

A Escala *Confusion Assessment Method for Intensive Care Unit*: Estudo de Validação numa Grande Coorte no Serviço de Urgência de um Hospital Terciário

The Confusion Assessment Method for Intensive Care Unit: A Large Cohort Validation Study in the Emergency Department of a Tertiary Hospital

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Resumo:

Introdução: A escala *Confusion Assessment Method for Intensive Care Unit* (CAM-ICU) apresenta um grande potencial de aplicação no Serviço de Urgência (SU). No entanto, existem ainda incertezas relativas à sua acurácia e fiabilidade, requerendo estudos com maiores coortes. Numa das maiores e mais heterogéneas coortes conhecidas até o momento, aqui o objetivo foi validar e explorar a aplicabilidade da CAM-ICU (versão Português Europeu) como ferramenta de rastreio e diagnóstico de delirium no SU de um hospital terciário.

Métodos: Os dados foram colhidos aleatoriamente e prospectivamente numa amostra de conveniência em doentes adultos admitidos no SU do Hospital de Braga. O delirium foi primeiramente avaliado usando a CAM-ICU. Para a validação, o padrão de referência foi a avaliação psiquiátrica, efetuada em intervalo de 3 horas da CAM-ICU, por psiquiatra oculto ao seu resultado, usando os critérios de diagnósticos da DSM-5, sem interferência nos procedimentos do SU relativa à operacionalização das avaliações psiquiátricas.

Resultados: Após aplicar os critérios de exclusão/inclusão, dos 592 doentes avaliados, 19,8% foram diagnosticados com *delirium* usando a CAM-ICU. O padrão de referência foi aplicado a 81 doentes. A CAM-ICU apresentou uma sensibilidade de 95,2% (IC 95% = 74,1 a 99,8) e especificidade de 88,3% (IC 95% = 76,8 a 94,8). A CAM-ICU mostrou uma acurácia de 90,1% em relação ao padrão de referência.

Conclusão: A CAM-ICU (versão Portuguesa) é um

instrumento prático, válido e fiável para a avaliação de *delirium* em ambiente real de SU, mostrando uma sensibilidade, especificidade e acurácia para o diagnóstico de *delirium*.

Palavras-chave: Delírio/diagnóstico; Índice de Gravidade de Doença; Serviço de Urgência Hospitalar; Unidades de Cuidados Intensivos

Abstract:

Introduction: The *Confusion Assessment Method for Intensive Care Unit* (CAM-ICU) is of great potential value in the emergency department (ED). However, there is still uncertainty about its diagnostic accuracy and reliability, with studies warranting larger cohorts. In one of the largest and most heterogeneous cohorts considered to date, the aim was to validate and explore the applicability of the CAM-ICU (European Portuguese) as a delirium screening and diagnostic tool in the ED setting of a main hospital referral centre.

Methods: Data were randomly and prospectively recorded in a convenience sample of patients with 18 years or older admitted to the ED of Hospital de Braga (Braga, Portugal). Delirium status was primarily assessed using the CAM-ICU. For the validation aspect, the reference standard was a psychiatric evaluation, conducted within 3 hours of the CAM-ICU by a psychiatrist blind to the finding, using the DSM-5 diagnostic criteria, without external interference on the regular proceedings in the ED on the timing, number and operationalization of psychiatric evaluations in the setting.

Results: After exclusion/inclusion criteria, of the 592 patients evaluated, 19.8% were diagnosed with delirium using the CAM-ICU. The reference standard was applied to 81 patients. The CAM-ICU presented a sensitivity of 95.2% (95% CI= 74.1 to 99.8) and specificity of 88.3% (95% CI= 76.8 to 94.8). CAM-ICU showed an accuracy of 90.1% with the reference standard.

Conclusion: The CAM-ICU (Portuguese version) is practical, valid and reliable instrument for the assessment of delirium in the real setting of an ED showing sensibility, specificity and accuracy for delirium diagnosis.

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Keywords: Delirium/diagnosis; Emergency Service, Hospital; Intensive Care Units; Severity of Illness Index.

