Predicting Hospital Mortality and Length of Stay: The Delirium Screening Checklist versus Confusion Assessment Method for Intensive Care Units

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Abstract

Background: Both the intensive care delirium screening checklist (ICDSC) and confusion assessment method for ICU (CAM-ICU) are valid tools for identification of delirium, however their relative predictive validity for important delirium outcomes, such as hospital mortality and LOS have not been well-established. We aim to compare the two tools for their predictive validity for outcomes related to delirium, hospital mortality and length of stay (LOS).

Methods: The prospective cohort study conducted in six medical ICUs at a tertiary care hospital in Taiwan. The study enrolled consecutive adult patients (≥20 years) who were delirium free at ICU admission. Delirium was screened daily by trained research nurses using the ICDSC and CAM-ICU in random order. Arousal was assessed by the Richmond Agitation-Sedation Scale (RASS). Participants with any one positive result were classified as ICDSC- or CAM-ICU-delirium groups, respectively.

Results: Delirium incidence evaluated by the ICDSC and CAM-ICU were 69.1% (67/97) and 50.5% (49/97), respectively. Although the ICDSC identified 18 more cases as delirious, substantial concordance (κ =0.63; $p < 0.001$) was found between tools. Independent of age, APACHE II score, and Charlson comorbidity index, both ICDSC- and CAM-ICU-rated delirium significantly predicted hospital mortality (adjusted odds ratio [aOR] 4.93; 95% confidence interval [CI]:1.56 to 15.63 *vs*. 2.79; 95% CI, 1.12 to 6.97, respectively), and only the ICDSC significantly predicted hospital LOS with a mean of 17.59 additional days compared to the no-delirium group. Irrespective of delirium status, a sensitivity analysis of normal-to-increased arousal (RASS≥0) test results did not alter the predictive ability of ICDSC- or CAM-ICU-delirium for hospital mortality (aOR 2.97; 95% CI, 1.06 to 8.37 *vs*. 3.82; 95% CI, 1.35 to 10.82, respectively). With reduced arousal (RASS<0), neither tool significantly predicted mortality or LOS.

Conclusions: The ICDSC identified more delirium cases and may have higher predictive validity for mortality and LOS than the CAM-ICU. However, arousal substantially affected performance. Future studies may want to consider patients' arousal when deciding which tool to use to maximize the effects of delirium identification on patient mortality.

Trial registration: NCT 04206306

Introduction

Intensive care unit (ICU)-acquired delirium impacts patient outcomes, i.e., higher mortality [1–6] and prolonged length hospital of stay (LOS) [1–3, 6–9]. Delirium can be accurately identified by widely validated screening tools such as the intensive care delirium-screening checklist (ICDSC) and the confusion assessment method for the ICU (CAM-ICU) [10, 11], but delirium in ICU settings is still poorly recognized [12]. Only 40% of clinicians consistently screen for ICU delirium [13], and clinically effective screening tools are not consistently applied [14].

To encourage consistent application of effective ICU-acquired delirium screening tools, we considered that a head-to-head comparison of tools might help to guide tool selection. While both the ICDSC and CAM-ICU have been recommended by the Society of Critical Care Medicine for detecting ICU delirium [15], it remains unclear which tool is more clinically relevant. Their ability to predict delirium-related outcomes such as mortality and LOS warrants investigation.

Outcomes in ICU settings are affected by many factors. Mortality may be more strongly influenced by altered arousal (either reduced or increased) than by delirium diagnosis alone [16]. Indeed, a six-study meta-analysis found that altered arousal in patients with delirium was associated with higher mortality than normal arousal in patients with or without delirium [16]. Moreover, reduced arousal may interfere with delirium diagnosis, especially when using screening tools such as the ICDSC and the CAM-ICU. For example, reduced arousal has been suggested to overidentify delirium [17], as delirium rates were reduced significantly if test results from patients on the Richmond Agitation-Sedation Scale (RASS) scores − 2 to − 3 were excluded [18]. The authors of that study noticed that a lower RASS score (− 2 or deeper) tended to fulfill the delirium diagnosis, and delirium rates increased by approximately a quarter to a third [18]. In short, when studying the impact of delirium on mortality, reduced arousal, irrespective of delirium status, is an important confounder requiring further study.

