

**Recognition of delirium in ICU patients**  
**A diagnostic study of the NEECHAM confusion scale in ICU patients**

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## **Background**

The acute confusional state, also known as delirium, is a serious, high-frequency complication in intensive-care-unit (ICU) patients (incidence: 40% to 57%) [1,2,3,4]. It is defined as a transient organic mental syndrome characterised by a disturbance in awareness, cognition and attention [5]. These disturbances are frequently manifested in expressions of disorientation, memory impairment, disturbance in the mental process, motor unrest, sleep problems, anxiety and agitation. Abrupt onset and fluctuation of the symptoms are characteristic, and onset frequently occurs from within a few hours to a few days of hospital admission. It can take various forms: a hyperactive/hyper-alert form, a hypoactive/hypo-alert form or a combination of these two [6].

The patient can be restless, agitated and aggressive. In the confused state, the patient will often remove his or her drip, catheters and/or breathing tube. Nurses are most familiar with the hyperactive/hyper-alert form and often overlook the hypoactive/hypo-alert type of patients [1], who are calm and sleepy, react slowly and move little. Sometimes they mumble to themselves or make inappropriate gestures. Research indicates that the majority of acute confusional state patients are not recognised by doctors and nurses. They are treated either inadequately or not at all [2, 7, 8], largely because the acute confusional state is not considered a potential medical emergency. Moreover, with the elderly patient in particular, it is regarded as dementia or another mental illness [9], and hospitals do not systematically screen for it [1].

The consequences for the patient can be serious: greater risk of morbidity and mortality, longer hospital stay, greater need for nursing care, and greater risk of complications, bodily injuries in general, and more frequent admission to nursing homes following discharge from hospital [1,10,11]. Nurses can, through early recognition of the acute confusional state, enhance the prognosis and treatment results [1, 12].

Since nursing staff monitor the patient 24 hours a day, they can, with little effort, recognise the symptoms of the acute confusional state and note small changes [1,13]. Despite its high incidence and clinical importance, relatively little research has been done into the acute

confusional state in intensive care [2]. There is a need to increase awareness and to develop and implement valid and user-friendly assessment tools to minimise under recognition [4]. In order to improve recognition and thus treatment of, and prognosis for, the patient, the present study tested a nursing observation scale specifically applied to ICU patients. This scale, the NEECHAM confusion scale, gives positive results when used in the general hospital population [14,15,16]. A small pilot study in 19 ICU patients [17] showed positive results.

The aim of our study was to further test the NEECHAM confusion scale for use in ICU patients. Enables the NEECHAM confusion scale nurses to detect delirium in ICU patients reliable, valid and user-friendly?

## **Methods**

### **Design and sample**

The reliability, validity and user-friendliness of the NEECHAM confusion scale were tested in a prospective study. Data regarding validity and reliability of the scale were collected from observing patients. Data regarding the user-friendliness of the scale were collected from nurses experiences with the scale. The research, after approval from the medical ethics committee, was conducted in the Intensive Care Unit (9 beds) of a medium size general hospital.

Patients were included in the study if they had given informed consent, were present at the time the ICU nurses completed the scale, were not under the influence of barbiturates and/or sedatives, and were able to submit a case history. Patients who did not satisfy these criteria or were not able to sign the informed-consent form (too seriously ill, unconscious, foreign language) were excluded. The study was conducted between May and August 2000 with 105 patients. The patients stayed in the ICU between 1 and 14 days (on average 2.34). 45 women (43%) and 60 men (57%) took part. The average age of the patients was 68.3 years, SD 13.5.

All ICU nurses (n = 39) in the unit were asked to participate in the study. Responses were collected from 36 nurses (92%), 26 women (72%) and 10 men (28%). The average age of the ICU nurses was 36.5 years, SD 7.9. The number of years of work experience of the nurses in the ICU unit was on average 9.4, SD 7.4.

### *Procedures*

Preceding the study all nurses were trained in rating the NEECHAM confusion scale. On weekdays during the routine 4 p.m. rounds, the ICU nurses rated the NEECHAM confusion scale with each patient who was participating in the study. In total 253 scales were rated. In almost half of all ratings immediately after the nurses had completed the NEECHAM confusion scale (123 scales for 53 patients), a psychiatric intern, blinded for the nurses' ratings, assessed and diagnosed the behaviour of the patient. The Diagnostic Statistical Manual (DSM)-IV criteria for delirium were used as the gold standard for the diagnosis. These 123 completed NEECHAM scales and the interns' DSM-IV diagnosis were used to define the diagnostic value of the NEECHAM scores.