Introduction

Delirium is a common neurobehavioral syndrome considered to be caused by a dysregulation of baseline neuronal activity secondary to systemic disturbances.¹ In the hospital setting, delirium is a risk factor for clinical complications, a longer length of stay and discharge to a post-acute nursing facility.² Even with respect to long-term outcomes there is evidence that delirium episodes are associated with poorer outcome, independently of confounders such as age, sex, comorbid illness or illness severity, and baseline dementia.³ It is well recognized that the first step in delirium management, in any hospital setting, is to perform a timely and accurate diagnosis, preferably via the use of a brief (validated) instrument that assesses features in the Confusion Assessment Method algorithm.^{2,4} The systematic assessment of delirium may, nevertheless, be rendered difficult in the Emergency Department (ED) due to the intrinsic characteristics of the setting: acute patients and time constraints. Thus, for the ED, the few studies available indicate that health care providers may miss delirium up to approximately 75% of the time,⁵⁻⁷ which may hinder a translation into appropriate (early) treatment measures of delirium.^{5,6}

For the ED environment, a total of 7 different scales have been identified for delirium screening.⁵ Of these, The Confusion Assessment Method for Intensive Care Unit (CAM-ICU) is the most widely used.^{5,6} Overall, the CAM-ICU has shown a good profile of specificity and sensitivity, having been validated across different hospital settings.⁸⁻¹³ Concerning the ED setting there are few studies; however, Han *et al* (2014) validated the CAM-ICU in the ED in a cohort of 406 older (>65 years) patients. The study indicated a CAM-ICU sensitivity of 72.0% (95% confidence interval [CI] = 58.3% to 82.5%) and 68.0% (95% CI = 54.2% to 79.2%) in the emergency physician and in the research assistants' application of the scale, respectively, and a specificity of 98.6% (95% CI = 96.8% to 99.4%) for both raters.⁷ In Europe, so far, the only study that directly addressed the process of validation of the CAM-ICU for delirium in the ED setting, from Van de Meeberg *et al*, reported a sensitivity of 100%, a specificity was 98%, and a positive predictive value of 92%, and negative predictive value was 100%.¹⁴ In another study from Holland, Lucke *et al* applied the CAM-ICU in a large cohort of ED patients, and founded a low prevalence of delirium, suggesting a low performance. However, it was not a study of the validation of the CAM-ICU in the ED.¹⁵

To our knowledge, no other groups have addressed the performance of the CAM-ICU in the ED, particularly outside the United States. In fact, a recent review indicates that the validation data of the CAM developed specifically for the ED

setting is limited.¹⁶ Thus, despite the relevant work on the application of the CAM-ICU in critically ill, intensive care unit and older patients,^{7,8,11-13} uncertainty about its diagnostic accuracy and reliability remains,⁷ with an identified need for continued assessment across ED settings and in large(r) cohorts.⁵

Here, in the ED of a main hospital referral centre, across its emergency units (allocation to these specialized units is based on patients' screening and severity), the aim was two-fold: (i) to compare the results of the CAM-ICU on the identification of delirium *versus* the 'gold standard' DSM-5, and (ii) to address for the applicability of the CAM-ICU European Portuguese version, as applied by researchers (senior medical students) and medical professionals (emergency inter- nists), trained for its application, "in lieu" of the DSM-5.

Methods

CHARACTERIZATION OF THE EMERGENCY DEPARTMENT

The study was conducted at the ED of Hospital de Braga (Braga, Portugal), a University of Minho (Braga, Portugal) affiliated hospital with 705-beds, which serves a population of 1 200 000 as a tertiary referral centre. The ED at the Hospital de Braga has an annual census of approximately 175 000 visits, and it comprises two ED clinical decision units, the EDCDU1 and the EDCDU2, an ED physician office (EDPHOF) and an ED intermediate care unit (EDIMCU). These units are rooms properly organized with priority hierarchies based on patients' screening and severity. All the units are physically connected to the ED, sharing medical and nursing staff.

For the ED patients (all age ranges), the EDCDUs provide an alternative to discharge or hospital inpatient admission; patients may benefit from an extended observation period, generally less than 24 hours. Patients screened on admission with the Yellow or the Orange criteria of the Manchester triage,¹⁷ or who need to stay in the supine position in a stretcher, are referred to the EDCDU1 and the EDCDU2, respectively. The EDPHOF unit attends to problems related to patients' health with low severity degree; where, any patient screened to the EDPHOF may be forwarded to other ED units in case of worsening health status and if this referral is justified. The EDIMCU is a 9-bed unit that receives patients from multiple intra- and inter-hospital origins, including from the ED, surgical and medical wards (as a step-up unit), ICU (as a step-down unit), recovery operating room, and other hospitals (without intermediate and/or intensive care units). The criteria for admission to the EDIMCU follows the Guidelines on Admission and Discharge for Adult Intermediate Care Units of the Society of the Critical Medicine.¹⁸

