

# Comparison of delirium assessment tools in a mixed intensive care unit\*

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**Objective:** Delirium is a frequent problem in the intensive care unit (ICU) associated with poor prognosis. Delirium in the ICU is underdiagnosed by nursing and medical staff. Several detection methods have been developed for use in ICU patients. The aim of this study was to compare the value of three detection methods (the Confusion Assessment Method for the ICU [CAM-ICU], the Intensive Care Delirium Screening Checklist [ICDSC] and the impression of the ICU physician with the diagnosis of a psychiatrist, neurologist, or geriatrician).

**Design:** Prospective study.

**Setting and patients:** During an 8-month period, 126 patients (mean age 62.4 years, *SD* 15.0; mean Acute Physiology and Chronic Health Evaluation II score 20.9, *SD* 7.5) admitted to a 32-bed mixed medical and surgical ICU were studied.

**Measurements:** The included patients were assessed independently by trained ICU nurses using either the CAM-ICU or

the ICDSC. Furthermore, the ICU physician was asked whether a patient was delirious or not. A psychiatrist, geriatrician, or neurologist serving as reference rater diagnosed delirium using established criteria.

**Main results:** The CAM-ICU showed superior sensitivity and negative predictive value (64% and 83%) compared with the ICDSC (43% and 75%). The ICDSC showed higher specificity and positive predictive value (95% and 82% vs. 88% and 72%). The sensitivity of the physicians view was only 29%.

**Conclusions:** ICU physicians underdiagnose delirium in the ICU, which underlines the necessity of standard evaluation in all critically ill patients. In our mixed ICU population, the CAM-ICU had a higher sensitivity than the ICDSC. (*Crit Care Med* 2009; 37:1881–1885)

**KEY WORDS:** delirium; intensive care unit; diagnosis

**D**elirium is a common and serious disorder in the intensive care unit (ICU). Frequencies up to 87% have been reported, and previous studies showed an association with increased mortality and costs, as well as longer hospital stay and long-term cognitive impairment. After adjustments for covariates, including comorbidity and severity of disease, delirium remained associated with an increase in negative outcomes (1–7). Delirium develops over a short period of time and is characterized by a disturbance of consciousness and change in cognition with a typically fluctuating course (8). Three subtypes of delirium

can be distinguished: hypoactive, hyperactive, and mixed-type delirium (which presents with both hypo- and hyperactive features). Despite the clinical importance, delirium often goes unrecognized by healthcare professionals (9–11). Therefore, standard assessment is recommended by the Society of Critical Care Medicine and the American Psychiatric Association (12, 13).

Various delirium detection tools have been developed for use by nonpsychiatric personnel, such as ICU nurses, to evaluate critically ill patients (14). The most well-known tests are the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) and the Intensive Care Delirium Screening Checklist (ICDSC). The ICDSC and the CAM-ICU are both validated using *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV) criteria for delirium, and tested in mechanically ventilated patients as well as nonmechanically ventilated patients (15–17). Studies using the CAM-ICU show a higher prevalence (48%–87%) (2, 16–18) than investigations using the ICDSC (16%–35%) (5, 15, 19, 20). This variation may be the result of differences in patient population or the result of differences in the diagnostic

value of the assessment tools. Recently, the CAM-ICU and the ICDSC were compared within the same population of ICU patients, and a  $\kappa$  value of 0.80 was reported (21). However, the authors “did not compare these instruments with a gold standard” or reference rater (RR); therefore, it was unclear which tool was superior to the other. Furthermore, the study was conducted in a surgical ICU and not in a mixed ICU setting, potentially hampering generalization of the findings.

The main objective of our study was to evaluate the CAM-ICU and the ICDSC in a population of mixed ICU patients, and to compare test results with an RR using the DSM-IV criteria for delirium. Second, we assessed the diagnostic value of the ICU physician’s impression whether or not a patient was delirious.

## METHODS

The study was performed in a 32-bed multidisciplinary intensive care unit of the University Medical Center Utrecht with adult medical, surgical, neurologic, neurosurgical, and cardiothoracic surgical patients. The study protocol was reviewed and approved by the Institutional Medical Research Ethics Committee, and informed consent was ob-

\*See also p. 2102.

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The authors have not disclosed any potential conflicts of interest.

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DOI: 10.1097/CCM.0b013e3181a00118

tained from the patient (if verbal and written communication was possible) or their legal representative. As delirium is a fluctuating disease, delirious patients may, at lucid moments, decide whether or not they want to participate in a study, at other moments they are not capable of giving their consent.