In this prospective cohort study, we aimed to compare the predictive validity of the ICDSC versus CAM-ICU in predicting delirium-related outcomes of hospital mortality and LOS. The time spent being tested with each tool, as a proxy for their clinical utility, was also compared. Moreover, we examined whether the tools' predictive validity and time spent in tests were affected by patients' arousal status.

Materials And Methods

After this prospective cohort study was approved by the Institutional Review Board and registered in the clinical trial registry (NCT 04206306), we enrolled consecutive adult patients (≥ 20 years) who stayed > 24 hours in six medical ICUs at a university affiliated hospital in Taiwan from December 2019 to October 2020. Patients were excluded by these criteria: 1) had pre-existing delirium; 2) were bedridden, had moderate dementia (clinical dementia rating [CDR] score ≥ 2), had severe hearing impairment, or could not communicate; or 3) were placed on contact and droplet precaution. All patients or their surrogates signed written informed consent forms to participate in the study. The detailed study flow chart is in Fig. 1.

Data Collection

A standardized data entry form was developed to collect all participants' clinical data: age (years), sex (%), education level (%; under high school; high school and above), very mild or mild dementia (%; defined by CDR = 0.5 or 1), Charlson comorbidity index (CCI) score, ICU admission diagnosis (acute respiratory failure; noncardiogenic shock; cardiac emergency; other), use of mechanical ventilation (MV; yes/no), and the acute physiology and chronic health evaluation (APACHE II) score (24 hours within admission).

Regarding study outcomes, in-hospital mortality and LOS in the hospital were abstracted from the medical record.

Delirium Assessment

Research nurses screened patients daily and up to 14 days of ICU stay sequentially with the ICDSC and CAM-ICU; the nurses' screening for ICU delirium was calibrated with an experienced psychiatrist. To limit bias introduced by the same assessor's consecutive evaluation with two similar instruments, a random order was created using the REDCap data collection system and strictly followed to determine which tool was administered first at each paired assessment.

Before each delirium screening, participants' arousal was evaluated by the RASS, with scores ranging between − 5 (unarousable) and 4 (combative). For arousable participants (RASS − 3 and higher), delirium was assessed by both the ICDSC and CAM-ICU. Briefly, based on Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria, the ICDSC is an 8-item checklist of delirium symptoms (consciousness, inattention, disorientation, hallucinations/delusions/psychosis, psychomotor agitation or retardation, inappropriate speech or mood, sleep/wake cycle disturbances, and symptom fluctuation); any 4 items presented within a 24-hour time frame indicate delirium [19]. The CAM-ICU consists of 4 consecutive items (1-acute change/fluctuation in mental status, 2-inattention, 3-altered level of consciousness, 4-disorganized thinking); at least 3items (1 + 2 + 3 or 1 + 2 + 4) must be presented to indicate delirium [20]. In this study, participants with any one positive result during the first 14 days of their ICU stay were classified accordingly into ICDSC- or CAM-ICU-delirium groups.

Outcomes: Mortality, Los, And Time Spent Administering Tools

The primary outcomes were in-hospital mortality and hospital LOS, abstracted from medical records. The secondary outcome, time spent (minutes) administering the ICDSC versus the CAM-ICU was automatically recorded for each paired test administered with a built-in random tool order. Notably, for both tools, we did not count the time trained research nurses spent to collect participant data in the last 24 hours from the chart or from the primary nurse, given that the same assessor consecutively evaluated these two tools; only time spent in rating tool items was recorded for comparison.

Statistical analysis

Data were analyzed using SPSS 22.0 (IBM, New York, NY), with all tests being two-tailed and $p < 0.05$ considered significant. The sample was described by means and standard deviations (SDs) for continuous variables, with counts and percentages for categorical variables. The degree of agreement between the ICDSC and CAM-ICU was measured using kappa (κ). Agreement was defined as moderate

(0.41–0.60), substantial (0.61–0.80), or perfect (> 0.80) [21]. Mortality risk and LOS in the ICDSC- *vs*. CAM-ICU-delirium cohorts were estimated using multiple logistic and linear regressions models.

All models were adjusted for relevant confounders, including age, APACHE II, and CCI scores, to obtain adjusted odds ratios (aORs) and adjusted β. To test whether arousal state changed the predictive ability of delirium for mortality and LOS, we conducted sensitivity analyses to stratify normal-to-increased arousal (RASS ≥ 0) versus reduced arousal (RASS < 0) test results, irrespective of delirium status. In fact, a RASS score of ≥ 0 indicates either altered or aggressive symptomatology; thus, we defined RASS ≥ 0 as "normal-to-increased arousal," with negative RASS scores of − 1 to − 3 indicating drowsiness and being defined as "reduced arousal."