STUDY POPULATION AND DESIGN

In order to obtain an approximate sample to the reality of the ED at Hospital de Braga, across time, data were randomly and prospectively recorded, in a convenience sample,

across 3 separate collection periods (June 2014 to November 2014; July 2015; and, April 2016 to July 2016), across the ED units (EDCDU1 and 2, EDIMCU and EDPHOF). Winter season (December to March) was not considered due to the ED overcrowding (mainly respiratory illnesses in older adults and chronic patients), and the potential overextension of the ED waiting period, or length of stay, that can characterize the Department in that time of year [a phenomenon termed “exit block” (or access block)].¹⁹

The study inclusion criteria included patients aged 18 years or older, admitted to the ED, whenever members of the study research team were present. Patients were excluded if: (i) obstetric and pediatric population; (ii) ambulatory patients in their full range of movements and autonomous who refer directly to the ED; or, (iii) unviable to assess for delirium using the CAM-ICU20 at any time during the initial screening procedure, including clinical evaluation refusal by the patient, inability to follow simple commands before acute illness onset, language communication barriers, advanced dementia previously diagnosed, or other diagnosed neuropsychiatric disorder, and coma. The exclusion criteria used are in accordance with previous similar studies.^{8,21} Patients who had been evaluated using the CAM-ICU in prior ED admissions, or that were evaluated outside the formal study periods of assessment for the purpose of this work, were also excluded due to impossibility to control any methodological or selection bias. The sample size estimated to determine the validity of the CAM-ICU was based on the subject to item ratio. A subject to item of 10 was fixed as the minimum, which makes it necessary to have a minimum sample of 70 patients enrolled considering 7 items associated with CAM-ICU: Feature 1, Feature 2, Feature 3, Feature 4 (which contains 4 questions to evaluate the disorganized thinking).²²

Before the start of data collection, all researchers (senior medical students) and medical professionals (emergency internists), who participated in delirium assessment using the CAM-ICU, underwent a training period coordinated by two staff members as part of the hospital Quality Assurance Program. Training materials were provided by Vanderbilt University including training manuals, didactic lectures, demonstrations and direct practice of the assessment tools in patient scenarios.²⁰

The Ethical Committee at Hospital de Braga approved the study protocol and waived informed consent. The study was non-interventional; therapies with regard to the clinical diagnosis, delirium and sedation state were left to the discretion of the attending physician.

MEASUREMENTS

Delirium status was assessed using CAM-ICU20 following the same methodology reported by Han *et al*.^{7,23} and Mariz *et al*.²¹ The CAM-ICU takes less than 2 minutes to complete and reports on: i) acute onset of mental status changes or

a fluctuating course, ii) inattention, iii) disorganized thinking, and iv) altered level of consciousness.^{8,20} The Richmond Agitation and Sedation Scale (RASS) was used to categorize the psychomotor subtype of delirium (RASS score between: +1 and +4, hyperactive delirium; 0 and -3, hypoactive delirium).^{20,24} Depending on resident psychiatrists' availability, within a 3-hour time period of the CAM-ICU assessment by the researcher/medical professional, and if the patient had not yet been discharged from the ED, delirium was assessed by the resident psychiatrist using the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as the gold standard for delirium status diagnosis.⁴ This involved an inclusive interpretation of Criteria A and D, as indicated by the European Delirium Association and the American Delirium Association.²⁵ The psychiatrists involved in the study have a permanent presence at ED, sharing the patients' management in the same setting as the physicians in the frontline of the ED, but were blind to the CAM-ICU result. Patients were assessed no more than once by each method and, if evaluated by both methods, these were conducted within a 3-hour timeframe.

Patient data included: age, gender, admission type (emergency department, operating room, wards, intensive care unit, inter-hospital transfer), location in the ED, and diagnostic groups (cardiovascular, drug toxicity/ withdrawal, gastrointestinal, genitourinary, neurologic, haemato-oncologic, pulmonary, trauma/ musculoskeletal and other). The systemic inflammatory response syndrome (SIRS) criteria (two or more of the following criteria: heart rate > 90 beats/min; body temperature < 36 or > 38°C; respiratory rate > 20 breaths/min; white blood cell count < 4x10⁹ or > 12x10⁹ cells/L [23]) was used as a surrogate for severity of illness. Data were collected from the Clinical Process through the Glintt® computer system which only the researcher responsible for the project had access.