All patients were eligible for inclusion in this study. We excluded deeply sedated patients (defined as a Ramsay score [22] >4), comatose patients (defined as a Glasgow Coma Score [23] <8), patients in whom no informed consent was obtained, patients who did not speak or understand Dutch or English, or who were deaf. From November 2006 to July 2007, 135 patients were included in this study. Each included patient was allowed to participate one time. Delirium evaluations were performed by different investigators independently and blinded to each others' assessments as follows:

**CAM-ICU.** The Dutch version of the CAM-ICU was administered by specially trained critical care study nurses. The ICU study nurses were trained in a plenary session and personally at the bedside by the investigators. Ongoing support was given by an independent expert who was available for questions or problems that arose during the study period. The CAM-ICU considers patients delirious when an acute onset of mental status change or a fluctuating course is accompanied by either disorganized thinking or an altered level of consciousness. The level of consciousness was assessed with the Richmond Agitation and Sedation Scale, a scale ranging from -5 (unrousable) to +4 (combative) (16, 17).

**ICDSC.** The Dutch version of the ICDSC was rated by the patient's bedside critical care nurse based on the 8-hour work shift and reports of the previous 24 hours. Each critical care nurse was instructed verbally how to use the ICDSC. Written instructions and ongoing support were also available. During the study, an independent expert was available for questions or problems. The ICDSC evaluates the level of consciousness, inattention, disorientation, hallucinations, psychomotor activity, speech or mood disturbance, sleep disturbance, and fluctuation of symptoms. According to the ICDSC, patients are delirious when at least four of the above eight items are deviant (15).

**ICU Physician.** The ICU physician treating the patient, either an intensivist, a fellow, or resident in intensive care medicine, was asked by a study nurse whether the patient was delirious or not at that moment. This conclusion was based on his or her impression during standard patient care and was not based on extra formal testing.

**Reference Raters.** A neuropsychiatric assessment was performed by an expert, a clinical geriatrician (R.M.), a psychiatrist (I.K.), or a neurologist (A.S.), with wide experience in the diagnosis of delirium. The diagnosis of delirium was based on all available information and DSM-IV criteria (8). In delirious pa-

**Table 1.** Characteristics of the study population

	Total (n = 126)	Delirium (n = 43)	No Delirium (n = 83)	<i>p</i>
Age (mean ± SD)	62.4 ± 15.0	65.7 ± 13.3	60.7 ± 15.7	0.08
Men, n (%)	91 (72)	29 (67)	62 (75)	0.40
APACHE II (mean ± SD)	20.9 ± 7.5	24.3 ± 7.2	18.5 ± 6.9	0.00
ICU admission, n (%)				0.60
Medical	30 (24)	9 (21)	21 (25)	
Surgical	31 (25)	14 (33)	17 (21)	
Cardiothoracic surgical	37 (29)	10 (23)	27 (33)	
Neurological/neurosurgical	28 (22)	10 (23)	18 (22)	
Verbal communication, n (%)				0.10
Possible	77 (61)	22 (51)	55 (66)	
Not possible	49 (39)	21 (49)	28 (34)	
Cerebral disorder other than delirium, n (%)				0.88
Yes	48 (38)	16 (37)	32 (39)	
No	78 (62)	27 (63)	51 (61)	

APACHE II, Acute Physiology and Chronic Health Evaluation II; ICU, intensive care unit.

tients, the type of delirium (hypoactive, hyperactive, or mixed type) was noted. To decrease interobserver variability, 30 patients were evaluated with two or three of the RRs together, these 30 patients were not assessed using the CAM-ICU or ICDSC and therefore not further analyzed in this study.

Demographic data, reason for admission, Acute Physiology and Chronic Health Evaluation II scores and mechanical ventilation status were recorded. Daily and incidental administration of sedatives, opiates, or haloperidol was registered, and medical files were reviewed for any cerebral disorder other than delirium, for example, a brain tumor or stroke.

The Student's *t* test and the chi-square test were used to study continuous normally distributed variables and comparison of proportions, respectively. The diagnostic value of the CAM-ICU, the ICDSC, and the view of the ICU clinician were described as sensitivity (true-positive/[true-positive + false-negative]), specificity (true-negative/[false-positive + true-negative]), positive predictive value (true-positive/[true-positive + false-positive]), and negative predictive value (true-negative/[false-negative + true-negative]) using simple 2 × 2 tables. Prespecified subgroup analyses were based on the type of delirium (hypoactive, hyperactive, and mixed), the ability to communicate verbally, and the presence or absence of a cerebral disorder other than delirium. Interobserver reliability was expressed as κ for the 30 patients assessed by two or three RRs. *A priori*, we defined the best assessment tool as the instrument with the highest sensitivity.