Results

Of 384 adult patients admitted to medical ICUs and prospectively screened, 97 participants were included in the analysis. Details of the study flow chart are in Fig. 1. As shown in Table 1, 97 participants had a mean (SD) age of 67.1 (13.9) years, 67% were male, and 55.7% (54/97) had a high school education level or above. Only 3 (3.1%) had very mild or mild dementia (CDR score = 0.5 or 1). The participants' comorbidity burden was high (mean (SD) CCI score = 3.9 (2.3) points). The most common ICU admission diagnosis was acute respiratory failure (51/97; 52.6%), followed by noncardiogenic shock (35/97; 36.1%), cardiac emergency (7/97; 7.2%), and other (4/97; 4.2%). The mean (SD) APACHE II score at 24 hours after ICU admission was 22.7 (7.2), and 66/97 (68%) of patients received mechanical ventilation (MV). Ultimately, 35 patients died, resulting in an in-hospital mortality rate of 36.5% (35/96). The mean (SD) LOS was 40.6 (32.2) days. Notably, in 571 daily paired delirium screenings over a mean (SD) of 5.9 (4.0) days, the time spent screening with the ICDSC and CAM-ICU did not differ significantly (mean minutes [SD], 1.1 [0.9] *vs*. 1.1 [0.8] for CAM-ICU; $p = 0.96$).

Table 1
Sample characteristics and outcomes

Characteristics	**Total Cohort** *n* = 97	**ICDSC Delirium** *n* = 67	**CAM-ICU Delirium** *n* = 49	**CAM-ICU (-) but ICDSC (+)** *n* = 18
Demographics				
Age (yr), mean (SD)	67.1(13.9)	67.6 (14.3)	68.7(12.9)	64.4(17.6)
Male, *n* (%)	65 (67.0)	45 (67.2)	33 (67.3)	12 (66.7)
Education level, *n* (%)				
Under high school	46 (44.3)	34 (50.7)	28 (57.1)	6 (33.3)
High school or above	54 (55.7)	33(49.3)	21 (42.9)	12 (66.7)
CCI, mean (SD)	3.9 (2.3)	3.8 (2.1)	4.0 (2.1)	3.2 (2.1)
Very mild/mild dementia [a], *n* (%)	3 (3.1)	2 (3.0)	2 (4.1)	0
ICU admission diagnosis, *n* (%)				
Acute respiratory failure	51 (52.6)	37 (55.2)	29 (59.2)	8 (44.4)
Noncardiogenic shock	35 (36.1)	23 (34.3)	16 (32.7)	7 (38.9)
Cardiac emergency	7 (7.2)	6 (9.0)	3 (6.1)	3 (16.7)
Other	4 (4.2)	1 (1.5)	1 (2.0)	0
APACHE II, mean (SD)	22.7 (7.2)	23.2 (6.8)	23.8 (6.5)	21.7(7.5)
Use of mechanical ventilator, *n* (%)	66 (68.0)	56 (83.6)	44 (89.8)	12 (66.7)
Outcomes				
Hospital LOS (d), mean (SD)	32.6 (26.8) [b]	37.9 (29.6) [b]	36.8 (28.9) [b]	40.6 (32.2)
In-hospital mortality, *n* (%)	35 (36.5) [b]	30 (45.5) [b]	23 (47.9) [b]	7 (38.9)

SD = standard deviation, CCI = Charlson comorbidity index, APACHE II = acute physical and chronic health evaluation within 24 hours of ICU admission, LOS = length of stay, CDR = clinical rating scale. [a] defined as CDR = 0.5 or 1. [b] One participant remained hospitalized; uncounted.

ICDSC vs. **CAM-ICU: concordance and predictive validity**

As shown in Table 2, 67/97 participants were classified with ICDSC delirium, resulting in a delirium incidence of 69.1%. Conversely, only 49 participants were classified with CAM-ICU delirium, resulting in a delirium incidence of 50.5%. Although the ICDSC identified 18 more delirium cases than the CAM-ICU, concordance (κ = 0.63; $p < 0.001$) was substantial between the ICDSC and CAM-ICU for detecting delirium given their complete agreement on 49 delirium cases. A detailed 2x2 contingency table is provided in Supplemental Table 1a.