STATISTICAL ANALYSIS

All statistical analyses were conducted using SPSS statistics version 23.0. Measures of central tendency and dispersion for continuous variables were reported as medians and standard deviation (SD). Categorical variables were reported as absolute numbers and proportions. Criterion validity was determined by comparing the CAM-ICU raters to the delirium expert rating by using the DSM-5 criterion as the reference standard. To determine validity a 2 x 2 table was created comparing the reference standard ratings with the CAM-ICU ratings included the number of true positives (TP), false positives (FP), false negatives (FN), and true negatives (TN). Sensitivity= TP/(TP+FN); specificity=TN/(FP+TN); accuracy=(TP+TN)/(TP+FP+FN+TN); likelihood ratio= sensitivity/(1-specificity); positive predictive value (PPV) and negative predictive value (NPV). Ninety-five percent confidence intervals (CI) for these test characteristics were calculated by using “VassarStats: Website for Statistical Computation” (<http://vassarstats.net>). Exact chi-square tests

and ANOVA analysis were performed as appropriate to determine if baseline features differed between 'Delirium' and 'No Delirium' groups. Prevalence of delirium in the ED of Hospital de Braga was determined. Agreement between CAM-ICU/DSM-5 diagnosis of delirium was calculated with the kappa statistic and the McNemar's test.

Results

A total of 768 patients were screened in the time periods referred; of these, all 592 patients that met the inclusion criteria (study sample) were evaluated using the CAM-ICU and, of these, 81 (13.7%) were further evaluated by the resident psychiatrist on duty (blind to the CAM-ICU result) following the DSM-5 criteria (Fig. 1). Baseline characteristics of the study cohort are presented in Table 1. The median age of the study sample was 65.74 years old (\pm 18.68), 61.3% (n = 363) were aged 65 years or more, and 263 (44.4%) were female. The distribution of patients by emergency units was: 35.5% (n = 210) EDCDU1, 33.6% (n = 199) EDCDU2, 27.4% (n = 162) EDIMCU and 3.5% (n = 21) EDPHOF. Characteristics of the CAM-ICU evaluation cohort by the ED physicians versus the psychiatric evaluation cohort are presented in Table 2. There were no significant differences between the psychiatric evaluation and the ED physician's evaluation, besides more patients from intra-hospital transfer in the former (32.1% vs 20.9%; $p = 0.021$).

Using the CAM-ICU, delirium was observed in 17.6% (90/511) (ED physician evaluation); while, using the standard evaluation technique DSM-5, 25.9% (21/81) delirium cases were diagnosed (psychiatric evaluation). Characteristics of

the 'Delirium' patients are presented in Table 3; these were significantly older compared to 'No Delirium' (mean 71.0 vs 66.5, $p < 0.001$) and presented higher percentage conforming to the SIRS criteria (38.1% vs 18.3%, $p = 0.034$). Most patients were alert and calm at evaluation time (RASS = 0; 68.1% via CAM-ICU, 70.4% via DSM-5); most of those assessed with delirium were hypoactive (79.5% via CAM-ICU; 71.4% via DSM-5). One false negative was observed; at the moment of CAM-ICU assessment, the patient was at his mental status baseline (RASS=0) and there was no evidence of a fluctuating course of mental status.

The CAM-ICU identified 20 of the 21 delirious patients identified by the DSM-5 and showed an overall sensitivity of 95.2% (95% CI= 74.1 to 99.8) and specificity of 88.3% (95% CI= 76.8 to 94.8). The negative likelihood ratio (LR-) was 0.05 (95% CI= 0.01 to 0.37). The positive likelihood ratio (LR+) was 8.16 (95% CI= 4.04 to 16.48) (Tables 4 and 5).

Discussion

A psychiatric evaluation of a fluctuating case in an ED is a high constrain depending on time and immediate psychiatric staff availability, with time being of priority in delirium treatment. The present study was carried out in the ED of a central district hospital, across multiple collection points, assessing for a large cohort of patients. The study corroborates for the easy-of-use of the scale and its feasibility and practicality in the ED setting. The scale incorporates objective assessments, allowing to remove any possible subjectivity from delirium assessment and rendering it easier to use by eventually less experienced users.