In addition, one of the researchers (HI, ICU nurse) independently rated the NEECHAM confusion scale on a number of different days, 10 to 15 minutes after the ratings of the ICU nurse. The total of 39 completed NEECHAM scales were used to determine the interrater reliability.

After collecting the data in the unit, the ICU nurses were asked to complete a questionnaire on the user-friendliness of the scale. The questionnaire contained 18 questions to be rated on a 5-point Likert scale and one open question (see box 1).

Insert box 1

### *The NEECHAM confusion scale*

The NEECHAM confusion scale, developed by Neelon and Champagne et al. [18], measures cognitive dysfunction such as the acute confusional state. This scale was extensively tested

on the general hospital population [13, 14, 15,16, 19] and is based on observations made by nurses during the routine rounds at the bedside. It is not burdensome for the seriously ill patient (not alert, intubated). It measures the acute confusional state in the early stages and can be easily administered several times, as it takes only a few minutes to complete. The scale consists of 9 items divided over 3 subscales. Each scaled item gives 3 to 6 descriptions. Subscale 1 (information processing), contains the first three items: attention, processing commands and orientation; Subscale 2 (behaviour), contains the next three items: appearance, motor and verbal; Subscale 3 (physiological condition), contains the last three items of the scale: vital function, oxygen saturation and urinary continence. Some items can be rated only after the patient has answered a few short questions. Intubated patients who are not sedated can often communicate only non-verbally. The extent to which this led to problems with the scale was examined in this study by questioning the nurses. The overall score of the NEECHAM ranges from 0 through 30 points. A score of 30 indicates that the patient gives a maximal (normal) reaction and 0 indicates a minimal reaction. The scale gives four grades of acute confusional state: moderate to severe confusion, mild to early confusion, 'not confused' but at high risk of confusion, and 'not confused' – the patient is functioning normally.

### *Statistical analysis*

The reliability of the NEECHAM confusion scale was determined by means of the following reliability indicators: interrater reliability (Cohen's Kappa) and internal consistency (Pearson's item-total coefficient of correlation, Pearson's inter-item coefficient of correlation and Cronbach's alpha).

The validity of the NEECHAM confusion scale was determined by the following measures of validity: concurrent validity (chi-square, gamma, Somer's, Kendall's tau-b and c), construct validity (principal component analysis), and diagnostic precision (percentages).

The user-friendliness was determined by the average score per question a cut-off point of 3.75. All data were processed using SPSS.

## **Results**

An overall score of  $\leq 19$  points on the NEECHAM, indicating moderate to severe acute confusion, was rated on 49 (19.4%) scales. An overall score of between 20 and 24, indicating mild or early acute confusion, was rated on 40 (15.8%) scales.

All other rated scales ( $n = 164$ , 64.8%) with scores of 25 or higher, indicated non-acute confusion. For 72 (43.9%) of these, a NEECHAM score of 25 or 26 was found. This score indicates non-acute confusion, however, presence of high risk.

### *Reliability*

The NEECHAM Confusion Scale showed high internal consistency in this study (Chronbach's alpha 0.88). The item-total correlation (Table 1) correlated well with information processing (attention, processing of commands, orientation) and behaviour (appearance, motor, verbal) (Pearson  $r \geq 0.68$ ), while urinary continence control (Pearson  $r 0.24$ ) and vital function/oxygen saturation (Pearson  $r \geq 0.20$ ) correlated less to not at all with the item-total coefficient of correlation. Table 1 shows under 'alpha if item deleted' that removal of these items increases the alpha values.

The Pearson product-moment coefficient of correlation between the items ranges from 0.04 to 0.90 (Table 2). A low correlation between vital function (Pearson of  $r 0.04$  to  $0.06$ ) and oxygen saturation (Pearson from  $r 0.09$  to  $0.27$ ) and the other items was found. Urinary continence (Pearson from  $r 0.13$  to  $0.32$ ) correlated reasonably with all the other items, which in turn correlated strongly with each other (Pearson  $r$  from  $0.61$  to  $0.90$ ). The interrater's reliability indicated a reasonable conformity between raters above the expected coincidental conformity with Cohen's Kappa of  $0.60$  (Table 3).