## RESULTS

A total of 249 patients were evaluated for possible inclusion. From these, we excluded patients who were deeply sedated (n = 49) or comatose (n = 46), as well as patients in whom no informed consent was obtained (n = 12), who did

not speak or understand Dutch or English (n = 5) or were deaf (n = 2). Therefore, 135 patients were evaluated. Of these, nine patients were not assessable with DSM-IV criteria. In these patients, the RRs concluded that the level of consciousness was too low to diagnose or exclude a diagnosis of delirium. Therefore, the final study population consisted of 126 patients.

As shown in Table 1, the study population was moderately ill (mean Acute Physiology and Chronic Health Evaluation II score of 20.9; SD 7.5) and represented a mixed ICU population. Sixty-one percent (n = 77) of the patients were able to communicate verbally. According to RR evaluation, 43 of 126 patients were diagnosed as delirious (prevalence 34%). Delirious patients were older and significantly more ill. Agreement between the three RRs who used DSM-IV criteria was high (κ RR 1-2 = 0.75; 1-3 = 0.87; and 2-3 = 0.75). Of the 43 delirious patients, 69% (n = 29) had hypoactive delirium, 12% (n = 5) hyperactive delirium, and 19% (n = 8) a mixed type of delirium. In one patient, the subtype of delirium could not be classified.

One CAM-ICU and eight ICDSC assessments were missing or incomplete; therefore, a total of 125 CAM-ICU evaluations and 118 ICDSC examinations were eligible for statistical analysis (Table 2). The time between the reference assessment and evaluation with the CAM-ICU was on average 90 minutes (SD 80 minutes). As the ICDSC and the view of the ICU clinician were based on a shift of 8 hours, it was not possible to calculate time between these assessments.

Table 2. Overall results of the assessment tools compared with reference rater (gold standard)

	Reference Rater Delirium	Reference Rater No Delirium	Total
CAM-ICU positive	27	10	37
CAM-ICU negative	15	73	88
Total	42	83	125
ICDSC positive	18	4	22
ICDSC negative	24	72	96
Total	42	76	118
Physician positive	9	3	12
Physician negative	22	64	86
Total	31	67	98

CAM-ICU, Confusion Assessment Method for the Intensive Care Unit; ICDSC, Intensive Care Delirium Screening Checklist.

Numbers represent individual patients. Physician positive (negative) refers to the clinical impression of the intensive care unit physician (a resident, fellow, or intensivist) on the delirious status of the patient without the use of a standard method.

As shown in Table 3, the CAM-ICU identified 29% of the patients as delirious and showed overall sensitivity of 64% (95% confidence interval [CI] 49%–77%) and specificity of 88% (95% CI 79%–93%). The ICDSC identified 19% of the patients as delirious. Overall sensitivity of the ICDSC was 43% (95% CI 29%–58%) and specificity 95% (95% CI 87%–98%). As further shown in Table 3, in the group of patients without a cerebral disorder other than delirium, the sensitivity of both instruments was moderate and almost the same. In patients with another cerebral disorder, sensitivity of CAM-ICU was much higher than the sensitivity of ICDSC (80% vs. 31%).

In 98 patients, ICU physicians reported whether a patient was delirious or not in their view. Compared with the RR, sensitivity was 29% (95% CI 0.15%–0.48%) and specificity 96% (95% CI 87%–99%) (Table 3). The medical specialists (intensivists and fellows) showed better diagnostic capabilities (sensitivity = 63%, specificity = 100%, positive predictive value = 100%, negative predictive value = 72%) than the residents (sensitivity = 14%, specificity = 93%, positive predictive value = 50%, negative predictive value = 69%).

In subgroup analysis of the different types of delirium, either the hypoactive, hyperactive, or mixed-type delirious patients (according to the RR) were included and compared with nondelirious patients. In hypoactive delirious patients, the CAM-ICU showed higher sensitivity and negative predictive value than the ICDSC (57% and 86% vs. 32% and 79%, respectively), the ICDSC showed higher specificity and positive predictive value in these patients (Table 4).