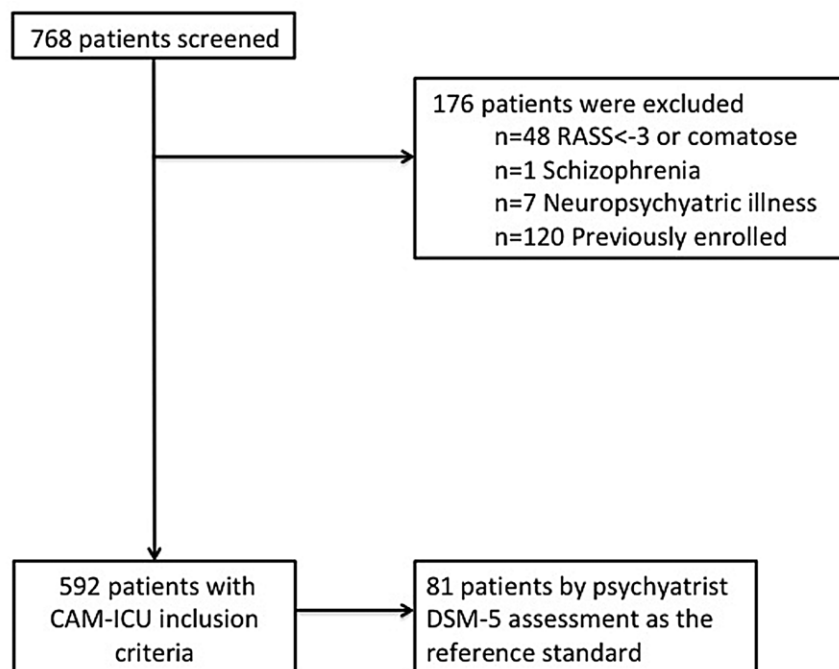


Figure 1: Flow chart of the study sample selection.

Table 1: Patient characteristics stratified by delirium status assessed using CAM-ICU.

	Delirium	No delirium	p-value
Patients, n (% total) ^a	117 (19.8%)	475 (80.2%)	p <0.001
Characteristics			
Mean age, years (SD)	76.0 (±14.0)	63.2 (±18.7)	p <0.001
Female, n (% group)	71 (60.7%)	192 (40.4%)	
SIRS criteria, %	29 (24.8%)	81 (17.1%)	p = 0.049
Emergency Department Units, n (%group, %emergency department)			p = 0.072
EDCDU1	39 (33.3%; 18.6%)	171 (36.0%; 81.4%)	
EDCDU2	32 (27.4%; 16.1)	167 (35.2%; 83.9%)	
EDIMCU	43 (36.8%; 26.5%)	119 (25.1%; 73.5%)	
EDPHOF	3 (2.6%; 14.3%)	18 (3.8%; 85.7%)	
Admission type, n (%group, %origin)^b			p = 0.012
Home	65 (55.6%; 16.3%)	335 (70.5%; 83.8%)	
Elderly home	5 (4.3%; 35.7%)	9 (1.9%; 64.3%)	
Intra-hospital transfer	37 (31.6%; 27.8%)	96 (20.2%; 72.2%)	
Inter-hospital transfer	10 (8.5%; 22.2%)	35 (7.4%; 77.8%)	
Emergency physician diagnosis by organ n (%group, %diagnostic)			p = 0.172
Cardiovascular	10 (8.5%; 11.6%)	76 (16.0%; 88.4%)	
Drug toxicity/withdrawal	4 (3.4%; 28.6%)	10 (2.1%; 71.4%)	
Gastrointestinal	17 (14.5%; 17.3%)	81 (17.1%; 82.7%)	
Genitourinary	16 (13.7%; 19.0%)	68 (13.5%; 81.0%)	
Neurologic	14 (12.0%; 21.9%)	50 (10.5%; 78.1%)	
Hemato-oncologic	3 (2.6%; 16.7%)	15 (3.2%; 83.3%)	
Pulmonary	23 (19.7%; 26.4%)	64 (13.5%; 73.6%)	
Trauma/musculoskeletal	5 (4.3%; 11.4%)	39 (8.2%; 88.6%)	
Other	25 (21.4%; 25.8%)	72 (15.2%; 74.2%)	

^a Of the n=768 patients enrolled, n=176 were excluded due to schizophrenia, RASS<-3 or comatose, neuropsychiatry illness or previously enrolled patients (CAM-ICU not conducted). SIRS systemic inflammatory response syndrome.

^b Significant differences between Home and Intra-hospital transfer (p=0.019).