Table 2
Incidence and kappa between ICDSC- and CAM-ICU-identified delirium cases

	ICDSC Delirium, *n* (%)	CAM-ICU Delirium, *n* (%)	Cohen's kappa (κ) [a]
All participants	67/97 (69.1)	49/97 (50.5)	0.63
Stratified by normal-to-increased arousal	33/87 (37.9)	27/87 (31.0)	0.75
Stratified by reduced arousal	59/74 (79.7)	42/74 (56.8)	0.44

[a] Agreement between tools was calculated; detailed 2x2 contingency tables are in Supplemental Table 1.

Furthermore, as shown in Table 3, the ICDSC-delirium cohort had higher in-hospital mortality (45.5% *vs*. 16.7% for the no ICDSC-delirium group; $p = 0.007$) and longer hospital LOS (mean days [SD], 37.9 [29.6] *vs*. 20.9 [13.47] for the no ICDSC-delirium group; $p = 0.004$). In the CAM-ICU group, participants had higher in-hospital mortality (47.9% *vs*. 25.0% for the no-delirium group; $p = 0.02$) but a comparable LOS (mean days [SDs], 36.8 [28.9] *vs*. 28.3 [24.1] for the no delirium group; $p = 0.12$). Logistic regression models revealed that belonging to the ICDSC-delirium group was associated with a 4.93-fold (aOR) higher in-hospital mortality (95% CI, 1.56–15.63; $p = 0.007$) than the 2.79-fold mortality risk for those in the CAM-ICU delirium group (95% CI, 1.12–6.97; $p = 0.028$). For LOS, linear regression analyses indicated that belonging to the ICDSC-delirium group was associated with prolonged LOS; participants in the ICDSC-delirium group stayed 17.59 days longer in the hospital (adjusted β [95% CI], 17.59 [6.11–29.09]; $p = 0.003$). For the CAM-ICU delirium group, LOS was longer but not significantly so (adjusted β [95% CI], 8.49 [-2.61-19.59]; $p = 0.13$).

Table 3
All participants: ICDSC-Delirium and CAM-ICU-Delirium on hospital mortality and LOS

In-Hospital Mortality	Delirium			No Delirium			Adjusted odds ratio [b]	95% CI
	Total	Death	(%)	Total	Death	(%)		
ICDSC	67	30	(45.5) [a]	30	5	(16.7)	4.93	(1.56–15.63) *
CAM-ICU	49	23	(47.9) [a]	48	12	(25.0)	2.79	(1.12–6.97) *
LOS	Delirium			No Delirium			Adjusted difference [b]	95% CI
	Mean [a]	(SD) [a]		Mean	(SD)			
ICDSC	37.9 [a]	(29.6)		20.9	(13.7)		17.59	(6.11–29.09) *
CAM-ICU	36.8 [a]	(28.9)		28.3	(24.1)		8.49	(-2.61–19.59)

*$p < 0.05$

[a] One participant remained hospitalized; uncounted.

[b] All models were adjusted for age, APACHE II, and CCI scores.

Sensitivity Analysis – Effect Of Arousal

As arousal may impact not only delirium diagnosis but also its predictive validity, we stratified patients by normal-to-increased arousal (RASS ≥ 0) *vs.* reduced arousal (RASS < 0), irrespective of delirium status, to determine whether the findings were consistent. Delirium rates varied between arousal groups (Table 2). For both tools, delirium incidence was lower in the RASS ≥ 0 subgroup (272 daily paired screenings), whereas it was higher in the RASS < 0 subgroup (299 daily paired screenings). This trend was evident, especially for the ICDSC-delirium group (79.7% incidence for the reduced arousal subgroup *vs.* 37.9% for the normal-to-increased arousal subgroup). Similarly, concordance also varied between arousal groups. A much higher concordance (κ = 0.75; $p < 0.001$) was reported for RASS ≥ 0, while a lower concordance (κ = 0.44) was reported for RASS < 0.

The prognostic difference in mortality between arousal states also varied (Table 4). Both tools' predictive validity for mortality diminished when stratified by reduced arousal (RASS < 0). For normal-to-increased arousal, the CAM-ICU-delirium group had higher mortality odds than the ICDSC-delirium group (aOR, 3.82 *vs.* 2.97 for ICDSC), although both tools predicted hospital mortality. For LOS, neither the ICDSC nor CAM-

ICU predicted this outcome, regardless of arousal state. Similarly, for each tool, the time spent screening for delirium did not differ. As expected, the mean (SD) time spent screening for delirium in the RASS < 0 subgroup was longer than in the RASS ≥ 0 subgroup for both tools: 1.3 (0.9) *vs*. 1.0 (0.9) min for the ICDSC and 1.2 (0.8) *vs*. 1.0 (0.8) min for the CAM-ICU.