### *Validity*

The concurrent validity with the DSM-IV criteria showed a strong link (chi-square  $67.52$ ,  $p \leq 0.001$ ). In addition, the strength and the direction of this connection are specific and also

strong and positive (gamma 0.988, Somer's 0.739, Kendall's tau-b 0.741, Kendall's tau-c 0.662, each with a  $p \leq 0.001$ ). The diagnostic precision of the scale can be considered fairly high to high, 70% to 98.6% (Table 4). Principal component analysis (Table 5) in connection with the determination of the construct validity shows that the NEECHAM scale is composed of two components. Component 1 contains the items attention, processing of commands, orientation, appearance, motor and verbal. Component 2 contains the last three items: vital function, oxygen saturation and urine continence. This is in contrast with the three subscales (Subscale 1: Item 1, attention; Item 2, processing of commands; Item 3, orientation; Subscale 2: Item 4, appearance; Item 5, motor; Item 6, verbal; and Subscale 3: Item 7, vital function; Item 8, oxygen saturation; Item 9, urine continence) described by Neelon et al. [14]. During the analysis, two eigenvalues greater than 1 (4.9 and 1.5) were found after a varimax rotation, which suggests that two sources already contribute considerably to the distributed variation among the items. Together, Components 1 and 2 account for (54.6% + 17% =) 71.7% of the variation in the 9 variables. The attention, processing commands, orientation, appearance, motor and verbal items load from fairly high (0.762) to high (0.949) on the first component. Vital function, oxygen saturation and urine continence score fairly high (0.71 – 0.74) on the second component.

#### User-friendliness

ICU nurses completed the NEECHAM confusion scale in 3.69 minutes (SD 1.21) average. The application of the scale was assessed as moderately. A few questions showed a score lower than 3.75 (2.11 to 3.53), however, these questions involved mostly intubated patients, with whom the ICU nurses encountered difficulties when completing the scale. The precision of the scale was assessed as good (Is the scale clear? Are the instructions clear? Do the items lend themselves to being explained once?). Content validity, measured by the language used, was rated good. There were, however, doubts regarding the relevance of the items (3.42). As with the question of the application, the issue here involved completing the scale with intubated patients. For two items of the NEECHAM confusion scale (item 3, orientation and item 6, verbal) a verbal answer is required from the patient, which is

impossible for intubated patients. It is possible by means of non-verbal communication; however, this option is not explicitly given on the scale.

The ICU nurses gave a number of valuable responses to the open question concerning possible improvements to the scale. With regard to item 5, motor, it was observed that ICU patients frequently have polyneuropathy, which can influence the classification of whether the patient is suffering acute confusion or not. With regard to item 8, oxygen saturation, the nurses found that the normal value (93 or higher, according to the NEECHAM confusion scale) for a COPD (chronic obstructive pulmonary diseases) patient was too high.

Frequently, the normal O<sup>2</sup> saturation value for this patient group in the ICU unit is taken to be between 90 and 92. The value of rating the physiological items was also questioned since the reason for admission of many ICU patients is threatening of the vital functions. Finally, some of the ICU nurses wondered whether the scale could be made more compact and printed on a single A4 page. According to the ICU nurses, this would make it more practical.

## **Discussion and conclusions**

The psychometric characteristics of the NEECHAM confusion scale of this ICU study are generally consistent with validity research previously reported for the general hospital population. The interrater's reliability between two raters (kappa 0.60) is, as in Neelon's research (13) (0.65), fairly good. The internal consistency of the scale is good, as it is in all the other studies [13, 14,15,16] (Cronbach's alpha  $\geq$  0.81), and the physiological functions correlate with the total item coefficient of correlation. On the basis of both the results from the internal consistency and from the principal component analysis (PCA), one can be suggest that these items could be removed from the NEECHAM confusion scale. In both this study and Neelon's study [13], two components were found after a PCA. Neelon [13], however, divided the instrument into three subscales, which appears to imply that there are three components. We found no reason for this in the present study.

The chi-square value of 67.5 ( $p \leq 0.001$ ) between the DSM-IV criteria and the NEECHAM scale show a good concurrent validity. All measures of association indicate that there is a

strong positive relationship between the DSM-IV diagnosis and the ratings on the NEECHAM scale. The sensitivity is just as high (> 90%) as in other studies, however, we found the specificity of 82.8% to be higher in this study than in Neelon's study (78%) [18].

The user-friendliness of the NEECHAM scale has not been previously examined in this way. The ICU nurses rated the user-friendliness generally as good. The low average score (2.11 to 3.53) on a number of questions and the answers to the open question indicate that the scale in its present form is not suitable for use with intubated ICU patient.