ED emergency department; EDCDU1 emergency department acute unity 1 - yellow Manchester screening; EDCDU2 emergency department acute unity 2 - orange Manchester screening; EDIMCU emergency department intermediate care units; EDPHOF- emergency department physician office; CAM-ICU confusion assessment method for intensive care unit; SD standard deviation.

The results indicate that the CAM-ICU has high levels of sensitivity (95.2%: 95% CI= 74.1 to 99.8) and specificity (88.3%: 95% CI= 76.8 to 94.8), suggesting that when the CAM-ICU is positive (in the ED setting) any relevant treatment for this condition may be initiated. A common feature of every published research work on CAM-ICU is its high specificity. The routinely use of delirium screening and diagnostics tools can increase the detection rate of cases. Ely *et al* (2001) carried out the first validation study of the CAM-ICU in an intensive care unit (ICU) in critically ill patients in a study sample of 31 patients.⁸ The study showed a high specificity (95% to 100%) and sensitivity (89% to 93%) and an excellent interrater correlation. The same authors published a second study enrolling 111 patients on mechanical ventilation that confirmed the high interrater correlation (kappa coefficient: 0.99, 95% CI: 0.92 – 0.99), and the high sensitivity (93% to 100%) and specificity (98% to 100%) of the scale.⁹ Tobar *et al* (2010) validated the Spanish CAM-ICU version in 29 critical patients, also undergoing mechanical ventilation, obtaining a sensitivity between 80% to 83% and a specificity of 96%.¹⁰ Flores *et al*, (2011) validated the CAM-ICU in a mixed population

of critically ill patients in four ICUs in Brazil, enrolling a total of 119 patients, and showed an overall sensitivity of 72.5% (95% CI: 55.9% – 84.9%) and specificity of 96.2% (95% CI: 88.5% – 99%).¹¹

Still, the present study differs in some respects from other works. Here, at 88.3%, the calculated specificity was not as high for the CAM-ICU as others have published (varying from 93% to 100%). This difference does not seem to be related to the implementation of CAM-ICU using the European Portuguese language as other authors have applied Spanish and Portuguese (Brazil) and translations of the CAM-ICU and have obtained high specificities.^{10,11,14} The most likely explanation relates with the patient's characteristics. Here, the study was carried out with a high spectrum of patients with different characteristics, including range in ages, emergency physician diagnosis, admission type and disease severity. In contrast, many of the previous studies were done using more homogeneous cohorts either in terms of age and less critical conditions,⁷ or in well-defined diagnosis groups such as medical oncology and patients with acute stroke.^{12,13} Thus, the sensitivity and specificity differences showed in different CAM-ICU

Table 2: Patient characteristics stratified by evaluation.

	Psychiatrist evaluation cohort	Emergency physician evaluation cohort	p-value
Patients, n (% total) ^a	81 (13.7%)	511 (86.3%)	
Characteristics			
Mean age, years (SD)	67.64 (±18.1)	65.43 (±18.6)	<i>p</i> = 0.276
Female, n (% group)	44 (54.3%)	192 (42.9%)	<i>p</i> = 0.054
SIRS criteria, %	19 (23.5%)	91 (17.8%)	<i>p</i> = 0.225
Emergency Department Units, n (%group)			
EDCDU1	99 (35.8%)	181 (35.4%)	<i>p</i> = 0.947
EDCDU2	22 (27.2%)	177 (34.6%)	<i>p</i> = 0.186
EDIMCU	28 (34.6%)	134 (26.2%)	<i>p</i> = 0.118
EDPHOF	2 (2.5%)	19 (3.7%)	<i>p</i> = 0.573
Admission type, n (%group)			
Home	48 (59.3%)	352 (58.9%)	<i>p</i> = 0.086
Elderly home	2 (2.5%)	12 (2.3%)	<i>p</i> = 0.947
Intra-hospital transfer	26 (32.1%)	107 (20.9%)	<i>p</i> = 0.021
Inter-hospital transfer	5 (6.2%)	40 (7.8%)	<i>p</i> = 0.602
Emergency physician diagnosis by organ n (%group)			
Cardiovascular	15 (18.5%)	71 (13.9%)	<i>p</i> = 0.273
Drug toxicity/withdrawal	4 (4.9%)	10 (2.0%)	<i>p</i> = 0.101
Gastrointestinal	9 (11.1%)	89 (17.4%)	<i>p</i> = 0.172
Genitourinary	10 (12.3%)	74 (14.5%)	<i>p</i> = 0.156
Neurologic	7 (8.6%)	57 (11.2%)	<i>p</i> = 0.499
Hemato-oncologic	4 (4.9%)	45 (2.7%)	<i>p</i> = 0.285
Pulmonary	13 (16%)	74 (14.5%)	<i>p</i> = 0.711
Trauma/musculoskeletal	2 (2.5%)	42 (8.2%)	<i>p</i> = 0.067
Other	217(21%)	80 (15.7%)	<i>p</i> = 0.229