Table 4
Stratify by arousal: ICDSC-Delirium and CAM-ICU-Delirium on hospital mortality and LOS

Normal-to-Increased arousal (RASS ≥ 0 subgroup)								
In-hospital mortality	Delirium			No Delirium			Adjusted odds ratio [b]	95% CI
	Total	Death	(%)	Total	Death	(%)		
ICDSC	33	15	(46.9) [a]	54	13	(24.1)	2.97	(1.06–8.37) *
CAM-ICU	27	14	(53.8) [a]	60	14	(23.3)	3.82	(1.35–10.82) *
LOS	Delirium			No Delirium			Adjusted difference [b]	95% CI
	Mean [a]	(SD) [a]		Mean	(SD)			
ICDSC	35.5 [a]	(29.9)		30.5	(25.4)		5.12	(-7.84–18.07)
CAM-ICU	32.3 [a]	(24.6)		32.4	(28.3)		-1.12	(-14.38–12.13)
Reduced arousal (RASS < 0 subgroup)								
In-hospital mortality	Delirium			No Delirium			Adjusted odds ratio [b]	95% CI
	Total	Death	(%)	Total	Death	(%)		
ICDSC	59	27	(46.6) [a]	15	5	(33.3)	1.65	(0.47–5.86)
CAM-ICU	42	20	(48.8) [a]	32	12	(37.5)	1.33	(0.48–3.66)
LOS	Delirium			No Delirium			Adjusted difference [b]	95% CI
	Mean [a]	(SD) [a]		Mean	(SD)			
ICDSC	38.3 [a]	(30.8)		25.5	(18.6)		13.19	(-3.74–30.13)

*$p < 0.05$

[a] One participant remained hospitalized; uncounted.

[b] All models were adjusted for age, APACHE II, and CCI scores.

Normal-to-Increased arousal (RASS ≥ 0 subgroup)						
CAM-ICU	38.2 [a]	(30.2)	32.6	(27.8)	4.72	(-9.40–18.84)
*$p < 0.05$						
[a] One participant remained hospitalized; uncounted.						
[b] All models were adjusted for age, APACHE II, and CCI scores.						

Discussion

The most important finding of our study is that ICU delirium identified by either screening tool, the ICDSC or CAM-ICU, was linked with increased deaths during hospitalization. The ICDSC outperformed the CAM-ICU because it identified delirium with higher odds of mortality and predicted hospital LOS. However, the performance of both tools was affected by patient arousal.

Two findings are worth emphasizing. First, as delirium incidence rates evaluated by the ICDSC and CAM-ICU were 69.1% and 50.5%, respectively, and the ICDSC identified 18 more cases of delirium, we found that a wider net was cast by the ICDSC, capturing more delirium cases than the CAM-ICU. Our result is consistent with that of the only study available for comparison, a Brazilian study of 162 surgical ICU patients whose delirium rate evaluated by the ICDSC was 34.5% ($n = 56$) *vs.* 26.5% ($n = 43$) by the CAM-ICU [22]. This wider net cast by the ICDSC may be welcome by certain institutions but may also bring additional diagnostic and care burden and fatigue to the nursing and physician staff as more cases were identified.

We thus focused on the tools' relative predictive validity for important outcomes and found that the ICDSC identified delirium had higher predictive validity for both mortality and LOS than the CAM-ICU. Participants in the ICDSC-delirium group had a 4.93-fold higher mortality risk and stayed at the hospital 17.59 days longer than those in the no-delirium group, while those in the CAM-ICU group were linked with a 2.79-fold lower odds of mortality. This finding is consistent with prior reports that ICU delirium increased hospital mortality in patients evaluated by either the ICDSC [23–25] or CAM-ICU [5, 6, 27–28], but different from a previous finding that the CAM-ICU better predicted outcome [22]. The reason for this difference requires further study, but one factor to consider is participants' arousal state.

