, Staats K, Kaji AH, D'Arcy N, Niknam K, Donofrio-Odmann JJ. Comparison of prehospital professional accuracy, speed, and interrater reliability of six pediatric triage algorithms. JACEP Open. 2022;3:e12613.

13 Tiyawat G, Liu JM, Huabbangyang T, Roza-Alonso CL, Castro-Delgado R. Comparative Analysis of META and SALT Disaster Triage in an Adult Trauma Population: A Retrospective Observational Study. Prehosp Disaster Med. 2024;39:142-50.

Author Affiliations: [1]Unidad de Gestión Clínica de Urgencias, Hospital Universitario Central de Asturias, Oviedo, Spain. [2]Instituto de Investigación Sanitaria del Principado de Asturias (ISPA). Grupo de Investigación en Asistencia Prehospitalaria y Desastres (GIAPREDE), Oviedo, Spain. [3]Área del Corazón, Hospital Universitario Central de Asturias, Oviedo, Spain. [4]Departamento de Medicina, Universidad de Oviedo, Oviedo, Spain. [5]Instituto de Investigación Sanitaria del Principado de Asturias, Grupo Patología Cardiaca, Oviedo, Spain. [6]Centro de Investigación Biomédica en Red de Enfermedades Cardiovasculares (CIBERCV), Madrid, Spain. [7]Servicio de Atención Médica Urgente (SAMU), Oviedo, Spain.
Email: enfermero_cabrera@outlook.com
Conflict of Interest Disclosures: None declared.
Author Contributions, Funding, and Ethical Responsibilities: The author has confirmed their authorship, the non-existence of external funding, and the maintenance of confidentiality and respect for patients' rights in the author's responsibilities document, publication agreement, and assignment of rights to EMERGENCIAS. This study was approved by the Ethics Committee of the Principality of Asturias (CEimPA) (Code 2023.236).
Article not commissioned by the Editorial Board and with external peer review.
Editor in Charge: Xavier Jiménez Fábrega.
Corresponding Author: Víctor Cabrera García. Unidad de Gestión Clínica de Urgencias. Hospital Universitario Central de Asturias. Avenida de Roma, s/n. 33011 Oviedo, Spain.