^a Of the n=768 patients enrolled, n=176 were excluded due to schizophrenia, RASS<-3 or comatose, neuropsychiatry illness or previously enrolled patients (CAM-ICU not conducted). SIRS systemic inflammatory response syndrome. ED emergency department; EDCDU1 emergency department acute unit 1 - yellow Manchester screening; EDCDU2 emergency department acute unit 2 - orange Manchester screening; EDIMCU emergency department intermediate care units; EDPHOF- emergency department physician office; CAM-ICU confusion assessment method for intensive care unit; SD standard deviation.

validation works may be related to the patients' characteristics, namely age and illness severity, warranting continued work in the area. Nonetheless, it also of note that a cohort's heterogeneity may not necessarily explain relatively low specificities. The CAM-ICU's specificity may also be diminished in patients with dementia⁷ or, also of consideration, can also be explained by random chance. Here, the sensitivity obtained for the CAM-ICU presented a higher value than the values presented in other studies, which may be related with the (high) severity of patients in the cohort.

There are other influences to be noted, regarding ED organization and structure. In particular, our ED system is very based on Clinical Decision Units (CDU), that overall could be partially compared with the Observation Units in the US, although CDU are fully integrated in the ED. More so, our ED is an open system, absorbing a very substantial proportion of non-urgent situations, which for a multitude of reasons are not managed in the primary care system. It is estimated that approximately 25% of the attendees at hospital emergency units do not need immediate care.²⁶ This number can be higher in central district hospitals. Accordingly, at the ED of Hospital de Braga, following the Manchester Triage System classification,

an average of 35% of patients were green coded in 2017 (internal hospital data, unpublished), mainly in the EDPHOF. For that reason, we chose not to include patients from the EDPHOF, as these patients are mainly low priority, non-urgent patients, who should have been attended in their GPs.

LIMITATIONS

The study has limitations that are of note. Throughout the data collection time periods different researchers/medical professionals applied the CAM-ICU. Albeit all receiving the same procedural training this may potentially have influenced results. Nonetheless, the tool is simple and easily applied, and several studies have indicated for an excellent interrater correlation in the application of the CAM-ICU. In this regard, another possible limitation was that only research personnel and clinicians administered the CAM-ICU (the scale was not applied by support staff to the ED, technical staff or nurses); which may bias possibly toward higher performances of the CAM-ICU. Still, the researchers were senior medical students, which may add value to the hypothesis that even less experienced health personal may, when properly trained, also aptly apply the tool.

Table 3: Patient characteristics stratified by delirium status assessed using both the CAM-ICU and the DSM-5 by psychiatrist assessment.

	Delirium	No delirium	p-value
Patients, n (% total) ^a	21 (25.9%)	60 (74.1%)	p <0.001
Characteristics			
Mean age, years (SD)	71.0(±15.7)	66.5 (±18.9)	p <0.001
Female, n (% group)	10 (47.6%)	34 (56.7%)	p = 0.585
SIRS criteria, %	8 (38.1%)	11 (18.3%)	p = 0.034
Emergency Department Units, n (%group, %emergency department)			p = 0.084
EDCDU1	6 (28.6%)	23 (38.3%)	
EDCDU2	2 (9.5%)	20 (33.3%)	
EDIMCU	12 (61.9%)	15 (25.0%)	
EDPHOF	-	2 (3.3%)	
Admission type, n (%group, %origin)			p = 0.032
Home	7 (33.3%)	41 (68.3%)	
Elderly home	1 (4.8%)	1 (1.7%)	
Intra-hospital transfer	10 (47.6%)	16 (26.7%)	
Inter-hospital transfer	3 (14.3%)	2 (3.3%)	
Emergency physician diagnosis by organ n (%group, %diagnostic)			p = 0.144
Cardiovascular	1 (4.8%)	14 (23.3%)	
Drug toxicity/withdrawal	1 (4.8%)	3 (5.0%)	
Gastrointestinal	2 (9.5%)	7 (11.7%)	
Genitourinary	3 (14.3%)	7 (11.7%)	
Neurologic	4 (19.0%)	3 (5.0%)	
Hemato-oncologic	-	4 (6.7%)	
Pulmonary	3 (14.3%)	10 (16.7%)	
Trauma/musculoskeletal	1 (4.8%)	1 (1.7%)	
Other	6 (28.6%)	11 (18.3%)	

Table 4: Diagnostic performance of the CAM-ICU.