## DISCUSSION

In this comparison study, we found the use of formal delirium detection tools superior to the impression of the ICU physician. The physician missed almost three quarters of all ICU delirium. With delirium assessment by RRs using the DSM-IV criteria as “gold standard,” the CAM-ICU had a higher sensitivity than the ICDSC. We found the overall sensitivity for the CAM-ICU and the ICDSC to be 64% and 43%, respectively, and the specificity to be 88% and 95%, respectively.

This study has several limitations. Delirium is by definition a fluctuating disease, with different presentations over time. Not all registrations were performed at the same moment in time. The authors tried to minimize the time between the evaluations; however, this was not always possible due to logistic difficulties. Furthermore, some patients (n = 16) received psychoactive medication (for example, haloperidol or a benzodiazepine) between the evaluations. When the diagnostic characteristics for the subgroup without psychoactive medication between the evaluations (n = 109) were compared with the whole study population, similar findings were obtained (data not shown), thus we chose not to exclude the patients with psychoactive medication between assessments.

The blinded and independent assessment of the CAM-ICU and the ICDSC is one of the strengths of this study. The study population included a wide spectrum of diseases and conditions representing a mixed ICU. The case mix in this study ensures generalization of the study results. This is the first study on the use of the CAM-ICU and the ICDSC in neu-

rologic, neurosurgical, and cardiothoracic surgical ICU patients. This expands the scope of delirium assessment in the ICU. Furthermore, the use of the reference standard with high interobserver reliability (mean  $\kappa$  0.79) offered reliable assessment of the diagnosis delirium. This study was designed to resemble the daily practice. The assessment methods were administered by ICU nurses without a psychiatric background, who received training before the start of the study.

The ICDSC and the CAM-ICU differ in their method of delirium detection. The ICDSC is an eight-item scoring system, based on observations during routine patient care. With the ICDSC, no cooperation of the patient is required. The items of the ICDSC are scored over a period of 24 hours, whereas the CAM-ICU gives an indication of the state of the patient at one moment in time, although the CAM-ICU also registers changes in mental status in the previous 24 hours. The CAM-ICU uses simple tests to evaluate the cognitive abilities of the patient. Both tools are relatively easy to learn and quick.

Both the CAM-ICU and the ICDSC have been validated in comparison with an RR in previous studies. In separate studies, both methods showed high sensitivity (15, 16). The inclusion and exclusion criteria used in this study differ from those used in the original validation studies (patients were more ill in the validation studies and neurologic patients were excluded). This in part may explain the lower sensitivity and specificity of both instruments. In a study published in 2007, the two methods were compared in the same population. This study showed relatively high  $\kappa$  coefficients ( $\kappa$  = 0.80), implying that the CAM-ICU and the ICDSC are comparable in a single population (21). However, from this investigation it is unclear which tool is superior as there was no comparison with an RR. To our knowledge, the two methods have not been compared with DSM-IV criteria within the same population. Besides diagnostic parameters, in daily practice, other factors are important, for example, ease of use. The decision on which instrument to use may depend on the local preferences.

The low sensitivity and specificity of the ICU physician in detecting delirium in ICU patients is remarkable. This stresses the necessity of standard screening for delirium in critically ill patients. A possible explanation for the major differ-

Table 3. Diagnostic parameters of the assessment instruments

Reference Rater (DSM-IV)	Sensitivity, % (95% CI)	Specificity, % (95% CI)	PPV, % (95% CI)	NPV, % (95% CI)
Total study population (n = 126) 34% delirious				
CAM-ICU (n = 125)	64 (49–77)	88 (79–93)	73 (57–85)	83 (74–89)
ICDSC (n = 118)	43 (29–58)	95 (87–98)	82 (61–93)	75 (65–83)
Physician (n = 98)	29 (15–48)	96 (87–99)	75 (43–93)	74 (64–83)
Verbal communication possible (n = 77) 29% delirious				
CAM-ICU (n = 77)	55 (35–73)	98 (90–100)	92 (67–99)	84 (74–91)
ICDSC (n = 72)	50 (31–69)	98 (90–100)	92 (64–98)	82 (70–89)
Physician (n = 69)	37 (17–61)	98 (88–100)	88 (47–99)	80 (68–89)
Verbal communication not possible (n = 49) 43% delirious				
CAM-ICU (n = 48)	75 (53–89)	68 (49–82)	63 (43–79)	79 (60–90)
ICDSC (n = 46)	35 (18–57)	88 (71–96)	70 (40–89)	64 (48–78)
Physician (n = 29)	17 (03–49)	88 (62–98)	50 (09–91)	60 (39–78)
Cerebral disorder other than delirium (n = 48) 33% delirious				
CAM-ICU (n = 47)	80 (55–93)	84 (68–93)	71 (47–87)	90 (74–97)
ICDSC (n = 45)	31 (12–59)	93 (76–99)	71 (30–95)	71 (54–84)
Physician (n = 36)	30 (08–65)	100 (84–100)	100 (31–100)	79 (60–90)
No cerebral disorder other than delirium (n = 78) 35% delirious				
CAM-ICU (n = 78)	56 (37–72)	90 (79–96)	75 (53–89)	79 (67–88)
ICDSC (n = 73)	50 (30–70)	96 (84–99)	87 (58–98)	78 (64–87)
Physician (n = 62)	29 (12–52)	93 (79–98)	67 (31–91)	72 (57–83)