This leads to our second point. For both the ICDSC and CAM-ICU, reduced arousal affects performance. Although both the ICDSC and CAM-ICU can be used when patients' RASS level was − 1 to − 3 (awakening to voice), their performance seemed to be less stable. Namely, agreement between tools is low ($\kappa = 0.44$ at RASS − 1 to − 3 compared to 0.75 at RASS ≥ 0). Moreover, if used with patients in reduced arousal states ($-3 \leq$ RASS < 0), both the ICDSC and CAM-ICU tended to identify delirium cases at a higher rate (Table 2) than with patients in normal-to-increased arousal. This trend is particularly apparent for the ICDSC, as its delirium incidence reached 79.7%, representing a 15% increased incidence from the sample mean. With

this higher rate of delirium, neither ICDSC- nor CAM-ICU-identified delirium predicted hospital mortality or LOS. This loss of predictive validity is noteworthy.

Why delirium identified in the reduced arousal subgroup was not associated with mortality and LOS is an important research question. The diminished effect on mortality may be due to misclassification of delirium cases (e.g., more false positives), resulting in reduced analytic power. Moreover, when participants have RASS levels between − 1 and − 3, the ICDSC and CAM-ICU may measure pure sedation effects. As decreased arousal is likely be multifactorial, combining both non-serious and serious conditions (e.g., medication/sedation effects versus serious neurologic events) may thus exert less consistent prognostic effects on mortality and/or LOS. Lastly, our study may be underpowered to detect the desired difference due to a relatively small sample. Future studies with larger sample sizes are indicated to verify our results.

Apart from the over-identification perspective, a wider spectrum has been recommended in delirium diagnosis (i.e., more inclusive recognition of delirium). For example, a 14-study meta-analysis (21,198 medical admission patients) found that reduced arousal (mostly defined by the Glasgow Coma Scale; only one with RASS) on hospital admission was associated with 5.7-fold greater mortality rates [29]. In that study, the authors argued that as delirium and reduced arousal are closely related and both are linked with high mortality, delirium studies should include patients who are too drowsy to undergo cognitive testing or interviews. Otherwise, the restricted spectrum (by eliminating patients with reduced arousal) may have led to underestimating the relationship between delirium and mortality [29].

Nevertheless, consistent with prior studies, ICU delirium evaluated by the ICDSC and CAM-ICU demonstrated substantial diagnostic agreement, and both tools could be completed in a comparable time, slightly over 1 minute in our study. A more sensitive screening tool, such as the ICDSC, holds promise by casting a wider net and capturing more delirium cases than the CAM-ICU. Whether systematically using the ICDSC changes predicted outcomes requires an impact-evaluation study. Moreover, given that the two tools' agreement and predictive validity were much lower in the reduced arousal subgroup, future studies with larger samples may want to account for patients' arousal when deciding which tool to use to maximize the effects of delirium identification on patient mortality.

Study Strength And Limitations

Our findings should be considered with certain limitations, including potential confounders and misclassification biases. As participants with any one positive result were classified into the delirium group, "days being assessed" was a confounder inherent in our study design; participants who stayed in the ICU longer were more likely to be classified into the delirium group. Moreover, the impact of delirium was assumed to be equal irrespective of its duration. Second, the same rater completed both measures so their administration could not be blinded to each other. The randomization of ordering was important but cannot overcome this limitation, which should be acknowledged. Third, delirium has no gold standard for diagnosis; thus, the "truth" of which measure better reflected delirium cannot be definitely established.

Along these lines, we acknowledge the limitation that delirium was screened by well-trained research nurses instead of an experienced psychiatrist. However, both the ICDSC and CAM-ICU have been designed and used by nonpsychiatric personnel, especially nurses, with high reliability. Fourth, our study was limited by its small sample and power may have been limited for many of the analyses. Moreover, the study was limited by enrolling participants from a single institution with an enrolment rate of 83.3% (100 of 120 invited eligible patients). While all eligible patients were offered enrollment, selection bias remains a limitation that will need to be addressed by replicating the findings in future studies.

Conclusions

Delirium, identified either by the ICDSC or CAM-ICU, was linked with hospital death in critically ill patients. A head-to-head comparison indicated that the ICDSC identified delirium with higher predictive validity for both mortality and LOS than the CAM-ICU. However, this evaluation may change based on level of arousal. More studies are needed to consider ICU patients' arousal when deciding which tool truly maximizes the effects of delirium identification on patient mortality.