Sensitivity (95% CI)	Specificity (95% CI)	LR+ (95%CI)	LR- (95% CI)	PPV (95% CI)	NPV (95% CI)
95.2% (74.1-99.8)	88.3% (76.8-94.8)	8.16 (4.04-16.48)	0.05 (0.01-0.37)	74.1% (53.4-88.1)	98.1% (88.8-99.9)

LR+ positive likelihood ratio; LR- negative likelihood ratio; PPV positive predictive value; NPV negative predictive value; CI confidence interval; CAM-ICU Confusion Assessment Method for Intensive Care Unit

Table 5: A comparison of the CAM-ICU and the DSM-5.

	Delirium	No delirium	Total
CAM-ICU			
DELIRIUM	20	7	27
No delirium	1	53	54
Total	21	60	81

Kappa coefficient: 0.77, p<0.001; McNemar Test p=0.070. CAM-ICU Confusion Assessment Method for Intensive Care Unit; DSM-V Diagnostic and Statistical Manual of Mental Disorders.

Another limitation, a selection bias is of note given that a convenience sample was enrolled for the confirmatory psychiatry evaluation (those present in the ED at the time) due to the difficulty of psychiatrist's availability by limitations of staff. Albeit the psychiatrist having no influence on the selection of patients,

the difference of CAM-ICU positive patients between the group who received the psychiatrist evaluation and the group who did not (26% vs 33%, respectively) may point out that psychiatrists may have inadvertently selected patients who were more obviously delirious; that is, more true positives. This may falsely

increase sensitivity while falsely decreasing specificity. We think the differences are merely due to chance but care in data interpretation is of note. It is also of care, particularly given the age spectrum of the delirious patients, that there is not a measure of the effect of dementia and severity of illness in the diagnostic performance. Importantly, all the psychiatrists involved have a strong training in ED work. Finally, the setting of the ED here addressed is very different than most EDs particularly in the US, thus any generalizations should be of great caution. As described, here the vast majority of patients were enrolled in the EDCDU and EDIMCU and may likely comprise a minority of the more conventional ED population particularly in the US setting; more so, only 3% were evaluated in the EDPHOF which could be lower than in other places. In this context, the cohort studied may be characterized by being 'sicker' and 'older' compared to other EDs, although of note that it is the delirium assessment tool currently recommended by the Geriatric Emergency Department Guidelines is the bCAM, which is a modification of the CAM-ICU to improve the CAM-ICU's sensitivity and enhance its brevity.^{27,28} However, as we discussed above, there is still uncertainties of the performance of the different scales in different EDs outside where they were validated. Ultimately, such differences may affect diagnostic performances and are here of final consideration.

Conclusion

The work indicates that the CAM-ICU European Portuguese is a practical instrument for the assessment of delirium in the real setting of an ED showing sensibility, specificity and accuracy for delirium diagnosis in the setting considered. The findings indicate for the accuracy of the CAM-ICU in delirium diagnosis, suggesting that is an appropriate tool to develop a delirium diagnostic profile in ED patients. Also, the CAM-ICU observed a prevalence of delirium of 19.8% in the ED, following previous works.²³ It is expected that its systematic use in the ED will improve delirium detection rates and contribute to decrease the morbidity and mortality associated with clinical diagnosis of delirium, bridging the gap regarding to the subjectivity about delirium status. In the future, delirium should be systematically assessed in the ED and a protocol should be considered to follow-up and evaluation of delirious patients. ■

Declaração de Contribuição / Contributorship Statement:

José António Mariz – Planeamento do estudo, Análise de dados, Escrita do manuscrito

Olga Pires – Colheita de dados, Análise de dados, Revisão do manuscrito

Amândia Lopes – Colheita de dados

João Bessa, Luís Correia – Colheita de dados, revisão do manuscrito

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Jorge Teixeira, Nuno Sousa – Revisão do manuscrito

Nadine Correia Santos – Planeamento do Estudo e Escrita do Manuscrito

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