DSM-IV, *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition; CI, confidence interval; PPV, positive predictive value; NPV, negative predictive value; CAM-ICU, Confusion Assessment Method for the Intensive Care Unit; ICDSC, Intensive Care Delirium Screening Checklist.

Physician refers to the impression of the intensive care unit physician (resident, fellow, or intensivist) on the delirious status of the patient without the use of a standard method.

Table 4. Diagnostic parameters of the assessment instruments in delirium subtypes

Reference Rater (DSM-IV)	Sensitivity, % (95% CI)	Specificity, % (95% CI)	PPV, % (95% CI)	NPV, % (95% CI)
Hypoactive delirium (n = 29) (no delirium n = 83)				
CAM-ICU (n = 111)	57 (37–75)	88 (79–94)	62 (41–79)	86 (76–92)
ICDSC (n = 104)	32 (17–52)	95 (86–98)	69 (39–90)	79 (69–87)
Physician (n = 88)	29 (12–52)	95 (87–99)	67 (31–91)	81 (70–89)
Hyperactive delirium (n = 5) (no delirium n = 83)				
CAM-ICU (n = 88)	80 (30–99)	88 (79–94)	29 (10–58)	99 (92–100)
ICDSC (n = 81)	60 (17–93)	95 (86–98)	43 (12–80)	97 (90–100)
Physician (n = 71)	25 (01–78)	96 (87–99)	25 (01–87)	96 (87–99)
Mixed type delirium (n = 8) (no delirium n = 83)				
CAM-ICU (n = 91)	88 (47–99)	88 (78–94)	41 (19–66)	99 (92–100)
ICDSC (n = 84)	75 (36–96)	95 (86–98)	60 (27–86)	97 (90–99)
Physician (n = 72)	40 (07–83)	96 (87–99)	40 (07–83)	96 (87–99)

DSM-IV, *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition; CI, confidence interval; PPV, positive predictive value; NPV, negative predictive value; CAM-ICU, Confusion Assessment Method for the Intensive Care Unit; ICDSC, Intensive Care Delirium Screening Checklist.

Physician refers to the impression of the intensive care unit physician (resident, fellow, or intensivist) on the delirious status of the patient without the use of a standard method.

ence between medical specialists and residents in delirium detection is the lack of experience in the latter. As residents are the primary caregivers for the patients, we think that these results are of great clinical importance.

In the present study, a frequency of 34% is found; however, as the delirium status was registered only once per patient, this number should be regarded as point prevalence and not as an incidence number, partly explaining the discrepancy between the previously reported fre-

quencies and the frequency of delirium in this study. A second explanation for the difference in delirium rate is the different study population, not only differing in inclusion and exclusion criteria, but also in severity of illness. In the current study, the mean Acute Physiology and Chronic Health Evaluation II score was 20.88, whereas this score was higher (approximately 26) in other validation and frequency studies. The majority of cases with delirium in this study had the hypoactive subtype. Previous studies suggest

that older patients with hypoactive delirium in the ICU are often misdiagnosed (24). Also in our study, the hypoactive form was the subtype most frequently missed with the CAM-ICU and the ICDSC. In previous studies on the CAM-ICU and the ICDSC, neurologic patients were excluded (16, 17). In the present study, we also included patients with a cerebral disease other than delirium and found higher sensitivity for the CAM-ICU than for the ICDSC in these patients.

## CONCLUSION

This study shows that the impression of intensive care physicians is not sensitive enough to identify delirium, particularly its hypoactive forms. In this investigation in a mixed ICU population, the CAM-ICU had a higher sensitivity than the ICDSC.

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