Possible limitations of the present study could be the reliability of the gold standard (diagnosis by a psychiatric intern) and the collection of the data by nurses in the course of their regular duties. Both of these elements, however, are representative of clinical reality and therefore enhance the implementation of the results.

We conclude that the NEECHAM confusion scale has good psychometric characteristics and is easy to use with ICU patients who are not intubated. In view of the high diagnostic value of the scale, the instrument is promising for screening acute confusional states in ICU. Further study of the scale needs to be done to adapt it for use with intubated patients. The results of this study indicate that the scale could be shortened from nine to six items which would enhance the user-friendliness. The advantage of the NEECHAM confusion scale is low respondent and rater burden. This enables rapid and repeated ratings.

Current ICU clinical practice does not routinely screen for behavioural changes so many patients who are in an acute confusional state are not recognised in a timely fashion. The NEECHAM confusion scale offers an opportunity to screen behaviour with little stress on either the seriously ill ICU patients or the busy ICU nurses. The instrument is simple, repeatable, and quick to apply on the basis of observation during regular care.

Competing interests

The author(s) declare that they have no competing interests.

### Authors' contributions

MS proposed the original idea for the study and HI, MS and JB designed the study protocol. HI executed the study and the statistical analyses. MS and JB were involved in the interpretation of data. HI drafted the manuscript, MS and JB the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

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<b>Table 1: Pearson Item-total coefficient of correlation N = 253</b>		
Alpha if Deleted	Correct Item-total Correlation	item
Attention	.8644	.8392
Processing commands	.8815	.8346
Orientation	.8698	.8361
Appearance	.6821	.8627
Motor	.8235	.8425
Verbal	.7948	.8456
Vital function	.1158	.8983
Oxygen sat.	.1956	.8887
Continence.	.2444	.8888
Cronbach's alpha 0.88		

Table 2: Pearson Inter-item coefficients of correlation								
N = 253								
Items	Attention	Processing	Orientation	Appearance	Motor	Verbal		
Vital	Oxygen sat.	Continen	Commands					
function								
Attention	1.0000							
Processing commands	.9007	1.0000						
Orientation	.8665	.8954	1.0000					
Appearance	.6465	.6646	.6613	1.0000				
Motor	.8353	.8615	.8133	.6150	1.0000			
Verbal	.7412	.7943	.7899	.6174	.7416	1.0000		
Vital function	.0618	.0479	.0506	.0461	.0363	.0504	1.0000	
Oxygen sat.	.0900	.1077	.1365	.1365	.0685	.1679	.2720	1.0000
Continen	.1741	.1282	.1698	.1698	.1604	.1741	.3190	.2989
	1.0000							

Figure 2

<b>Table 3: Interrater reliability: Cohen's Kappa N = 39</b>				
		First rater		Total
		Delirious (0 – 24)	Not delirious (25 – 30)	
Second Rater	delirious (0 – 24)	8	4	12
	not delirious (25 – 30)	3	24	27
Total		11	28	39
Cohen's Kappa 0.60				

<b>Table 4: clinical index to predict acute confusion from the NEECHAM scale</b>	
Sensitivity [(35/36)x100]	97.2%
Specificity [(72/87)x100]	82.8%
Predicted value for positive test [(35/50)x100]	70.0%
Predicted value for negative test [(72/73)x100]	98.6%
Precision [(35+72/35+15+1+72)x100]	86.9%

<b>Table 5: NEECHAM confusion scale Component Loading and Communalities</b>			
NEECHAM Item	Component 1	Component 2	Communality
Attention	0.930	6.313E-02	0.868
Processing commands	0.955	4.131E-02	0.913
Orientation	0.935	8.002E-02	0.880
Appearance	0.762	0.121	0.596
Motor	0.909	3.392E-02	0.827
Verbal	0.864	0.110	0.759
Vital function	-1.715E-02	0.738	0.545
Oxygen saturation	7.478E-2	0.707	0.506
Urine continence	0.134	0.731	0.553
Eigenvalue	4.912	1.534	
% explanatory var.	54.573	17.048	

\* Rotation method: Varimax matrix

**Additional files provided with this submission:**

Additional file 1: Box 1 Questionnaire for ICU nurses.doc : 19KB  
<http://www.biomedcentral.com/imedia/3894952976937227/sup1.doc>