Abbreviations

ICDSC
Intensive care delirium screening checklist; CAM-ICU:Confusion assessment method for intensive care unit; RASS:Richmond Agitation-Sedation scale; LOS:length of stay; VS:Versus; CCI:Charlson comorbidity index; APACHE II:Acute Physical and Chronic Health Evaluation; CDR:Clinical rating scale.

Declarations

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Authors' contributions

HL screened participants' delirium, analyzed the data, and draft the manuscript.

CC conceived of the study, participated in data collection, and helped to draft the manuscript.

TY participated in study design, funding and coordination.

SL participated in study design and coordination

AH cross-validated participants' delirium

YW performed the statistical analysis

SS participated in study design

SK conceived of the study and supervised the data collection in all clinical sites.

SI participated in study design, interpreted the data, and helped to draft the manuscript.

All authors read and approved the final manuscript.

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Availability of data and materials: All data generated and/or analyzed during the current study are included within the published article and its additional files.

Ethics approval and consent to participate

The prospective cohort study was approved by the Institutional Review Board and registered in the clinical trial registry (NCT 04206306). All patients or their surrogates signed written informed consent forms to participate in the study.

Consent for publication: Not applicable.

Competing interests: The authors declare that they have no competing interests.

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Figures

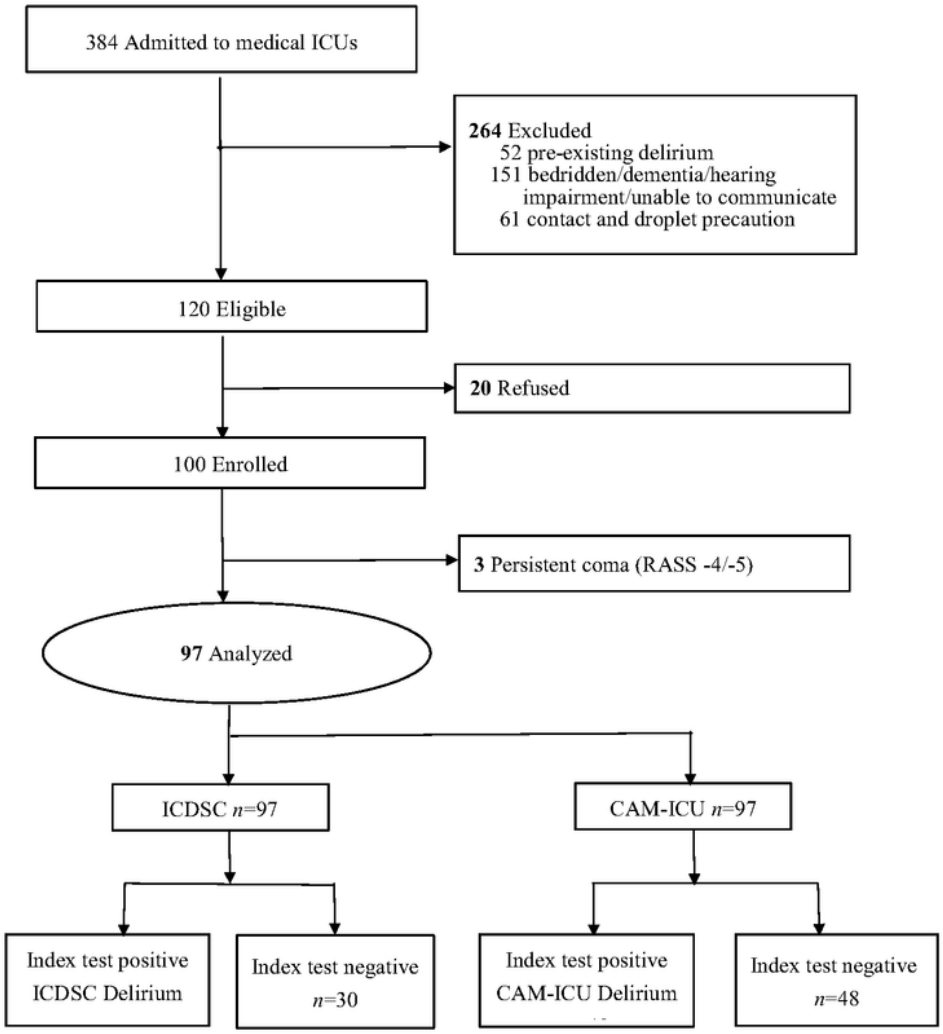

Figure 1

Study flowchart.

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